5-1997

The Efficacy of Guided Imagery for Recovery from Anterior Cruciate Ligament (ACL) Replacement

Deborah D. Durso-Cupal
Utah State University

THE EFFICACY OF GUIDED IMAGERY FOR RECOVERY FROM ANTERIOR CRUCIATE LIGAMENT (ACL) REPLACEMENT

by

Deborah D. Durso-Cupal

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Psychology

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1997

ABSTRACT

The Efficacy of Guided Imagery for Recovery

from Anterior Cruciate Ligament

(ACL) Replacement

by

Deborah D. Durso-Cupal, Doctor of Philosophy

Utah State University, 1997

Major Professors: Dr. Richard Gordin
Dr. Keith Checketts
Department: Psychology

As an exploratory, developmental injury intervention study, this research investigated the efficacy of providing psychological intervention in the form of relaxation and guided imagery to a group of orthopedic patients recovering from major knee surgery. Utilizing a prospective, experimental research design with 30 subjects randomly assigned to either an intervention, placebo, or control group, this study employed physiological as well as psychological outcome measures. Intervention consisted of 10 individual mental practice sessions for intervention group members as an adjunct to physical therapy. Content of these sessions was intentionally designed to facilitate physiotherapy goals. Imagery protocols with which to deliver these standardized sessions were also designed to

directly parallel established physical rehabilitation protocols. Placebo group participants were exposed to nonspecific intervention factors of attention and support, while control group members completed their physical therapy as usual.

Results of this study revealed that for this sample of anterior cruciate ligament (ACL) orthopedic patients, psychological injury intervention in the form of relaxation and guided imagery contributed to statistically significant better physical and psychological outcomes. Strength and extension improvement, as well as reduction in state, trait, and reinjury anxiety, were superior for the intervention group as compared to placebo and control groups from preintervention (2 weeks postsurgery) to post-intervention (24 weeks postsurgery). Other benefits of the intervention, according to subject self-report, included pain and stress management, empowerment, control of recovery, and overall body wellness. Implications of these research findings are discussed, as well as suggestions offered for subsequent injury intervention research.

(259 pages)

This work is dedicated to the memory of my father

Albert Peter Durso

ACKNOWLEDGMENTS

A project of this duration and magnitude calls for a great many thank yous. I would like to express my deepest appreciation for my two co-chairmen, Dr. Keith Checketts and Dr. Richard Gordin, for their guidance, support, encouragement, and mentoring. During my years here at Utah State, and particularly throughout this lengthy research, their patience and wisdom have sustained me. I am particularly indebted to Dr. Checketts for his continual belief in my abilities and encouragement, and to Dr. Gordin for countless hours of supervision, collegiality, and facilitation of my professional development.

I would also like to thank my other committee members: Dr. David Stein, for his guidance and support, and for insisting on a placebo group for this research; Dr. Kevin Masters, for serving on my committee; and Dr. Lani Van Dusen, for modeling high standards of excellence, providing feedback on earlier drafts of manuscripts, providing sound advice, and offering challenging interactions within the context of professional friendship.

So many others in the Psychology Department merit thanks--Dr. Carolyn Barcus, Dr. Blaine Worthen, and particularly Dr. Xitao Fan. A very special thank you goes to Cathryn Petersen, Jennifer Watts, and particularly Karen Ranson for their invaluable assistance to me, my students, and this research's participants. Thanks also goes to Shane for his assistance on this project, as well as to Beth and Perry. I am most grateful to Dr. Mary Doty and especially Dr. Mark Nafziger for their input, supervision, and

encouragement relative to this research and life in general. Thanks is also in order to Dr. James Shaver, for his confidence in my academic abilities and for his financial support.

I am grateful to the patients and entire staff of the Western Surgery and Mountain West Physical Therapy Center. Without their consent, assistance, cooperation, and interest, this research could not have been conducted. To those staff and participants who went far "beyond the call of duty," I am indebted. I am also thankful to the Association for the Advancement of Applied Sport Psychology, whose partial research funding in the form of a dissertation award made it financially possible to carry out this research.

Several people have encouraged my personal growth throughout this entire process. I wish to offer my sincere appreciation to those above whom I have mentioned who know of your support to me. As well, I wish to extend a very special thanks to Dr. Evelyn Hall at the University of Utah, who made time to be there for me as an outstanding model of professionalism and dedication.

Finally, I would like to thank my friends and family for their understanding and support. I am most grateful for their presence in my life and in my memories. Particularly important to me has been the influence of my parents, Mr. Albert P. Durso (deceased) and Dr. Mary W. Durso. Part of the inspiration for this research originates with my beloved grandmother, Bernice Marie Wilkes, whose wisdom and love sustain me always. I would also like to thank Shani and Tatum for their patience and unconditional love during demanding times. Perhaps the most important thanks of all

goes to my husband, Matt, for his enduring patience, love, assistance, and belief in me throughout this long process. You are truly a partner.

Deborah D. Durso-Cupal

CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The question of whether relaxation and mental practice can influence recovery from injury and subsequent surgery remains a controversial issue. In an age of increased emphasis on wellness and healthy lifestyle, the notion that mental-image rehearsal of physiological processes may facilitate healing has gained notoriety (Brewer, Van Raalte, & Linder, 1991; Pargman, 1993). Anecdotal evidence involving cancer patients, beginning in the 1970s with the work of the Simontons (Simonton, Matthews-Simonton, & Creighton, 1978), and more recent work with other medical populations, demonstrates that imagery may be helpful in facilitating wellness (AuBuchon, 1991; Green, 1992; Steadman, 1993).

Preliminary results from recovery programs using a combination of mental and physiological rehabilitative techniques suggest that resulting physiological outcomes are superior to outcomes from physical rehabilitation alone (Brewer, Jeffers, Petitpas, & Van Raalte, 1994; Faris, 1985; Green, 1992; Ievleva & Orlick, 1993; Nicol, 1993; Sthalekar, 1993; Wiese-Bjornstal & Smith, 1993). However, a paucity of controlled studies that include such components as control groups and directed interventions using standardized imagery protocols clouds the issue of whether mental practice in the form of guided imagery significantly contributes to recovery from injury and subsequent surgery. Moreover, the question of why some individuals struggle with psychological aspects of the rehabilitation process as manifested in increased frustration, high levels of pain, loss of motivation to perform physical therapy, and elevated anxiety levels more than other individuals has

largely been unanswered (Brewer, 1994; Duda, Smart, & Tappe, 1989; Mainwaring, 1993; Udry, 1995).

Purpose of the Study

The purpose of this study was to investigate the effectiveness of relaxation and guided imagery as a psychological rehabilitative intervention for recovering anterior cruciate ligament (ACL) patients. As a developmental, exploratory psychological-intervention research, both protocols and imagery scripts were created specifically to parallel these preestablished physiological rehabilitation protocols. Relaxation and imagery were then taught to, as well as practiced with members of the experimental group as an adjunct to physical therapy.

The most dramatic gains for strength and range of motion occur during the first 24 weeks of recovery (T. Rees, personal communication, October, 1993). Accordingly, if guided imagery is to make a difference in (a) amount of strength, extension, or flexion, (b) time to recovery, (c) patterns of recovery, or (d) anxiety reduction, the critical temporal framework for assessing these gains is within the initial 24-week period. Benchmarks for recovery and techniques assessing progress at these benchmarks have been preestablished by the medical staff of the Western Surgery and Mountain West Physical Therapy Center as a result of more than a decade of ACL replacements at this Center.

This study replicated previous research investigating the influence of cognitive processes such as imagery on somatic outcome, yet it breaks new ground relative to the

nature and content of the intervention, as well as target population, with definitive, physiological outcome measures. Using standardized imagery scripts created specifically for the purpose of enhancing recovery, this study goes beyond relaxation intervention, reflecting a more active, cognitive-behavioral, mental-skills approach to the physical healing process.

Most physically active individuals are unable to avoid injury. During the course of training and performance, individuals engaging in sport activities can expect to experience at least one serious, debilitating injury (Pargman, 1993). Within the context of activities that range from recreational to professional sports, over 17 million sport injuries are reported yearly in the United States alone (Booth, 1987). When an individual is physically injured, there is a direct impact on his or her psychological well-being, which in turn, directly influences health, performance, and the risk of further physical injury (Hardy, 1992; Heil, 1993). Because people of all ages and occupations in the United States consider fitness to be an important part of their identity, distinctions between psychological impact for the competitive versus the recreational athlete have become somewhat blurred. Recent inquiries into the nature of sport injuries suggest that the amateur and professional athlete be ranked similarly in terms of their seriousness about sport activities, as well as the importance of returning to a lifestyle after injury whereby they may regain health and fitness (Steadman, 1993; Udry, 1995).

The speed and effectiveness of recovery are believed to be the combined result of the severity of injury and its associated stress, as well as an individual's ability to cope

(Heil, 1993). Coping involves not only managing the logistics of physical recovery, but also dealing with a host of associated outcomes engendered by being "sidelined." One important aspect of this recovery process is that it involves differential rates of recovery (Faris, 1985; Ievleva & Orlick, 1991), implying that recovery is a function of personal response to injury, coupled with biological, personal, and situational variables.

In most cases of injury recovery, individuals follow a rehabilitation program that concerns itself with the physical aspects of injury, but which usually lacks a formal mind-body component addressing personal and psychological aspects of injury (Faris, 1985). Often omitted from a program of recovery is intervention that facilitates coping with an injury's accompanying threat to self-concept, beliefs, commitments, values, and social/emotional functioning. As a result, healing may be retarded, restricted, or prohibited (Danish, 1986).

Success of rehabilitation then, at least in part, is due to an individual's ability to deal with the stress of recovery, whether the individual is a professional athlete or a "weekend warrior." In a departure from earlier findings, several of the most recent studies investigating stress and coping of injury report that recreational athletes appear to be similarly at risk psychologically as the competitive athlete (Ross & Berger, 1996; Udry, 1995). It should be noted that stress will most likely occur when the injury is severe, is perceived as a threat to career or daily life functioning, requires surgery, and/or involves a protracted period of rehabilitation (Heil, 1993). For individuals engaged in

competitive sports and some recreational sports, sport medicine personnel believe that psychological variables operate on a continuum of stress intensity (Steadman, 1992).

Although there is a growing awareness that psychosocial factors play an important part in enhancing recovery, very few studies have empirically investigated the how's and why's of the psychological components of injury recovery. Moreover, extant literature concerning the use of mental practice techniques such as imagery for facilitation of healing of sport injuries is limited (Hall, Rogers, & Barr, 1990). In fact, as of the date of this study, only four prevention and 13 rehabilitation intervention studies have been conducted utilizing some form of mental practice to test this relationship empirically. While imagery has successfully been employed with athletes in the United States for motor-skill acquisition and perfection, the application of guided imagery as a mental practice technique for recovery from injuries has only begun to be empirically researched in the decade of the 1980s, with findings recently published in the past 3 to 5 years. As a result, we are just beginning to understand the complex interplay of psychological and physiological variables that contribute to healing.

Relative to physiological recovery, psychological intervention has typically been targeted to ameliorate the emotional malaise associated with injury, such as severe depression. Recent recovery work that includes aspects of psychological and physical well-being for individuals who suffer sport injuries, however, has met with beneficial results (e.g., Brewer et al., 1994; Ross & Berger, 1996). As a result, a number of guidelines for psychological intervention have been offered, including specific treatments

that focus on the role of mental practice techniques such as imagery (Brewer et al., 1994; Heil, 1993; Kerr & Goss, 1996; Ross & Berger, 1996; Rotella & Heyman, 1986; Wiese & Weiss, 1987).

In general, however, the application of imagery as a component of a psychological rehabilitative intervention promoting injury recovery is extremely limited. Moreover, it would appear that no empirical studies have been conducted to date to examine the effects of relaxation and guided imagery on recovery from a specific sport injury. In fact, previous studies involving imagery for healing orientations have been retrospective in nature, conducted without control groups and without regard to establishing or using psychological intervention protocols or standardized imagery sessions. Furthermore, mental practice techniques such as guided imagery have not been matched and integrated with physiological rehabilitation protocols, nor outcomes measured in terms of physiological outcomes. The small body of extant research in the area of mental practice (mind/body integration) and its effect on healing of injuries, however, does suggest that a structured, physical rehabilitation program that includes some form of imagery as mental practice is more effective in influencing the extent to which an individual will heal fully and quickly than physical rehabilitation alone (Brewer et al., 1994; Ievleva & Orlick, 1993). Preliminary results report that a comprehensive rehabilitation plan that interfaces the proper external, physiological rehabilitation procedures with internal states of mind results in enhanced recovery outcomes.

Anterior Cruciate Ligament Injuries

It is generally accepted that knee injuries are as common to the weekend runner or skier as they are to the professional basketball or football player (Faris, 1985; Steadman, 1993). For the competitive athlete (whether amateur or professional), however, the consequences of a serious injury may be exacerbated by a highly competitive, emotionally intense environment that demands the ideal body for performance, as well as a serious pursuit of excellence, depending upon the nature of the competition. Individuals at all levels, however, are driven by expectations and demands placed upon them by their sport and their own desire to excel.

In the past decade, a great deal of orthopedic clinical and laboratory research has been conducted on the anterior cruciate ligament. As one of the two mainstay ligaments in the knee providing stability and anti-sheer capabilities, the ACL (as well as the companion posterior cruciate ligament [PCL]), when severed through injury, must be replaced rather than repaired. This requirement qualifies those who experience such an injury for major, reconstructive surgery, with resulting physical recovery times anywhere from 9 to 18 months. The greatest preponderance of ACL and PCL injuries are the result of skiing, basketball, or football activities (Mohtadi, Webster-Bogaert, & Fowler, 1989).

Although surgical techniques have become quite refined, comparatively little is presently understood about postoperative ACL reconstruction physical rehabilitation (Shelbourne & Wilckens, 1990). Still part of the ACL experience for many individuals are postoperative complications such as stiffness, weakness and patellofemoral pain,

regardless of autograft (utilizing an individual's own tissue) or allograft (cadaver tissue) techniques. Physical therapy rehabilitation protocols have been recently revised to facilitate immediate postsurgical mobility for the ACL patient (Ross & Berger, 1996). While this has resulted in generally more positive physical outcomes for ACL reconstruction individuals, the accelerated rehabilitation program presents some interesting challenges for these individuals in the first 6 to 9 months of recovery, for example, increased demands of personal time investment, reinjury anxiety, and stress.

Following surgery, rehabilitation is generally divided into three phases, each with a specific focus and set of goals. The following outline of phases is a compilation of the Mountain West Physical Therapy Center (1994) rehabilitation protocols and those outlined by Goble (1988) and Shelbourne and Wilckens (1990).

Phase I consists of the first 2 weeks postsurgery, where goals are wound healing, full extension, minimization of swelling, and regaining leg control. A lack of full passive extension, for example, has been associated with quadriceps weakness and anterior knee pain (Sachs & Stone, 1989). Phase II extends anywhere from 2 to approximately 8 weeks, wherein the ACL patient increases flexion, develops a functional gait, and gradually returns to normal daily-living activities. Phase III usually begins after 2 months postsurgery, wherein an individual attempts to achieve 70% strength recovery initially, and 80 to 85% strength recovery within 24 weeks postsurgery. A return to desired sport activities, the ultimate goal of ACL rehabilitation, characterizes the end of Phase III. Generally, confidence in the reconstructed knee is the limiting factor in a return to

competition or desired activities (Shelbourne & Wilckens, 1990). As strength, endurance, and confidence return, activity level increases, as does strength.

This specific injury was chosen as the injury study focus for the following reasons:

1. Since ACL reconstruction has become a frequent surgery for individuals experiencing severe anterior cruciate ligament damage, an approved, structured protocol of physical rehabilitation has been established for this recovery process that provides stable, physical baseline measures.

2. A sports medicine facility in close proximity to Utah State University provides these ACL replacements.

3. The orthopedic surgeons at this facility routinely provide patients with a video tape of their ACL surgery. Once viewed, an image of the functioning ligament provides a concrete, visual basis for subsequent guided imagery sessions constructed around this visualization.

4. The specificity of this injury and accompanying surgery, as well as the rehabilitation program, are conducive for investigating the efficacy of a recovery program that offers mental practice in the form of relaxation and guided imagery to augment an established program of physiotherapy.

Research Questions

This study addressed the following research questions:

1. Is there a difference in strength recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

2. Is there a difference in extension recovery/acquisition (*improvement*) among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

3. Is there a difference in *patterns* of extension recovery/ acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

4. Is there a difference in flexion recovery/acquisition (*improvement*) among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

5. Is there a difference in *patterns* of flexion recovery acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

6. Is there a difference in reinjury anxiety among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

7. Is there a difference in state or trait anxiety among individuals who participate in a combined program of guided imagery and physical rehabilitation (intervention group) versus those who receive attention and physical rehabilitation (attention-control group) or physiotherapy (control group) alone?

Selected Definitions

The Center

The Western Surgery Center and the Mountain West Physical Therapy Center (Logan, Utah) are both housed within the same physical facility and share medical staff. Subjects in this study first received their ACL replacement at Western Surgery Center from one of the four surgeons named in this document, and then performed physical therapy at Mountain West Physical Therapy Center. However, some subjects from the outlying Cache Valley areas rehabilitated at the Mountain West Physical Therapy Center in Tremonton.

Anterior Cruciate Ligament

The anterior cruciate ligament (ACL) is situated nearer to the back of the knee joint than to the front, and is attached to the inner tuberosity of the femur at one end, and

the inner tuberosity and inner surface of the shaft of the tibia at the other. Both the ACL and the PCL are internal to the knee joint proper. Combined with the PCL, this ligament is regarded as the mainstay for knee strength, extension, flexion, and stability. Contrary to other soft-tissue injuries to the body, serious tearing or severing of either or both ligaments requires replacement, rather than repair.

Reconstruction/Replacement

Reconstruction or replacement is the surgical process by which the anterior cruciate is repaired in individuals with severe ACL and/or PCL damage. The surgical process utilized by surgeons in this study consisted of either an autograft (utilizing an individual's own body tissue to replace the ligament) or allograft (utilizing donated cadaver ligaments). This procedure is performed at the Western Surgery Center on an outpatient, arthroscopic basis, whereby patients usually receive the replacement and return home within the same day. Patients begin therapy immediately (within the first 3 days postsurgery) and are encouraged to increase range of motion without weight bearing. Crutch-assisted ambulation extends from 3 to 6 weeks, depending upon individual recovery responses, as well as extent of injury. Total recovery, as evidenced by a full return to all normal activities, ranges from 9 to 18 months in duration.

Intervention

Psychological rehabilitative injury intervention for the experimental group members consisted of 10 sessions of relaxation and guided imagery over a recovery

period of 24 weeks for each subject beginning immediately after ACL replacement surgery. Each session was designed to facilitate recovery through the learning and practicing of mental skills. Imagery protocols that directly paralleled physiotherapy protocols provided a framework for session content, which focused on mentally practicing weekly physical therapy goals.

Although not specifically regarded as an intervention, attention and support were provided for members of the attention-control (placebo) group, thus functioning as another level of intervention. The same amount of time was devoted to members of this group as to members of the intervention group, with the exception of delivery of any therapeutic intervention (relaxation and guided imagery).

Goniometers

Hand calibrators, or goniometers, are simple hinged devices utilized by physical therapists in this study to measure joint angles (DeBacher, 1989). Similar to a large protractor, goniometers were employed to assess ongoing range of motion acquisition by measuring degrees of extension and flexion between the tibia and femur.

Cybex 6000

The Cybex 6000 is an isokinetic dynamometer, which assesses concentric/eccentric ligament activity, measuring strength, range of motion, internal/external rotation, and leg extension and flexion (Cybex, 1993). Although other assessments of extension, flexion, and functionality combine to contribute to an overall

evaluation of recovery, the Cybex 6000 measurement at approximately 24 weeks postsurgery is presently regarded as the definitive physical rehabilitative benchmark.

Extension

Extension refers to the degree to which the leg can be extended outward relative to the tibia and femur. The normal amount of extension possible for each individual varies, although this range of motion usually falls within a range of 1 or 2 degrees either plus or minus zero.

Flexion

Flexion refers to the degree to which the leg can be bent relative to the tibia and femur. The normal amount of flexion possible for each individual varies, although flexion usually ranges from 135 to 150 degrees.

Physical Therapy

A course of physical therapy for ACL replacement usually involves 12 months of prescribed, standardized physiotherapy devoted to rehabilitating the reconstructed/replaced ligament. For approximately the first 3 months, patients generally attend physical rehabilitative sessions three times weekly. By the fourth month, however, patients often practice their rehabilitation through exercises at home, thereby considerably reducing their attendance at the physical therapy center. Each subject in this study received a 6-week checkup by his/her surgeon, and then subsequent checkups every 6 months, as needed. Strength (recovery) evaluation is performed at 24 weeks postsurgery,

and again if desired/needed at 12 months postsurgery. Present protocols call for patients to continue strength training over their life span to maintain recovery.

CHAPTER II

LITERATURE REVIEW

This chapter reviews and critiques relevant literature in several interrelated areas, including imagery, research support for psychological injury interventions, review of empirical psychological injury interventions to date, issues in injury management, and theoretical and practical issues in intervention development and implementation. This literature review begins with a brief discussion of injury context, followed by a history of imagery applications, and theoretical perspectives relative to the use of cognitive processes for somatic outcomes. A rationale for psychological injury intervention is presented, followed by a brief discussion of issues in injury management. Theoretical bases for psychological injury intervention implementation are also offered. The literature on studies supporting psychological injury intervention is reviewed, followed by a comprehensive review of empirical injury intervention research to date. This chapter is concluded with a discussion of background and components of a program of relaxation and guided imagery for psychological injury intervention.

The Context

A current trend in health care has been an increased interest in exploring the integration of mind and body for treatment of medical disorders, including recovery from injuries and subsequent surgery. Imagery has been employed as one technique for accomplishing this integration, having been researched and applied in major medical

centers and universities around the world, in situations ranging from the treatment of chronic pain, strength recovery, the healing of surgical wounds, and management of cancer (Rossman, 1984).

In an age of heightened awareness and concern for wellness, as well as a nascent receptivity to consider the multivariate contributors to this wellness, recovery from physical injury is recognized as an important aspect of daily life. Physical injury directly impacts an individual's psychological well-being, which, in turn, directly influences health, performance, and risk of further physical injury (Hardy, 1992). The importance of returning to a lifestyle of health and fitness after injury would appear to be self-evident. Yet the speed and effectiveness of recovery relies on much more than physiological factors. It is believed to be the combined result of the severity of the injury and its associated stress, as well as an individual's ability to cope (Heil, 1993). Recovery is therefore a function of personal response to injury, coupled with biological and situational variables.

Common medical practice for recovery from injury, which may or may not include surgery, is to follow a physical rehabilitation program that concerns itself with the physical aspects of injury. However, these programs usually lack a mind/body component that enables individuals to address personal aspects of injury. Often omitted from such a program of recovery is intervention that enables an individual to deal with an injury's accompanying threat to mental and emotional wellness. As a result, healing may be retarded, restricted, or prohibited (Danish, 1986).

Psychological intervention for injury has typically been employed to address the more serious of psychological ramifications of injury, as in the case of depression. However, results from recent psychological injury intervention studies demonstrate that mental practice techniques are also helpful in facilitating physical recovery (Brewer et al., 1994; Levitt, Deisinger, Wall, Ford, & Cassisi, 1995; Nicol, 1993; Ross & Berger, 1996; Sthalekar, 1993). Results of these studies, and those involving guided imagery in particular, suggest that a structured, physical rehabilitation program that includes some form of imagery and relaxation as mental practice is more effective in influencing the extent to which an individual will recover than physical rehabilitation alone.

History of Imagery Applications

The premise that psychological variables play a vital role in physical rehabilitation from injury predates contemporary thought. Imagination was recognized as an important contributor to health, as well as disease, at the time of Aristotle (McMahon & Sheikh, 1984). Ancient and Renaissance medical approaches embraced the holistic nature of biological and psychological functions. However, when Cartesian dualism invaded the philosophical basis of medical theory, imagination became separated from therapeutic procedures. The line between mind (as mental functions of the soul) and body was drawn to define a kind of philosophic principle of parallelism--a principle that replaced 2,000 years of a hypothesis of interaction. With this dualism, Descartes initiated the two independent movements of mentalism and materialism, principles which some subsequent outstanding thinkers and philosophers of the late 18th and early 19th century

were unable to reconcile, particularly given the presence of psychosomatic and psychophysiologic phenomena (McMahon & Sheikh, 1984)

When psychology emerged as a separate discipline in the late 19th century, European psychologists and psychiatrists, in particular, advocated a return to a monistic approach to the mind/body question. This renaissance of Aristotelian theory was slower to take hold in the United States, although renewed interest in the influence of imagery's involvement in human physiology surfaced mainly through developments in areas peripheral to mainstream psychology (Watkins, 1976). Some of these areas included biochemical and neuropsychological investigations, studies of sleep, sensory or perceptual deprivation research, and engineering psychology.

Current attempts to explain the intricacies of the healing process include a mind/body approach that views the human being as an interdependent system of constant interchange between mental and physiological functioning (Pargman, 1993). It has been suggested that the impetus toward this trend can be found in Cannon's principle of homeostasis, defined as a process of interaction between the mind and body toward maintenance of internal stability (Cannon, 1932; Ievleva & Orlick, 1991). The classic mind/body, psychophysiological principle proposed by Green, Green, and Walters (1970) builds on Cannon's principle of homeostasis, deriving much of the evidence supporting its assumption from psychosomatic, placebo, and biofeedback research (Ievelva & Orlick, 1991). In accordance with these principles, contemporary behavioral medicine and sport psychology research now advocate the use of mental practice in the healing of injuries

(McDonald & Hardy, 1990; Smith, Scott, O'Fallon, & Young, 1990). Additionally, the psychological impact of injury has been, and continues to be investigated (Brewer et al., 1994; Chan & Grossman, 1988; Levitt et al., 1995; Nicol, 1993; Nideffer, 1983; Ogilvie & Tutko, 1966; Pen, Fisher, Sforzo, & McManis, 1995; Ross & Berger, 1996; Rotella, 1982; Rotella & Campbell, 1983; Sthalekar, 1993).

Imagery Defined

Mental imagery can be defined as visualizations or quasi-sensory experiences of which one is consciously aware, and which exist in the absence of concrete stimulus conditions that are known to produce imagistic, genuine sensory counterparts (Richardson, 1969). Vealey (1986) suggested the use of imagery as a psychological tool, a mental technique, that directs the human mind to respond as programmed. Imagery involves utilizing all the senses, particularly visualizations, to recreate or create an experience in the mind. Visualizations are purported to originate in the primordial portions of the brain, being closer to our everyday experience than is stored verbal material (Sheikh & Jordan, 1983).

The role of imagery in the processing and storage of information is an important one. Imagistic thought integrates and processes experience, as well as prompts new solutions to problems that have eluded prior lexical resolution (Sheikh & Jordan, 1983). Moreover, imagistic thought is now regarded by many clinical, behavioral, and cognitive psychologists as equal in importance to lexical modalities for memory storage and retrieval.

Imagery is a universal human phenomenon, which permits adaptation of individual experience in ways in which semantic interpretation is incapable. The functional equivalence between imagery and actual stimuli is important to an understanding of imagery's capacity to foster therapeutic change. Mental pictures permit creation of experience, as well as facilitate storage and recall of important events. This visual experience is as simultaneous with an affective response as is real experience, often eliciting emotions more conducive to relaxation and healing than verbally/semantically directed stimuli. Either imagined or real external stimuli can evoke neurophysiological patterns that are qualitatively and quantitatively similar (Sheikh & Jordan, 1983).

Theoretical Perspectives

It is important to position a mind/body paradigm (with specific applications to the healing of injuries) within a theoretical framework that attempts to account for the biological and psychological consequences of imagery on health, illness, and healing. Two particular perspectives, the psychomotor and the psychophysiological, within the context of a systems theory approach (integrating several related theoretical orientations) provide such an adumbration.

The Psychophysiological and Psychomotor Orientations

The *psychophysiological orientation*: This perspective suggests that for every physiological change that occurs in the body, there is an appropriate change in the mental-

emotional state (Green et al., 1970). The credibility of utilizing a mind-body approach in explaining some of the intricacies of the healing process seems warranted when considering the principle of homeostasis, as previously mentioned (Cannon, 1932; Ievleva & Orlick, 1991), which proposes that a process of interaction between the brain and the body exists for the purpose of maintaining internal stability. A change in the physiological state is accompanied by an appropriate change in the mental state (conscious or unconscious) (Green et al., 1970). Conversely, every change in the mental state is accompanied by an appropriate change in the physiological state. Gardner (1985) further identified a "body-kinesthetic intelligence," or the ability to use one's body in differentiated ways, which included the ability to apply the expressive powers of the mind to physical healing.

The psychophysiological perspective assumes that there are specific psychological factors that enhance or hinder the effectiveness of rehabilitation--rehabilitation that includes an athlete's ability to cope with the injury. According to a thorough search of the extant literature, the most salient of these psychological variables are (a) an athlete's intrinsic motivation to recover, (b) the nature of social/emotional support available, (c) an athlete's belief in his/her own self-healing capacity, (d) positive self-talk, (e) his/her belief in the efficacy of the medical/psychological personnel, and (f) the use of some form of healing imagery.

Given these factors, guided imagery is believed to trigger and/or promote healing in the recovery process (Barabasz & McGeorge, 1978; Cousins, 1989; Green & Green,

1977; Korn & Johnson, 1983; Schwartz, 1984; Simonton et al., 1978). Researchers such as Brewer et al. (1994), Green (1992), Heil (1993), Ievleva and Orlick (1991), Nicol (1993), Pargman (1993), Spanos and O'Hara (1990), Surgent (1991), and Wiese, Weiss, and Yukelson (1991) are among the most recent to advocate its use for accelerated recovery.

The *psychomotor perspective*: Having been shown to facilitate the learning and execution of motor skills under controlled conditions (Corbin, 1972; Feltz & Landers, 1983), research in the field of sport medicine demonstrates that imagery has a profound effect on physical recovery. The efficacy of mental rehearsal as a facilitator for the learning and execution of motor skills is well documented (Pargman, 1993). In addition to producing physiological responses such as increased heart rate (May & Johnson, 1973), changes in electromyograms, blood-glucose, skin temperature, muscle innervation, pupillary reactions, and salivation (Barber 1985; Barber, Chauncey & Winer, 1964; Sheikh & Jordan, 1983), mental imagery plays an important role in facilitating physical changes produced by biofeedback, training, and placebos (Ievleva & Orlick, 1991). It should be noted that these changes tend to more often reflect changes at the process level of physiological functioning than at the specific, structural level.

A Theoretical Synthesis

A synthesis of the following theories that embrace the psychomotor perspective appears to most comprehensively explain the influence of guided imagery on healing: (a) *symbolic learning theory* (Sackett, 1935), (b) *psychoneuromuscular theory (*Jacobson,

1938), (c) *attention-arousal set theory* (Vealey, 1987), (d) *bioinformational* theory (Hecker & Kaczor, 1988), (e) *multilevel hierarchical control theory* (Green, 1972) and (f) *a two-process model of imagery* (Pibram, 1971).

Symbolic learning theory proposes that symbolic rehearsal advances the development of skills, particularly those that require cognitive processes, due to the influence of an associated visual code's reworking and restructuring of both semantic and motor schemas (Sackett,1935). In other words, imagery may function as a coding system that helps the brain acquire or understand movement patterns by blueprinting or encoding them into symbolic components (Vealey, 1987). In the case of healing, imagery can facilitate composition of healing blueprints (encodings) that translate to the somatic level.

A psychoneuromuscular orientation accounts for muscular innervations during imagery that are similar, if not identical, to muscular innervations during actual muscular performance (Jacobsen, 1938; Lang, 1979). According to Magill (1989), imagery is important in providing sensory information and feedback for a strong perceptual trace, which in turn contributes to a well-developed recall schema. The importance of using imagery for rehabilitation becomes rather self-evident when considering an athlete's need to engage in healing and strength-building physical movements while at the same time being physically incapacitated due to a severe injury. Many of the same beneficial effects of physical practice can be accomplished visually without initially involving the injured body part(s) since muscular innervation can be initiated through imagery. When the

injured part is well enough to begin movement for range of motion and strength, innervations due to visual images can facilitate a combined therapeutic effect.

The attention-arousal set theory integrates both cognitive and physiological aspects of rehearsal so as to distinguish between relevant and irrelevant informational cues for perfection of movement (Feltz & Landers, 1983; Green, 1992; Vealey, 1987). Bioinformational theory attempts to account for how stimulus characteristics of imagined events affect physiological responses that they produce (Lang, 1979). Both the multilevel hierarchical and two-process model of imagery attempt to further explain the interdependence of mind and body relative to motor movement. These two models both stress the existence of a mind/body system that operates at many levels of mental processing, while we interact with the environment.

The Cognitive-Somatic Connection

Guided imagery has been referred to as a method of communicating with autonomic physiological processes that occur outside of conscious awareness (Jaffe & Bresler, 1980). As such, it is believed to function in the role of an anatomical mediator. It is well established that the use of imagery triggers neurophysiological functions in much the same way as actual experience (Leuba, 1940; Richardson, 1969). As mentioned, the use of personal mental images to modify bodily processes is an ancient part of the healing tradition (Jaffe & Bresler, 1980). Recent evidence demonstrates that the autonomic nervous system can be modified through cognitive strategies--an internal exchange of information within the conscious mind can be recruited to promote specific

physiological changes. Surgent (1991) extended this notion, suggesting that a mind/body connection facilitates the healing process itself.

In the area of psychoneuroimmunology, an evolving, multidisciplinary field that attempts to account for the interactions of (a) psychological factors, (b) the central nervous sytem, and (c) the immune system, the relationship of cognitive functioning and immune system responses continues to be explored. Solomon and Moos (1964) first coined the term "psychoneuroimmunology" to refer to the interactional effects of psychological variables and somatic outcome. While early psychoneuroimmunology research focused on the effects of acute, short-term stressors on immune system functioning (Locke, 1982; Solomon, 1969), more recent work in the field suggests an ongoing reciprocal relationship between the central nervous system and the immune system (Gorman & Kertzner, 1990). Psychological states exhibit immunosuppressive components--that is, psychological variables appear to have a significant influence on the body's susceptibility, reaction to and recovery from injury or disease. Some of these influences include elevated cortisol levels, increased antigens and elevated white cell counts, as well as reduction in sympathetic tone, wound inflammatory response, noradrenergic hypothalmic turnover, and lymphoid organ activity (Richey, 1992).

As a cognitive strategy, imagery has been employed to positively influence somatic outcome. Increased positive immune system responses have been reported by Achterberg (1991), AuBuchon (1991), Green (1992), Hall (1983), Hall, Lingo, and Dixon (1982), Post-White (1991), and Surgent (1991) when triggered by imagery (process

change). Simonton et al. (1978) offered evidence supporting the use of imagery in the treatment of cancer (structural change), while others reported effective use of imagery during rehabilitation for such maladies as ulcers, paraplegia, fractures, hip disarticulations, and intraabdominal lesions (Korn, 1983), stress (Hanley & Chinn, 1989), and psoriasis (combinations of both process and structure); Gaston, Crombez, & Dupuis, 1989).

The positive effects of guided imagery on surgical stress and wound healing have been demonstrated by Holden-Lund (1988) through reduced levels of state anxiety, urinary cortisol levels, and wound inflammatory responses. Mason, Clark, and Reeves (1969) demonstrated a significant positive relationship between use of imagery to produce patient acceptance and healing for surgical detached retina patients, while George (1980) reported faster rates of gingival healing and less pain for patients experiencing positive expectations through imagery. State anxiety level reduction has also been demonstrated in a number of other studies for surgical patients (Hart, 1980).

According to Surgent (1991), the mechanism for this healing is due to feelings, attitudes and beliefs being cognitively organized in the brain, and then communicated by chemical "messengers" to the immune system--the immune system directly impacting the healing process in either a positive or negative way. Rossman (1984) proposed that imagery facilitates access to thought patterns that underlie symptoms of distress by focusing on the symbolic dimension of consciousness.

Many clinical researchers propose that an experience in imagination be regarded as equivalent in many important respects to the actual experience (McMahon & Sheikh, 1984). They propose that imagery and perception are experientially and neurophysiologically similar processes. In point of fact, the locus of image excitation corresponds to the locus of sensory functions in the brain (Penfield & Perot, 1963). This is to say that imagery appears to directly access the autonomic nervous system, which regulates breathing, blood chemistry, tissue regeneration and repair, immune and inflammatory responses, and many other bodily functions essential to life (Bresler, 1984).

A Rationale for Psychological Injury Intervention

Injury, particularly for the competitive athlete, is a problem for a number of reasons. As previously mentioned, more than 17 million injuries occur annually, with accompanying significant emotional and financial outcomes. Moreover, the behavioral and psychological consequences of injury in the form of subjective cost to the individual can be staggering (Heil, 1993). Additionally, there are recent reports of increasing injury incidence among intercollegiate athletes (Meeuwisse & Fowler, 1990).

There has been significant investigation into the psychological *antecedents* of sport injury (Anderson & Williams, 1988), yet research/theory/intervention regarding psychological *consequences* of athletic injury lags behind antecendent research. We are aware that some of these consequences include emotional distress, pain experience, timeliness of the injury, immediate pain experience, culpability, unpredictability of injury, loss of control, grief, loss of identity, separation/loneliness, anxiety, self-efficacy and self-

esteem reductions, performance decrements, relationship trauma, depression, anger, confusion, over-all body wellness, and personality disturbance (Heil, 1993; Murphy, 1995; Pargman, 1993). Special and/or exacerbated factors for competitive athletes include psychological stress of performance, rigorous training strategies, risky health practices, reliance on highly refined sport-specific mental skills, and the life-absorbing nature of athletic competition (Heil, 1993).

A paucity of empirical psychological injury intervention studies that include control groups, standardized prevention/rehabilitation protocols, and/or specific injury orientations serves to cloud the issue of how significantly psychological interventions contribute to prevention or recovery from injury. It is still unclear how profound an effect injury actually exerts on recovery; prevalence and severity of psychological disturbance in sport injury rehabilitation settings have yet to be adequately assessed (Brewer et al., 1994). Even more sparcely investigated have been the affective components of injury prevention and rehabilitation interventions (Kerr & Goss, 1996). Moreover, the question of why some individuals struggle more than others with psychological aspects of the recovery process as manifested in increased levels of frustration and pain, loss of motivation to perform physical therapy, and elevated anxiety has been largely unanswered (Udry, 1995). Additionally, questions regarding whether the competitive athlete can remain injury free or what multivariate components comprise coping are in need of much empirical research.

The following is offered as a noncomprehensive list of research goals and inquiry activities relative to the consequences of injury that, thus far, remain to be adequately addressed:

1. Assessing the prevalence/severity of psychological disturbance in injury rehabilitative settings.

2. Increasing adherence to physical rehabilitation protocols.

3. Investigating which psychological variables actually affect and/or predict recovery.

4. Providing physical functioning (outcome) measures to medical personnel.

5. Evaluating the evolution of coping.

6. Exploring injury prevention (psychological) approaches.

7. Investigating the efficacy of cognitive strategies (specifically relaxation and guided imagery) for physical recovery.

8. Exploring generalizability of findings to the recreational athlete.

Issues in Injury Management

The fundamental goal of intervention should be to identify the subjective cost of injury to an individual, while concurrently teaching and strengthening coping resources. This translates to an assessment and treatment process that begins with identifying the personal meaning of injury to an individual, as well as enabling him/her with active, cognitive/ emotional recovery "tools" (Heil, 1993).

To accomplish these goals, interventions should include objectives that contain proactive steps that identify, validate, and address personal and situational factors. According to a thorough review of the extant literature on recovery from injury, five components are most common across studies as psychological/psychosocial variables that contribute most positively to physical recovery, and thus necessitate integration, to one degree or another, into intervention objectives. These components include goal setting, mental training, positive self-talk, knowledge/education, and social support.

Goal setting includes defining the task; *mental training* involves an array of techniques including relaxation and imagery to accomplish control, coping, and healing; *positive self-talk* usually consists of a self-affirming dialogue; *knowledge/education* includes aspects of understanding the process of recovery; and *social support* involves aspects of emotional, physical, and financial assistance.

Theoretical/Conceptual Bases of Psychological Intervention for Injury

It has been common practice to separate theoretical foundations of sport injury interventions into investigations concerned with either (a) emotional *antecedents* of injury, (b) *effects* (consequences) of injury, or (c) psychological recovery factors. Empirical investigations, however, are beginning to reflect the multivariate influence of psychobiological factors inherent in the injury recovery process (Petitpas & Danish, 1995). The interactional effect of psychological variables not only explains and predicts

affective components of injury, but also plays an integral role in mediating adjustment to and recovery from athletic injury (Ross & Berger, 1996).

Although early intervention efforts were based on adaptations of *stage models* of grief and loss (e.g., Astle, 1986; Lynch, 1988; Rotella, 1985), *cognitive appraisal models* (e.g., Anderson & Williams, 1988; Gordon, 1986; Lazarus & Folkman, 1984) have recently been found beneficial in directing prevention and/or rehabilitation interventions (Brewer, 1994). In general, stage models have presented difficulties generalizing across individual athlete responses. Since cognitive appraisal models rest on the premise that an athlete's interpretations of injury are critical to understanding individual differences in emotional reactions to injury (Ross & Berger, 1996), these models are particularly applicable to the amelioration of associated emotional and physical distress/dysfunction.

A theoretical model of post-injury response as advanced by Wiese-Bjornstal and Smith (1993) has important implications for this dissertation research. As an integration of Anderson and Williams' (1988) pre-injury psychosocial model and Wiese and Weiss's (1987) stress model of injury, it acts as a pragmatic framework from which to address post-injury concerns. While attempting to account for the psychosocial impact of an athletic injury, it identifies factors influencing physical recovery, including post-injury cognitive and emotional responses. These often assume the form of specific characteristics of the injury, the prescribed physical rehabilitation, individual coping resources, goals, self-talk, perceived support, motivation, and pain tolerance, among others (Wiese-Bjornstal & Smith, 1993).

A significant permutation arising out of this model is the hypothesis that individual emotional response (coping) to athletic injury is determined by interpretation or cognitive appraisal of injury and its effects. This appraisal is believed to be affected by the combined influence of personal and situational factors. According to Brewer et al. (1994), Heil (1993), and Ross and Berger (1996), recommended injury treatment methods are increasingly being based on cognitive-appraisal theories of stress and coping. In particular, these models appear to support ameliorative efforts relative to management of pain and associated emotional distress/dysfunction more readily than the formerly popular stage models of grief and loss. In general, stage models have presented significant difficulties generalizing across individual responses to injury (McDonald & Hardy, 1990; Smith et al., 1990).

The importance of the Wiese-Bjornstal and Smith (1993) model to this research lies in its ability to serve as a preliminary theoretical model of sport injury intervention, while also exhibiting clinical utility in assessing and treating post-injury cognitive responses important to recovery. In this model, as in other cognitive appraisal models, injury is considered a stressor. According to Brewer (1994), responses to injury can be effectively analyzed in the context of this stress process, with a central role ascribed to cognition.

The foundations of psychological interventions in sport injuries owe much to the earlier stress research of Allen (1983) and Smith (1979), among others. According to Heil (1993), psychological injury rehabilitation approaches stem from a synthesis of the

stress-illness, stress-injury, and stress-accident literature. At the present time, however, specific psychological processes inherent in physical recovery, as well as behavioral outcomes accompanying injuries, are neither theoretically nor empirically based (Brewer, 1994).

While various models have been advanced for use as frameworks for psychological injury intervention, the field of sport psychology is currently limited in its ability to know how to direct and facilitate the rehabilitation process. This is due primarily to a dearth of controlled, empirical studies that investigate relationships among emotional responses, consequences, and physiological outcomes of sport injury, while actually manipulating a psychological treatment condition.

In contrast, then, to the existence of a relatively rich body of theoretical research supporting the use of psychological interventions in sport injury prevention and rehabilitation, there is a dearth of empirical, intervention studies. Most of the supportive, theoretical studies have been comparative or survey in nature, using retrospective and/or cross-sectional research designs to examine certain aspects of cognitive appraisal models. Additionally, within these approaches, the trend has been to identify either personal or situational psychological factors, rather than the joint influence of the two.

Literature Supporting the Use of Psychological Interventions

Although the primary purpose of this chapter is to review and critique the literature relative to psychological injury interventions, such discussion would be remiss

without a brief review of the supporting literature for these interventions. Subjects in these supportive studies are generally athletes ranging on a continuum from recreational to competitive status, representing a wide variety of both team and individual sports. In general, the term athlete refers to persons who maintain physically active lifestyles while pursuing a sport(s), whether competitively or recreationally. These studies are highlighted by topic areas of prevention, coping, adherence, formats, mental practice and sport medicine personnel.

Identifying variables that *predispose athletes to injury* has been an ongoing endeavor since the late 1960s. Coddington and Troxell (1980) were among the first to investigate the effects of emotional factors on injury rates. The effect of specific cognitive techniques, for example, association/dissociation, was studied by Masters and Lambert (1989), who found no relationship between injury and dissociation as a preventive strategy. Anderson and Williams (1993), Smith, Stuart, Wiese-Bjornstal, and Millner (1993), Kerr and Minden (1988), and Bonesteel, Marsden, Ogles, and Holdridge (1996) confirmed psychosocial variables as predictors of injury. In more applied contexts, McKnight (1994) identified seriousness and recurrence of injury, as well as depression, as factors predicting exercise behavior while injured, while Yukelson and Murphy (1993) successfully employed imagery and relaxation to prevent injuries.

Regarding *coping* strategies, Lynch (1988), Rotella (1985), Pargman and Lunt (1989), and Rotella and Heyman (1993) investigated personal and situational factors that enabled injured athletes to manage injury recovery. McDonald and Hardy (1990) and

Kleiber and Brock (1992) investigated the impact of severe or career-ending injuries. Chan and Grossman (1988), Smith et al. (1990), and Leddy, Lambert, and Ogles (1994) documented depression and anger varying as a function of injury severity. These studies demonstrated that problem-focused orientations were helpful in coping with injury, yet athletes displayed marked individual variation in emotional responses. Factors contributing to this variation included individual defensive mechanisms, personal adaptive patterns, activity level, goal attainment tendencies, and personality. Findings suggest that interventions consider athlete stage of development, personal and injury circumstances, and personality type.

The relationship between various situational variables and emotional adjustment to injury was investigated by Brewer, Linder, and Phelps (1995), and Brewer and Petrie (1995), who found injury status, perceived impairment, and social support to be contributors to stress and depression in recovering athletes. In contrast to earlier reports of severe emotional distress for injured athletes, Brewer et al. (1995) found severe distress to be an infrequent occurrence among injured athletes from the perspective of sport medicine personnel. Quakenbush and Crossman (1994) confirmed an evolution of emotional responses to injury over time (stages). These findings highlight the need for more systematic inquiry into the effect of psychosomatic factors on recovery over time, as well as difficulties by rehabilitation personnel in identifying clinically meaningful emotional disturbance inhibitory to recovery.

Shanahan (1991) found quality (as opposed to quantity) of social support most significant to recovery, Udry (1995) reported social support as crucial in the early stages of recovery, and Ievleva and Orlick (1991) reported social support as an essential factor in injury recovery. Gould, Udry, Bridges, and Beck (in press) confirmed the most salient stressors for injured athletes to be psychological, for example, reinjury anxiety, lack of social support, rather than medical stressors such as pain. With regard to coping with somatic responses, Pen et al. (1995) and Young, McTeer, and White (1994) (pain), and Evans and Hardy (1995) (grief responses) found cognitive strategies helpful in ameliorating affective responses to injury. As a phenomenon strategic to coping with injury, social support remains a problematic dynamic to assess due to its multivariate, subjective nature.

Intervention formats and strategies to reduce feelings of loss and anomie, as well as increase sense of control, and to promote effective goal setting and facilitate healing were proposed by Ermler and Thomas (1990) and Yukelson (1988). Green (1993) outlined sample imagery formats complementary to physical therapy programs, as did Grantini, Hogan, and Miller (1993). De Francesco, Miller, Larson, and Robinson (1994) also offered an intervention format for utilization throughout the entire recovery period. Heil (1993), Pargman and Lunt (1989), and Wiese-Bjornstal and Smith (1993) contributed significantly to knowledge concerning intervention strategies, format, and content, particularly in the area of mental practice skills.

Rehabilitation adherence as an activity that contributes to injury recovery has been studied by Duda et al. (1989), Leith and Taylor (1992), Udry (1995), and Fisher, Domm, and Wuest (1988). Daly, Brewer, Van Raalte, Petitpas, and Sklar (1995) reported emotional disturbance to be inversely related to physical rehabilitation attendance, a salient finding supporting the notion that cognitive appraisals of injury determine emotional responses to injury; these in turn influence behavioral responses. Fields, Murphy, Horodyski, and Stopka (1995), and Byerly, Worrel, Gahimer, and Dombolt (1994) identified self-motivation, scheduling, emotional support, and pain management as factors associated with rehabilitation adherence. Researching adherence differences for various types of athetes, Mortellano (1994) found no differences between locus of control and self-efficacy measures for recreational versus competitive athletes.

The use of *mental practice* (including biofeedback) has been found to be an effective preventive and rehabilitative treatment, for example, by Pargman and Lunt (1989), Achterberg, Kenner, and Casey (1989), Green (1993), Lynch (1988), Richardson and Latuda (1995), and De Francesco et al. (1994; imagery). Pen et al. (1995) successfully employed mental practice techniques to reduce pain and increase quadriceps strength. Certainly findings from these studies offer a solid, effective springboard for further preventive and rehabilitative injury intervention programs.

The recovery process as involving *sport medicine personnel* has been studied by Crossman (1986), Singer and Johnson (1987), Fisher, Mullens, and Frye (1993), Larson, Starkey and Zaichkowsky (1996) and Steadman (1993), among others. Wiese et al. (1991;

trainers), Shelley and Henschen (1995; youth), Smith and Milliner (1994; suicide), and Henderson and Carroll (1993) reported positive communication, goal setting, and self-motivation as important factors in preventive and rehabilitative interventions. Pero and Sachs (1995) developed and implemented an educational program for trainers to aid in identifying variables that predispose athletes to injury. Brewer et al. (1991) reported physician perceptions of high incidence of behavioral problems (relative to pain and rehabilitation noncompliance) in conjunction with athletic injuries. Paradoxically, however, physicians displayed a reluctance to refer athletes to sport psychologists for counseling to address these concerns. Wilder (1994) found a relationship between clinician expectations and rehabilitation compliance, suggesting a Pygmalion effect between physician and patient (athlete).

A discussion of conceptual and theoretical issues would be remiss without mention of four nonintervention, injury self-report studies particularly salient to injury intervention. Ievleva and Orlick (1991) were some of the first researchers to examine relationships between psychological variables and physical recovery rates among athletes with knee and ankle injuries. In a retrospective survey study, they found positive correlations with recovery rates for goal setting, positive self-talk, and healing mental imagery. Athletes who were satisfied with their rehabilitation and who had recovered most quickly had applied these mental skills without specific instruction during their recovery. In a follow-up study to Ievleva and Orlick (1991), Loundagin and Fisher (1993) retrospectively surveyed athletes recently recovered from knee and ankle injuries to

investigate the relationship of mental skills to injury rehabilitation. Their results indicated goal-setting, healing mental imagery, and focus of concentration as most highly related to faster healing rates. Both quantitative and qualitative results supported integration of mental skills training and injury rehabilitation programs, particularly for those skills that facilitate locus of control.

Latuda and Richardson (1995) compared differences between expected and actual healing rates and certain mental skills from responses by intercollegiate athletes. When holding severity of injury constant, results indicated nonsignificant correlations between healing time and use of imagery, self-talk, goal-setting, and relaxation. Results from qualitative data, however, revealed that athletes who successfully rehabilitate tend to self-engage in mental skills such as positive self-talk and goal setting. Findings from this research illustrate the need to operationalize definitions of mental skills, combine quantitative and qualitative inquiry, and investigate the difference in injury rehabilitative outcomes between when mental skills are taught and practiced as part of an intervention as opposed to when performed informally by athletes on their own.

Bond, Miller, and Chrisfield (1988) were among the first to empirically investigate the relationship between injury prevention and psychological variables. Although an unexpected negative correlation was discovered between high attentional control scores and swimming injuries for collegiate swimmers, this study demonstrated the critical importance of operationalizing injury definitions, reporting injury incidence accurately, and matching psychological assessments appropriately to type of injury or

sport in order to obtain accurate outcome data. Collectively, the Bond et al. (1988), Ievleva and Orlick (1991), Latuda and Richardson (1995), and Loundagin and Fisher (1993) studies laid important ground work for preventive and rehabilitative intervention with respect to research design, analysis, treatment, measurement, and application.

Empirical Intervention Research

In contrast to the rich body of empirical studies investigating psychological factors in sport injury occurrence and rehabilitation, there is a dearth of controlled *intervention* studies examining relationships among emotional antecedents, responses, consequences, and physiological outcomes of sport injury. Unfortunately, psychological injury intervention research has not kept pace with the development of theoretical models. Nevertheless, empirical investigations of interventions focused on the prevention or rehabilitation of sport injuries are beginning to accumulate.

A complete review of the literature to date reveals a total of four empirical prevention (Table 1) and 13 empirical injury rehabilitation intervention studies (Table 2). Of these 13 rehabilitative research studies, 6 utilized a control group(s). Of these six, only two studies (biofeedback) reported physiological outcomes. Interestingly, these two investigations both concern a specific injury, that is, knee injury with subsequent arthroscopic surgery. No relaxation/imagery studies utilized a control group or physiological outcome measures. Four intervention studies involved some form of guided imagery as an intervention application.

Table 1

Sport Injury Prevention Intervention Studies

Study	N	Population	Intervention	Control group(s)	Method	Intervention effects	Statistical comparisons
May & Brown (1989)	18	Olympic alpine skiers	Relaxation/ imagery/ counseling	No	Qualitative	Reduced injury; increased self-confidence and self-control	No
Schomer (1990)	10	Marathon runners	Attentional Strategies	No	Qualitative	Facilitative heavy training without injury	No
Davis (1991)	21	Collegiate swimmers/ football players	Stress management	No	Quantitative	52% reduction in swimming injuries; 33% reduction in football injuries	No
Kerr & Goss (1996)	24	Elite gymnasts	Stress management	Yes	Qualitative/ Quantitative	Reduced injuries and stress levels	Yes

Table 2

Sport Injury Rehabilitation Intervention Studies

Study	N	Population	Intervention	Control group(s)	Method	Intervention effects	Statistical comparisons
Sprenger, Carlson, & Wessman (1979)	1	Meniscal surgery	Biofeedback	No	Quantitative	Increased ROM	No
Krebs (1981)	26	Meniscal	Biofeedback surgery	Yes	Quantitative	Increased EMG output; increased strength	Yes
Rotella & Campbell (1983)	1	Basketball	Systematic desensitization	No	Qualitative	Reduced reinjury anxiety; increased confidence	No
Wise, Fiebert, & Kates (1984)	6	Patellofemoral pain	Biofeedback	No	Quantitative	Reduced pain; quicker return to sport	No
Draper (1990)	22	ACL	Biofeedback	Yes	Quantitative	Increased strength	Yes

(table continues)

Study	N	Population	Intervention	Control group(s)	Method	Intervention effects	Statistical comparisons
Draper & Ballard (1991)	30	ACL reconstruction	Biofeedback	Yes	Quantitative	Increased strength	Yes
Carroll (1993)	6	Mixed injuries	Imagery	Yes	Qualitative	Improved mood; quicker return to activities	Yes
Nicol (1993)	1	Strain injury	Imagery/ hypnosis/ counseling/	No	Qualitative	Pain reduction	No
Sthalekar (1993)	1	Waterskier (paralysis/ pain)	Imagery/ relaxation/ hypnosis	No	Qualitative	Pain reduction; some ROM recovery	No
Brewer, Jeffers, Petitpas, & Van Raalte (1994)	20	Mixed injuries	Goal setting/ imagery/ counseling	No	Quantitative /Qualitative	Positive perceptions of interventions; preference for goal setting; improved attitude toward rehabilitation	Yes

(table continues)

Study	N	Population	Intervention	Control group(s)	Method	Intervention effects	Statistical comparisons
Levitt, Deisinger, Wall, Ford, & Cassisi (1995)	51	Arthroscopic knee surgery—mixed injuries	EMG biofeedback	Yes	Quantitative	Greater extensor torque & quadriceps fiber recruitment at 2 weeks postsurgery	Yes
Durso-Cupal (1996)	30	ACL reconstruction	Relaxation/ guided imagery	Yes	Quantitative /Qualitative	Increased strength; increased extension; reduced state, trait & reinjury anxiety; quicker return to activities	Yes
Ross & Berger	60	Male arthroscopic meniscal surgery	Stress-inoculation training	Yes	Quantitative	Reduced anxiety; reduced pain; increased physical functioning	Yes

Injury Prevention Interventions

May and Brown's (1989) prevention/rehabilitation program applied a broad-spectrum systems theory approach to the delivery of injury interventions. Cognitive, behavioral, and humanistic frameworks were used with individual, dyadic, and group modalities to intervene with such techniques as attentional control, imagery, and other mental practice skills. Working with U.S. alpine skiers in the Calgary Olympics, May and Brown reported reduced injuries, increased self-confidence, and enhanced self-control as a result of prevention efforts. Much of the success of the program appears to be attributable to the comprehensive nature of injury prevention (i.e., mental skills training, crisis intervention, team building, communication, relationship orientations, and specific injury prevention [and rehabilitation] activities).

Investigating the effects of associative versus dissociative thought patterns with marathon runners, Schomer (1990) reported an ability to optimize training intensity without increasing injury. Intervention involved shaping associative thought processes over a 5-week training period using audio tapes of attentional strategies with a resulting convergence of increased associative thinking and perceptions of increased training effort. Through the use of lightweight recorders worn on the body during training, this study used a simple, yet effective method to shape attentional strategies to produce optimal, injury-free performance.

Davis (1991) focused on prevention treatment (stress management) using imagery with collegiate swimmers and football players to reduce injuries. Combining

progressive relaxation with imagined rehearsal of related sport skills, Davis approached prevention from a stress-intervention orientation. Although fraught with logistical problems relative to delivery of services to these two populations, Davis reported a 52% reduction in swimming injuries and a 33% reduction in football injuries. These findings raised important questions concerning specification of injury etiology, methods of injury data collection, the nature of the stress/injury relationship, and the need to identify types of interventions that hold potential to reduce injuries.

Most recently, the Kerr and Goss (1996) stress-management prevention study with elite gymnasts, based on Meichenbaum's stress inoculation training, reported a decrease in both injuries and levels of athletic stress. Intervention group participants completed 16 stress-management sessions, and members of the control group completed only stress and injury assessments. Reporting of injuries focused on gymnasts' perceptions of injury more than objective injury measures. Although injuries for the intervention group decreased during over an 8-month period, injuries for the control group increased during this same time period. Stress levels for the intervention group were reduced significantly more than for members of the control group. Findings from this study reinforce observations from previous research findings that psychosocial stress contributes to the experience of injury and that intervention targeted toward reduction of sport stress, as well as life stress, can be effective in preventing injury.

Injury Rehabilitation Interventions

Studies involving rehabilitative interventions with controlled treatment conditions and quantitative outcome measures have been documented in the sport injury literature only within the past decade with the exception of four studies. As early as 1979, Sprenger, Carlson, and Wessman (1979) intervened with biofeedback following medial meniscectomy to increase motivation, muscle strength, pain tolerance, and flexibility. Krebs (1981) also used (EMG) feedback for individuals following meniscectomy in an experimental analysis, with resulting increased EMG output and improved muscle strength. In a pioneering sport psychology study, Rotella and Campbell (1983) detailed the methods of systematic desensitization as a procedure that ameliorated reinjury anxiety as well as facilitated injury recovery. In a case study of an injured female basketball player, they offered pragmatic suggestions relative to conducting a program of systematic desensitization as part of a sport injury rehabilitation program. Wise, Fiebert, and Kates (1984) used a three-phase electromyographic biofeedback and exercise program with athletes with patellofemoral-pain symptoms, altering vastus medialis oblique activity to decrease pain.

Recent rehabilitative intervention studies have expanded treatment modalities to include guided imagery, relaxation, stress-inoculation, and goal setting, in addition to biofeedback. Draper (1990) and Draper and Ballard (1991) investigated the efficacy of electrical stimulation versus electromyographic biofeedback in the

recovery of quadriceps femoris muscle function following ACL surgery. In both studies, Draper reported significantly greater recovery of percentage of peak torque for athletes in the experimental group (biofeedback) than for those in the electrical stimulation group. Sthalekar (1993) provided imagery and hypnotic relaxation in a single-subject design for a partially paralyzed waterskier with resulting outcomes of pain reduction, increased range of motion, and increased self-esteem. Nicol (1993), who also used a single subject design, reported reduced pain and inflammation for a severe strain injury using imagery, relaxation, counseling, and hypnosis in close cooperative efforts with medical personnel. Although operating from informal intervention protocols, these studies offer useful suggestions for effective components of an imagery/relaxation rehabilitative intervention. Carroll (1993) investigated the influence of mental practice with six collegiate athletes (mixed injuries) with relaxation and guided imagery. Using case-study techniques with a small sample that included a control group, findings reflected enhanced recovery and reduced mood disturbance for some athletes. Brewer et al. (1994) investigated injured athletes' perceptions of counseling, goal setting, and imagery interventions. Their findings indicated positive athlete perceptions for all three intervention strategies.

The most recent rehabilitative intervention studies have used traditional control group designs. Levitt et al. (1995) investigated the effectiveness of ambulatory biofeedback (e.g., EMG) on gains in extensor torque and quadriceps muscle fiber with athletes following arthroscopic knee surgery. Biofeedback intervention produced

greater extensor torque and quadriceps muscle fiber recruitment 2 weeks postsurgery. Operating from a cognitive-behavioral intervention orientation, Ross and Berger's (1996) study examined the effects of stress inoculation training for male athletes undergoing arthroscopic meniscal surgery. Athletes in the treatment group reported significantly less postsurgical pain and anxiety and required fewer days to return to physical functioning than individuals in the control group.

Investigating the efficacy of mental-skills training for recovery from ACL reconstruction, Durso-Cupal (1996) provided sessions of relaxation and guided imagery as an adjunct to physiotherapy. Sessions were designed and implemented to parallel physical rehabilitation protocols. Positive physical and psychological results for 11 ACL patients were detailed, including self-report perceptions of surgery, rehabilitation, and psychological intervention. Outcomes at 24 weeks postsurgery revealed significantly greater gains in strength and degrees of extension, as well as significant reductions in reinjury, state, and trait anxiety, and a quicker return to desired activities, for intervention group members than for members of the other two groups.

Guided Imagery as an Intervention

Medical and sport injury research findings suggest that guided imagery has the potential to influence the healing process. These findings are based on self-report data, as well as data gathered from empirical research that attempts to account for such influence. Typically these results have occurred with populations exhibiting

disease processes (medical orientation), athletes (skills acquisition/stress reduction orientation), and/or clients in clinical settings (psychological, relaxation orientation). As such, however, these previous studies lack the following elements:

1. Utilization of an experimental research design that is conducted as a part of a prospective, empirical study, which includes both a placebo (attention-control) and a control study group, together with an experimental group, whose individual member foci is to recover from a specific sport-related injury and serious accompanying surgery.

2. Development of specific, established protocols for delivery of intervention in the form of guided imagery that parallel simultaneous, medically established physiological protocols for recovery.

3. Development and delivery of an intervention imagery format whose content addresses post-injury factors such as self-talk, mental practice, pain management, goal setting, type of physical rehabilitation, motivation, and individual coping resources--psychological intervention as an adjunct to physical rehabilitation.

4. Assessment of imagery intervention efficacy through utilization of concrete physiological outcome measures (along with psychological measures) as assessed by biomedical equipment and licensed physical therapists.

Background for a Guided Imagery Protocol

Guided imagery involves a number of mental practice techniques that encourage mental visualization (Pickett, 1991). Guided imagery most commonly

involves a one-to-one encounter between a qualified therapist and a client who wishes to engage in a process of visualization (Blankman, 1980). Present-day forms of guided imagery originate in a type of therapy developed by Leuner in the 1960s referred to as guided affective imagery (1969). Other clinicians/sport medicine professionals have loosely followed Leuner's format in therapeutic disease or injury applications (Basmajian, 1989; Brewer et al., 1994; Davis, 1991; Fiore, 1988; Meichenbaum, 1977; Nicol, 1993; Pickett, 1991; Rotella & Heyman, 1986; Simonton et al., 1978; Singer, 1974; Sthalekar, 1993; Tan, 1982; Wiese-Bjornstal & Smith, 1993).

Although there are a few well-designed sport training programs available for the learning of *physical skills* through imagery (Bump, 1989; Martens, 1989; Unestahl, 1982), little attention has been devoted to the use of imagery methods or development of protocols as applied to healing of injuries (Heil, 1993). For example, *self-regulation procedures,* which have been of benefit in the management of pain and the psychological sequelae of injury in general medical populations, have been employed only recently in sport settings (Turk, Meichenbaum, & Genest, 1983). In the absence of specifically designed mental practice methods and applications for sport settings, there are no established imagery protocols for the facilitation of healing of injuries.

Without established imagery protocols for healing, there is no "correct" way to proceed with symbolic rehearsal (Wilson, 1989). There are, however, certain

elements of the guided imagery process considered common to self-regulatory or mental practice. Although some mental training approaches use traditional meditative methods, most techniques currently in use today have been drawn largely from cognitive and behavioral psychological methods (Heil, 1993). Mental training methods such as imagery generally involve some combination of relaxation training, mental imagery, self-talk, biofeedback, and/or hypnosis.

Achterberg (1989) additionally has recommended that effective applications of imagery for healing should address: (a) the nature of the injury, (b) the physical rehabilitation treatments being conducted, and (c) the use of specific, healing imagery orientations. More specifically, Norris (1989) summarized three important elements of the treatment process as (a) defining the specific nature of the imagery focus, (b) embracing a variety of individual client perspectives, and (c) utilizing various sensory modalities. The focus of the imagery may actually involve various perspectives: *internal, external, visual, kinesethic, specific,* or *general*, depending on desired outcome.

An Imagery Protocol for Sport Injury Rehabilitation

In the absence of definitive protocols, combinations of techniques with varied applications to different sport and rehabilitation situations should comprise a mental training program (Heil, 1993; Murphy, 1995). Accordingly, as previously noted, elements of relaxation and imagery protocols, and methods employed by

researchers/clinicians in the field of medicine, form the basis for a healing imagery protocol for this research.

Components

While incorporating the five earlier mentioned components common to effective injury intervention research (goal setting, mental training, positive self-talk, education, and social support), the following eight proactive steps are offered as the essence of an efficacious program of psychological injury intervention (adapted from Heil, 1993).

1. *Actively facilitate the rehabilitation process*: What are the behavioral components and nature of injury?

2. *Address somatic responses*: How does pain need to be managed? What emotions are manifested in somatic form?

3. *Maintain emotional equilibrium*: What are the *affective* components of an individual's cognitions, as well as physiological experience? What are motivators for physical rehabilitation adherence? What are sources of anxiety?

4. *Mobilize existing coping resources*: What are the psychosocial variables active for the individual--"facilitative," "detrimental," "situational," or "personal?"

5. *Assess, access, enhance, reframe/restructure cognitive appraisals*: What are the cognitive components/perceptions? How can control be regained (injury and surgery are the antithesis of control)? How can the individual strike a balance between control of his/her own body recovery and rehabilitation compliance?

6. *Enhance mental readiness for performance*: What kinds of relaxation and imagery will promote healing, as well as prepare an individual for return to normal activities?

7. *Promote sense of self-efficacy and identity, as well as reduce reinjury anxiety*: What mental strategies will empower?

8. *Document health outcome measures*: What approaches produce the best results in different situations with different individuals or populations? Why?

Procedures/Techniques/Formats

When working with individuals in sport, many researchers suggest using relaxation inductions prior to imagery instructions in order to facilitate imagery control (Murphy & Jowdy, 1992). In a tradition that dates back to the psychological work of Wolpe on systematic desensitization, the use of relaxation prior to the practice of imagery has been shown to facilitate imagery control (Suinn, 1983; Vealey, 1986). According to Murphy and Jowdy (1992), however, no research examining the combined effect of relaxation and imagery conducted to date reports benefits superior to the use of imagery alone. Moreover, many studies that have demonstrated strong mental practice effects have not used relaxation procedures in combination with imagery. According to a survey of pertinent literature, Murphy and Jowdy have reported that, at least in the area of performance, there is no evidence to suggest that relaxation is a critical mediating variable in producing imagery effects. Injury intervention, however, includes much more than "performance."

Only two experts in the field of sports psychology have developed programs for athletes that utilize relaxation/imagery formats for healing. Unestahl (1982, 1986) and Orlick (1986a, 1990) have separately developed programs of mental training that concern relaxation, activation, imagery, anxiety control, positive self-talk, and self-hypnosis formats. Although neither program focuses specifically on the use of imagery for healing, both psychologists recommend similar formats for the application of imagery to various mind/body activities. According to Orlick (1990), imagery should be practiced 10-15 minutes every day to speed recovery and revitalize the mind and body. The physiological effects of imagery on healing can be enhanced by first engaging in brief relaxation techniques, since this activity has the presumed effect of engaging right brain hemispheric functions, which tap into the autonomic system (Unestahl, 1986). Orlick (1990) has advocated that if the objective of guided imagery is to heal the body, then an individual should prepare himself or herself to send healing thoughts and revitalizing images to the body, both during and after relaxation.

Unestahl's (1982) program of Inner Mental Training advocates an average of 10-12 minutes of imagery, 5 days per week. Positive physiological effects utilizing these formats have been noted not only for adults, but for youth as well, in a variety of studies by these two authors and associates (Orlick, 1986a, 1986b, 1990; Setterlind & Unestahl, 1981; Setterlind, Unestahl, & Kaill, 1986; Unestahl, 1982, 1983, 1986).

While these two training programs come the closest of all sport psychology research involving imagery applications for healing of injuries, it is important to note that they are not able to serve as models for this proposed study other than to offer informal recommendations for length, duration, and number of imagery sessions. Healing applications are only one small part of their suggested formats, with the major emphasis placed on comprehensive mental practice techniques for a variety of applications such as anxiety control and concentration, as well as healing.

In accordance with the procedures set forth in these programs, and other research in the field of imagery's effect on physiological healing, the following format was developed to conduct this exploratory study. The following procedures and accompanying rationale therefore combine to accomplish this goal.

Relaxation Training

The initial relaxation phase of guided imagery can be important to healing outcomes. It is characterized by parasympathetic dominance, a necessary prerequisite, since it inhibits somatic muscle activity and verbal thoughts (Jaffe & Bresler, 1980). Relaxation training develops increased body awareness and deepens muscular relaxation at rest (general relaxation), while increasing muscular efficiency during activity (differential relaxation; Heil, 1993). For example, an individual can learn to achieve and practice a relaxation response with a therapist that will enable him or her to become more receptive to forming mental images, which facilitate healing. This can be accomplished by encouraging an individual to become comfortable and

relaxed as he or she is sitting or lying down by inhaling and exhaling slowly and deeply. At the same time, an individual can consciously dissipate tension through the encouragement and direction of the therapist.

Guided Imagery

Once engaged in a relaxation response, the therapist facilitates an individual's engagement in mentally picturing an ongoing sequence of events, feelings, or physiological tasks, guiding the imagery according to client desired outcome and the context of that outcome (Lichstein, 1988). Guided imagery uses the imagination to create a private theater of the mind where sport situations can be rehearsed and replayed (Heil, 1993; Murphy, 1995).

For example, if an individual wants to achieve a greater degree of range of motion with his or her surgical knee, the therapist will encourage an individual to visualize his or her knee moving freely in a pain-free motion, while attending to and reporting on sensory details that center on the physiology of the knee and/or entire body (Jaffe & Bresler, 1984). The therapist may encourage the individual to use different techniques such as "picturing" his or her ligament as it looks inside the body (an internal focus) or "seeing" his or her knee functioning in harmony with the entire body (external).

Compliance and Practice

Confidence that results observed are, in fact, due to the influence of treatment variables rather than to extraneous influences can often be increased by giving careful attention to compliance procedures (Campbell & Stanley, 1963). The term "mental practice" correctly implies that an individual needs to practice mental techniques in order to become skilled. Bernstein and Borkovec (1973) are of the opinion that the importance of practicing cannot be overemphasized to a client. As a result, individuals must be provided with numerous opportunities to practice a mental skill such as imagery. Healing imagery should be performed on a daily basis, preferably twice daily, for periods of 10-15 minutes in length, or as determined by the length of the current physical rehabilitation exercises (Orlick, 1990; Pickett, 1991; Rotella & Heyman, 1986; Unestahl, 1986).

Individual, one-to-one sessions work well when teaching a mental skill (Bull, 1991). While audio and/or visual tapes have been shown to be reinforcing to the acquisition and practice of technique, one-to-one clinical intervention to teach imagery techniques appears to be an efficacious modality (Pickett, 1991; Simonton et al., 1978). To control for fluctuating treatment results due to individualized treatment, a standardized script for each imagery session is recommended (Green, 1993). Achterberg, Matthews-Simonton, and Simonton (1977), Bernstein and Borkovec (1973), Holden-Lund (1988), Pickett (1991), and other clinicians working in the field of psychophysiology have suggested frequent sessions of intervention, the

focus of which is tailored to specific stages of healing. Although the content of successive sessions may be similar throughout a process of recovery that extends over several month's time, Achterberg (1989) advised that the script be reworded/rephrased so as to maintain interest in the repetitive mental task.

Summary

The premise that psychological variables play a vital role in physiological rehabilitation predates modern allographic medicine approaches. Current theories of injury recovery view healing as the product of both mind and body--a reflection of the human being as an interdependent system of constant interchange between mental and physiological functioning. Psychological intervention for injury has been effective for serious ramifications of injury, such as depression. Recently, attention has turned to utilizing mental skills to facilitate physiological recovery. In fact, results of preliminary studies suggest that a structured, physical rehabilitation program that includes some form of imagery and relaxation as mental practice is more effective in influencing the extent to which an individual will recover than physical rehabilitation alone.

The cognitive-somatic connection is one in which communication with autonomic physiological processes occurs outside of conscious awareness, functioning as an anatomical mediator. As a cognitive strategy, imagery has been successfully employed to influence somatic outcome with medical populations. Yet a dearth of empirical psychological intervention studies has been conducted with sport

populations experiencing serious injury. Not only is it unclear how profound an effect injury actually exerts on psychological and physical health, affective components of injury recovery have only sparsely been investigated. Moreover, the question of why some individuals struggle more than others with psychological aspects of the recovery process is largely unanswered.

Five psychological variables emerge as common across the psychological injury intervention literature as contributing most positively to recovery. These variables include goal setting, mental imagery, social support, positive self-talk, and knowledge/education. In general, these reflect a trend for interventions based on cognitive appraisal models, models that consider individual perception as critical to amelioration of injury-associated emotional and physical distress or dysfunction. Responses to injury are analyzed and treated in the context of injury as a stressor, with a crucial role ascribed to cognition.

Although medical and sport injury research findings suggest the use of guided imagery to enhance recovery, previous psychological injury intervention research has been conducted without control groups, standardized treatment sessions and protocols, formats reflecting all five previously mentioned psychological variables, and physiological outcome measures combined with psychological outcome measures. The importance of practice has also been overlooked as an important component of mental skills acquisition.

In view of the need to further investigate the relationship between psychological intervention and injury recovery, eight proactive steps are offered as a basis for an effective program of psychological injury intervention. As part of a format to serve as a basis for mental imagery protocols, a rationale for the use of relaxation training, guided imagery, and practice techniques is discussed. As such, this review of literature serves as a foundation for this study's methodology, results, discussion, and conclusions.

CHAPTER III

METHOD

Subjects

The accessible study population includes individuals who complete reconstructive ACL surgery and a program of physical rehabilitative therapy at the Mountain West Physical Therapy Center. The Mountain West Therapy Center and the Western Surgery Center are both housed within one sport-medicine facility and share medical staff. Because all patients who received an ACL replacement at the Center from December 1994 to May 1995 (who met the inclusion criteria) also consented to participate in the research, this study's sample is representative of the accessible population for that 24-week time frame. While this sample is formally a medical convenience sample, it is comprised of all patients from that Center during that time period who were randomly assigned to one of three groups. As a type of convenience sample, however, it was outside the ability of this study to select or match individuals according to certain physical or psychological variables. Thirty consenting ACL reconstruction patients from the Western Surgery Center were randomly assigned to one of three groups, either an intervention (experimental), attention-control (placebo), or control group. Subjects in the intervention group received relaxation and guided imagery treatment; subjects in the placebo group

received attention and support; subjects in the control group engaged in physical therapy only.

One additional individual, recruited prior to the initiation of this study, served as a pilot-study subject. Each group for the study, therefore, was comprised of 10 subjects. All patients completed a minimum of 24-week course of physical rehabilitation therapy at the Mountain West Physical Therapy Center. Since the most dramatic gains for strength and range of motion occur during the first 24 weeks postsurgery (Shelbourne & Wilckens, 1990), the critical time for assessing gains is within these first 24 weeks. Benchmarks for recovery and techniques assessing progress at these benchmarks are well established by medical personnel.

Patients ranged in age from 18 to 50 years of age, with a mean age of 28.2, standard deviation of 8.2 years. Of the 30 patients, 16 were male and 14 were female. (The pilot study subject was male; pilot-study data are not included in analyses for this study.) Intervention was provided for the 30 subjects from December 1994 to October 1995, with data collection occurring from December 1994 to January 1996. (Each participant was followed for 24 weeks each, e.g., an individual receiving a reconstruction in May was followed until October.) All study participants had received either an allograft or autograft ACL reconstruction performed by one of the four orthopedic surgeons at the Western Surgery Center.

In an attempt to control for factors that might otherwise confound the results of this study, the following selection criteria were employed for consenting individuals.

1. Each patient must successfully complete an ACL arthroscopic replacement at the Center.

2. There must be no evidence of other debilitating trauma, such as fractures, medial or lateral ligament tears, or hemorrhage.

3. Participants must range in age from 18-50 years of age.

4. Patients must engage in continuous rehabilitation of at least 24 week's duration at the Center (either at the Logan or Tremonton facility).

Each subject in the intervention group was asked to commit to 10 sessions of one-on-one relaxation/mental practice sessions. To enhance willingness to participate in the study and reduce attrition by the intervention group members, each participant in this group was paid $5 at the conclusion of each completed session. It was the original intent of the study to provide intervention at the Center as a concurrent adjunctive experience to physical therapy sessions. Due to limited physical space at the facility, however, intervention was provided at the Psychology Community Clinic at Utah State University.

Generalizability

Findings from this sample should be generalizable to all individuals who seek similar ACL arthroscopic reconstructive surgery. According to the sports medicine team at the Western Surgery Center, an ACL reconstruction is usually the sequela of a sport-related activity, rather than normal, everyday activities. Fewer than 10% of the

people receiving these replacements in the past 7 years at the Center have an etiology other than sport.

Based on these statistics, the accessible population appeared to be relatively homogeneous with regard to etiology of knee injury, compliance to rehabilitation, and recovery time, and was equally represented with regard to gender. Comments in related literature suggest only *age of individual* and *activity level* (sport competitive status) as inherent characteristics of an orthopedic sample that may interact with the treatment to demonstrate differential effects (Draper & Ladd, 1993; Leddy et al., 1994; Shelbourne & Wilckens, 1990).

In no way did assignment to other than the treatment group constitute denial of treatment to members of the control or placebo groups, since the established, appropriate treatment for recovery is, without exception, physiological rehabilitative therapy. Follow-up was offered for individuals in the control and placebo groups desiring to avail themselves of imagery intervention subsequent to completion of 24 weeks of physical therapy. None of the 20 individuals, however, chose to exercise this option.

Instruments

Subject demographic data were gathered from a Subject Information Form (Appendix I) and from subjects' medical files (permission for access obtained in original consent form). Outcome data for this study included both physiological and psychological measures. Physiological dependent measures of strength and range of

motion were gathered by a Cybex 6000 isokinetic assessment at 24 weeks postsurgery, as well as repeated hand goniometer measurements of extension and flexion at five points in time throughout the first 24 weeks postsurgery by the Center physical therapists.

Psychological measures included subjective ratings of reinjury anxiety (0-10), trauma (1-3), pain (1-3), satisfaction with treatment and readiness to return to activities (1-3), as well as responses to the State-Trait Anxiety Inventory (STAI) for state and trait anxiety. (Each of the above subjective rating scales is explained in this method section.) Clients in the intervention group completed a weekly personal Imagery Log (as described). An open-ended Exit Interview Questionnaire was also administered to members of the intervention group so as to elicit structured, as well as unstructured, reflective comments regarding the relaxation/guided imagery intervention, physical rehabilitation, and surgical experience (Appendix J).

Reinjury Anxiety Scale

Participants were asked to rate their concern relative to reinjury of the replaced ligament on a scale from 0 to 10, where "0" represented the absence of any anxiety about reinjury, and "10" represented extreme anxiety concerning the prospects of reinjury. This rating was recorded at 2 weeks postsurgery and at 24 weeks postsurgery for all participants. Intervention group subjects were then surveyed a third time for reinjury anxiety at 18 months postsurgery.

The State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI; Speilberger, Gorsuch, & Lushene, 1970), used extensively in assessing clinical anxiety in medical, surgical, psychosomatic and psychiatric patients, is comprised of separate self-report scales for measuring state and trait anxiety. As a self-report instrument, it differentiates between general feelings of anxiety (trait anxiety, STAI-T) and current feelings of anxiety (state anxiety, STAI-S). Each scale comprises 20 items, for a total of 40. Items are rated on a scale ranging from "1" (not at all) to "4" (very much so). A higher score on either subscale (and thus total score) reflects a greater level of anxiety for that particular scale. The STAI is the most widely used outcome measure for measuring changes occurring as a result of treatment for anxiety. Internal consistency estimates range from .86 to .95 for the state scale, and .89 to .91 for the trait scale (Chaplin, 1984). Test-retest reliability ranged from .65 to .86; this instrument adequately discriminates between a normal and psychiatric sample.

Personal Imagery Log

The Personal Imagery Log required intervention group subjects to record number of days of physical therapy, number of times listened to tape, whether they could see and feel imagery exercises, and pain level (Appendix G). It additionally requested comments on the imagery content and its applicability/efficacy for the patient at given stages of recovery. Data collected included responses as to what images were

most personally helpful, exactly what was experienced cognitively and somatically, and what each patient thought was the hardest part of physical therapy at that point in time.

Exit Interview Questionnaire

Participants in the intervention group completed an 18-question Exit Interview Questionnaire at 24 weeks postsurgery (postintervention). In general, questions asked participants to reflect upon their physical rehabilitation and psychological intervention experience in a questionnaire composed of four closed-ended and 14 open-ended questions (Appendix I). Most of the questions were intended to elict direct responses and comments concerning each participant's subjective experience of recovery from ACL replacement. Each question was reviewed at the exit interview (session 10), which afforded each participant the chance to express thoughts orally as well as in written form.

Subjective Treatment Ratings

In response to requests from several of the surgeons, all participants were surveyed with five questions designed to assess participant perceptions of surgery and physical therapy. Specifically, these questions addressed trauma, pain, information, attention, and assistance. Answers were scaled on either a "yes/no" basis, or "less," "same," or "more than expected" basis. These questions were built into the Exit Interview Questionnaire for intervention group members; all responses from the other group members were elicited verbally by the clinician/researcher.

Design and Procedures

As patients completed an ACL reconstruction during the period from December 1994 to May 1995, they were contacted by phone to explain the nature of the study and to request their participation. All patients contacted agreed to participate. ACL patients completed a consent form, demographic data form, and a STAI questionnaire. Once verbal consent to participate was received, each individual was randomly assigned to one of the three groups, and the nature of his or her participation was explained according to group assignment. Upon each subject's verbal approval, consent forms were sent to each individual to complete (Appendixes B, C, and D).

Neither the respective subjects' surgeons nor physical therapists were aware of an individual's group membership during the 24-week recovery period; the staff of the Center was aware, however, that many of their ACL patients during this 14-month period were participating in the study. It was also the intent of this study to withhold information regarding group membership from all participants. Although the clinician/researcher interacted privately with patients at the sport medicine facility, it is reasonable to assume that patients were not totally unaware of membership in some manner. The clinician/researcher was blind to measurements performed during the 24-week recovery period for each subject. Medical data were not collected by the clinician/researcher until the conclusion of the entire study (14-month duration).

Repeated measures were obtained for range of motion (extension and flexion) in accordance with medically established temporal benchmarks as outlined in Appendix E.

These benchmarks are guided by the body's natural healing abilities/schedule that require an approximate number of weeks or months to repair soft tissue, fascia tissue, and bone. These range of motion (extension and flexion) measures were gathered for each individual at five distinct time periods: 2, 4, 8, 16, and 24 weeks postsurgery. A postintervention assessment for strength acquisition was conducted 24 weeks postsurgery for all subjects also according to medical protocols. Psychological data were collected preintervention (2 weeks postsurgery) and at postintervention (24 weeks postsurgery). Intervention group members were surveyed at 18 months postsurgery for a reinjury anxiety score.

All intervention procedures for the study were previewed with the pilot study individual who received the identical protocol to all subsequent 10 intervention group subjects, including being paid for each completed session. The purpose of previewing procedures with the pilot study subject was to test the protocols, imagery content, logistics of treatment delivery (two separate locations), and viability of monetary reimbursement to reinforce compliance. A profile of the pilot study individual's outcomes and responses appear in Appendix J, along with the other 10 intervention participants. Slight modifications were made to two imagery scripts (e.g., shortened the session length), and professional relationships between medical personnel and the clinician/researcher were enhanced as a result of completing testing procedures with the pilot-study individual. As well, a better system for insuring the 24-week Cybex testing was negotiated and implemented, whereby patients without insurance coverage were

permitted to complete this relatively expensive isokinetic testing without charge. Unfortunately, the pilot study participant, who was unable to be tested at the 24-week mark for this reason, completed his strength testing at approximately 4 months postsurgery, as opposed to the 24-week benchmark. This early testing reflects less strength gain than other intervention group members (68%), although state and reinjury anxiety were significantly reduced.

The intervention group treatment condition consisted of 10 individual therapy sessions conducted by the clinician/researcher with each participant over a 24-week recovery period (Appendix F). Sessions were spaced throughout this 24-week recovery period at approximately 2-week intervals. Mental practice strategies that directly paralleled physical rehabilitation strategies were taught and practiced in these sessions. As well, individuals practiced and applied imagery techniques daily through the use of an audio tape, both at home and sometimes (at their choosing) during physical therapy.

Each intervention session was developed to mentally practice physical rehabilitation goals as outlined in the Mountain West Physical Therapy Center protocols. Imagery protocols that directly parallel these physical rehabilitation protocols were developed specifically for this study. Goals and protocols appear in Appendix E. The visual baseline for this imagery originated in each patient's individual videotape of his or her arthroscopic surgery (viewed together with the researcher in the first session) as provided by one of the four orthopedic surgeons at the Western Surgery Center.

It was the intent of this research to build upon this personal, visual image for purposes of managing pain, reducing trauma/edema/inflammation, and increasing range of motion; strength acquisition; acceptance of cadaver tissue (if allograft); and reducing reinjury anxiety, increasing motivation for physical therapy, increasing goal setting, and promoting overall sense of body wellness and control.

Intervention Protocol for Intervention Group

Intervention in the form of relaxation and guided imagery was conducted on a one-to-one basis with each intervention group subject. An identical imagery script was utilized in the individual sessions for each subject so as to standardize treatment as closely as possible. Over a period of 24 weeks, each subject was guided through a series of imagery exercises with the intention of enhancing physical recovery. The visual baseline for such imagery originated in each individual's videotape of his or her arthroscopic knee surgery. Attention-control (placebo) and control group members received their videotape at the conclusion of their 24-week rehabilitation. This videotape provided clear documentation of the surgical procedure in which each individual's ACL is viewed as fully functional and healthy.

Approximately 10 sessions, 15-20 minutes in length, were conducted for each individual in the intervention group, for an average of one session every 2 weeks. In the interim between sessions, individuals practiced relaxation and guided imagery by listening to an audio tape of the previous week's session. Additionally, the researcher was on-hand at the sport medicine facility making face-to-face contact with

individuals as they engaged in physical therapy so as to encourage integration of mental and physical practice.

The following procedures were employed in an attempt to encourage the practice of mental skills learned in intervention sessions:

1. The content of each imagery session was designed to carefully parallel physiological recovery goals for each of the weeks in the 24-week time span.

2. Through the use of an identical imagery script, interventions were provided frequently, that is, on an every 2-week, one-to-one basis.

3. At least once during the 2-week time span between sessions, the clinician/researcher was present at the medical facility so as to facilitate in vivo practice of mental skills/goals while engaging in concomitant physical rehabilitation activities.

4. At the conclusion of each session, each individual was given an audio tape of that session and was encouraged to listen to this tape at least once daily while engaging in physical therapy, or at any other time.

5. All intervention group subjects were provided with a Personal Imagery Log in which to record subjective reflections of their recovery as they practiced "imagery homework" (Appendix H).

6. Follow-up to imagery sessions were provided on an as-needed basis by the researcher, generally in the form of a telephone call, or an extra visit with the subject to the sport medicine facility.

7. Individuals were asked to answer brief, general questions regarding their imagery sessions periodically during the 24-week recovery time period so that subjects might anticipate discussion and practice.

8. Individuals were paid $5 at the conclusion of each imagery session, which required submitting a completed Imagery Log form for the previous 2 weeks of listening to their imagery tape.

The content of these sessions consisted of relaxation and mental-imagery exercises in script form that had been deliberately composed to closely parallel and interface with ACL established physical rehabilitation protocols, having been created in consultation with the physicians and physical therapists. These scripts are consistent with the types of scripts employed by previous researchers as cited in this study. The content of the treatment sessions focused on relaxation, pain management, flexibility, range of motion, stamina, strength, and general coping. Although the focus of the relaxation and guided imagery varied from session to session, three elements were common to all intervention sessions:

1. *Defining the specific nature of focus*--for example, edema, pain, inflammation, and movement. Each session was designed around healing images that directly addressed the physiological structure and process in the knee.

2. *Accommodating individual client perspectives*--providing individuals with productive cognitive exercises that promote emotional coping responses.

3. *Utilizing varied imagery modalities*--for example, internal, external, visual and/or kinesthetic images provided in a structured, standardized dialogue that encourages individuals to experience various imagery modalities.

Each of the sessions addressed specific recovery goals as follows:

Session 1 (Week 1):

View ACL arthroscopic videotape and learn relaxation.

Session 2 (Week 2 through Week 3):

Reduction of knee trauma, pain management, establish limited range of motion.

Sessions 3-5 (Week 4 through Week 8):

Flexibility and range of motion, with reduction in edema; psychological coping; foreign tissue acceptance. The ACL graft is weakest at 5 weeks postoperative; weeks 4-8 tend to be tedious and discouraging.

Sessions 6-8 (Week 9 through Week 16):

Strength and range of motion; coping.

Sessions 9-10 (Week 17 through Week 24):

Strength, endurance and full range of motion; overcoming reinjury anxiety.

Session 10 or 11 (Week 24):

Review imagery goals, procedures; exit interview.

Each session, approximately 20 minutes in length, was directed by a written script, delivered by the same clinician/researcher with subjects positioned in a recliner

chair in the same clinic room for each session. Each intervention session began with relaxation techniques, then proceeded through the program of outlined imagery protocol relative to specific recovery goals for each time period of rehabilitation as indicated. For example, for a subject 4 weeks postoperative (Session #2) with physiological goals of edema reduction, and increasing range of motion and strength, imagery goals focused on (a) reinterpretation of pain as pressure, (b) visualizing scar tissue releasing during wall slide, fitter, and stationery bike exercise, and (c) seeing/ feeling strength and resiliency of the reconstructed ligament, among other techniques of mental practice.

In the interim between sessions (approximately two weeks), subjects listened to an audio tape of the previous session, as well as completed a weekly Imagery Log. The clinician/researcher attended the facility weekly, providing a didactic and encouraging presence in order to facilitate subject integration of mental and physical practice.

Intervention Protocol for Attention-Control Group

Individuals in the attention-control (placebo group) were requested to sit or lie down quietly following their physical rehabilitation sessions for the same amount of time (10 minutes) as individuals in the intervention group devoted to imagery on a daily basis. The clinician/researcher provided 30 minutes per week of attention, encouragement, support, or answering questions with each attention-control subject, either in the form of physical presence at the Center and/or through telephone contact. Conversation was informal and included any topic and content except comments,

information, or instructions regarding imagery and relaxation techniques. Participants were also contacted specifically at 24 weeks postsurgery for personal perception data.

Intervention Protocol for Control Group

Individuals in the control group were contacted approximately three times during the 24-week recovery period. These contacts included request to participate, completion of forms, and personal perception data. No other intentional contact was initiated by the clinician/researcher for these subjects who engaged in a normal program of medically prescribed physiotherapy.

Treatment/Intervention Assessment

Goniometer measurements of degrees of extension and flexion for the 30 study participants were obtained during the 24-week postsurgery recovery period at weeks 2, 4, 8, 16, and 24 by Center physical therapists. During this same 24-week postsurgery recovery period, these 30 subjects completed the State-Trait Anxiety Inventory (STAI) at approximately four weeks postsurgery. Members of the intervention group only (n=10) also completed the STAI a second time at postintervention. Intervention group subjects also completed a weekly Imagery Log and Exit Interview Form.

At 24 weeks postsurgery (and after having completed 10 psychological intervention sessions, if an intervention group member), all subjects completed a Cybex 6000 isokinetic assessment of strength recovery ($\pm$ or 21 days). All 30 subjects also answered questions relative to their perceptions of their surgery and rehabilitation

experience. Additionally, the 10 intervention group subjects completed a written Exit Interview Questionnaire (Appendix I). At the conclusion of the study, scores on these psychological measures were compared with each patient's physiological dependent measures.

Analysis

Factorial analysis of variance (ANOVA) procedures were employed to test for differences among groups for strength, range of motion acquisition (extension and flexion), reinjury, state, and trait anxiety. Where appropriate, additional analyses in the form of separate post hoc univariate tests were conducted. Since gender was unequally distributed among groups, ANCOVAs were conducted to control for gender as an extraneous variable when testing for strength, extension, flexion, and reinjury anxiety. As well, a paired samples t test was conducted for state/trait anxiety data for the intervention group only.

Repeated measures MANOVAs were performed to examine *improvement* and *patterns* of recovery over time for extension, flexion, and reinjury anxiety. The objective of examining improvement and patterns of recovery was an attempt to (a) demonstrate improvement in recovery, (b) graphically highlight trends or patterns of recovery over time, and (c) compare how well *imagery treatment goals* matched *physical treatment goals* based on physiological outcome. Answers to questions number 8 and 9 from the weekly Personal Imagery Log (e.g., "yes" or "no" as to whether subjects achieved imagery goals) were compared to physiological outcome.

Repeated range of motion assessments involved a series of standard physiological assessments as performed by licensed physical therapists at the sports medicine facility according to a medically established schedule. Although these dependent assessment measures are closely related to each other in their ability to ascertain strength and range of motion, they are considered as separate, mutually exclusive outcome measures and were treated as such for analysis purposes.

Pearson r correlations were computed to assess the strength of linear relationships between strength recovery and selected variables. As well, standardized mean difference (SMD) and variance treatment (η^2) effect sizes were also calculated for postintervention data.

CHAPTER IV

RESULTS

The accessible population for this research consisted of all individuals who have experienced an ACL arthroscopic reconstruction procedure at the Western Surgery Center. The sample for this study consisted of all individuals experiencing an ACL arthroscopic procedure at the Western Surgery Center who met the inclusion criteria between December 1994 and May 1995. Every individual who met the criteria between these dates consented to participate in the study and was randomly assigned to one of three groups.

A randomly selected sample of the accessible population was impractical. Although ACL reconstruction is not an uncommon orthopedic surgical procedure for ligament replacement, the Western Surgery Center only performs 75-100 ACL surgeries annually. As well, the bulk of these surgeries are seasonal, that is, generally occurring from fall through the early spring months of the year, representing injuries sustained while engaging in football, basketball, downhill (alpine) skiing, and other sports. Approximately 50% of these individuals met the inclusion criteria as stated in the method section. For the purposes of this study, a normal distribution of variables was desirable from a sample of this population consisting of *physiological* dependent variables: strength, extension, and flexion; *psychological* variables: reinjury, state, and trait anxiety; and *demographic* variables: age and activity level.

All participants engaged in a normal course of physical rehabilitative therapy, with the study providing two levels of intervention therapy, either (a) attention/support or (b)

relaxation/guided imagery as an adjunct to this physical therapy. The attention-control group functioned as both a placebo (control) group, and as a level of treatment (attention). In the absence of ability to randomly select, and in order to assume normality, this study relied on the robustness of random assignment.

Preintervention Analyses

A preliminary examination of all descriptive variables was performed in order to gather information concerning population characteristics. Initial analyses revealed that study subjects did not differ across the three groups with respect to age, activity level, state, trait, or reinjury anxiety. Additionally, frequency counts were also performed to determine the distribution of other independent variables such as sport, competitive status, gender, physical therapist, and physician. With the exception of gender and competitive status, these variables were evenly distributed across groups. No further analyses/ computations were performed for these two variables, however, since there is no theoretical basis that these bias results in samples of ACL patients. As previously mentioned, age and activity level are the two demographic variables of interest for outcomes with this population

.

Postintervention Analyses

To answer the question of whether group means for strength, extension, flexion, state, trait, and reinjury anxiety reflected statistically significant differences with regard to level of treatment, a factorial ANOVA procedure for each of these dependent variables was employed. ANOVA procedures test the hypothesis that the group means for each

dependent variable are equal. To answer the question of whether group means reflected statistically significant differences for *improvement* in extension and flexion, *patterns* of extension and flexion, and reduction of reinjury anxiety, a repeated measures MANOVA procedure was performed for each of these dependent variables. In order to determine where differences lie between groups after rejection of the null hypothesis for dependent variables of strength, extension, and reinjury anxiety, planned post hoc comparisons were performed for these three variables. A paired difference t test was employed to examine reinjury anxiety reduction for the intervention group members from 24 weeks to 18 months. In order to answer the question of whether the treatment group exhibited statistically significant differences from pre- to postintervention for state and trait anxiety, a correlated pairs t test was performed. Questions related to the strength of the linear relationship between strength recovery and selected study variables were explored with a series of Pearson r correlations.

In order to statistically confirm or uncover differences between these groups in this small-n study in a manner not dependent on sample size, standardized mean difference and variance treatment effect sizes were also calculated for posttest data. Standardized mean difference effect sizes were calculated by subtracting the means on dependent measures of the control group (group three) from the intervention or experimental group (group one), and then dividing by the standard deviation of the control group. This procedure was repeated for analysis between the intervention group and the attention-control (placebo) group. Variance effect sizes (η^2) were calculated by dividing the sum of squares main

effect by the total sum of squares for ANOVA and repeated measures MANOVA procedures. Eta^2 is a useful coefficient for assessing the strength of the association between the independent variable (intervention) and a dependent variable (e.g., extension). Strength of association assesses the proportion of variance in the dependent variable that is associated with levels of an independent variable, that is, how much of the variance in results of a multivariate analysis is attributable to treatment (Tobachnick & Fidell, 1989).

According to Cohen (1988), a conventional metric for interpretation of *univariate* effect sizes is to consider ES = .50 as "low," ES = .70 as "moderate," and ES = .90 and above as "high." The term effect size (ES), with accompanying metric interpretation, refers specifically to standardized mean difference effect sizes, not to Eta^2 (*mulitivariate* variance effect sizes). The specific values associated with low, moderate, or high should consider the area of study, the variables of interest, and the type of statistical test. Accordingly, it is unrealistic to expect a standard unit of interpretation to be assigned to numeric values. Additionally, there is no systematic summary to date of how to interpret effect sizes for a sport injury/orthopedic surgery population. Therefore, while there is lack of consensus in the research literature upon this metric, and such operational definitions may be arbitrary, the conventional labels suggested by Cohen will be used to interpret numeric values of standardized mean difference effect sizes for this study.

Demographic Variables

Subjects ranged in age from 18 to 50 years of age, with a mean age of 28.2 years (SD = 8.9; Table 3). Of the 30 study participants, 16 were male, 14 were female. These

individuals experienced their ACL injuries while participating in basketball (28%), alpine/downhill skiing (47%), soccer (6%), volleyball (3%), hockey (3%), rodeo (3%), and other activities (10%). Skiing and basketball injuries for the subjects in this study, often the most frequent activity sources of ACL injuries, were evenly distributed across groups.

Study participants reported that they exercised moderately three times per week. Nine of the 30, or 30% of study participants, categorized themselves as either collegiate competitive or recreational competitive athletes. Breakdown of competitive status by group includes four subjects in the intervention group, one subject in the attention-control group, and four subjects in the control group.

Physiological Variables

In order to assess the efficacy of relaxation and guided imagery intervention, *strength* recovery (24 weeks postsurgery), and *extension* and *flexion* (five times over a 24-week period) measurements were compared among the three groups. Analysis of variance (Cybex 6000 scores) and repeated-measures MANOVA procedures (extension and flexion) were performed; effect sizes and variance effect sizes were calculated.

Strength recovery: Cybex 6000 at 24 weeks. In regard to research question number one ("Is there a difference in strength recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive physical rehabilitation [attention-control group], or physiotherapy alone [control group]?"), subjects in the intervention group exhibited statistically significant greater gains in strength ($F = 7.13$, $p=.003$) at the 24-week

Table 3

Preintervention Analysis: Means and Standard Deviations

Variable	Intervention mean (SD)	Placebo mean (SD)	Control mean (SD)	Total mean (SD)	Norms
Age	28.1 (9.55)	32.0 (10.10)	24.5 (5.56)	28.2 (8.90)	--
Activity level[1]	2.9 (1.10)	2.5 (.849)	2.9 (1.10)	2.77 (1.00)	--
State anxiety	35.8 (9.02)	32.9 (11.92)	42.7 (7.33)	37.13 (10.18)	36.2
Trait anxiety	39.5 (8.82)	36.3 (9.09)	37.1 (8.43)	37.63 (8.59)	35.4
Reinjury anxiety[2]	8.4 (1.0)	8.5 (.53)	8.0 (.94)	8.3 (.88)	--

[1]Activity Level: 1= no activity; 2 = 1 or 2 x wk; 3 = 3 x wk; 4 = competitive

[2]Reinjury Anxiety: 0 = absence of reinjury anxiety; 10 = extreme reinjury anxiety

Cybex testing (± 21 days) than individuals in either the attention-control (placebo) or control groups (Table 4). According to standard physiotherapy isokinetic testing, gains were computed in terms of a ratio, that is, performance of the injured (reconstructed) knee as compared to performance of the uninjured knee. Results were then reported in terms of

Table 4

ANOVA: Strength Recovery by Group

Source	df	Mean squares	F Ratio	Sig of F	η^2
Between groups	2	.1271	7.128	.003	.35
Within groups	27	.4815			

percentage recovery for the injured/reconstructed knee (Figure 1). The intervention accounted for 35% of the variance in strength recovery ($\eta^2 = .35$).

Subjects in the intervention group averaged 83.2% strength recovery of the injured knee in comparison to the uninjured knee as measured in peak torque footpounds, while the attention-control (placebo) and control group subjects averaged 63.1 and 66.3%, respectively (Table 5). Effect size calculations revealed that intervention group individuals demonstrated gains in excess of one and a half standard deviations (ES = 1.67) above the attention-control (placebo) group individuals, and nearly one and a half standard deviations above the control group members (ES = 1.39). There was little difference between the attention-control and control group members' strength gains ($p = .853$; ES = .03). Variance effect size calculations derived from Scheffe post hoc comparisons revealed that the intervention accounted for 44% of the variance ($\eta^2 = .44$) in strength recovery between the intervention group and attention control group subjects, and 35% of the variance ($\eta^2 = .35$) between the intervention group and control group subjects.

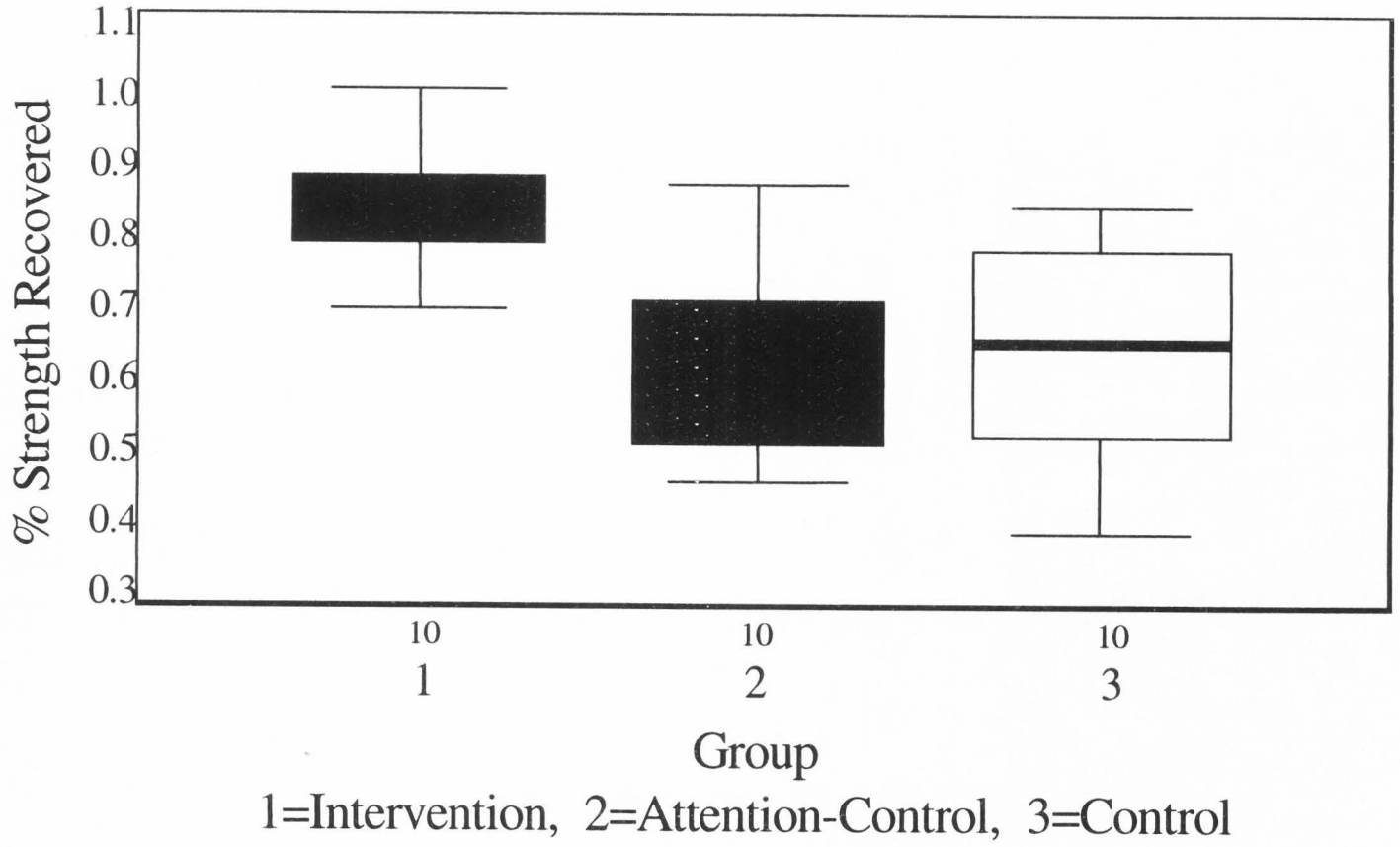

Figure 1. Percentage strength recovery by group.

Table 5

Scheffe Post Hoc Comparisons for Strength Recovery by Group

Group	Mean (SD)	Group 2	Group 3	Group 1	ES
Group 2: Placebo	.6310 (.129)				1.39
Group 4: Control	.6630 (.151)				.03
Group 4: Treatment	.8320 (.112)	*	*		1.67

* = significant differences at .05 level or less

Extension improvement. Although measurements were obtained for extension and flexion at five points in time, that is, 2, 4, 8, 16 and 24 weeks, an explanation of the following comparisons is in order. Three extension improvement analyses were completed: (a) extension improvement from 2 weeks to 24 weeks, (b) extension improvement from 4 weeks to 24 weeks, and (c) extension improvement from 4 weeks to 16 weeks. The rationale for these computations is as follows.

First, the 2-week measurement is utilized by medical personnel more as a rough indicator of extension due to surgical trauma, rather than as an official beginning baseline benchmark in the standard ACL physical rehabilitation protocols. However, 2 weeks postsurgery is the official initial range-of-motion benchmark in the standard ACL physical

rehabilitation protocols. Therefore, a 2-week to 24-week extension comparison (improvement) with repeated measures MANOVA was performed.

Second, the 4-week measurement is generally considered to be more accurate temporally with regard to extension recovery by physical therapy personnel than is the 2-week mark, which may be biased because of individual patient reaction to edema, and so forth. Therefore, a 4-week to 24-week extension improvement was also calculated with repeated measures MANOVA.

Third, although 24 weeks is an important recovery benchmark for the ACL patient, there is some concern among medical and physical rehabilitation personnel that it may represent a type of ceiling effect for some individuals. At this 24-week mark, patients are approaching, or are expected to approach, 80% recovery. Somewhere between 6 months and 9 months, most patients recover 80% of strength and range of motion, and it may be that 24 weeks represents too long a time period to accurately assess psychological intervention effects. It is for this reason that a third comparison was performed between extension at 4 weeks and 16 weeks, 16 weeks being the closest measurement obtained prior to the extension measurement at 24 weeks. All rationale and subsequent procedures as described apply to analyses for flexion, as well.

Findings from a repeated measures MANOVA including *all five points* in time demonstrated statistically significant extension recovery treatment by time (pattern) effects ($\underline{F} = 3.52$, $\underline{p} = .001$), as well as statistically significant extension recovery differences across

time for individuals ($F = 69.59$, $p = .000$). However, there were no statistically significant differences among the three groups for main effects of extension recovery ($F = .54$, $p = .591$; Table 6).

When considering the 2 to 24 weeks postsurgery extension improvement time period, there were also statistically significant interactional effects ($F = 5.04$, $p = .01$), and statistically significant differences across time for individuals ($F = 150.53$, $p = .000$). Statistically significant main effects among groups were also evident for this timeperiod ($F = 3.19$, $p = .05$, $\eta^2 = .19$; Table 7) . Planned posthoc ANOVA comparisons

Table 6

Extension Recovery: (Repeated Measures MANOVA) for 2, 4, 8, 16, and 24 Weeks Postsurgery

Source	df	Mean squares	F ratio	Sig of F	η^2
Between Subjects:	29				
Treatment	2	21.74	.54	.591	.038
Error (1)	27	40.54			
Within Subjects:	120				
Time	4	301.59	69.59	.000	
Time X Tx	8	15.25	3.52	.001	
Error	108	4.33			

revealed that subjects in the intervention group demonstrated statistically significant greater gains in extension from 2 to 24 weeks when compared with individuals in the attention-control ($\underline{F} = 5.56$, $\underline{p} = .03$, $\underline{ES} = 1.05$, $\eta^2 = .24$) and control groups ($\underline{F} = 4.23$, $p = .05$, $\underline{ES} = .92$, $\eta^2 = .19$; Table 8).

However, there were no statistically significant interactional or main effects from 4 to 24 weeks postsurgery or from 4 to 16 weeks postsurgery for extension improvement for the three groups. Individuals did, however, demonstrate statistically significant differences across time for both the 4 to 24 weeks ($\underline{F} = 72.26$, $\underline{p} = .000$) and the 4 to 16 weeks ($\underline{F} = 67.66$, $\underline{p} = .000$) time periods (Tables 18 and 19 in Appendix A).

Table 7

Repeated Measures MANOVA: Extension Improvement from 2 Weeks to 24 Weeks

Source	df	Mean squares	F ratio	Sig of F	η^2
Between Subjects:	29				
Treatment	2	42.35	3.19	.05	.19
Error (1)	27	13.29			
Within Subjects:	30				
Time	1	897.07	150.53	.000	
Time X Treatment	2	30.02	5.04	.014	
Error (2)	27	5.96			

Therefore, in regard to research question number two ("Is there a difference in extension recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive attention and physical rehabilitation [attention-control group] or physiotherapy alone [control group]?"), there were statistically significant differences in improvement among groups for the 20-week duration from 2 to 24 weeks, but not for the other two recovery time periods.

Extension recovery: Patterns. Results from repeated measures MANOVA revealed a statistically significant group-by-time interactional pattern among groups for *all*

Table 8

Post Hoc Comparisons: Extension Improvement from Pre- to Postintervention (2 to 24 Weeks Postsurgery)

Group	F	p	ES	η^2
Repeated measures	3.19	.05		.19
Post hoc ANOVA comparisons				
Group 1 and Group 2	5.56	.03	1.05	.24
Group 1 and Group 3	4.23	.05	.92	.19

Group 1 = Intervention Group

Group 2 = Attention-Control (placebo) Group

Group 3 = Control Group

five points in time as mentioned previously. This was also true for the 2- to 24-week extension recovery period ($\underline{F} = 5.04$, $\underline{p} = .014$; Table 7 and Figure 2). In other words, differences in *patterns* of extension recovery were attributable to individuals in the three groups demonstrating different patterns of extension recovery across time. However, there were no statistically significant differences among groups in patterns of extension recovery for the 4- to 24-week duration ($\underline{F} = .43$, $\underline{p} = .657$), or for the 16- to 24-week time period ($\underline{F} = 1.04$, $\underline{p} = .368$).

Therefore, in regard to research question number three ("Is there a difference in *patterns* of extension recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive attention and physical rehabilitation [attention-control group] or physiotherapy alone [control group]?"), there were statistically significant differences in patterns of extension recovery among groups for the 20-week duration from *2 to 24 weeks*, but there were no differences in patterns of extension recovery when analyzed over other time periods.

Flexion improvement. In regard to research question number four ("Is there a difference in flexion recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive attention and physical rehabilitation [attention-control group] or only physiotherapy alone [control]?"), there were no statistically significant interactional or main effects for flexion improvement among groups, either for the 2-week to 24-week recovery

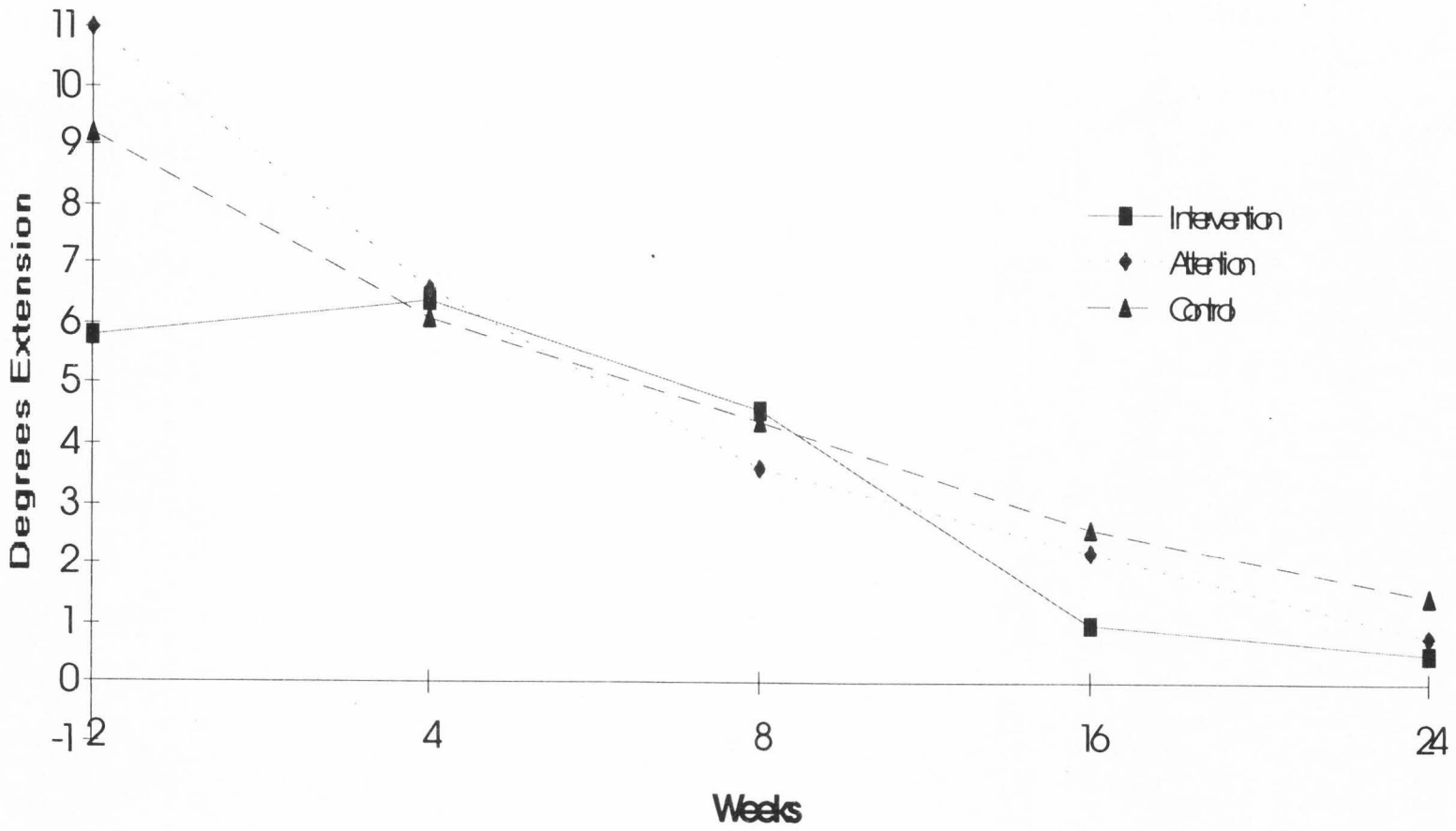

Figure 2. Patterns of extension by group.

period (F = 1.04, p = .367, η^2 = .07; Table 20, Appendix A), the 4-week to 24-week recovery period (F = .85, p = .439;,η^2 = .06; Table 21, Appendix A), or the 4-week to 16-week recovery period (F = 1.18, p = .322, η^2 = .08; Table 22, Appendix A).

Flexion recovery: Patterns. In regard to research question number five ("Is there a difference in *patterns* of flexion recovery/acquisition among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive attention and physical rehabilitation [attention-control group] or physiotherapy alone [control]?"), group members exhibited no statistically significant differences in patterns of flexion recovery as calculated with repeated measures MANOVA (F = 1.16, p =.329, η^2 = .08; Table 9). However, results of repeated measures MANOVA did reveal statistically significant differences for individuals across time for all five points in time (F = 101.95, p = .000), as well as the 2- to 24-week period (F = 203.73, p = .000; Table 20, Appendix A), the 4- to 24-week period (F = 51.14, p = .000; Table 21, Appendix A), and the 4- to 16-week period (F = 38.09, p = .000; Table 22, Appendix A). In other words, differences in *patterns* of flexion recovery were not demonstrated as a result of group membership, but were attributable to differences in individual patterns of flexion recovery across time (Figure 3).

Psychological Variables

Reinjury anxiety reduction. In regard to research question number six ("Is there a difference in reinjury anxiety among individuals who participate in a combined program of

Table 9

Flexion Recovery: (Repeated Measures MANOVA) 2, 4, 8, 16, and 24 Weeks Postsurgery

Source		df	Mean squares	F ratio	Sig of F	η^2
Between Subjects:	29					
Treatment		2	382.81	1.16	.329	.08
Error (1)		27	330.38			
Within Subjects:	120					
Time		4	7672.93	101.95	.000	
Time X Tx		8	81.76	1.09	.378	
Error		108	75.27			

guided imagery and physical rehabilitation [intervention group)] versus those who receive attention and physical rehabilitation [attention-control group] or physiotherapy alone [control group]?"), results of repeated measures MANOVA revealed statistically significant interactional effects ($F = 15.14$, $p = .000$) and main effects ($F = 11.23$, $p = .000$) for reinjury anxiety reduction. There were also statistically significant differences among individuals across time for reduction of reinjury anxiety ($F = 537.92$, $p = .000$).

Subjects were asked to rate themselves at the beginning of their physical therapy treatment and then again at 24 weeks postsurgery as to how much anxiety they were

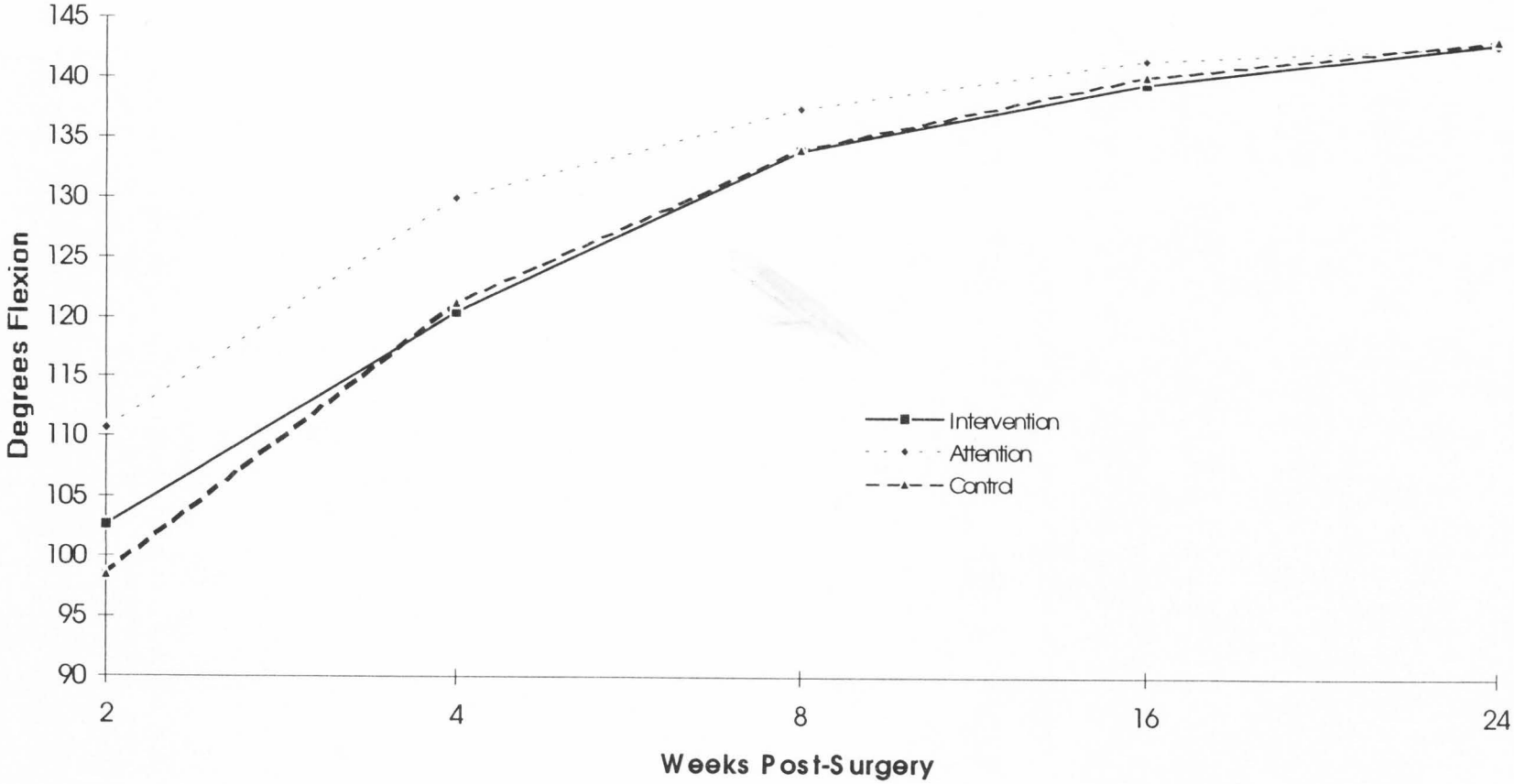

Figure 3. Patterns of flexion by group.

experiencing regarding reinjury. On a scale from 0 to 10, where "0" represented total absence of reinjury anxiety and "10" represented extreme reinjury anxiety, the three groups began at Time 1 (2 weeks postsurgery) with similar levels of reinjury anxiety (mean = 8.2, SD=.89). After completion of 24 weeks of physical therapy, however, group members demonstrated considerable differences in reinjury anxiety (Table 10 and Figure 4). Calculation of a variance effect size revealed that the psychological intervention accounted for approximately 45% of the variance in this reduction ($\eta^2 = .45$, Table 11).

Planned post hoc comparisons revealed that intervention group members significantly reduced reinjury anxiety to a greater extent than did attention-control group ($F = 26.13$, $p = .000$; Table 12) or control group members ($F = 8.80$, $p = .008$). There were no statistically significant differences between attention-control and control group members for reduction in reinjury anxiety ($F = 2.54$, $p = .857$). Variance effect size calculations suggested that the intervention accounted for 59% of the variance ($\eta^2 = .59$) between intervention and placebo group members, and 33% of the variance ($\eta^2 = .33$) between intervention and control group members for reinjury anxiety.

Intervention group subjects were surveyed 18 months postsurgery as to current concerns regarding reinjury anxiety. Nine of the 10 subjects were successfully contacted, gathering self-report data utilizing the same 0 to 10 Likert-scale rating of reinjury anxiety. A paired samples t test revealed no statistically significant differences

Table 10

Reinjury Anxiety Reduction: Means and Standard Deviations

Reinjury Anxiety	Intervention mean (SD)	Placebo mean (SD)	Control mean (SD)	Sample mean (SD)
Preintervention:				
2 weeks post-surgery	8.4 (1.07)	8.5 (.53)	8.0 (.94)	8.3 (.88)
Postintervention:				
24 weeks post-surgery	1.1 (.74)	4.0 (1.05)	3.4 (1.26)	2.8 (1.62)
18 months post-surgery	1.33 (1.0)			

in anxiety regarding reinjury anxiety ($p = .347$) from 24 weeks postsurgery to 18 months postsurgery for these nine subjects, suggesting that reduction in anxiety concerning reinjury had been maintained by individuals in this group (Table 13 and Figure 5).

State-trait anxiety. One of the original intentions of this study was to assess whether subjects would experience differences in state or trait anxiety from 2 weeks postsurgery to 24 weeks postsurgery. Accordingly, the State-Trait Inventory (STAI) was administered to all patients 2 weeks postsurgery. Disappointingly, however, it was not possible to obtain measures on the STAI at 24 weeks postsurgery for other than members of the intervention group, plus a handful of the other subjects due to a lack of compliance on the part of many placebo and control group members.

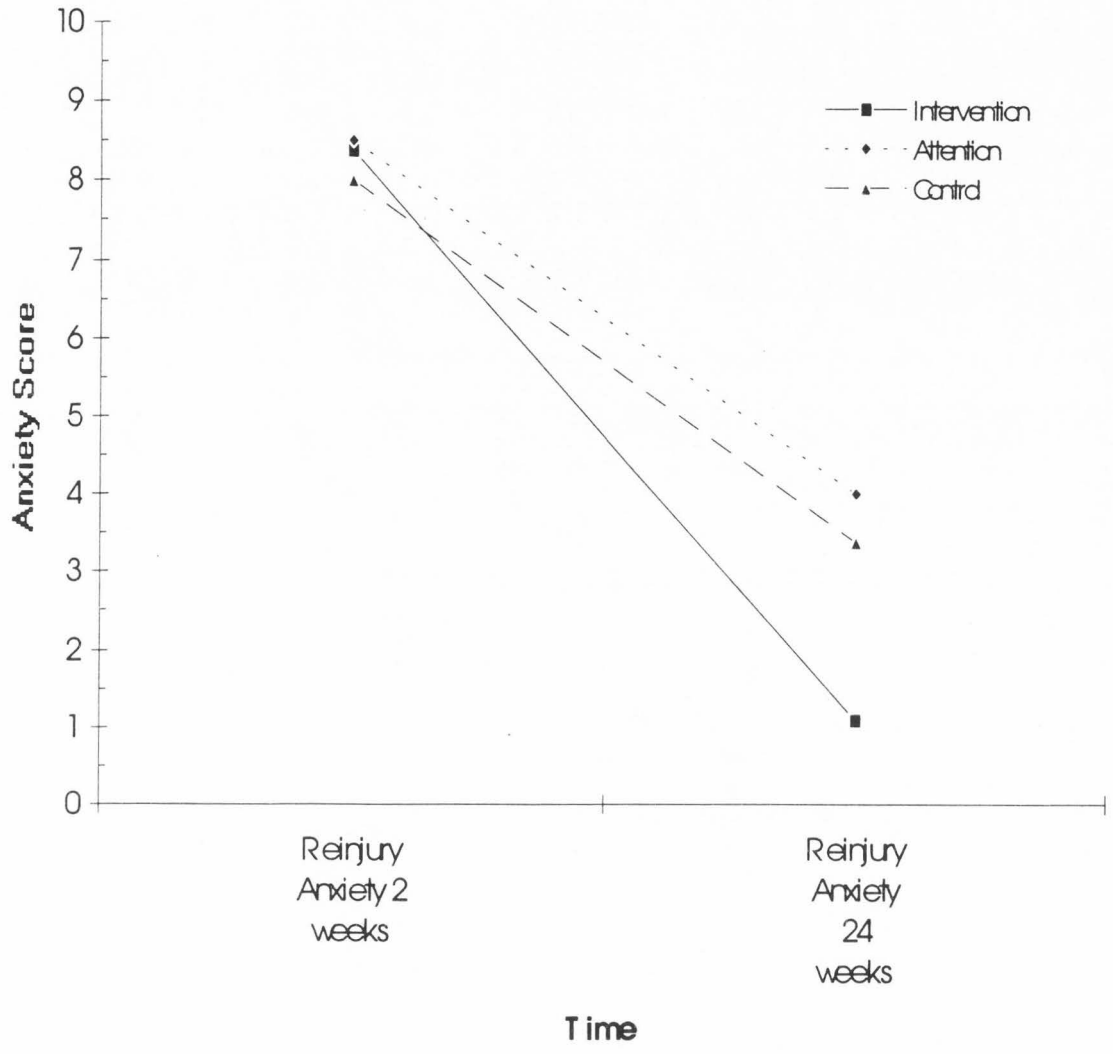

Figure 4. Reinjury anxiety reduction from 2 to 24 weeks postsurgery.

Therefore, in regard to research question number seven ("Is there a difference in state or trait anxiety among individuals who participate in a combined program of guided imagery and physical rehabilitation [intervention group] versus those who receive

Table 11

Reinjury Anxiety Reduction from 2 weeks to 24 weeks Postsurgery; Repeated Measures (MANOVA)

Source	df	Mean squares	F ratio	Sig of F	η^2
Between Subjects:	29				
Treatment	2	11.52	11.23	.000	.45
Error (1)	27	1.03			
Within Subjects:	30				
Time	1	448.27	537.92	.000	
Time X Tx	2	12.62	15.14	.000	
Error	27	.83			

attention and physical rehabilitation [attention-control group] or physiotherapy alone [control group]?"), it was not possible to calculate this difference.

In lieu of this assessment, this study analyzed the difference between pre-intervention (2 weeks postsurgery) and post-intervention (24 weeks postsurgery) scores on the STAI for the intervention group members only. It should be remembered that ANOVA testing revealed no statistically significant differences among the three groups on the two subscales of the STAI (and therefore the composite totals) at 2 weeks postsurgery.

Table 12

Planned Post Hoc Comparisons (ANOVA): Reinjury Anxiety Reduction

Group comparisons	F ratio	p	η^2
Group 1 and Group 2	26.13	.000	.59
Group 1 and Group 3	8.80	.008	.33

Group 1 = Intervention

Group 2 = Attention-Control (placebo)

Group 3 = Control

Table 13

Reinjury Anxiety Reduction Maintenance For Intervention Group:

Paired Samples t Test

24 Weeks Postsurgery	18 Months Postsurgery			
Mean (SD)	Mean (SD)	t	p	corr.
1.111 (.782)	1.333 (1.0)	-1.0	.347	.746

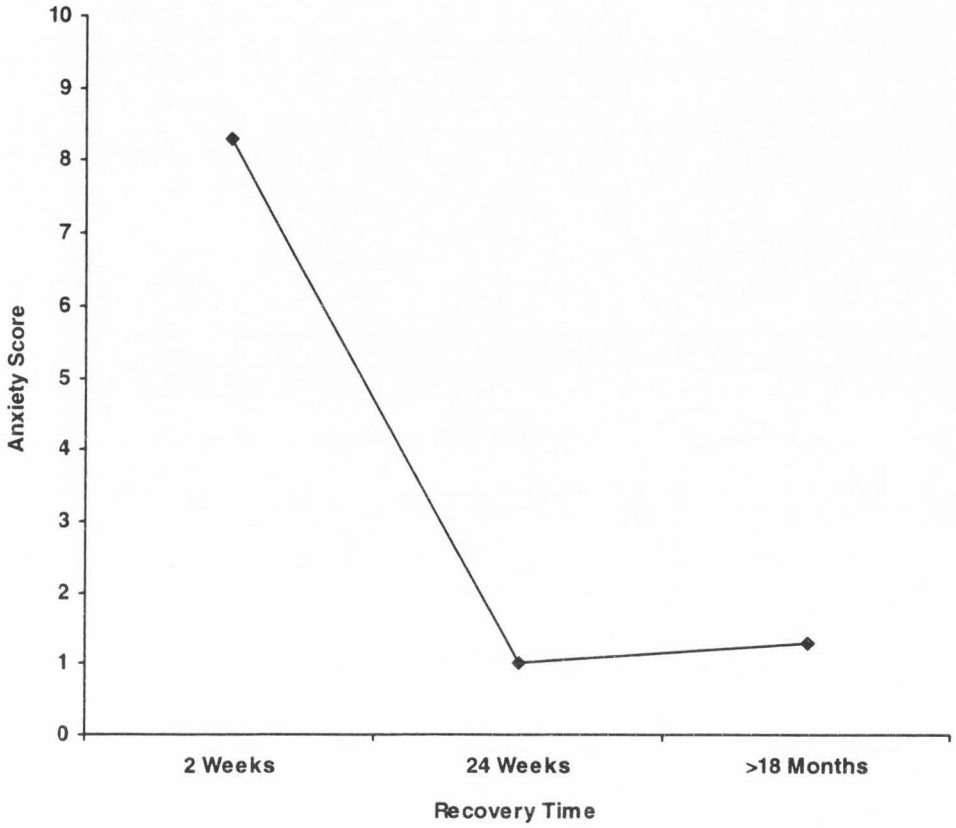

Figure 5. Reinjury anxiety reduction maintenance for intervention group.

Intervention group means for preintervention and postintervention are illustrated in Table 14 and Figure 6. Standardized mean difference effect size calculations reveal a moderate effect for reduction of state anxiety (ES = -.64), as well as a low effect for trait anxiety reduction (ES = -.52), with a moderate total inventory state/trait effect of ES = -.62 for members of the intervention group. In other words, individuals in the intervention group experienced low to moderate reductions in state and trait anxiety. A correlated pairs, or paired difference, t test, however, failed to reveal statistically

Table 14

Paired Difference t Test for State-Trait Inventory Scores from Pre- to Postintervention (2 weeks to 24 weeks): Intervention Group Members

Preintervention (2 weeks) Mean (SD)	Postintervention (24 weeks) Mean (SD)	t	p	ES
State Anxiety[a]				
35.8 (9.03)	30.0 (9.32)	1.38	.200	-.64
Trait Anxiety[b]				
39.5 (8.82)	35.0 (8.37)	1.97	.048	-.52
Total Inventory Anxiety[c]				
75.3 (16.89)	65.0 (16.11)	1.70	.123	-.62

Note. A negative effect size indicates positive outcome (reduction of anxiety scores).

National norms for same age group: [a] = 36.2; [b] = 35.4; [c] = 71.6.

significant differences for these individuals except on the measure of trait anxiety ($t = 2.29$, $p = .05$).

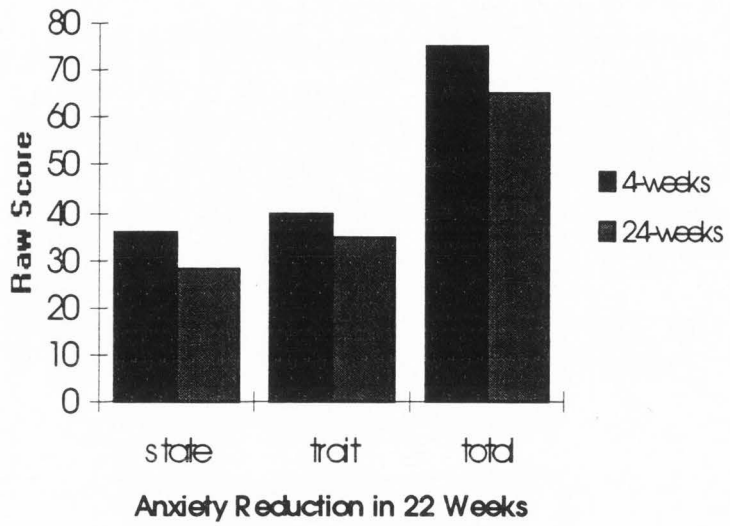

Figure 6. State-trait anxiety for intervention group.

Correlational Data

Correlation coefficients were computed with selected variables in order to examine the relationship of these variables to strength recovery at 24 weeks. For example, since the psychological injury intervention literature suggests that two variables in particular, age and activity level, are related to recovery from serious injury and surgery as is the case for ACL patients, the relationship between strength recovery, and age and activity level was examined. Additionally, correlation coefficients were computed to examine the relationship of other study variables to strength recovery. As previously discussed, many medical personnel suggest that range of motion assessments at 2 weeks postsurgery are not particularly valid as predictors of strength recovery at 24 weeks (r = -.50, p = .005). Additionally, the relationship between extension at 4 weeks and strength at 24 weeks approached statistical significance (r = -.32, p = .06). The 16-

week benchmark for extension and strength recovery at 24 weeks exhibited a strong linear relationship (r = -.51, p = .004). Of all flexion data point measurements, only the 2-week flexion measurement approached statistical significance with strength recovery at 24 weeks (r = .34, p = .07; Table 15).

There were no statistically significant relationships between age, activity level, gender, sport, number of days per week spent in physical therapy, or number of times listened to imagery tape per week with strength recovery. Because strength recovery is the focal point of a program of physical rehabilitation for ACL reconstructions, all correlations were oriented to this variable.

These findings demonstrate that in this sample of ACL patients, the better the extension at the beginning of physical rehabilitation (2 weeks), as well as at the 4-week and 16-week benchmark, the better the strength recovery. In other words, the lower the extension score 2 weeks postsurgery, as well as throughout recovery, the greater amount of strength was regained at 24 weeks.

Subjective pain level ratings at 8, 12, and 24 weeks, however, as well as an overall pain average for the 24-week recovery period, demonstrate statistically significant correlations with Cybex 6000 strength recovery at 24 weeks (p = .06, p = .05, p = .04, and p = .02, respectively). The lower the average subjective pain experience, the better the Cybex 6000 strength recovery measurement at 24 weeks (r = -.73, p = .02; Table 15). Pearson r correlational analysis also revealed that reinjury anxiety reduction was highly correlated with strength recovery (r = -.63, p = .000), as well as whether

Table 15

Pearson r Correlation Coefficients: Strength Recovery With Selected Variables

Variable	CP24 Pearson r Sig of r	Variable	CP24 Pearson r Sig of r
Age	r = -.048 p = .799	Trait Anxiety[a]	r = -.050 p = .782
Group	r = -.490 p = .006	State Anxiety[c]	r = -.335 p = .344
Activity Level	r = .220 p = .252	Trait Anxiety[c]	r = -.530 p = .115
Days P.T.[c]	r = -.120 p = .746	Ex2	r = -.500 p = .005
Tape[c]	r = .030 p = .935	Ext4	r = -.320 p = .060
Av.Pain[c]	r = -.730 p = .018	Ext8	r = -.240 p = .200
Trauma	r = -.090 p = .641	Ext16	r = -.510 p = .004
MD Info/ Support	r = .470 p = .010	Ext24	r = -.300 p = .105
PT Info/ Support	r = .170 p = .363	Flx2	r = .340 p = .070
PT Help	r = .090 p = .652	Flx4	r = .290 p = .119
Reinjury Anxiety[b]	r = -.630 p = .000	Flx16	r = .120 p = .530
State Anxiety[a]	r = -.180 p = .346	Flx24	r = .310 p = .090

a = Preintervention data for sample
b = Postintervention data for sample
c = Postintervention data for intervention group

subjects perceived his or her surgeon to have provided sufficient support and information ($r = .47$, $p = .01$). Group membership (intervention) was highly correlated with strength recovery ($r = -.49$, $p = .006$), yet there were no statistically significant relationships between gender and strength recovery, extension, flexion, state, trait, or reinjury anxiety.

Participant Perceptions

Intervention group members were asked five questions relative to their subjective experience of surgery and physical rehabilitation (Table 16). These questions related to perceptions of pain, trauma, medical information/support, and physical therapy assistance (1 = "less than expected," 2 = "same as expected," and 3 = "more than expected") on a 3-point Likert scale. On a 2-point Likert, 1 = "yes" and 2 = "no." Study participants reported experiencing the same or more than expected pain and trauma. While self-report scores reflect satisfaction with respective surgeons, scores averaged less satisfaction with guidance/assistance from physical therapists and physical therapy assistants.

Participant Perceptions of Intervention Benefits

Subjects were asked to comment on all aspects of their recovery process, including that portion which constituted relaxation and guided imagery intervention (Table 17). Responses were gathered in written (Exit Interview Questionnaire) as well as oral format at the 24-week postsurgery exit interview. Subjects believed participation in the treatment included the following benefits:

Table 16

Subject Perceptions of Surgical and Physical Rehabilitative Experience

Question	Value/Label	N	%	Cum %
1. Did you experience less, the same or more trauma than you originally anticipated during surgery and physical rehabilitation?	1 = Less	1	3.3	3.3
	2 = Same	9	30.0	33.3
	3 = More	20	66.7	100.0
2. Did you experience less, the same or more pain than you originally anticipated during surgery and physical rehabilitation?	1 = Less	2	6.7	6.0
	2 = Same	12	40.0	46.7
	3 = More	16	53.3	100.0
3. Do you feel your surgeon provided you with enough information/attention/encouragement for you to understand/cope adequately with your surgery?	1 = Yes	20	66.7	66.7
	2 = No	10	33.3	100.0
4. Do you feel your physical therapist provided you with enough information to understand and carry out your physical therapy to this 24-week point in your recovery?	1 = Yes	12	40.0	40.0
	2 = No	18	60.0	100.0
5. Do you feel your physical therapist provided you with enough assistance and/or guidance through the physical therapy process to this 6-month point?	1 = Yes	10	33.3	33.3
	2 = No	20	66.7	100.0

Table 17

Participant Perceptions of Intervention Benefits: Intervention Group

Perceived benefits of intervention	% Subjects
1. Confidence in surgery and ability to heal	100
2. Motivation to push through pain to rehabilitate	100
3. Ability to relax to deal with stress of major surgery	100
4. Dealing with pain and soreness	82
5. Setting attainable recovery and other goals	82
6. Empowerment to take control of own physical recovery	82
7. Engaging in positive self-talk	64
8. Increasing patience with recovery/reducing frustration	55
9. Normalizing traumatic experience/losses	45

1. Building of *confidence* to rehabilitate aggressively (trusting that the transplant would not tear) (100%of group members).

2. Being able to *relax* so as to deal with the stress of major surgery and rehabilitation (100% of group members).

3. *Managing pain* and soreness (82% of group members).

3. *Managing pain* and soreness (82% of group members).

4. *Empowerment* to take control of one's own recovery (82% of group members).

5. *Setting attainable goals* (82% of group members).

6. Increasing *positive-self talk* (64% of group members).

7. Increasing *patience/reducing frustration* (55% of group members),

8. *Normalizing* the experience (45% of group members).

9) *Amelioration of other somatic complaints* (e.g., headaches, insomnia, benign cyst) (36% of group members).

All intervention group subjects reported to have successfully visualized and somatically experienced the imagery experience during each of the 10 sessions, as indicated by a "yes" response recorded on their Imagery Logs, where 1 = "yes" and 2 = "no" (mean = 1.16, SD = .38). Occasionally a subject experienced difficulty with one specific visualization of imagery content for a particular session as indicated by a "no" response.

Imagery and relaxation techniques rated as most effective by subjects in the intervention group were exercises that included "the paintbrush," reinterpretation of pain, peak performance/power, "the golden egg," "the internal journey," comparison of knee functions, ligament bonding to bone, and scar tissue releasing. (These exercises are described, along with others, in Appendix G).

Participant Recommendations

Subjects in the intervention group offered three major recommendations to improve their physical rehabilitative experience, which included aspects of the psychological intervention.

1. More information regarding the nature of long-term fitness requirements to maintain the allograft was requested. This was a unanimous request among not only intervention group members, but attention-control group members as well. Their expectation was that the appropriate source of this information resides with each subject's physical therapist.

2. All intervention group members, as well as attention-control group members, requested that the researcher/clinician be present more often during physical therapy. "More often" ranged from a desire for that presence every day of their physical therapy to once a week. (The clinician researcher was present at the facility a minimum of 1 day per week for each subject; psychological intervention sessions were performed at the Utah State Psychology Community Clinic.)

3. In an unsolicited response, all intervention group members strongly believed that psychological intervention should be an adjunctive part of their physical rehabilitation from ACL reconstructive surgery. Six of the 10 group members requested the researcher/clinician prepare an audio "maintenance" tape(s) to encourage them to continue to use the mental practice skills they had learned during the 24-week study period.

Summary

Statistical significance testing revealed that intervention group members exhibited statistically significant greater gains in strength than individuals in either the attention-control (placebo) or control groups at 24 weeks postsurgery. Effect size calculations indicated that the intervention group demonstrated high, positive treatment effects compared to both control group subjects with respect to strength recovery.

Participants in the intervention group also demonstrated statistically greater gains for extension acquisition (improvement) from 2 weeks to 24 weeks postsurgery than individuals in either of the other two groups. Standardized mean difference effect-size calculations confirmed that the intervention subjects experienced high, positive treatment effects compared to control group subjects with respect to extension improvement. Statistically significant differences in *patterns* of extension recovery were demonstrated by the intervention group for the 2- to 24-week period only.

Statistical significance testing did not indicate that groups differed for either flexion improvement or patterns of flexion acquisition. Although intervention group subjects revealed greater flexion improvement than either of the other two groups, these differences were not statistically significant. Effect-size calculations, however, demonstrated a low, positive treatment effect for intervention group members as compared to placebo (ES = .49) and control group members (ES = .25).

Intervention group members exhibited statistically significant reductions in reinjury anxiety as compared to the other two study group subjects. Effect-size

calculations supported these differences, wherein treatment effects were high for the intervention group as compared to the attention-control group and the control group. Confidence in the integrity of the replaced ligament (i.e., low reinjury anxiety) was maintained 18 months postsurgery by intervention group members.

In the absence of data for all three groups at postintervention for STAI scores, standardized mean difference effect-size and variance effect-size calculations revealed a moderate, positive treatment effect for intervention group members for reduced state anxiety from preintervention (2 weeks postsurgery) to postintervention (24 weeks postsurgery) (ES = -.64), and a low to moderate effect for trait anxiety reduction (ES = -.52). In a paired t-test analysis, intervention group member scores failed to demonstrate statistically significant reduction in state anxiety, but scores were statistically significantly reduced for trait anxiety. Effect-size calculations from t-values, however, demonstrated low to moderate positive treatment effects for both state and trait anxiety reduction.

Participant perceptions of surgical, physical therapy, and intervention experiences were reported at varying levels of satisfaction. In regard to benefits of intervention, subjects reported that psychological intervention was most important in building confidence to rehabilitate, being able to relax, manage pain, foster a sense of personal empowerment, and help set attainable goals. Subject recommendations included a desire to (a) receive more information about long-term effects of this orthopedic surgery, (b) have the clinician/researcher present during physical therapy, and

(c) integrate a psychological intervention component into the standard physical therapy program.

CHAPTER V

DISCUSSION

The main objectives of this study were to investigate the effect of relaxation and guided imagery for a group of ACL replacement patients on (a) physiological variables of strength and range-of-motion acquisition and (b) psychological variables of reinjury, state, and trait anxiety. Results associated with each study research question will be discussed individually in this section. A discussion of research strengths and weaknesses, importance of study findings, and recommendations for further research is offered in Chapter VI.

Strength Recovery

The Cybex 6000 provides the standard isokinetic assessment of strength (and ligament stability) for ACL reconstruction patients at approximately 24 weeks postsurgery. Although other methods and measurements are utilized by physical therapists to evaluate strength recovery, this one measurement is most accurately reflective of recovery, particularly when combined with measurements of degrees of flexion and extension. At 24 weeks postsurgery, surgeons and physical therapists anticipate a 70 to 80% strength recovery; when the ACL patient reaches 85% recovery, the patient/athlete is generally given a medical release to return to normal activities, with certain limitations and restrictions.

While the significance value and effect size for the intervention group for strength recovery are notable in themselves, what is of particular importance to this study for patients and medical personnel alike is evidence of a quicker return to pre-surgery strength. The intervention group averaged 83.2% strength recovery of the injured knee in comparison to the uninjured knee, with attention-control (placebo) and control groups averaged 63.1% and 66.3%, respectively (Figure 1). Strength recovery in excess of approximately 75% at 24 weeks is considered notable (Draper & Ladd, 1993). A quicker return to normal activities is a major important outcome of the intervention for these individuals. Therefore, in regard to research question number one, there is a difference in strength recovery for individuals who received psychological intervention as compared to individuals in the other two groups.

Relative to age of an ACL patient, an unexpected finding associated with strength recovery for many of the intervention group subjects was that age did not appear to be a limiting factor in strength (nor range of motion) recovery. As mentioned previously, the injury intervention literature suggests that age is one intervening variable in the process of injury recovery to be considered when examining treatment effects. In this study, the oldest subject in the intervention group (age 45) achieved the highest scores on strength and extension recovery the most quickly, not only for all cohorts in the intervention group, but also for all subjects in the study. Moreover, this subject reached 95% strength recovery by 16 weeks, and 100% recovery by 24 weeks. If this finding for

the intervention group can be generalized, it may be significant in influencing medical expectations surrounding ACL surgery and rehabilitation.

Individuals in this study did not appear to be particularly influenced by activity level. That is, individuals reporting higher average levels of activity did not demonstrate quicker recovery times. However, these results should be interpreted in the context of sport injury recovery, since 90% of subjects were injured performing a specific sport, which generally requires at least a moderate level of regular physical activity. The 30 individuals in this study reported an average activity level of three times per week of moderately strenuous exercise. It may be that once a certain level of fitness is achieved and maintained, "more" (in this case activity) is not necessarily "better."

Range of Motion Recovery

Extension

Results of analyses for extension recovery reinforce experiences of previous ACL reconstruction patients (Draper, 1990; Goble, 1988). Not only do individuals tend to exhibit considerable variability over the course of their respective recovery processes, but patterns are also difficult to predict in the initial recovery stages (first 4 to 6 months). By 12-18 months postsurgery, however, physical outcome has generally stabilized and is less variable.

As depicted in Figure 2, groups began physical therapy at markedly different degrees of extension (the lower the number, the better). However, a difference between a mean of 8 and 11 degrees of extension 2 weeks postsurgery may be neither particularly

important, nor necessarily "accurate." At this early stage of recovery, the body's natural response to the trauma of injury/surgery, for example, edema, will cause measurements of extension and flexion to vary within each individual according to time of day, activity level, accuracy of hand caliper measurement, and so forth. As rehabilitation progresses, range-of-motion measurements tend to stabilize as swelling is minimized, with strength and flexibility beginning to increase at approximately 4 to 6 weeks postsurgery. This was the case at 4 weeks postsurgery for individuals in this study for extension improvement. Measurements of extension and flexion become increasingly important as the graft and other soft tissue in and around the joint heal.

There were no significant differences in extension improvement among groups, however, when extension improvement was calculated from the 4- to 24-week or the 4- to 16-week recovery mark. Some reasons for this inability to demonstrate a statistically significant treatment effect for these time periods are as follows. First, 24 weeks may not be a temporal benchmark that reflects a ceiling effect, as previously suspected. Without intervention, 20 individuals (placebo and control groups) averaged 64% strength recovery. Considering that individuals from these two groups were similar to the individuals in the intervention group across variables such as age and activity level, 64% may well represent a fairly accurate strength recovery for 24 weeks postsurgery. If so, the 24-week benchmark does not reflect a ceiling effect.

Second, since no treatment effect was found for the 4- to 24 week period (when individuals were assessed to be at similar degrees of extension at 4 weeks), it is possible

that the treatment effect observed with the 2- to 24-week recovery period may be due to factors in addition to or exclusion of the intervention. The 4-week extension data point measurements, where individuals in the three groups displayed similar scores, may be the accurate initial extension data point.

Although ANOVA and MANOVA procedures yielded results (extension improvement and patterns of recovery) that confirmed the relative "instability" of the 2-week extension assessment, and by inference, this natural healing cycle, the strong relationship of this 2-week extension assessment with the 24-week strength recovery assessment is somewhat puzzling. Since results of this research indicate that those who began recovery with better extension, and who maintained this flexibility throughout rehabilitation recovered strength more quickly, further studies should focus careful attention on the first 4 weeks of recovery. This may be particuarly important to investigate, since this study also confirmed that measures of extension, flexion, and strength acquisition are closely related. The disparity among group means at the 2- week mark may or may not reflect an anomaly.

Even though questions surrround the initial 4-week recovery period, results from statistical significance testing and effect-size calculation indicate that improvement in extension recovery for intervention group individuals was enhanced as a result of the intervention when improvement was calculated from the 2- week to 24-week mark. As opposed to 2 weeks postsurgery, at 24 weeks postsurgery, a difference of 3 degrees does assume significance to strength recovery, facilitating a return to normal physical activity.

Therefore, in regard to research question number two, there is a difference in extension improvement for individuals in the intervention group as compared to individuals in the other two groups, most apparently because of the difference in where the intervention group began extension.

Regarding a lack of statistically significant differences in *patterns* of extension among groups for the 4- to 24-, and the 16- to 24-week periods, again, these findings confirm previous research findings that individuals exhibit great variability over the course of the recovery process. Results from statistical significance testing for this study's data demonstrate that differences in patterns of extension recovery were generally attributable to individuals manifesting different patterns of extension recovery across time. Again, differences in patterns of extension recovery for the 2- to 24-week time period were due to differences in the initial 2-week extension measurement. Therefore, in regard to research question number three, there are differences in patterns of extension among groups for the 2- to 24-week time period only.

Flexion

A repeated measures MANOVA revealed no statistically significant differences among the three groups on either flexion *improvement* or *patterns* of flexion recovery. As seen in Figure 3, group means are plotted across these five points. As with measures of extension, while the three groups began at different degrees of flexion at 2 weeks postsurgery, by 4 weeks postsurgery, group means began to converge. Attention-control group subjects maintained a lead in degrees of flexion gained until approximately the 24-

week benchmark, when, at such time, all three group averages of flexion recovery appeared equal. Neither actual degrees of flexion at 24 weeks nor flexion improvement from pre- to postintervention revealed statistically significant correlations with strength testing at 24 weeks. Therefore, in regard to research questions number four and five, there are no statistically significant differences among groups for either flexion improvement or patterns of flexion recovery.

Repeated measures analysis of variance did, however, reveal statistically significant differences for individuals across time ($p = .000$), yet no time-by-flexion interaction ($p = .38$). In other words, differences in patterns of flexion recovery were attributable to variability in individuals, rather than to the intervention (treatment) condition or an interaction with group membership (treatment) across time. According to reports by physical therapists at the Center, this is in keeping with observations concerning flexion recovery for ACL patients wherein patients display a great deal of individual variability in range of motion recovery.

Relative to physiological and psychological outcome, the attention-control (placebo) and control groups achieved fewer gains than the intervention group. It was assumed that nonspecific intervention activities such as attention, encouragement, and support would have some demonstrable effect on physiological and/or psychological recovery for attention-control (placebo) group members. The clinician/researcher spent a minimum of 30 minutes per week with each placebo group member at the sport medicine facility and/or in telephone contact. Each subject in this group was asked to

spend 10 minutes after each physical therapy session relaxing and visualizing a peaceful scene (usually while icing). In addition, the clinician/researcher provided physical assistance whenever necessary, particularly at the initiation of therapy when all subjects were on crutches for an average of 3 to 6 weeks. Providing these two levels of intervention increased confidence that differences observed in the intervention group were in fact due to the intervention by attempting to account for an attention effect.

One explanation for the poorer performance on the part of the attention-control (placebo) (as well as control) subjects may be that characteristics inherent in the sample itself, yet not measured by this study, were influential. For example, marital and employment status, family obligations, or financial concerns may have affected motivation and ability to rehabilitate. As well, the attention-control (placebo) group contained only one competitive athlete, which may or may not reflect motivation to aggressively rehabilitate/recover.

Reinjury Anxiety Reduction

Anterior cruciate ligament surgery is considered a significant life and/or body stressor (Hardy, 1992). As previously described, the anterior cruciate ligament, unlike most other soft tissue injuries, requires complete replacement when severed. It was assumed, therefore, that knee reconstructive surgery would be associated with at least a temporary increase in anxiety. Although arthroscopic procedures have reduced hospitalization stays and lengthy recoveries, ACL replacement still constitutes major

orthopedic surgery, whether the ligament is replaced with one's own body tissue (autograft) or cadaver tissue (allograft). In an assessment of mood disturbance for recreational athletes undergoing ACL reconstructive surgery, Udry (1995) found that mood disturbances (including anxiety) for the recreational athlete paralleled mood disturbance levels of elite athletes. Apparently regardless of where the individual falls along the competitive continuum, stress/anxiety is most likely to occur when an injury is (a) severe, (b) perceived as a threat to career or daily life functioning, (c) requires surgery, and/or (d) involves a protracted period of rehabilitation (Heil, 1993). By definition, ACL replacement injury and surgery meet these criteria. An interesting aspect of the recovery process, be it ACL or other injury related, is that it involves differential rates of recovery for each individual, implying that recovery is a function of personal response to injury, coupled with personal, biological, and situational variables (Faris, 1985; Ievleva & Orlick, 1991).

Fear associated with reinjury of the ACL is the greatest psychological barrier to recovery from this major surgical experience (Draper & Ladd, 1993). This anxiety is credited as a central reason for timidity in physical rehabilitation, reduced motivation to return to normal athletic activities, feelings of lack of control over one's body, and wearing of a constricting leg brace well past the time of complete healing. It is essential that the ACL patient learn to trust the cadaver ligament graft or his/her own tendon graft in order to properly rehabilitate the leg for complete functioning. Certain elements of

this study's intervention were, therefore, geared throughout the course of the 24 weeks to increase confidence and reduce reinjury anxiety.

It is particularly salient, then, that findings for this study sample of 30 subjects reported a strong relationship between amount of anxiety reduction (improvement) and strength recovery, confirming this as an important part of psychological intervention for this population. As well, the 24-week anxiety reinjury scores demonstrated a strong relationship with strength recovery, where the lower the reinjury anxiety score at 24 weeks postsurgery, the greater the strength of the knee at 24 weeks postsurgery.

Anxiety reduction is one expected outcome from intervention specifically designed to address that affect, among others. These results are particularly noteworthy, however, because a strong statistical significance was supported by positive effect-size calculations that exceeded two standard deviations. Neither statistical significance testing nor effect-size calculations demonstrated significant differences for the attention-control (placebo) and control group members for reinjury anxiety reduction. As well, it would appear that intervention effects for anxiety reduction for the intervention group were maintained over time, that is, confidence in the integrity of the replaced ligament was sustained at 18 months postsurgery. It may be inferred for this sample, therefore, that treatment in the form of attention/support was not sufficient to adequately reduce reinjury anxiety, while treatment in the form of relaxation and imagery had a strong, positive effect on reinjury anxiety reduction. Therefore, in regard to research question

number six, there is a difference in reduction of reinjury anxiety for individuals who received psychological intervention compared to those who did not.

State-Trait Anxiety

A limitation of this study involved difficulty in obtaining assessments on the STAI for all study subjects at 24 weeks postsurgery. As mentioned previously, some subjects lived in outlying areas and rehabilitated at the Tremonton facility. This physical-distance parameter exacerbated difficulties in obtaining a 100% return rate on the STAI. Frequency of interaction was also a contributing factor. Since interaction with intervention group members occurred on a regularly scheduled basis, and was monetarily reinforced, data collection was not a problem. Frequent interaction with attention-control (placebo) group members also contributed to a better return rate on assessment measures.

In the absence of comparative data, means and standard deviations for intervention group subjects only demonstrated that both state and trait anxiety were lowered from pre- to postintervention. Although effect-size calculations suggest a positive, moderate treatment effect for this group, results should be interpreted cautiously (Table 11). A paired samples t test on STAI intervention group data confirmed a statistically significant reduction in trait anxiety, but not a statistically significant difference between state anxiety scores for this group from pre- to postintervention. Effect-size calculations, however, suggest moderate treatment effects for both state and

trait anxiety. While this is certainly encouraging, particularly with respect to reduction of state anxiety, without adequate comparative data from the other two groups, psychological intervention cannot assume sole credit for improved state or trait anxiety outcomes. Other explanations for this difference may include a natural function of recovery over 24 weeks, variables not accounted for by this study, or perhaps a chance occurrence for the intervention group members.

It would appear difficult to account for all the variables related to physical rehabilitation. Parts of this rehabilitation process may well override what is done in psychological intervention. A relatively strong relationship among state, trait, and reinjury anxiety, however (and their positive relationship to strength recovery at 24 weeks), lends credence to the efficacy of the intervention for state/trait anxiety reduction. Results of Pearson product moment correlations suggest that both state anxiety ($r = .68$, $p = .03$) and trait anxiety ($r = .68$, $p = .029$) at 24 weeks exhibit strong relationships with reinjury anxiety at 24 weeks for this group. This is also true when compared with reinjury anxiety at 18 months postsurgery for this group (state: $r = .79$, $p = .01$; trait: $r = .87$, $p = .002$). Although inappropriate to make a theoretical leap of inference from reinjury anxiety to state or trait anxiety, the constructs are certainly related, as outcome data for this group demonstrate. Given these correlations in the face of rather solid physiological outcome data, this relationship merits subsequent empirical investigation.

The literature concerning emotional reaction to injury clearly suggests that situational and personal variables combine in synergistic fashion in recovery from

serious injury (Brewer, 1994). It is therefore important to identify this multivariate process whenever possible when reporting outcome data. Such was the case for at least 2 of the 10 intervention group members. During the 24-week rehabilitative period, these subjects reported heightened state anxiety, rather than state anxiety reduction. In particular, one subject experienced heightened anxiety, as reflected in state/trait scores at 24 weeks, due to involvement in another athletic injury in the 22nd week of recovery. This injury was serious enough for the subject to be hospitalized overnight, although there was no damage to the ACL. The other subject experienced a major life stressor in her personal life beginning approximately in the 20th week of recovery, and which continued beyond the time frame of this research. Both subjects orally reported that they were relatively confident in the integrity of the allograft, and that, to their knowledge, their present levels of stress were not directly related to their ACL surgery. Nonetheless, having just undergone ACL surgery, the most recent injury or personal life issues apparently combined to significantly raise state and trait anxiety levels. These personal and situational variables may help to explain the statistical significance of treatment by time interaction for reinjury anxiety reduction.

These two cases illustrate the importance of utilizing psychological assessment instruments appropriately sensitive to the variables of interest. Perhaps a more accurate method of teasing out those factors that contribute to recovery would have been to use the STAI in combination with another instrument(s) that better delineated biological,

situational, and personal variables. A reinjury-anxiety rating scale was appropriately helpful in this regard, however.

CHAPTER VI

CONCLUSION

The results of this study demonstrated that in a sample of anterior cruciate ligament patients, intervention in the form of relaxation and guided imagery effectively improved strength and extension recovery, as well as reduced reinjury, state, and trait anxiety. Psychological intervention in the form of relaxation and guided imagery for a serious knee injury and subsequent surgery made a statistically significant difference for members of the intervention group when compared with members of an attention-control (placebo) and a control group.

There were other accompanying benefits for the intervention group as a result of participation in a program of relaxation and guided imagery tailored specifically to recovery from ACL reconstruction knee surgery. Some of these benefits, according to subject self-report, included pain and stress management; a sense of empowerment, control, and active participation in rehabilitation; overall body wellness; setting attainable goals; normalizing of a traumatic body experience; elimination of chronic insomnia; and amelioration of other somatic problems. In this study, age was not a limiting factor for physiological recovery. The three subjects in the intervention group who were older than the study's mean age of 28 did as well or better on strength acquisition than those of mean age or younger. This outcome suggests that healing of body tissue may not be as drastically retarded by age as popularly believed, and that there may be some advantages associated with age (up to a certain point) relative to physical

recovery. It is quite possible that one of these advantages might include cognitive maturity, since the ability to engage in abstract reasoning and perform skills of mental imagery, for example, does not necessarily peak until age 35 or older (Gagne, Yekovich, & Yekovich, 1993). A combined program of recovery that includes mental practice skills with aggressive physiotherapy may be an effective combination for the maturing adult.

Strengths and Weaknesses

The attention-control (placebo) group for this study performed as both a separate level of intervention (attention/support) and as a control. Without these controls, which include assessing the impact of nonspecific, intervention placebo effects such as caring, attention, or support, it is difficult to separate true intervention (treatment) effects from other intervening variables. As well, clarification and identification of the multivariate influences exerted by personal and situational variables for physical recovery become a confusing research labyrinth in the absence of attempts to control for confounding influences.

Findings from this study also offer evidence pertaining to the presence of physician and/or clinician iatrogenic effects influencing somatic outcomes. The strong relationship between strength recovery at 24 weeks and surgeon information/ support/encouragement, for example, suggests a fertile area for future study inquiry. Considering the comparatively little amount of time a patient spends with his or her physician relative to time spent with his or her physical therapist, the influence of the

"medical authority" as this authority impacts personal beliefs about wellness and self-efficacy, and thus influences patient recovery, remains to be adequately investigated. As well, the relationship between superior recovery at 24 weeks for a few subjects who actively sought additional information, attention (two placebo members), and help with an understanding of emotions and behavior surrounding their surgery (five intervention group members) from the clinician/researcher invites future inquiry into the relationship of physician/clinician variables on recovery.

Utilization of "medical" samples usually reflects inherent methodological and statistical weaknesses since subjects are not randomly selected. Having been comprised of a sample of all individuals experiencing an ACL procedure during a 14-month period who met the inclusion criteria, this study relied on random assignment of subjects to one of three groups, as well as on biomechanical equivalence of group members for its methodological strengths. Important to the internal validity of this research was the fact that every subject approached to participate agreed to do so. This being the case, the difference between the accessible population and this study sample is that this sample represents a temporal subset of ACL patients who undergo this specific procedure.

Threats to internal validity were addressed through (a) random assignment, (b) evaluation of the uninvolved limb's muscle performance characteristics, (c) investigation of only one type of injury, and (d) use of self-report measures of both pre- and postsurgery activity levels. The second and third of these procedures are salient to this research. A homogenous sample is particularly important in sport medicine research

since rapidly changing physical rehabilitation protocols and surgical techniques tend to exacerbate problems of generalizability.

A weakness of this study was the lack of STAI postintervention data for all study participants. In retrospect, it would have been more desirable to have subjects rehabilitate at only one facility so as to be able to more easily encourage completion, as well as to accomplish collection of all STAI inventories. One physical rehabilitation facility would also have limited the number of different physical therapists, and therefore reduced the number of potential confoundings to treatment. Additionally, perhaps compliance to return the STAI forms at 24 weeks could have been increased by reimbursing attention-control (placebo) and control group members in a manner commensurate with their participation in the study.

As mentioned previously, a strength for this study involved 100% agreement to participate, with a zero attrition rate. Certain characteristics of the intervention were also strengths. Specifically, relaxation and imagery sessions (a) delivered in the form of standardized scripts, (b) based on imagery protocols, and (c) designed to parallel standardized physical rehabilitation protocols contributed to internal validity.

On a related note, while practice of mental skills cannot be coerced, all intervention subjects were encouraged to listen to an audio tape of the imagery session at least once per day, with the expectation that practice would facilitate skill acquisition. Attempts to increase compliance of practice can increase confidence that results observed are due to the effect of treatment variables, rather than to extraneous variables.

Since relaxation and guided imagery are forms of mental skills that require practice, integration of mental practice and physical practice was encouraged by the presence of the clinician/researcher during physical therapy.

In an additional effort to increase incentives to practice, monetary reimbursement for imagery sessions did not take place before completing the appropriate imagery session as scheduled and turning in a weekly Imagery Log, wherein subjects recorded number of times listened to tape (however frequent or infrequent). According to self-report, there was great variability in practice, which did not appear to influence physiological or psychological outcomes. This study attempted to reduce assessment bias, since surgeons and physical therapists were blind to group membership, while the clinician/researcher remained blind to physiological assessments until completion of each subject's 24-week recovery period. Outcome data may reflect an expectancy effect, however, due to the dual role of the researcher/clinician while eliciting subject responses at the exit interview.

Relaxation and guided imagery protocols for this study were created to directly parallel established physical rehabilitation protocols in a brief-therapy format. This appeared to be effective as an empirical intervention in a sport medicine environment, which necessitates an individual to experience an expedient recovery. The research design and procedures appeared to be particularly important methodological strengths, as they provided for a psychological intervention harmonious with a sport medicine setting such that medical personnel and subjects alike perceived psychological intervention as a

positive adjunct to their recovery regimen. Moreover, findings from this study indicated that those components of the psychological intervention that enabled subjects to perceive themselves as active agents of recovery contributed most significantly to better physiological and psychological outcomes. As well, participant responses identified components of intervention that were most effective for their recovery, thus providing suggestions for subsequent inquiries into component-relative contributions to positive somatic outcomes.

While it is difficult to evaluate the theoretical soundness of this cognitive-behavioral research with regard to other interventions, perhaps another strength of this study is a refrain from attempting to oversimplify the complex issues involved in the interface of treatment methods and outcomes. At present, the paucity of psychological injury rehabilitative empirical studies makes the task of assessing this study's theoretical soundness more difficult: Based on a general cognitive-behavioral appraisal model, more specifically a post-injury model of intervention, this study was designed to address the internal experience of injury, that is, behavioral, cognitive, and affective components of injury, through application of (a) a prospective approach, (b) standardization of delivery protocols, (c) use of a placebo group, and (d) use of a combination of psychological and physiological quantifiable outcome variables.

Both a strength and weakness is the study sample size. Although a larger number of subjects for this study would have been preferable for statistical significance testing purposes, a total of 11 subjects (one pilot study subject included) received the

intervention. Since each subject received 10 sessions each over a 24-week period of time, the smaller sample certainly proved practical logistically for a time-limited research study.

Implications of Research Findings

The most obvious importance of this research is that physiological and psychological outcomes were improved for a group of ACL reconstruction patients as a result of a program of psychological intervention. A structured program of relaxation and guided imagery enhanced somatic outcome for members of the treatment group. Mental practice (imagery) of physical rehabilitation goals by members of the intervention group facilitated statistically significant strength and extension acquisition, as well as reduction of reinjury, state, and trait anxiety. These outcomes proffer important implications for future research into the mind/body connection.

Four intervention-specific implications merit discussion. First, although the ability to predict recovery outcomes from initial postsurgery data (2 weeks postsurgery) would be helpful to patients and medical personnel alike, findings from this study suggest that this is not necessarily practical. The 2-week extension measure that correlates so strongly with strength recovery at 24 weeks appears to be unstable due to initial individual reactions to surgical trauma, as well as time of day, level of pain, or reluctance on the part of physical therapists to force extension so soon out of surgery. Subjects displayed considerable variability for range-of-motion measures, sometimes with group-by-time interactions.

Second, outcome data, as well as subject self-report, confirmed the importance of imagery content concentration on *structural* elements of recovery, and therefore "skill acquisition," particularly with respect to a concurrent emphasis on extension and strength acquisition. In this same vein, imagery content that addressed *process* elements of recovery (e.g., reduction of edema) was particularly important to subjects in dealing with emotions and physical limitations of the surgery.

Third, results also statistically confirmed the importance of addressing reinjury anxiety in the psychological intervention in order to effect better physiological outcomes such as strength recovery. This importance was reflected in a variety of statistical significance testing procedures, including computation of correlation coefficients and follow-up measures, for example, reinjury anxiety reduction scores at 18 months postsurgery, for intervention group members.

Fourth, study findings confirmed the efficacy of imagery content concentration on certain other affective components of injury. Content designed to reduce state anxiety, increase motivation, build confidence, increase positive self-talk, and facilitate empowerment had a strong positive effect for intervention subjects.

Outcome data from this study suggest that a psychological program that speeds recovery and reduces anxiety can be designed for a homogenous sample of injured subjects as an adjunct to an extant program of physical therapy. While empirical psychological injury intervention research is not easily accomplished in a medical setting, the fact that this research was possible to design and carry out may be an

indication of a nascent harmonious context in which medical and psychological orientations can work together to benefit surgical patients. The expectation that other protocols and standardized interventions can be designed to meet the needs of other injury patients is certainly realistic, given these results. A brief therapy modality (30 minutes every 2 weeks), which included cognitive and behavioral practice with tapes and physical therapy, proved efficacious for the purposes of this research.

In this particular study, a cognitive-behavioral appraisal model appeared to be an appropriately useful adumbration to (a) direct implementation of the intervention, (b) account for individual differences in coping with injury, and (c) interpret outcome data. Results of this study offer findings that will hopefully furnish the sport-medicine community with workable assumptions concerning injury recovery. These assumptions are more grounded than most previous studies in some of the multivariate influences involving interaction of mind and body, reflecting the behavioral, cognitive, and affective components of injury.

Findings from this research have reinforced previous findings that personal perceptions of active participation or control are a critical component of injury rehabilitation. Affective and somatic reactions to injury are generally global and varied. These unique perceptions and behaviors result in different outcomes, as borne out by this study's results. This seems particularly pertinent given that attention-control (placebo) group members did not ostensibly appear to benefit from attention and support. Since preliminary analyses revealed that this group did not differ with respect to

preintervention demographic, physiological, or psychological variables, one conclusion is that personal perceptions for these individuals were different from the other two group members' perceptions. Whether these were influenced by the fact that other individuals in their cohort were receiving a different level of intervention and perhaps improving faster, or the presence of other unaccounted for variables, this group saw themselves as less physically and mentally in control of their recovery. This study, therefore, confirms that cognitive processes contribute significantly to reactions to injury. To ignore the role of mental factors in physical recovery is to offer incomplete injury treatment.

While outcome data from this study do not establish a direct linkage between relaxation/guided imagery and healing, positive outcomes for subjects in this study lay an essential groundwork for further investigation of this potential. Relaxation and guided imagery effect somatic change, whether on a structural, process, and/or cellular level. Subjects in the intervention group often reported (unsolicited) that they experienced some of these changes while in session, while others expressed noticing a more gradual change over a week or two week's time. For example, all subjects in the intervention group described bodily sensations of increased warmth, energy, and/or pain reduction while in session. Sixty percent of these same subjects reported feeling "tingling needles" in the surgical knee, with visible accompanying knee jerk, when performing an imagery exercise designed to restore sensation and improve coordination in the newly reconstructed knee. When encouraged to employ visual and kinesthetic imagery in an exercise designed to relieve inflammation and soreness, 80% of the

intervention subjects offered not only feeling a cooling sensation in the joint, but also a lightness of the leg that was more similar to the uninjured leg. According to subject self-report, all of these benefits remained with the subjects upon leaving the sessions.

Finally, findings from this research have also reinforced, albeit indirectly, the notion that mental practice improves physical skill acquisition. In this case, skills learned and practiced related to both simple (e.g., contract quadriceps) and complex (e.g., normal ambulatory gait) motor tasks as outlined in the patients' physical therapy programs. The combination of mental and physical practice of these skills through (a) sessions of imagery, (b) physical therapy, and (c) daily listening to audio imagery tapes produced positive effects for members of the intervention group that exceeded outcomes for either attention-control (placebo) or control group members.

Recommendations

This study offers important recommendations for further treatment and research in the area of psychological rehabilitative injury intervention. Key aspects of these recommendations are concerned with research design, levels of treatment, generalizability, assessment, intervention formats, intervention content, and theoretical orientations.

With respect to research design, future studies should attempt to replicate these results with larger sample sizes and, if possible, include more males in the intervention. In this study, random assignment to groups resulted in slightly more females in the intervention group; it would have been preferable to have an equal number of males and

females. Again, however, neither previous research nor theoretical foundations suggest gender as a confounding for this population.

Since medical samples often make it difficult to match subjects for independent variables, it is important to initially limit replication to homogenous samples. Varying levels of treatment, as in this study with an attention-control (placebo) group, as well as controlling for other potentially confounding psychosocial variables such as socioeconomic or marital status, will help to more accurately assess effects of treatment. Varying levels of treatment also will help delineate the most efficacious treatment to meet individual injury recovery needs. Moreover, generalizability may be enhanced by clearly delineating those aspects of the imagery intervention that are "generic" to injury (e.g., relaxation or pain reduction) versus those that need to specifically address anatomical elements specific to the injury or illness (e.g., mechanics of the knee).

Future intervention studies would do well to repeat assessment measures more often during a protracted period of recovery. Not only could the intervention group subjects in this study have completed a third STAI during the 24 weeks, but as well, it was essential that attention-control (placebo) and control subjects provide comparative post-intervention data for STAI measures. This raises the important issue of treatment compliance. Most participants are willing to fill out a limited number of forms and attend a reasonable number of therapy sessions, regardless of reinforcement measures such as personal interaction and monetary reimbursement.

As previously mentioned, assessment measures should be consistent with those variables that the study is designed to measure. For example, the Minnesota Multiphasic Personality Inventory and Profile of Mood States inventories were not considered pertinent for this study, as the focus was strength and range of motion acquisition, as well as reduction of reinjury anxiety. Thoughtful interpretation of the data, however, suggests that it may be important to assess certain psychosocial and/or mood variables in order to further clarify treatment effects. For example, although a somewhat problematic influence to tease out, social support appeared to be one of these unaccounted for psychosocial variables. Although the clinician/researcher provided a certain type of support and attention to the attention-control (placebo) group, findings for subjects in this study did not indicate positive results superior to the imagery intervention. However, a statistically significant correlation emerged for this sample between attention/support by their surgeon and strength acquisition. Not only is it important to identify the presence of certain psychosocial variables, it is also apparently imperative to pinpoint the *perceived* appropriate source and characteristics of these variables.

As a result of research with this sample, three pragmatic intervention-specific suggestions are offered for future psychological intervention research. First, vary levels of monetary reimbursement according to level of participation. Even though control group members may only fill out forms as their participation, a small remuneration will most likely increase motivation to return necessary documentation. Second, limit the sample to individuals rehabilitating in a relatively close proximity to the surgical and

physical therapy center(s). This will increase the likelihood that these subjects can be successfully contacted, as well as minimize extraneous influences inherent in differing therapy contexts, regardless of level of research participation.

Third, provide psychological intervention in the same facility that patients attend for physical therapy. Separate trips to the psychological clinic create logistical problems for both participants and the researcher/clinician that may reflect in outcomes (although this did not necessarily appear to be the case in this study).

In terms of recommendations for intervention development and implementation, future psychological injury interventions should consider designing and managing treatment from an established protocol basis. Programs of intervention that parallel medical protocols, and thus operate as adjuncts to established rehabilitative programs, will promote acceptance and effectiveness. When interventions are orchestrated as an integral piece of the recovery puzzle with sport medicine providers, a credible, professional relationship is promoted. In particular, subsequent interventions should further explore the efficacy of mental training skills for physical recovery. Standardized imagery contents, alone or in tandem with biofeedback techniques, can be employed to test hypotheses and identify curative factors.

Applied psychological research must increase efforts to establish sound theoretical foundations in order to expand the knowledge base concerning curative factors. Toward this end, research should continue to investigate the interdependence of substantive theoretical foundations with accompanying methods/techniques to answer

questions of treatment efficacy. One approach is to utilize theoretical orientations that maximize attention paid to individual differences in coping--a monitoring of the internal experience. We should ask, "What is the personal meaning of injury?" Models that concurrently address loss, interpersonal conflict, developmental dysynchrony, and somatic responses are particularly pertinent. By definition, these include the ability to deal with the *behavioral, cognitive,* and *affective* components of injury.

Although this intervention appears to have been effective in facilitating physiological and psychological recovery from a debilitating injury, the purpose of this exploratory, developmental study did not include identification of specific mechanisms responsible for this change. Current epistemologies have spawned a large body of research, which demonstrates that imagery clearly improves skill acquisition, but the causal path from imagery to physiological healing is still clouded. Although empirical research findings continue to confirm a strong relationship among workings of the autonomic nervous system, mental imagery, and healing, as researchers and clinicians we must be prudent in assuming causal relations. The specific mechanisms responsible for structural, process, and/or cellular somatic change have yet to be identified. Findings from this exploratory, developmental study offer an empirical foundation for inquiries into these mechanisms. Although we are only beginning to understand how to investigate this potential, future research should endeavor to identify those agents and processes that facilitate somatic change.

REFERENCES

Achterberg, J. (1989). Mind and medicine: The role of imagery in healing. The Journal of the American Society for Psychical Research, 83(2), 93-100.

Achterberg, J. (1991, May). Enhancing the immune function through imagery. Paper presented at the Fourth World Conference on Imagery, Minneapolis, MN.

Achterberg, J., Kenner, C., & Casey, D. (1989). Behavioral strategies for the reduction of pain and anxiety associated with orthopedic trauma. Biofeedback and Self Regulation, 14(2), 101-114.

Achterberg, J., Matthews-Simonton, S., & Simonton, O. C. (1977). Psychology of the exceptional cancer patient: A description of patients who outlive predicted life expectancies. Psychotherapy: Theory, Research, and Practice, 14, 416-422.

Allen, R. J. (1983). Human stress: Its nature and control. Minneapolis, MN: Burgess International.

Anderson, M. B., & Williams, J. M. (1988). A model of stress and athletic injury: Prediction and prevention. Journal of Sport and Exercise Psychology, 10, 294-306.

Andersen, M. B., & Williams, J. M. (1993). Psychological risk factors and injury prevention. In J. Heil (Ed.), Psychology of sport injury (pp. 49-58). Champaign, IL: Human Kinetics.

Astle, S. J. (1986). The experience of loss in athletes. Journal of Sports Medicine and Physical Fitness, 26, 279-284.

AuBuchon, B. (1991, May). The effects of positive mental imagery on hope, coping, anxiety, dyspnea and pulmonary function in persons with chronic obstructive pulmonary disease: Tests of a nursing intervention and a theoretical model. Paper presented at the Fourth World Conference on Imagery, Minneapolis, MN.

Barabasz, A. F., & McGeorge, C. M. (1978). Biofeedback, mediated biofeedback and hypnosis in peripheral vasodilation training. American Journal of Clinical Hypnosis, 21, 28-37.

Barber, T. X. (1985). Changing "unchangeable" bodily processes by hypnotic suggestions: A new look at hypnosis, cognitions, imagining, and the mind-body problem. In A. Shiekh (Ed.), Imagination and healing imagery and human development series (pp. 69-128). New York: Baywood.

Barber, T. X., Chauncey, H. M., & Winer, R. A. (1964). The effect of hypnotic and nonhypnotic suggestions on parotid gland response to gustatory stimuli. Psychosomatic Medicine, 26, 374-380.

Basmajian, J. V. (1989). Biofeedback principles and practice for clinicians. Baltimore, MD: Williams & Wilkins.

Bernstein, D. A., & Borkovec, T. D. (1973). Progressive relaxation training: A manual for the helping professions. Champaign, IL: Research Press.

Blankman, S. M. (1980). Guided fantasy as a psychotherapeutic intervention: An experimental study. In J. Shorr, G. Sobel, P. Robin, & J. Connella (Eds.), Imagery its many dimensions and applications (pp. 267-280). New York: Plenum.

Bond, J. W., Miller, B. P., & Chrisfield, P. M. (1988). Psychological prediction of injury in elite swimmers. International Journal of Sports Medicine, 9, 345-348.

Bonesteel, K., Marsden, K., Ogles, B., & Holdridge, P. (1996). Running addiction as a predictor of injury. Medicine and Science in Sports & Exercise, 28(5), S806.

Booth, W. (1987). Arthritis Institute tackles sports. Science, 237, 846-847.

Bresler, D. (1984). Mind-controlled analgesia: The inner way to pain control. In A. Sheikh (Ed.), Imagination and healing imagery and human development series (pp. 211-230). New York: Baywood.

Brewer, B. W. (1994). Review and critique of models of psychological adjustment to athletic injury. Journal of Applied Sport Psychology, 6, 87-100.

Brewer, B. W., Jeffers, K. E., Petitpas, A. J., & Van Raalte, J. L. (1994). Perceptions of psychological interventions in the context of sport injury rehabilitation. The Sport Psychologist, 8, 176-188.

Brewer, B. W., Linder, D. E., & Phelps, C. M. (1995). Situational correlates of emotional adjustment to athletic injury. Clinical Journal of Sport Medicine, 5, 241-245.

Brewer, B. W., Van Raalte, J. L., & Linder, D. E. (1991). Role of the sport psychologist in treating injured athletes: A survey of sports medicine providers. Journal of Applied Sport Psychology, 3, 183-190.

Brewer, B. W., & Petrie, T. (1995, Spring). A comparison between injured and uninjured football players on selected psychosocial variables. The Academic Athletic Journal, 11-18.

Bull, S. J. (1991). Personal and situational influences on adherence to mental skills training. Journal of Sport & Exercise Psychology, 13, 121-132.

Bump, L. A. (1989). American coaching effectiveness program, level II: Sport psychology study guide. Champaign, IL: Human Kinetics.

Byerly, P., Worrel, T., Gahimer, J., & Dombolt, E. (1994). Rehabilitation compliance in an athletic training environment. Journal of Athletic Training, 29(4), 352-355.

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Chicago: Rand McNally.

Cannon, W. B. (1932). The wisdom of the body. New York: Norton.

Carroll, S. A. (1993). Mental imagery as an aid to healing the injured athlete. Unpublished master's thesis, San Diego State University, San Diego, CA.

Chan, C., & Grossman, H. (1988). Psychological effects of running loss on consistent runners. Perceptual and Motor Skills, 66, 875-883.

Chaplin, W. F. (1984). State-Trait Anxiety Inventory. In D. J. Keyeser & R. C. Sweetland (Eds.), Test critiques (Vol. I, pp. 626-632). Kansas City, MO: Test Corporation of America.

Coddington, R., & Troxell, J. (1980). The effect of emotional factors on football injury rates: A pilot study. Journal of Human Stress, 6(4), 3-5.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Corbin, C. (1972). Mental practice. In W. Morgan (Ed.) Ergogenic aids and muscular performance (pp. 93-118). New York: Academic Press.

Cousins, N. (1989). Belief becomes biology. Advances, 6(3), 20-29.

Crossman, J. (1986). Psychological and sociological factors supporting athletic injury. Coaching Review, 54-58.

Cybex Corporation. (1993). Cybex extremity systems. New York: Author.

Daly, J., Brewer, B., Van Raalte, J., Petitpas, A., & Sklar, J. (1995). Cognitive appraisal, emotional adjustment, and adherence to rehabilitation following knee surgery. Journal of Sport Rehabilitation, 4, 23-30.

Danish, S. (1986). Psychological aspects in the care and treatment of athletic injuries. In P. E. Vinger & E. F. Hoerner (Eds.), Sports injuries: The unthwarted epidemic (2nd ed., pp. 345-353). Littleton, MA: PSG.

Davis, J. (1991). Sports injuries and stress management: An opportunity for research. The Sport Psychologist, 5, 175-182.

DeBacher, G. (1989). Feedback goniometers for rehabilitation. In J. Basmajian (Ed.), Biofeedback principles and practice for clinicians (3rd ed., pp. 359-367). Baltimore, MD: Williams & Wilkins.

De Francesco, C., Miller, M., Larson, M., & Robinson, K. (1994, October). Athletic injury, rehabilitation and psychological strategies: What do the athletes think? Paper presented at the 9th Annual Conference of the Association for the Advancement of Applied Sport Psychology, Incline Village, NV.

Draper, V. (1990). Electromyographic biofeedback and recovery of quadriceps femoris muscle function following anterior cruciate ligament reconstruction. Physical Therapy, 70, 11-17.

Draper, V., & Ballard, L. (1991). Electrical stimulation versus electromyographic biofeedback in the recovery of quadriceps femoris muscle function following anterior cruciate ligament surgery. Physical Therapy, 71, 455-464.

Draper, V., & Ladd, C. (1993). Subjective evaluation of function following moderately accelerated rehabilitation of anterior cruciate ligament reconstructed knees. Journal of Athletic Training, 28(1), 38-41.

Duda, J. L., Smart, A. E., & Tappe, M. K. (1989). Predictors of adherence in the rehabilitation of athletic injuries: An application of personal investment theory. Journal of Sport & Exercise Psychology, 11, 367-381.

Durso-Cupal, D. D. (1996, May). Can mental practice enhance recovery for ACL patients? Summary report. Logan, UT: Western Surgery and Mountain West Physical Therapy Center,

Ermler, K. L., & Thomas, C. E. (1990). Interventions for the alienating effect of injury. Athletic Training, 25, 269-271.

Evans, L., & Hardy, L. (1995). Sport injury and grief responses: A review. Journal of Sport and Exercise Psychology, 17(3), 226-245.

Faris, G. J. (1985). Psychologic aspects of athletic rehabilitation. Clinics in Sports Medicine, 4(3), 545-551.

Feltz, D. L., & Landers, D. M. (1983). The effects of mental practice on motor skill learning and performance: A meta-analysis. Journal of Sport Psychology, 5, 25-27.

Fields, J., Murphey, M., Horodyski, M., & Stopka, C. (1995). Factors associated with adherence to sport injury rehabilitation in college-age recreational athletes. Journal of Sport Rehabilitation, 4(3), 172-180.

Fisher, A., Domm, M., & Wuest, D. (1988). Adherence to sports-injury rehabilitation programs. The Physician and Sportsmedicine, 16, 47-52.

Fisher, A., Mullens, S., & Frye, P. (1993). Athletic trainers' attitudes and judgment of injured athletes' rehabilitation adherence. Journal of Athletic Training, 28, 43-47.

Fiore, N.A. (1988). The inner healer: Imagery for coping with cancer and its therapy. Journal of Mental Imagery, 12(2), 79-82.

Gagne, E. D., Yekovich, C. W., & Yekovich, F. R. (1993). The cognitive psychology of school learning. New York: Harper Collins.

Gardner, H. (1985). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Gaston, L., Crombez, J., & Dupuis, G. (1989). An imagery and meditation technique in the treatment of psoriasis: A case study using an A-B-A design. Journal of Mental Imagery, 13(1), 31-38.

George, J. M. (1980). The effects of psychological factors and physical trauma on recovery from oral surgery. Journal of Behavioral Medicine, 3, 291-310.

Goble, E. M. (1988). Fluoroarthroscopic allograft anterior cruciate reconstruction. Techniques in Orthopaedics, 2(3), 65-73.

Gorman, J. M., & Kertzner, R. (1990). Psychoneuroimmunology and HIV infection. Journal of Neuropsychiatry and Clinical Neurosciences, 2, 241-252.

Gordon, S. (1986, April). Sport psychology and the injured athlete: A cognitive-behavioral approach to injury response and injury rehabilitation. Science Periodical on Research and Technology in Sport, 11, 1-10.

Gould, D., Udry, E., Bridges, D., & Beck, L. (in press). Rehabilitating from season-ending injuries: Stress sources and roadblocks. The Sport Psychologist.

Grantini, V., Hogan, J., & Miller, L. (1993). Sport psychology and injury rehabilitation: A description of the performance enhancement group for injured athletes. In G. Tenenbaum & T. Raz-Liebermann (Eds.), 2nd Maccabiah-Wingate International Congress on Sport and Coaching Sciences: Proceedings (pp. 151-154). Bethshem, Israel: Wingate Institute.

Green, E. E., & Green, A. M. (1977). Beyond biofeedback. New York: Delacorte Press/Seymour Lawrence.

Green, E., E., Green, A. M., & Walters, E. D. (1970). Voluntary control of internal states: psychological and physiological. Journal of Transpersonal Psychology, 2, 1-26.

Green, L. B. (1993). The use of imagery in the rehabilitation of injured athletes. In D. Pargman (Ed.), Psychological bases of sport injuries (pp. 199-218). Morgantown, WV: Fitness Information Technology.

Green, L. B. (1992). The use of imagery in the rehabilitation of injured athletes. The Sport Psychologist, 6(4), 416-428.

Green, P.H. (1972). Problems of organization of motor systems. In R. Rosen & F. M. Snell (Eds.), Progress in theoretical biology (Vol. 2, pp. 304-333). New York: Academic.

Hall, H. R. (1983). Hypnosis and the immune system: A review with implications for cancer and the psychology of healing. American Journal of Clinical Hypnosis, 25(3), 92-103.

Hall, H. R., Lingo, S., & Dixon, R. H. (1982). Hypnosis and the immune system: The effect of hypnosis on T and B cell function. American Journal of Clinical Hypnosis, 25(3), 92-103.

Hall, H. R., Rogers, W. M., & Barr, K. A. (1990). Imagery use among athletes. The Sport Psychologist, 4, 1-10.

Hanley, G. L., & Chinn, D. (1989). Stress management. An integration of multidimensional arousal and imagery theories with case study. Journal of Mental Imagery, 13(2), 107-118.

Hardy, L. (1992). Psychological stress, performance, and injury in sport. British Medical Bulletin, 48(2), 615-629.

Hart, R. R. (1980). The influence of a taped hypnotic induction treatment procedure on the recovery of surgery patients. The International Journal of Clinical and Experimental Hypnosis, 28, 324-332.

Hecker, J. E., & Kaczor, L. M. (1988). Application of imagery theory to sport psychology: Some preliminary findings. Journal of Sport & Exercise Psychology, 10, 363-373.

Heil, J. (1993). Sport psychology, the athlete at risk, and the sports medicine team. In H. Heil (Ed.), Psychology of sport injury (pp. 1-13). Champaign, IL: Human Kinetics.

Henderson, J., & Carroll, W. (1993). The athletic trainer's role in preventing sport injury and rehabilitating injured athletes: A psychological perspective. In D.

Pargman (Ed.), Psychological bases of sport injuries (pp. 15-31). Champaign, IL: Human Kinetics.

Holden-Lund, C. (1988). Effects of relaxation with guided imagery on surgical stress and wound healing. Research in Nursing & Health, 11, 235-244.

Ievleva, L., & Orlick, T. (1991). Mental links to enhanced healing: An exploratory study. The Sport Psychologist, 5(1),25-40.

Ievleva, L., & Orlick, T. (1993). Mental links to enhanced healing: An exploratory study. In D. Pargman (Ed.), Psychological bases of sport injuries (pp. 219-235). Morgantown, WV: Fitness Information Technology.

Jacobson, E. (1938). Progressive relaxation. Chicago: University of Chicago Press.

Jaffe, D. T., & Bresler, D. E. (1980). Healing through the mind's eye. In J. Shorr, G. Sobel, P. Robin, & J. Connella (Eds.), Imagery its many dimensions and applications (pp.253-266). New York: Plenum.

Jaffe, D. T., & Bresler, D. E. (1984). Guided imagery. In J. S. Gordon, D. T. Jaffe, & D. E. Bresler (Eds.), Mind, body and health: Toward an integral medicine (pp. 56-69). New York: Human Sciences Press.

Kerr, G., & Goss, J. (1996). The effects of a stress management program on injuries and stress levels. Journal of Applied Sport Psychology, 8, 109-117.

Kerr, G., & Minden, H. (1988). Psychological factors related to the occurrence of athletic injuries. Journal of Sport and Exercise Psychology, 10, 167-173.

Kleiber, D., & Brock, S. (1992). The effect of career-ending injuries on the subsequent well-being of elite college athletes. Sociology of Sport Journal, 9, 70-75.

Korn, E. R. (1983). The use of altered states of consciousness and imagery in physical and pain rehabilitation. Journal of Mental Imagery, 7(1), 25-34.

Korn, E. R., & Johnson, K. (1983). Visualization: The uses of imagery in the health professions. Homewood, IL: Dow Jones-Irwin.

Krebs, D. E. (1981). Clinical EMG feedback following meniscectomy: A multiple regression experimental analysis. Physical Therapy, 61, 1017-1021.

Lang, P. J. (1979). A bioinformational theory of emotional imagery. Psychophysiology, 16(6), 495-511.

Larson, G., Starkey, C., & Zaichkowsky, L. (1996). Psychological aspects of athletic injuries as perceived by athletic trainers. The Sport Psychologist, 10, 37-47.

Latuda, L. M., & Richardson, P. A. (1995). The use of psychological skills in enhancing the rehabilitation of injured athletes. Journal of Sport & Exercise Psychology, 17, S70.

Lazarus, R. S., & Folkman, S. (1984). Stress, appraisal, and coping. New York: Springer.

Leddy, M. H., Lambert, M. J., & Ogles, B. M. (1994). Psychological consequences of athletic injury among high-level competitors. Research Quarterly for Exercise and Sport, 65(4), 347-354.

Leith, L., & Taylor, A. (1992). Behavior modification and exercise adherence: A literature review. Journal of Sport Behavior, 15(1), 60-74.

Leuba, C. (1940). Images as conditioned sensation. Journal of Experimental Psychology, 26, 345-351.

Leuner, H. (1969). Guided affective imagery: A method of intensive psychotherapy. American Journal of Psychotherapy, 23, 4-22.

Levitt, R., Deisinger, J. A., Wall, J. R., Ford, L., & Cassisi, J. E. (1995). EMG feedback-assisted postoperative rehabilitation of minor arthroscopic knee surgeries. Journal of Sport Medicine and Physical Fitness, 35, 218-223.

Lichstein, K. (1988). Clinical relaxation strategies. New York: Wiley.

Locke, J. (1982). Stress, adaptation, and immunity: Studies in humans. General Hospital Psychiatry, 4, 49-58.

Loundagin, C., & Fisher, L. (1993, October). The relationship between mental skills and enhance injury rehabilitation. Paper presented at the annual meeting of the Association for the Advancement of Applied Sport Psychology, Montreal, Quebec, Canada.

Lynch, G. (1988). Athletic injuries and the practicing sport psychologists: Practical guidelines for assisting athletes. Sport Psychology, 2(2), 161-167.

Magill, R. A. (1989). Motor learning concepts and applications. Dubuque, IA: William C. Brown.

Mainwaring, L. M. (1993). The psychological response of athletes to sport-related knee injury rehabilitation (sport injuries). Unpublished doctoral dissertation, York University, North York, Ontario, Canada.

Martens, R. (1989). Coaches guide to sport psychology. Champaign, IL: Human Kinetics.

Mason, R. C., Clark, G., & Reeves, R. B. (1969). Acceptance and healing. Journal of Religion and Health, 8, 123-142.

Masters, K., & Lambert, M. (1989). The relations between cognitive coping strategies, reasons for running, injury and performance of marathon runners. Journal of Sport and Exercise Psychology, 11(2), 161-170.

May, J. R., & Brown, L. (1989). Delivery of psychological services to the U.S. alpine ski team prior to and during the Olympics in Calgary. The Sport Psychologist, 3, 320-329.

May, J., & Johnson, H. (1973). Physiological activity to internally elicited arousal and inhibitory thoughts. Journal of Abnormal Psychology, 82, 239-245.

McDonald, S. A., & Hardy, C. J. (1990). Affective response patterns of the injured athlete: An exploratory analysis. The Sport Psychologist, 4(3), 261-274.

McKnight, K.' (1994). Psychological responses to athletic injury: An inquiry into self-discrepancy theory. Unpublished master's thesis, University of Arizona, Tucson.

McMahon, C. E., & Sheikh, A. (1984). Imagination in disease and healing processes: A historical perspective. In A. A. Sheikh (Ed.), Imagination and healing imagery and human development series (pp. 1-36). Farmingdale, NY: Baywood.

Meichenbaum, D. (1977). Why does using imagery in psychotherapy lead to change? In J. Singer & K. Pope (Eds.), The power of human imagination (pp. 36-39). New York: Plenum.

Meeuwisse, W. H., & Fowler, P. J. (1990). Frequency and predictability of sports injuries in intercollegiate athletes. Canadian Journal of Sport Sciences, 13, 35-42.

Mohtadi, N.G., Webster-Bogaert, S., & Fowler, P. J. (1989, November). Limitation of motion following ACL reconstruction. Paper presented at the Annual Meeting of the American Organization of Surgical Medicine, Traverse City, NV.

Mortellano, P. (1994). Locus of control, attribution and self-efficacy in the adherence to sports injury treatment. Unpublished master's thesis, University of South Alabama, Montgomery.

Mountain West Physical Therapy Center. (1994). ACL reconstruction protocols. Logan, UT: Author.

Murphy, S. M. (1995). Sport psychology interventions. Champaign, IL: Human Kinetics.

Murphy, S. M., & Jowdy, D. P. (1992). Imagery and mental practice. In T. Horn (Ed.), Advances in sport psychology (pp. 221-250). Champaign, IL: Human Kinetics.

Nicol, M. (1993). Hypnosis in the treatment of repetitive strain injury. Australian Journal of Clinical and Experimental Hypnosis, 21, 121-126.

Nideffer, R. M. (1983). The injured athlete: Psychological factors in treatment. Orthopaedic Clinics of North America, 14(2), 373-385.

Norris, P. A. (1989). Clinical psychoneuroimmunology: Strategies for self-regulation of immune system responding. In J. Basmajian (Ed.), Biofeedback principles and practice for clinicians (pp.57-66). Baltimore, MD: Williams & Wilkins.

Ogilvie, B. C., & Tutko, T. A. (1966). Problem athletes and how to handle them. London: Pelham Books.

Orlick, T. (1986a). Psyching for sport: Mental training for athletes. Champaign, IL: Leisure Press.

Orlick, T. (1986b). Coaches training manual to psyching for sport. Champaign, IL: Leisure Press.

Orlick, T. (1990). In pursuit of excellence: How to win in sport and life through mental training. Champaign, IL: Leisure Press.

Pargman, D. (1993). Sport injuries: An overview of psychological perspectives. In D. Pargman (Ed.), Psychological bases of sport injuries (pp. 5-14). Morgantown, WV: Fitness Information Technology.

Pargman, D., & Lunt, S. (1989). The relationship of self-concept and locus of control to the severity of injury in freshman collegiate football players. Sports Training, Medicine and Rehabilitation, 1(3), 203-208.

Pen, L., Fisher, A., Sforzo, G., & McManis, B. (1995). Cognitive strategies and pain tolerance in subjects with muscle soreness. Journal of Sport Rehabilitation, 4(3), 181-194.

Penfield, W., & Perot, P. (1963). The brain's record of auditory and visual experience. Brain, 86, 595-696.

Pero, S., & Sachs, M. (1995, September). Development, implementation and evaluation of an educational program in sport psychology for athletic trainers. Paper presented at the 10th Annual Conference of the Association for the Advancement of Applied Sport Psychology, New Orleans, LA.

Petitpas, A. J., & Danish, S. J. (1995). Caring for injured athletes. In S. M. Murphy (Ed.), Sport psychology interventions (pp. 255-281). Champaign, IL: Human Kinetics.

Pibram, K. (1971). Languages of the brain. Englewood Cliffs, NJ: Prentice-Hall.

Pickett, E. (1991). Programme development imagery psychotherapy in head trauma rehabilitation. Brain Injury, 5(1), 33-41.

Post-White, J. (1991, April). The effects of mental imagery on emotions, immune function and cancer outcome. Paper presented to the Fourth World Conference on Imagery, Minneapolis, MN.

Quackenbush, N., & Crossman, J. (1994). Injured athletes: A study of emotional responses. Journal of Sport Behavior, 17(3), 178-187.

Richardson, A. (1969). Mental imagery. London: Routledge & Kegan.

Richardson, P. A., & Latuda, L. M. (1995). Therapeutic imagery and athletic injuries. Journal of Athletic Training, 30, 10-12.

Richey, G. K. (1992). The impact of psychosocial variables on immune system functioning in a sample of HIV positive males. Unpublished doctoral dissertation, Utah State University, Logan.

Ross, M. J., & Berger, R. S. (1996). Effects of stress inoculation training on athletes' postsurgical pain and rehabilitation after orthopedic injury. Journal of Consulting and Clinical Psychology, 64, 406-410.

Rossman, M. L. (1984). Imagine health! Imagery in medical self-care. In A. Sheikh (Ed.), Imagination and healing (pp. 231-258). Farmingdale, NY: Berkley Books.

Rotella, R. J. (1982). Psychological care of the injured athlete. In D. Kuland (Ed.), The injured athlete (pp.213-224). Philadelphia: Lippincott.

Rotella, R. J. (1985). The psychological care of the injured athlete. In L. Bunker, R. Rotella, & A. Reilly (Eds.), Sport psychology: Psychological considerations in maximizing sport performance (pp. 173-187). Ann Arbor, MI: McNaughton and Gunn.

Rotella, R. J., & Campbell, M. S. (1983). Systematic desensitization: Psychological rehabilitation of injured athletes. Athletic Training, 18, 149-152.

Rotella, R. J., & Heyman, S. R. (1986). Stress, injury and the psychological rehabilitation of athletes. In J. M. Williams (Ed.), Applied sport psychology: Personal growth to peak performance (pp. 343-364). Palo Alto, CA: Mayfield.

Rotella, R. J., & Heyman, S. R. (1993). Stress, injury, and the psychological rehabilitation of athletes. In J. Williams (Ed.), Applied sport psychology: Personal growth to peak performance (2nd ed., pp. 338-355). Mountain View, CA: Mayfield.

Sachs, R. A., & Stone, M. L. (1989). Patellofemoral problems after ACL reconstruction. American Journal of Sports Medicine, 17(6), 760-765.

Sackett, R. S. (1935). The relationship between the amount of symbolic rehearsal and retention of a maze habit. Journal of General Psychology, 13, 113-128.

Schomer, H. H. (1990). A cognitive strategy training programme for marathon runners: Ten case studies. South African Journal for Research in Sport, Physical Education and Recreation, 13, 47-78.

Schwartz, G. E. (1984). Psychophysiology of imagery and healing: A systems perspective. In A. A. Sheikh (Ed.), Imagination and healing (pp. 35-50). Farmingdale, NY: Baywood.

Setterlind, S., & Unestahl, L. (1981). Introducing relaxation in Swedish schools. Orebro, Sweden: Veje.

Setterlind, S., Unestahl, L., & Kaill., B. (1986). Teacher's manual relaxation training for youth and further developments. Karlstad, Sweden: Veje.

Shanahan, A. (1991). Sports injury: Its effect on self esteem and social support. Unpublished master's thesis, Flinders University of South Australia, Flinders.

Sheikh, A. A., & Jordan, C. S. (1983). Clinical uses of mental imagery. In A. A. Sheikh (Ed.), Imagination and healing (pp. 391-435). Farmingdale, NY: Baywood.

Shelbourne, K. D., & Wilckens, J. H. (1990). Current concepts in anterior cruciate ligament rehabilitation. Orthopaedic Review, XIX(11), 957-964.

Shelley, G., & Henschen, K. (1995). Athletic injuries: Individual and group concerns for the high school coach. Applied Research in Coaching and Athletics Annual, 124-140.

Simonton, O. C., Matthews-Simonton, S., & Creighton, J. (1978). Getting well again. New York: St. Martin's.

Singer, J. L. (1974). Imagery and daydream methods in psychotherapy and behavior modification. New York: Academic.

Singer, R., & Johnson, P. (1987). Strategies to cope with pain associated with sport-related injuries. Athletic Training, 22(2), 100-103.

Smith, R. (1979). A cognitive affective approach to stress management for athletics. In C. Nadeau, W. Halliwell, K. Newell, & G. Roberts (Eds.), Psychology of motor behavior and sport (pp. 54-72). Champaign, IL: Human Kinetics.

Smith, A., & Milliner, E. (1994). Injured athletes and the risk of suicide. Journal of Athletic Training, 29(4), 337-341.

Smith, A. M., Scott, S. G., O'Fallon, W. M., & Young, M. L. (1990). Emotional responses of athletes to injury. Mayo Clinic Proceedings, 65, 38-50.

Smith, A., Stuart, J., Wiese-Bjornstal, D., & Milliner, E. (1993). Competitive athletes: Preinjury and postinjury mood state and self-esteem. Mayo Clinic Proceedings, 68, 939-947.

Solomon, G. F. (1969). Stress and antibody response in rats. International Archives of Allergy, 35, 97-104.

Solomon, G. F., & Moos, R. H. (1964). Emotions, immunity, and disease: A speculative theoretical integration. Archives of General Psychiatry, 11, 657-764.

Spanos, N. P., & O'Hara, P.A. (1990). Imaginal dispositions and situation-specific expectations in strategy-induced pain reductions. Imagination, Cognition and Personality, 9(2), 147-156.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). STAI manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.

Sprenger, C. K., Carlson, K., & Wessman, H. C. (1979). Application of EMG biofeedback following medial meniscectomy: A clinical report. Physical Therapy, 59, 167-169.

Steadman, J. R. (1993). A physician's approach to the psychology of injury. In J. Heil (Ed.) Psychology of sport injury (pp. 25-32). Champaign, IL: Human Kinetics.

Sthalekar, H. A. (1993). Hypnosis for relief of chronic phantom pain in a paralysed limb: A case study. The Australian Journal of Clinical Hypnotherapy and Hypnosis, 14, 75-80.

Suinn, R. M. (1983). Imagery and sports. In A. Sheikh (Ed.), Imagery: Current theory research and application (pp. 507-534). New York: Wiley.

Surgent, F. S. (January, 1991). Using your mind to beat injuries. Running & Fit News, 9(1), 4-5.

Tan, S. (1982). Cognitive and cognitive-behavioral methods for pain control: A selective review. Pain, 12, 201-228.

Tobachnick, B. G., & Fidell, L. S. (1989). Using multivariate statistics. New York: Harper & Row.

Turk, D. C., Meichenbaum, D., & Genest, M. (1983). Pain and behavioral medicine: A cognitive behavioral perspective. New York: Guilford.

Udry, E. M. (1995). Examining mood, coping and social support in the context of athletic injuries. Unpublished doctoral dissertation, University of North Carolina, Greensboro.

Unestahl, L. E. (1982). Better sport by I.M.T.--inner mental training. Orebro, Sweden: Veje.

Unestahl, L. E. (1983). The mental aspects of gymnastics. Orebro, Sweden: Veje.

Unestahl, L. E. (1986). Self-hypnosis. In J. Williams (Ed.), Applied sport psychology: Personal growth to peak performance (pp. 285-300). Mountain View, CA: Mayfield.

Vealey, R. S. (1986). Imagery training for performance enhancement. In J. Williams (Ed.), Applied sport psychology personal growth to peak performance (pp. 209-231). Mountain View, CA: Mayfield.

Vealey, R. S. (1987). Imagery training for performance enhancement. Paper presented at the Sports Psychology Institute, Portland, ME.

Watkins, M. M. (1976). Waking dreams. New York: Harper.

Wiese, D. M., & Weiss, M. R. (1987). Psychology rehabilitation and physical injury: Implications for the sportsmedicine team. The Sport Psychologist, 1(4), 318-330.

Wiese, D. M., Weiss, M. R., & Yukelson, D.P. (1991). Sport psychology in the training room: A survey of athletic trainers. The Sport Psychologist, 5, 15-24.

Wiese-Bjornstal, D. M., & Smith, A. M. (1993). Counseling strategies for enhanced recovery of injured athletes within a team approach. In D. Pargman (Ed.), Psychological bases of sport injuries (pp. 149-182). Morgantown, WV: Fitness Information Technology.

Wilder, K. (1994). Clinicians' expectations and their impact on an athlete's compliance in rehabilitation. Journal of Sport Rehabilitation, 3(2), 168-175.

Wilson, T. (1989). Behavior therapy. In D. Corsini & P. Wedding (Eds.), Current psychotherapies (pp. 48-63). Itasca, IL: Peacock.

Wise, H. H., Fiebert, I. M., & Kates, J. L. (1984). EMG biofeedback as treatment for patellofemoral pain syndrome. Journal of Orthopaedic and Sports Physical Therapy, 6, 95-103.

Young, K., McTeer, W., & White, P. (1994). Body talk: Male athletes reflect on sport, injury and pain. Sociology of Sport Journal, 11(2), 175-194.

Yukelson, D. (1988). Sports psychology: Psychological intervention strategies for the injured athlete. Sports Medicine Digest, 10(7), 5.

Yukelson, D., & Murphy, S. (1993). Psychological considerations in injury prevention. In P. Renstroem (Ed.), Sports injuries: Basic principles of prevention and care (pp. 321-333). Boston: Blackwell Scientific Publications.

APPENDIXES

Appendix A

Repeated Measures MANOVA Tables

Table 18

Repeated Measures MANOVA: Extension Improvement from 4 Weeks to 24 Weeks

Source	df	Mean Squares	F ratio	Sig of F	η^2
Between Subjects	29				
Treatment	2	.65	.03	.970	.002
Error(1)	27	21.44			
Within Subjects	30				
Time	1	442.82	72.26	.000	
Time X Treatment	2	2.62	.43	.657	
Error(2)	27	6.13			

Table 19

Repeated Measures MANOVA: Extension Improvement from 4 Weeks to 16 Weeks

Source	df	Mean Squares	F ratio	Sig of F	η^2
Between Subjects	29				
Treatment	2	3.05	.13	.880	.009
Error(1)	27	23.78			
Within Subjects	30				
Time	1	294.82	67.66	.000	
Time X Treatment	2	4.52	1.04	.368	
Error(2)	27	4.36			

Table 20

Repeated Measures MANOVA: Flexion Improvement from 2 Weeks to 24 Weeks

Source	df	Mean Squares	F ratio	Sig of F	η^2
Between Subjects	29				
Treatment	2	175.55	1.04	.367	.071
Error(1)	27	168.94			
Within Subjects	30				
Time	1	23049.60	203.73	.000	
Time X Treatment	2	203.85	1.80	.184	
Error(2)	27	113.14			

Table 21

Repeated Measures MANOVA: Flexion Improvement from 4 Weeks to 24 Weeks

Source	df	Mean Squares	F ratio	Sig of F	η^2
Between Subjects	29				
Treatment	2	133.82	.85	.439	.06
Error(1)	27	157.53			
Within Subjects	30				
Time	1	5606.67	51.14	.000	
Time X Treatment	2	150.62	1.37	.270	
Error(2)	27	109.63			

Table 22

Repeated Measures MANOVA: Flexion Improvement from 4 Weeks to 16 Weeks

Source	df	Mean Squares	F ratio	Sig of F	η^2
Between Subjects	29				
Treatment	2	199.02 1.18	.322	.08	
Error(1)	27	168.28			
Within Subjects	30				
Time	1	4150.02	38.09	.000	
Time X Treatment	2	95.02	.87	.429	
Error(2)	27	108.94			

Appendix B

Sample Informed Consent Letter--Control Group

Deborah D. Durso-Cupal
Department of Psychology
Utah State University
Logan, Utah 84322
(801) 797-3391

SPORTS INJURY STUDY

Dear:

We are conducting a study at Utah State University on recovery from sports injury. The purpose of this study is to gain a better understanding about the psychological aspects of sports-injury rehabilitation. Your participation in this research is on a completely voluntary and confidential basis. All data gathered during your recovery time will be kept strictly confidential and are intended for the purposes of this study and your recovery only.

You need do nothing different from what your physician has prescribed for you during the normal course of physical rehabilitative therapy. For the purposes of data comparison for this research, however, I would like permission to monitor your physical progress during the next six months so that we may gather important recovery data.

If you would like to help further research in recovery from sport injury, please sign your name below to confirm your interest in participating in this study. For the research records, however, your name will be assigned a number to insure confidentiality throughout the duration of the study and after its completion.

Thank you again for your willingness to participate in this study.

_____ _____

Name Date

Appendix C

Sample Informed Consent Letter--Attention-Control [Placebo] Group

Deborah D. Durso-Cupal
Department of Psychology
Utah State University
Logan, Utah 84322
(801) 797-3391

SPORTS INJURY STUDY

Dear:

We are conducting a study at Utah State University on recovery from sports injury. The purpose of this study is to gain a better understanding about the psychological aspects of sports-injury rehabilitation. Your participation in this research is on a completely voluntary and confidential basis. All data gathered during your recovery time will be kept strictly confidential and are intended for the purposes of this study and your recovery only.

You need do nothing different from what your physician has prescribed for you during the normal course of physical rehabilitative therapy other than to ask you to rest quietly for 10 minutes per day following your therapy. For the purposes of data comparison for this research, however, I would like permission to monitor your physical progress during the next six months so that we may gather important recovery data.

If you would like to help further research in recovery from sport injury, please sign your name below to confirm your interest in participating in this study. For the research records, however, your name will be assigned a number to insure confidentiality throughout the duration of the study and after its completion.

Thank you again for your willingness to participate in this study.

_____ _____

Name Date

Appendix D

Sample Informed Consent Letter--Intervention Group

Deborah D. Durso-Cupal
Department of Psychology
Utah State University
Logan, Utah 84322
(801) 797-3391

SPORTS INJURY STUDY

Dear:

We are conducting a study at Utah State University on recovery from sports injury. The purpose of this study is to gain a better understanding into the possible role of guided imagery in sports-injury rehabilitation. Your participation in this research is on a completely voluntary and confidential basis. All data gathered during your recovery time will be kept strictly confidential and are intended for the purposes of this study and your recovery only.

During the normal course of your physical therapy as prescribed by your physician, I would like to provide 10 sessions of imagery as an adjunct to your physical rehabilitation during the next six months. These imagery sessions will be approximately 15 minutes in length, available for your convenience at the Western Surgery Center, and will address issues of your recovery such as relaxation, pain management, improving range of motion and strength, and general issues of coping.

For the purposes of data comparison, I would also like your permission to monitor your physical progress during the next six months so that we may gather important recovery data.

Previous studies have demonstrated beneficial effects of combining a program of guided imagery with physical therapy. Some of these benefits include quicker recovery times with reduced pain experience. If you consent to be a participant in this program, you will be provided with 10 imagery sessions at no cost to you, conducted by an experienced, professional doctoral-candidate psychologist. Your physician has approved this research for his patients, given your willingness to participate. Due to the continuing nature of your physical therapy, we would ask that you commit, as much as possible, to attending all 10 sessions over the course of six months.

Imagery is a mental skill that requires practice and application to be effective. Previous research suggests practicing imagery techniques on a daily basis, in conjunction with regular physical therapy to improve recovery results from injury. Accordingly, if you agree to participate in this study, you will be asked to practice this imagery daily by listening to audio tapes, as well as record your thoughts about your recovery in an ongoing log. All materials will be provided to you.

As far as can be determined, participation in this study presents no ostensible risks to you. Minimal benefits include learning relaxation, pain-management and coping techniques to help you better deal with recovery from your surgery.

Please sign your name below to confirm your interest in participating in this study. For the research records, however, you will be assigned a number to insure confidentiality throughout and subsequent to completion of the study.

Thank you for your willingness to further research in the area of sports injury.

_____ _____

Name Date

Appendix E

Rehabilitation Protocol For ACL Replacement

(As of 12/94)

POST OPERATIVE WEEK #1: TRAUMA, REST, ELEVATE

A. Physical Treatment Goals: REDUCE TRAUMA

1. Re-establish range of motion

2. Decrease joint swelling

3. Establish quad control

4. Ambulate toe-touch gait with crutches

B. Imagery Training Goals:

1. Visualize and feel contraction of quad:
a. with neuromuscular stimulation
b. without neuromuscular stimulation

2. Visualize healing, knee returning to normal size, trauma subsiding

3. Visualize and feel ACL extending and flexing through its range of motion; feel the tightness of the swollen joint as normal and protective, gently forcing the knee to bend and flex against this tightness, while using active assistive ROM with other leg, as well as with wall slides

4. Visualize back of knee cap as well hydrated and lubricated

5. Visualize leg raises and heel raises as stimulating the back of the knee cap to provide this fluid cushion

6. Visualize entire joint as accepting new tissue

7. Visualize restful place, mobilization of all body to heal

C. Benchmarks:

1. ROM: no limitations
2. No measure of strength
3. Use pain medication

POST OPERATIVE WEEKS #2-5: RANGE OF MOTION

A. Physical Treatment Goals: REESTABLISH RANGE OF MOTION

1. Progress to full weight bearing at 4 weeks, with crutches

2. Gradual discontinuation of compression wrap

3. ROM: no limitations

4. Taper down pain medication to after workouts and/or nighttime medication

B. **Imagery Training Goals:**

1. Visualize interior of joint returning to normal, with all surrounding tissue healing and intact

2. Visualize and feel strength returning *(graft is weakest at 5 weeks post-op)*

3. Visualize ACL bending and flexling like large cable, particularly as knee moves against adhesions that are normal to have formed, due to invasiveness of surgery.

4. Visualize gently stretching these scar tissue a little at a time, reinterpreting pain messages as "pressure"; hold the stretch, picture scar tissue releasing and allow knee to move back into extension gently. Repeat as patient sees and feels ACL bending and stretching with resiliency as this pattern is repeated.

5. Visualize entire knee joint moving as a team as patient rides bike

6. Visuaize performing at peak--see self 3 months subsequent, i.e., see self healed, working out, walking.

7. Patient dealing with feelings of discouragement, alternating emotions of helplessness and empowerment.

C. Modalities:

1. Exercise in ROM brace

2. Non-weight bearing resistive exercise: stationery bike, SPORT cord, elimination of ankle pumps (closed-chain activities)

D. Benchmarks:

1. 90 percent of swelling reduced
2. ROM: unlimited

POST OPERATIVE WEEKS # 6-9: WEIGHT BEARING AND ROM

A. Physical Treatment Goals: WEIGHT BEARING, ROM AND STRENGTH

1. Full weight bearing
2. ROM: from 0 to 140 degrees
3. D/C pain medications
4. Leg-lifts with 10 percent body weight
5. Begin to leg press
6. Begin weight-bearing SPORT cord
7. Begin high abduction, adduction, extension, flexion
8. Begin submaximal open-chain isokinetics
(fixed speed, varied resistance)

B. Imagery Goals:

1. Visualize entire joint as intact and solid
2. Visualize ACL flexing and extending its entire range
3. Visualize Quad as getting stronger with every set of lifts, presses,
4. Ride stationery bike 20 minutes per day, while visualizing the circular motion is aligning and strengthening all components of the knee, as well as the ACL "pumping"

C. Modalities:

1. Continue icing after activity
2. Continue in ROM brace until fitting for sport brace

3. D/C neuromuscular stimulator

D. Benchmarks:

1. 10 percent body weight on leg lifts by week 9

2. Occasional discomfort from exercise

3. Full weight bearing

4. Measurement on cybex at week 9: approximately 50-60% of non-operative leg

POST OPERATIVE WEEKS #10-11: TESTING & STRENGTH

A. **Physical Treatment Goals**:

1. Isokinetic testing--patient achieves 55-65 percent strength on non-operative side

2. Begin one-third squats, one-third lunges

3. Proprioceptive training

B. Imagery Training Goals:

1. Visualization of returning to and surpassing previous strength-- emphasis on power, endurance and strength

2. Visualization of all soft tissue healed

3. Visualization of graft healing from outside of surface to inside of core

4. Sensations of knee feeling good, normal, yet sensitive to torque

C. Modalities:

1. Ice
2. Repeat KT-1000 and isokinetic tests at 3 months, six months, nine months and 12 months post-op

D. Benchmarks:

1. Swelling only after workouts

2. 65 percent strength in non-operative leg

POST OPERATIVE WEEKS 12-24: STRENGTH, ENDURANCE, CONFIDENCE

A. Physical Treatment Goals:

1. Protect against patellofemoral pain
2. Attain 85% strength of operative leg
3. Improve proprioception

B. Imagery Training Goals:

1. Establishing confidence in ligament integrity
2. Alleviating anxiety concerning reinjury
3. Strength
4. Proprioception improvement
5. Endurance

C. Modalities:

1. Ice
2. Repeat KT-1000
3. Repeat isokinetic testing

D. Benchmarks:

1. 85 percent strength of operative leg to non-operative leg
2. Range of motion: lacks 2 degrees flexion; lacks 4-5 degrees extension

3. From 7 to 9 months post-operative, may begin straight-ahead jogging on predictable surfaces, no cutting allowed.

4. Maintain leg strengthening program for rest of active life.

Appendix F

Relaxation and Imagery Scripts ©

Deborah D. Durso-Cupal 1997

Session 1

Viewing arthroscopic video and teaching relaxation

(This is the first session with the client. The individual is approximately one week postoperative and will be viewing part of the videotape of his/her surgery which details the working of the anterior cruciate ligament. After this tape has been viewed together, the therapist will engage the individual in a session of relaxation as follows.)

"Find a comfortable place to sit or lie down. Allow now a feeling of peace and relaxation to come into your body and mind. You might just want to close your eyes and allow your hands and arms to rest comfortably at your side. Take a slow, deep breath, hold it, and then let it go. Breathe in through your nose, and then exhale slowly through your mouth. Feel the tension in your neck and shoulders when you inhale and hold the breath. Consciously drop your shoulders, relax your neck muscles and exhale. Spend a few minutes becoming mindful of your breathing. Breathe in oxygen, breathe in peace, breathe in healing. Every time you breathe out, breathe out all conflict, pain tension and difficulty. As you breathe out, picture filling this balloon

with any tension, conflicts or difficulties. When it is full, just let the balloon go, watching it float away on the wind. Watch the balloon now grow smaller and smaller and smaller, until you can no longer see it.

Allow your muscles to become warm and relaxed. Clear your mental screen and prepare yourself for new visions. Take another deep breath and clear your mind as you exhale. Go through your mind, scrubbing out all the folds and corners, clearing it and cleansing it and preparing it for healing. Take another long, deep, slow breath. Your body is now clear and receptive, ready to be filled with new energy.

In this relaxed place, curl up and take a moment to nurture and heal yourself. In this relaxed place, it is safe to let go of any thoughts that worry you, knowing that when you leave, you can pick up where you left off if you decide to do that. For these next few minutes, there is nothing more important than being here and concentrating on yourself. Allow the energy to be here for yourself. Feel it now gently warming your body. Feeling your face relax and soften behind your eyes. Your body is warm, pliable and flexible. All the tension has drained out of your body. It is relaxed, comfortable and totally at peace and in harmony.

I'm going to ask you now to bring your attention back to your breathing. Notice how easily your chest rises and falls with each breath without your even trying. You might also notice how the chair feels beneath your body, the sound of my voice, sounds inside or outside the room. And when you are ready, you may open your eyes, feeling peaceful, rested and energized."

(The client is instructed to listen to a tape of this relaxation at least once a day.)

Session 2

Reviewing relaxation, introduction of imagery

(The client is now approximately four weeks post-operative. This session reviews relaxation and then introduces imagery to aid in pain management, reduction of knee trauma and increase range of motion.)

Repeat relaxation as in Session 1 (breath assisted). Continue with

"In this comfortable place, allow yourself to drop down inside. Take another long, deep breath and release it slowly. You are ready for healing."

"Focus your attention now on your knee. Allow yourself to become fully aware of its shape, its size and its depth--the feel of your knee. Perhaps you will permit yourself to visualize a contraction of your quadriceps muscle. Visualize and feel that contraction strong and hard when you lift your leg with the neuromuscular stimulation in physical therapy. Visualize and feel that contraction strong and hard as you lift your leg without the electrical stimulation. Every time you do your leg lifts in your mind, picture and feel this strong contraction, seeing the muscle grow tight and hard in your mind. Every time you actually do your leg lifts in therapy, picture in your mind your quadriceps contracting at the same time.

Bring your focus now back to your breathing. Feel how relaxed and

restful your body is. Perhaps you might want to allow your body now to just take over its job of healing the entire joint and accepting this new tissue gladly as part of itself. Go ahead and focus on your knee--center your attention there for just a moment. Acknowledge your new ligament as a very special and tightly connected part of your whole body. You might notice once again as you focus on your knee the size of that knee.

Try now to remember what your new ligament looks like inside your knee. When you move your leg slowly out and back, feel the tightness of your swollen joint as normal and protective. It feels larger than your other knee because of the protective fluid in the joint. In your mind, allow yourself now to gently force the knee--to bend and flex against this tightness as you move your leg up and down on the wall, sliding it gently up and down with your other leg. Each time you move your leg gently up and down, see in your mind how your new ligament bends and flexes easily inside your knee. It feels so good to your ligament to stretch back and forth, strong and resilient and healthy.

As you do your leg raises and your wall slides, picture now the back of your knee cap as well hydrated and lubricated. Visualize that with each exercise, you are stimulating the back of the knee cap to provide this fluid cushion.

As you move through your exercises, you feel some discomfort. Think about this discomfort for just a moment. Allow yourself now to concentrate on this discomfort, but perhaps, this time, allowing yourself to interpret this discomfort in a

different way. Your knee is telling you that there is pressure, but it is good to allow the knee to move gently back and forth. Even though there is resistance, you know this temporary swelling is protecting your entire joint.

As you hold a stretch, feel the pain as pressure. Picture now small pieces of scar tissue releasing. The scar tissue is the normal response by your body to your surgery, and as you hold your stretch, see and feel these thin white spindles releasing, letting go, and dissolving. Now they are being carried and flushed away by your body.

Tell yourself every day: My knee is strong, powerful and flexible. It is feeling better and better every day. It is becoming stronger and more flexible and more supple with each passing day."

(Reconnect client to present space)

Session 3

Edema reduction and increasing range of motion

(The client is now four weeks post-operative. More of a focus is placed on reduction of knee trauma (edema) and increasing range of motion, as well as the acceptance by the body of the transplanted ligaments.)

Initiate relaxation (breath and imagery assisted, with the addition of the following:

"Picture above your head a golden egg--as you watch this egg, it breaks open and gently, slowly begins to spill its golden warmth, like a great light, on top of your head. As it begins to move down across your face, you feel its warmth and light. Now it begins to coat your neck, front and back, shoulders, your chest, your arms--(radiate out to extremities) feel its warmth as it moves into your abdomen, spreading slowly like warm honey into your thighs, through your knees, down into your legs, your calves and your feet, and finally, gently into your toes. Feel in every part of your body its golden warmth.

Allow yourself now to see and feel into your knee as you are relaxed and comfortable. Your knee joint is returning to normal, with all the surrounding tissue healing and intact. As you exercise your leg, you are bringing rich, warm blood to the cells that are carrying away any pieces of scar tissue or debris, and giving your new ligament and the surrounding knee joint lots of oxygen and nutrients to heal completely.

Your new ligament is bending and flexing like a large, shiny, strong cable. As you ride the bike and you feel the pressure against your knee cap, remember that this pressure is normal and natural. Try now to see the knee cap moving back and forth, up and down, stimulating the release of fluid that will coat and soothe your joint, and make your knee function perfectly. As you feel the discomfort of this motion, remember that it is a message from your knee to you that has a word written on it--the word is pressure, and as you focus on this pressure, you can see and feel your ligament moving and bending, strong and flexible and healthy. As you exercise your knee back and forth and around each time on the bike, you are bringing the blood cells to the joint that will clean away all debris and will flush out the swelling you feel in your joint. Every time your leg goes in that circular motion, your knee cap is tracking exactly where it should be and your quadriceps are getting stronger, pulling your cap back into its proper place.

Permit yourself to refocus on your breathing. Take another deep breath, and slowly, slowly let it out, releasing any tension you may feel anywhere in your body. Take a moment now to feel this overall relaxation. When you feel particularly relaxed, allow yourself to again picture your quadriceps contracting and your new ligament stretching back and forth. Now attempt to feel what that feels like, without actually doing it. In your mind, see your uninjured leg. In just a moment, I'm going to ask you to shift your concentration, to just listen to whatever wisdom about your body which resides in this uninjured knee. Although this may feel awkward at first, it is important

to allow yourself now to consult with this uninjured knee. Mentally step back for just a moment and watch how it moves, feel how strong it is, moving effortlessly and smoothly through its range of motion.

Now that you have done that, in your mind contract both of your legs' quadriceps at the same time. Do this five times--slowly. After the last contraction, I would like you to simply let your uninjured knee take over, advising your surgical knee, teaching it how to work and bend and stretch and walk. You need do nothing to help this happen except to continue to focus on both knees together and continue with your feelings of relaxation and warmth. Take a few moments to do that now.

Tell yourself every day: my knee is flexible and strong. My whole body is healthy and strong--I am healing quickly. Thank your body now for the healing, vitalizing energy that is there. You can now begin to see and feel yourself performing at your peak--happy, lively, pain free and content."

(Reconnect client to present space)

Session 4

Internal guided imagery for strength in range of motion and confidence

(The client is now approximately six weeks post-operative. This session continues to focus on body acceptance, range of motion and beginning to feel strength in the range of motion. This session is the longest imagery session; specific guided imagery journey inside the knee.)

Relaxation (as before)

"And now you might just permit your muscles to become even more warm and relaxed. Focus your attention on your knee once again. Take another deep breath, and allow yourself to relax even more. As you do, imagine yourself as being able to shrink down to a very small size. You will be able to return to your original size after you are done with your mental journey, but for now, you can feel yourself becoming smaller and smaller, until you could fit into the palm of someone's hand.

Before you is a staircase, leading down in front of you. It has ten stairs numbered from ten to one. You will descend this staircase with no problem from your knee, step by step, counting down. As you do you will gradually grow even smaller, until you can magically enter the world of your knee where you can see it, touch it and experience it. Remember now what the inside of your knee looked like on your videotape, for your journey will be a discovery that looks something like this.

You are standing on the step numbered ten. Begin now to descend. You step down--nine. You notice the step is smaller than the one before. So too is your foot

smaller yet, and the rest of your body. Eight...seven....etc. Near the bottom step you notice a red glow emanating from below. It is warm and inviting and you are drawn to it. Step off and become suspended in the liquids of your body--you can breathe freely and easily.

You are perfectly safe--and anytime you are ready to leave, you can return when you wish, assuming your normal size.

Begin to move down the corridor to the inside of your knee and see this wonderful place. As it opens up, the corridor reveals caverns and folds--see how clean and supple, shiny and strong the muscles are. Before you, you can see the expanse of your knee cap. There is a warm light behind it, casting a red glow all /about, softly illuminating everything near your knee. As you move closer, you can begin to see a giant, sweeping smoothness which is your quadriceps. Take a moment and admire how large and strong it has become with your exercising.

You are near the edge of a cavern where the light is brighter here, showing you more detail in your surroundings. You pass near an artery. Reach out to touch it. It is dark red and warm--feel it--it is pulsing with the rhythm of your heart. There are many arteries and veins, like giant hoses, pumping healthy blood cells that bring nourishment and cleansing and healing to every part of your knee.

Very near the light coming from the rear of the cavity lie 2 securely fixed ligaments, your ACL and your PCL. They look as they did in the video--they are glisteny white and very flexible. You are reaching out now to feel how smooth the

strong bands before you, noticing that your ACL is particularly thick and strong looking. It is shiny and ribbed, with thick fibers running lengthwise. These 2 ligaments are flexing and stretching and bending together with, like giant, flexible cables. As you look at the fibers of the ACL, the strands twirl and make an invincible pattern that is powerful.

Now that you have checked out these ligaments, take another moment to look around you, touching, seeing, smelling, looking at whatever you want to.

You may return to visit inside your knee whenever you desire, but for now, it is time to return. You are magically back at the bottom of the staircase and will now begin to ascend the steps, once again, one at a time. One--two--as you look down at your feet, you notice that your foot is beginning to grow larger, as are the steps. Three, etc.--10--you are at the top, and you are nearly back to your full size. Sit or lie down again, take a long, deep breath, exhale and feel the chair beneath you, as you realize you are fully returned to your normal size.

Notice how it feels where the chair supports your back, buttocks, legs, feet, arms, hands, neck and head. Allow yourself to also notice how relaxed you feel after your journey. You may begin to reconnect now with your present space--bringing your focus back to your breathing, You might just also notice that, while you were thinking about other things, your body has been breathing for you. You have been allowing it to use its wisdom and energy to do what it does so well. And so it is, when

you relax and image, that you are simply helping your body to do what it does naturally.

Remind yourself that you are becoming healthy and whole--thank your body for its healing work as you begin to reconnect with its sensations. When you are feeling ready, you can open your eyes, feeling refreshed, alert and at peace.

Session 5

Coping with restriction; building confidence

(The client is now eight weeks post-operative. Strength, range of motion and methods of coping (affirmations) with the restriction imposed by this surgery are the focus.)

Relaxation (breathing and imagery orientation).

"As you are sitting or lying here feeling relaxed and peaceful, focus all of your attention on your knee. Remember how the inside of your knee looked and felt? Allow yourself to concentrate now completely on your knee as you feel a new energy inside it. Feel the tender, sore parts healing, moving, stretching. Feel the warm blood, circulating around the healing parts, building new tissue that is strong and supple. Feel the warmth and energy caressing your knee, in and out, around and around, until it is well and totally healthy.

As you are relaxed and safe, begin to visualize yourself returning to and surpassing your previous strength. Indulge yourself now with a mental picture of what you look and feel like completely recovered. What are you doing? What are you wearing? Where are you?

With your new ligament, you are stronger, more powerful and have more endurance than perhaps even before you were injured. All the soft tissue in and around your knee joint is healing well, turning to a soft pink or white color. The

soreness that you have felt in the past is melting away literally as each day passes. Feel how strong and tight your new ligament is. Just like the small incisions on the outside of your knee are healing, so the graft, your ligament, the entire joint, is healing on the inside.

Allow yourself to think about what it feels like when you ride the bike and do your exercises in physical therapy. Place yourself mentally on the bike right now. As you pedal, you can feel the quadriceps muscle getting stronger with the rotations, stronger and tighter when you do lifts and presses. Think about your non-surgical leg now. Notice how the surgical leg and knee is beginning to feel a lot more like that non-surgical leg and knee. As you are riding the bike in therapy, close your eyes, see the inside of your knee going in this circular motion, aligning and strengthening all components of your knee. Your stretchy, strong cable of an ACL is pumping and this motion is bringing lots of oxygen and rich, red blood cells to the entire area. Even as you elevate your leg to ice, look consciously at your non-surgical knee and actively visualize your surgical knee returning to its proper size, looking just like your "good" leg--with quads hard and bulging--with the knee cap high, defined and free of all swelling.

You are in control of how well you are healing. Your most important job right now is to allow the healing energy that you are seeing and feeling in your body do its best job as you exercise. Every time you relax and image, you are maximizing your body's natural ability to heal. Now might be a very good time to thank your body

again for the healing, vitalizing energy that is there, knowing that your body is working for you--restoring you to good health and endurance. When you are completely healed, you will be stronger and in better shape than you ever were before.

Say to yourself every day: My knee is strong, powerful and flexible. My knee feels better every day. It is becoming stronger and more flexible every day. I am strong and pain free and powerful.

(Reconnect client--emphasize care from body through natural breathing)

Session 6

Increasing strength/range of motion through positive self talk and projective imagery

(The client is now approximately 10 weeks post-operative. This session focuses on ways to engage in positive self-talk imagery relative to final healing outcome, increasing strength and dealing with frustration/general coping.)

Relaxation

"In this relaxed place, allow yourself to just curl up, taking a moment to nurture yourself. In this relaxed place, it is safe to totally relax, allowing all worries or random thoughts, things to do, places to be, people to attend to, to just wait for a few moments while you nurture yourself. Perhaps you will allow yourself to clear your mental screen and prepare yourself for new visions. You can allow your muscles to become even more warm and relaxed. Take another deep breath and clear your mind, releasing any leftover tension as you exhale. Now you can mentally go through your mind, scrubbing out all the folds and corners where you might find random thoughts. If thoughts come to you while you are relaxing or imaging, allow them to simply pass through, like the wind through the branches of a tree. When you are done here, you will remember all you need to, but for now, clear your mind and prepare your body for complete healing and complete control.

Allow yourself to take another long, deep, slow breath, inhaling that fresh energy, and exhaling any last bits of remaining concerns. Mentally scan your body for any tightness that you do not want. You may want to imagine a beam of light scanning your body. If you find any improper level of tightness for you, guide the beam of light to the spot to dispel or reduce the tightness, and it will disappear. Take as much time now as you wish to scan from head to toe.

Your knee is beginning to feel good, more normal in size and yet sensitive to a lot of external stress or torque you may place on it. This is good, because the sensitivity is a good sign that all the nerves and muscles are working just as they should. You still feel some pressure inside the knee, perhaps near the kneecap, but this is very normal and natural. The swelling you experience is protective and nurturing for your knee.

As you are relaxed and thinking about your healing, allow yourself to focus completely on both knees. Permit yourself to feel how your non-surgical knee feels as you sit or lie there quietly. It probably feels smaller and cooler inside than your surgical knee. It may feel more supple and strong. However it feels, allow yourself now to focus on your surgical knee, comparing it to your nonsurgical knee. Permit yourself to transfer this healthy, strong feeling to your surgical knee and allow this knee to advise and consult your surgical knee, telling it that this is how it is to look and feel. Take a moment to allow this to happen, quietly, almost without your even thinking about it.

It will not be very long now before you will be able to walk with very little discomfort and with a lot of strength. You are stronger and healthier every day and in a very short time, you will be stronger than you ever were. Your new ligament is incredibly strong and thick. In the next few minutes, I would like you to picture yourself as you look at home doing what you do there, at work, at school, inside the house, outside, outdoors--everywhere. You are moving and working and playing completely healed and performing at your peak. As you see and feel this in your mind, take particular notice of your surroundings. What are you wearing this time? How do you look? What expression is on your face? How does your body feel? What are you wearing? Who is with you? You are happy, lively, and content. You are in complete control and you are deciding what you can and cannot, or want or do not want to do.

(Reconnect client to present space)

Session 7

Reduction of inflammation, general coping, increasing strength, regaining control

(The client is now approximately 12-14 weeks post-operative. The focus continues to be on increasing strength, general coping and healing in general. Inflammation/ patello-femoral discomfort/pain due to the cap rubbing over the area is common.)

Relaxation

"Allow yourself to notice how your arms and legs are feeling. I'd like you to inhale very slowly, and then exhale very slowly. You may find that your hands and feet, as well as your arms and legs are so relaxed that the warm, relaxed heaviness you were feeling is now giving way to a wonderful lightness, particularly in your hands and feet.

At the same time, allow yourself to notice how your surgical knee feels. I'm going to ask you to imagine that you are very, very tiny again, and this time, you want to take a look inside your knee again to see how it is doing. But this time, you are taking with you on your journey a bucket and a paintbrush that you will use to coat any muscle or ligament or tendon that feels the least bit sore or tender with a magical liquid. Your magical liquid can be of any color or consistency you think is best--it may be thick or thin, clear or colored. And you always have enough to do the job.

You may choose to go down the steps, or perhaps you will just find yourself there, inside the knee joint, ready to go to work.

Picture yourself now looking inside your knee joint, searching out any sore or tender places. But first, notice how they look. What color are they? Are they warm or cold? What do they feel like if you reach out to touch them? Whenever you spot one of these places, and you know where these are, imagine that you are dipping your brush into your bucket to coat it with your magic liquid that immediately soothes and heals the area. Take as much time as you desire to do brush on this magical liquid to as many places as you want to, or to coat an area as many times as it feels good to do this.

Of course, this is the same kind of thing your body does on its own when it sends millions of oxygen-rich blood cells to cleanse and soothe and help heal your knee. But by using your paintbrush, you are telling your body right now where it needs to concentrate its energy with your magical liquid, and you are speeding the process along.

When you are done with your job to your satisfaction, look around you to make sure you haven't missed any spots. For now, pick up your bucket and paintbrush, and allow yourself to return to sitting comfortably in your chair. Of course, you have returned to your normal size, and you can feel this is so because of how your body feels against the chair. Anytime you are feeling soreness or tenderness, particularly after you exercise, you can go back in with your bucket and paintbrush and then feel

the soothing coolness that this brings. If you are icing your knee, this is also a good time to feel this imagery.

Thank your body again for its healing energy and its endurance. Begin now to reconnect with your present space, bringing your focus back to your breathing. You will notice again that while you have been busy with your task, your body has breathed for you, knowing exactly what to do, even though you were focusing on something else. You can begin to notice the sounds of the room, the smells, the feeling of your body against the chair or floor. When you open your eyes, you will be refreshed, alert, in control and at peace.

Session 8

Confidence in ligament integrity and patience

(The client is now approximately 14-16 weeks post operative. Allowing the body to engage in its natural timetable of healing, patience with physical therapy schedule, feelings of restriction, and alleviating anxiety concerning reinjury are the imagery foci.)

Relaxation.

In this relaxed place, allow your mind to drift ahead to one year from now. Permit yourself to picture what you may be doing. Are you inside the house or in the out of doors? Are you performing your sport? See yourself at whatever activity you would like, taking care, again, to notice what clothes you are wearing, what kind of a day it is, who is there with you and how you look and feel.

Allow yourself to feel how freely and easily and pain free you are moving as you see yourself completely healed. When you get up in the morning, there is no stiffness or soreness--you are up and getting ready for the activities of the day before you realize how good your knee feels. You didn't really notice it because it is functioning exactly as it is supposed to, working as one unit with your body, without discomfort or restriction.

You have been exercising regularly, so your muscles are tight and strong. You can go all day on your knee, walking, running, swimming, skiing, playing, hiking, shopping, or whatever physical activity you choose to do. You are confident in the

strength of your knee, because you know the ligament is solidly and very firmly attached to your bones. Your body has done an excellent job of accepting it and welcoming it, and if you were to go inside your knee again, you would not be able to find the places where the ligament was attached because the ligament tissue and bone have become one and the same.

Allow yourself to mentally look at this union of tissue and bone, this very strong bond, right now. See how the thick, shiny cable of your ligament arches perfectly through your knee and then blends and melds into the gray of the bone. See your ligament as a giant cable again. You are fascinated as you see it bending and moving with ease, and as you watch it more closely you can just barely see each of the fibers that make up this wonderful part of your body winding their way into the microscopic openings in the bone where it attaches. Each of these fibers are so firmly entrenched in the bone that they are virtually cemented into the bone. The further you go in your recovery, the stronger each of these fibers become bonded and cannot let go. The point where tissue and bone join is indistinguishable.

This means that everything you used to do and even more is possible. Whatever activity it was that you were doing when your original ligament was damaged cannot tear that ligament from the bone now, for your new ligament, really two ligaments wound closely together, is at least twice as strong and resilient as your original ligament. This means that in about one year from now you can perform whatever motion or activity or exercise without any fear or concern that you will hurt

the ligament again. You always want to keep those muscles strong around your knee so that you can be as active as you want, but your new ligament is now freeing you to return to the things you want and need to do without worrying about its stability.

Say to yourself again, "My knee is strong, powerful and flexible. My knee feels better and better every day. I am strong and pain free and powerful. I am completely healed and performing at my peak."

(Reconnect the client)

Session 9

Complete range of motion, confidence, endurance

(The client is now 16-20 weeks post-operative. Strength, endurance, positive outcome, full range of motion and psychological coping through imagery are the foci.)

Relaxation

In this healing place, curl up and take a moment to nurture yourself. Allow the energy to be here for yourself, while you feel it gently warming your body. Notice that even your face is relaxing and softening behind your eyes. All the tension has drained out of your body.

Focus on your knee once again. Remember how the ACL looks inside your joint? Allow yourself to think of that ligament as an invincible cable, fiber upon fiber upon fiber wound together. Think about how flexible and resilient it is, bending and stretching and arching, supporting your knee and flexing. It is so strong. See and feel it, isolate it in your mind, and as you move your leg all the way out in extension, and all the way back in flexion, the ligament stretches and bends with complete comfort.

There is still some resistance, but this is normal and natural, even if you have to coax your leg to stretch by gently pulling back against your leg when it is bent and pushing gently down when it is out straight in front of you. If you feel resistance, there is no problem, for your ligament can bend easily. See and feel this stretching every time you flex and extend your knee. Just as it feels good to you to stretch your arms

above your head when you wake in the morning, so it feels good to your entire leg to extend and flex. The more your ligament stretches, the more easily you will move through your range of motion. Remember how easily the ligament bent when you saw your video? How much more so it is now, now that it is firmly anchored and an integral part of your body. Mentally see and feel how easily the ligament bends every time you exercise your knee. In fact, if you extend and flex your knee when you exhale, you can relax into that stretch, becoming even more flexible.

(Reconnect the client)

Session 10

Anatomical and neurological comparison, peak performance, reinjury anxiety

(The client is now 21-24 weeks post operative. Overcoming re-injury anxiety, positive outcome, return of full strength and range of motion through imagery are the foci.

Relaxation

Now once again, allow yourself to focus your attention on your knee. Take a few moments in this safe and peaceful place to become even more fully aware of its shape, its size, its depth--the whole feel of your knee. Now switch to your non-surgical knee. Compare the two knees as you sit or lie quietly and peacefully. As you are feeling very relaxed and peaceful, focus all of your attention on your knees, allowing yourself to become even more mindful of how they feel. What do you see and feel? How do they feel the same? How do they feel different? Are you aware of different thoughts about each knee? What are these?

What can your non-surgical knee tell your surgical knee? As you may have experienced before, they can talk to each other in this relaxed state. Not talking in the "outloud" sense, but in a quiet, wise sense, the way that parts of the body relate to each other. Now that you are farther in your recovery, what advice does the non-surgical knee have for you or for your surgical knee? It may be the same advice, or it may be different. Being confident that you need not be consciously aware of any transfer of

information between the two, relinquish control for just a few moments, step back, and allow the wisdom of your uninjured knee to guide your reconstructed knee.

Since you are already peaceful and relaxed, now is a good time to, once again, thank your body once again for its healing, vitalizing energy. Your body is restoring you to good health, full of endurance. Your body is responsive to its own needs, and you can help it to do what it does so well when you use your mind with relaxation and imagery.

I would like you to see a time six months from now. And now, bring up once more a clear, colorful mental picture of yourself, with all your senses--a picture of yourself performing at your peak. As you watch yourself performing, what does it feel like? Go ahead and feel this now--enjoy every minute of this feeling. You are completely healed in your picture, with boundless energy. Take as long as you desire right now to experience this with all of your senses.

Any time you begin to have any doubts about your recovery, or you feel soreness or fatigue, remember this image of pain-free power--of a place of complete healing and control. No matter what activity you choose, you need not be concerned in the future, for your knee is completely functional and limited in power only by how hard you work to make it stronger.

Tell yourself again: "My knee is flexible, powerful and ready. I am completely healed. I am performing at my peak. I am refreshed, alert and at peace."

(Reconnect the client)

Exit Session

The client is now six months post-operative. This final session reviews the imagery goals, procedures, and physical progress, as well as asks the client to respond with his/her impressions of surgery, physical rehabilitation and psychological intervention via the Exit Interview Questionnaire (Appendix H).

Appendix G

Personal Imagery Log

(To be completed once per week)

1. Day: (month/day/year)_____
2. Time of Day of this recording:_____
3. Number of Days of Physical Therapy this week: 1 2 3 4 5
4. Pain level this week on a scale from 0 to 10, according to the physical therapist's scale:

   0 1 2 3 4 5 6 7 8 9 10.

5. I listened to my tape 1 2 3 4 5 6 7 or ___ times this week.
6. The imagery I used helped me by:

_____
_____
_____.

7. On my own, I did the following imagery:

_____
_____
_____

8. I could **see** the images I learned in our imagery session when I was doing my physical therapy exercises: Yes/No

9. I could **feel** the images I learned in our imagery session when I was doing my physical therapy exercises: Yes/No.

I saw and felt:

_____
_____

10. I experienced:

_____
_____
_____

11. The hardest thing for me right now is:

_____

_____

12. I would like help with:

_____

_____

_____

_____

_____

Appendix H

Subject Information Form

Name: _____

Date of Birth: _____

Phone number: _____

Address: _____

_____

Date of injury: _____

Date of surgery: _____

Date began physical therapy: _____

Time Spent Training or Participating
(Indicate times per week)

Sport(s)/Activities:

1.

2.

3.

4.

5.

Appendix I

Exit Interview Questionnaire

1. Do you have any thoughts, imaginings or worries about reinjury? Please explain.

2. Did you set specific goals for recovery? Explain

3. Did you actually experience by either feeling or seeing or otherwise, healing imagery working to help your recovery?

4. Circle all that apply: I practiced my imagery

    a. at night
    b. during physical therapy at the facility
    c. during exercises at home
    d. otherplaces/times:explain

_____

_____

_____.

5. When you did the imagery that saw yourself as healthy, recovered and/or performing at your peak, what did it look and feel like?

6. When were you able to see yourself recovered from your injury?

7. Do you ever replay your injury in your mind? If yes, how often?

8. Some people find that out in spite of the trauma of injury, valuable lessons are learned, or new perspectives are attained which contribute towards future achievement. Although none would wish to have an injury, it is sometimes viewed as a beneficial experience--an opportunity that may otherwise not have been taken. Did you find this to be the case for you? If so, please explain.

9. What sort of advice would you give another person with the same injury to enhance their recovery?

10. Please comment about your experience with these sessions. How have they been helpful? How could they have been more helpful? What did you like the most about them? What did you like the least about them? As you think back on the content of the sessions, what pieces stick out in your mind as making the biggest difference for you. Explain.

11. On a scale from 0 to 10, where 0 is no worries about reinjury, and 10 is great anxiety about reinjury, please circle:

a. 2 weeks after the surgery: 0 1 2 3 4 5 6 7 8 9 10
b. Now: : 0 1 2 3 4 5 6 7 8 9 10

12. Did your physician give you enough information before surgery to prepare you for what you would encounter for your recovery?

Yes or No

13. What would you **like** for him to have shared with you? Please be specific.

14. Did your physical therapist give you enough information as you went through your physical therapy for your recovery? Please explain.

Yes or No

15. What would you like for him/her to have shared with you? Be specific.

16. What has been the most effective image(s) for you in these sessions? Please explain.

17. Check all images that were helpful to you.

__breathing/relaxing
__golden egg
__knee comparisons
__accepting donor tissue
__flushing out swelling
__ACL cable/earth-worm
__inside-the-knee journey
__shrinking
__quadricep contraction
__ligament/bone union
__performing at your peak
__circular bike motion
__blood cells nurishing/cleansing
__circulating energy
__muscles relaxing
__reinterpreting pain as pressure
__releasing tension
__preparing mental screen (relaxing the mind)
__paintbrush
__strength of two ligaments wound together

__ACL stretching/feeling good

__seeing ACL move through range of motion

__wisdom of the body

__lightness of relaxation

__swelling as normal

__power and strength

18. Others you experienced:

19. Thank you for helping us attempt to find out more about the healing process. If you are interest in seeing a summary of the results from this survey, please indicate your interest by circling either yes or no below. Since this is a longitudinal study, results will not be available before sometime in 1996. Please indicate an address below where you will be at that time. Thank you again for your cooperation. Have a great life!!

a. Yes
b. No

Appendix J

Patient Profile Summaries

(These numbers have been assigned to Intervention Group patients for this report in the interest of confidentiality. *Patient number is neither indicative of order of treatment or group assignment.)*

Patient #1:
(Pilot Study)

1. Age: 21
2. Gender: Male
3. Activity Level: 1 to 2 times per week
4. Cybex 24 weeks: 68% (tested at 21 weeks).
5. Reinjury Anxiety at 24 weeks on scale from 0-10: "1"
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. ___ During exercises at home
    d. ___ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"It helped me do my physical therapy when I was in pain. Knowing I was coming to see you every other week also motivated me to go to physical therapy. It really gave me the confidence I was going to come back strong."
"The two biggest benefits are
    1) that they helped me relax when my body was going through a lot of stress,
    2) that I had the desire to get my whole body in shape--I lost 25 pounds and I feel great."
"It helped me to trust a lot more--the imagery made what I went through more real to me--I have a better idea of how to perform basketball at my peak."

8. Specifically, what images in these session were the most important for your recovery?

"Seeing myself and feeling myself at my peak performance."
"Painting the inside of my need with coolness when it was swollen and inflamed--I could feel the difference."

Patient #2:

1. Age: 21
2. Gender: Female
3. Activity Level: Competitive
4. Cybex 24 weeks: 87%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 0
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. ___ During physical therapy at the facility
    c. ___ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"It helped me to relax, to talk about my worries and give me confidence in the strength of my ligament"

"I think I used the imagery the most when I had pushed my rehab too far--when my knee was sore and hurting"

"It really helped me to put aside my worries about reinjury"

"It was important to me that you understood what I was going through."

8. Specifically, what images in these session were the most important for your recovery?

"The best images were the paintbrush [addressed inflammation/edema], the golden egg [relaxation] and seeing and feeling myself completely whole and painless, doing my sport."

Patient #3:

1. Age: 42
2. Gender: Female
3. Activity Level: 1 to 2 times per week.
4. Cybex 24 weeks: 79%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 2
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. ___ During physical therapy at the facility
    c. _X__ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"Helping me to relax!"
"I am choosing to redirect my life goals now...self-empowerment...to take care of me."
"To think positively and not dwell on what I can't do."

8. Specifically, what images in these session were the most important for your recovery?

"Seeing myself performing at my peak--skiing down a mountain with the sun shining."

Patient #4:

1. Age: 19
2. Gender: Male
3. Activity Level: Competitive
4. Cybex 24 weeks: 86%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 0
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. _X__ During exercises at home
    d. ___ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"Seeing and feeling myself as better and stronger than before."

"Having you [clinician/researcher] there in physical therapy was encouraging-- it reminded me to do my imagery while doing my exercises."

"Helping me relax."

"I was able to see and feel myself recovered early on--this was important to me."

8. Specifically, what images in these session were the most important for your recovery?

"The internal journey into my knee gave me clarity and confidence-- the golden egg was really relaxing so that I could straighten my leg out even though it hurt."

"The golden egg really helped a lot at night with pain and also for overall body relaxation."

Patient #5:

1. Age: 23
2. Gender: Female
3. Activity Level: 3 times per week.
4. Cybex 24 weeks: 61%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 2
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. _X__ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"It helped me to minimize the pain--think of it as pressure--the imagery blocked out some of the pain and helped me to relax."

"Taking a mental look inside my knee helped me to understand what was going on--seeing scar tissue releasing helped my extension."

"It made me think about happier things--things I could be doing--things in my control--making the suffering worthwhile."

8. Specifically, what images in these session were the most important for your recovery?

"Reinterpreting pain as pressure helped me do my exercises--I liked all the images, particularly the paintbrush, the internal journey and the golden egg."

Patient #6:

1. Age: 45
2. Gender: Male
3. Activity Level: 1 to 2 times per week.
4. Cybex 24 weeks: 100%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 1
6. When did you practice your imagery?

    a. ___ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. _X__ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"This has been a great experience--able to accomplish my goals ahead of schedule."

"Having you [clinician/researcher] there was helpful--I would like you to have been there for more physical therapy sessions."

"I have become much more aware of how my body is synchronized. I like the idea of replacement, the continuation of life. Your program has helped give my mind some new parameters, energy and empowerment."

"I think I saw myself fully recovered by the third session."

8. Specifically, what images in these session were the most important for your recovery?

"The most important ones were shrinking and going inside my knee, comparing both knees, but particularly seeing and feeling the healing process in my right knee with the paintbrush exercise. The relaxation level I achieved was just right for me."

Patient #7:

1. Age: 23
2. Gender: Female
3. Activity Level: Competitive.
4. Cybex 24 weeks: 88%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 3
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. _X__ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"I found that the sessions calmed me down about the whole thing and got me focused on recovery instead of being angry about the injury. The imagery helped me realize what was going on inside my knee, gave me confidence, quickened the recovery for me."

8. Specifically, what images in these session were the most important for your recovery?

"The image of the ligament as a cable of strength gave me confidence, as well as picturing little Pacman dudes taking eating up and taking away the swelling. Seeing myself performing at my peak gave me more hope and the painting of my knee helped soothed it inside--it helped the whole area relax.

Patient #8:

1. Age: 36
2. Gender: Male
3. Activity Level: 3 times per week.
4. Cybex 24 weeks: 84%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 2
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. _X__ During exercises at home
    d. _X__ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"The relaxation and visualization--to think about what was really going on inside my knee and believing it was really going to get better. Learning to relax was important and how to focus on my knee."

8. Specifically, what images in these session were the most important for your recovery?

"The most important was actually seeing and feeling myself running, riding my bike, snow and waterskiing. I could see myself kneeling."

Patient #9:

1. Age: 27
2. Gender: Female
3. Activity Level: 1 to 2 times per week.
4. Cybex 24 weeks: 70%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 2
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. ___ During physical therapy at the facility
    c. _X__ During exercises at home
    d. ___ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"It was really helpful to have you at physical therapy--I think a lot of rehabilitation is mental and it's hard to do"

"It was helpful in reinterpreting my symptoms of pain in a positive way."

"Knowing you [clinician/researcher] cared about me made a big difference. It made me more motivated to hang in there with the physical therapy when I got discouraged."

8. Specifically, what images in these session were the most important for your recovery?

"All the sessions were helpful to me. Feeling energy moving through my leg and helping it relax--seeing the ligament as healthy when I went I nside--seeing it bonded to the bone gave me a lot of confidence. The paintbrush really helped with soreness. I always felt peaceful and not stressed after the sessions."

Patient #10:

1. Age: 19
2. Gender: Female
3. Activity Level: Competitive.
4. Cybex 24 weeks: 94%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 6
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. ___ During physical therapy at the facility
    c. ___ During exercises at home
    d. ___ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

"The imagery really helped take out the swelling--I felt like the swelling really did go down when we did it in the sessions. The paintbrush worked really well-soothed and actually gave me strength."

"The sessions relaxed me a helped me stay positive--I think they sped up my recovery a lot when I was listening to them [tapes] often."

"Being whole seemed too good to be true--it's been so long since I've been able to do my sport--the sessions helped me believe it, but I still have doubts about getting hurt again."

8. Specifically, what images in these session were the most important for your recovery?

"The paintbrush was the best--but also knee comparisons, quadricep contraction, ACL stretching, performing at my peak, feeling the circular bike motion as healing, going inside my knee in that journey and flushing out swelling."

Patient #11:

1. Age: 26
2. Gender: Female
3. Activity Level: 1 to 2 times per week.
4. Cybex 24 weeks: 83%
5. Reinjury Anxiety at 24 weeks on a scale from 0-10: 2
6. When did you practice your imagery?

    a. _X__ At night to sleep and reduce pain
    b. _X__ During physical therapy at the facility
    c. ___ During exercises at home
    d. ___ Other places/times

7. In your opinion, what were the most helpful aspects of participating in this intervention?

> "It was very important that you [clinician/researcher] were there reminding me how to do my imagery during physical therapy. The sessions kept my frustration level down, and helped me remember that I would get better. I am definitely more mindful of my body now and more aware of an overall body wellness. It has helped me set long-term goals. I have learned to relax and accept certain restrictions in spite of frustration--definitely feel more in control of my recovery. Most of all it helped my confidence."

8. Specifically, what images in these session were the most important for your recovery?

> "Seeing and feeling the quadracep contracting was important--relaxation was key, as well as pain management. All the images were good--the paintbrush made things more real for me and soothed the soreness. I learned how to breathe and move into the pain to get the stretch I needed."

CURRICULUM VITAE

Deborah Deena Durso-Cupal

EDUCATION:

Ph.D. Research and Evaluation Methodology,

Utah State University, Logan: 1997.

Major Professors: Richard Gordin, Ph.D.

Keith T. Checketts, Ph.D.

M.A. Medical Anthropology/Counseling,

University of South Florida, Tampa: 1980.

Major Professor: Michael Angrosino, Ph.D.

B.A. Psychology/Anthropology

University of South Florida, Tampa: 1978.

ACADEMIC AWARDS AND HONORS

1995 Dissertation Research Award

Association for the Advancement of Applied Sports Psychology

1994 Outstanding Graduate Teaching Assistant

Department of Psychology, Utah State University

1993 Graduate Scholarship

School Graduate Studies, Utah State University

1992 Seely-Hinkley Scholarship

Utah State University

1991 Presidential Fellowship

Utah State University

1983 Outstanding Young Woman Award

Kiwanis

Tampa, Florida Branch

1980 Master of Arts, Magna Cum Laude

University of South Florida

1980 Membership Phi Kappa Phi - Graduate Honor Society

University of South Florida Chapter

1978 Bachelor of Arts, Cum Laude

University of South Florida

PROFESSIONAL EXPERIENCE

Research Experience

1992-1993 Research Assistant. Utah State University, Logan, Utah.

Dr. Karl White - Early Intervention Research Institute. Hearing impairment in children - performed two meta-analyses.

1991-1992 Research Assistant. Utah State University, Logan, Utah.

Dr. Glenna Boyce, Center for Persons with Disabilities.

Data coding, analysis and write-up of Parent Child Interactional Coding Systems.

1980-1982 Mental Health Counselor/Liaison. Hillsborough County, Tampa, Florida (Florida Department of Health and Human Services). Wrote legislative budget proposal, plans for state hospital patient deinstitutionalization, collected system data, coded data, analysis and report write up.

1979-1980 Research Assistant. University of South Florida, Tampa, Florida. Collected and coded data for project on network analysis of mental health care givers.

Clinical Experience

1997-present Counselor. Utah State University Counseling Center, Utah State University, Logan. Utah. Part-time therapist.

1995-1996 Intake Counselor. Utah State University Counseling Center, Utah State University, Logan, Utah. Volunteer intake counselor.

1992-1996 Sport Consultant. Utah State University Gymnastics, Utah State University, Logan, Utah. Intervention services to gymnasts and staff, focusing on performance enhancement.

1988-1990 Therapist. Human Resource Associates, Jackson, Wyoming. Full-time position providing individual, marital, family and group therapy for clients of all ages experiencing a variety of emotional and behavioral problems, including crisis intervention.

1987-1988 Therapist. Tampa Bay Neuropsychiatric Institute, Tampa,

Florida. Full-time position providing individual, marital, and family therapy for clients of all ages experiencing a variety of emotional and behavioral problems, including crisis intervention. Inpatient (eating disorders) and outpatient therapy. Conducted various wellness workshops, including stress management, healthy eating and anxiety reduction.

1982-1987 Therapist/Program Coordinator. Children's Kidney Center, Department of Pediatrics, University of South Florida Medical School, Tampa, Florida. As a member of the pediatric renal team, provided individual and family therapy for children in chronic renal failure, as well as their families. Team liaison activities between patient and medical staff, as well as between program and state medical staff.

1980-1982 Mental Health Counselor/Liaison. Department of Health and Human Services, and Hillsborough Community Mental Health Center, Tampa, Florida. Therapy and case management activities for state hospital clients, both while inpatient, as well as outpatient, with main emphasis on returning clients to self-sufficient, community living; coordination between community services.

1978-1979 Counselor in Training. C. A. U. S. E., Department of Counselor Education, Tampa, Florida. Individual single-mother and children, as

well as group teen counseling activities for single-mother and teen university students.

1979-1980 Counselor in Training. Psychiatric Emergency Assessment Services, Hillsborough Community Mental Health Center, Tampa, Florida. Provided crisis intervention services and appropriate referrals to both in-house programs, as well as external agencies.

Teaching and Administrative Experience

1993-present Instructor. Department of Psychology, Utah State University, Logan Utah. Courses taught include Educational Psychology (undergraduate) and Cognition and Learning (graduate).

1991-1993 Teaching Assistant. Department of Psychology and Department of Health and Physical Education, Utah State University, Logan, Utah. Courses taught include sport psychology, educational psychology, and guest lecturing in developmental psychology and human sexuality.

1988-1990 Instructor. Central Wyoming College, Jackson, Wyoming. Courses taught include native American topics and anthropology.

1982-1987 Part-time Faculty. Hillsborough Community College, Tampa, Florida. Courses taught include introductory psychology, physical and cultural

1980-1982 Mental Health Counselor/Coordinator. Department of Health and Human Services, Tampa, Florida. Administrating deinstitutionalization

activities among service providers, coordinating inpatient and outpatient programs and overseeing related budgets/funding.

PUBLICATIONS

Durso-Cupal, D. D. (1997, in press). Psychological interventions in sport injury prevention and rehabilitation, Journal of Applied Sport Psychology, 9.

Durso-Cupal, D. D. (1996). Can mental practice enhance recovery for ACL patients? Report for Western Surgery and Mountain West Physical Therapy Center, Logan, Utah.

Openshaw, D. K., Graves, R., & Durso, D. D. (1993, April). Sexual offenders: A comprehensive bibliography of journal references. Family Relations, 42, 318-323.

Openshaw, D. K., Mills, T. A., Adams, G. R., & Durso, D. D. (1992, October). Conflict resolution in parent-adolescent dyads: The influence of social skills training. Journal of Adolescent Research, 7(4), 457-468.

Durso, D. D. (1980). Network analysis: A cultural approach to mental health care. Unpublished master's thesis, University of South Florida, Tampa.

PRESENTATIONS

Durso-Cupal , D. D. (1996). The efficacy of guided imagery on recovery for individuals with anterior cruciate ligament (ACL replacement. Paper presented at the meeting of the Association for the Advancement of Applied Sport Psychology, Williamsburg, VA.

Durso-Cupal, D. D. (1995). From patient to professional: building research relationships. Paper presented at the meeting of the Association for the Advancement of Applied Sport Psychology, New Orleans, LA.

Durso-Cupal, D. D. (1994). Injury in sport: Research and application. Paper presented at the Fourth Annual Sport Psychology Symposium, University of Utah, Department of Exercise and Sport Science, Salt Lake City, UT.

Durso, D. D. (1986). Goal setting: Problem solving skills for women. Talk presented at the 7th Annual Conference of Women's Issues, Neuropsychiatric Institute, Tampa, Florida.

Durso, D. D. (1984). Cultural factors influencing use of health services by Cuban and Haitian populations: Listening to the inner healer. Paper presented at the Suncoast Organization of Practicing Anthropologists, March, Tampa, Florida.

AFFILIATIONS

American Psychological Association

Wyoming Psychological Associaiton

Association for the Advancement of Applied Sports Psychology

Phi Kappa Phi National Graduate Honor Society

Licensed Professional Counselor, State of Utah: #97-325883-6004

Wilderness Medicine Society