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Near avulsion amputation of the left forearm in a rock climber : a case study

Jennifer K. Pease
San Jose State University

NEAR AVULSION AMPUTATION OF THE LEFT FOREARM IN A ROCK CLIMBER

A CASE STUDY

A Thesis

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Masters of Art

By

Jennifer K. Pease

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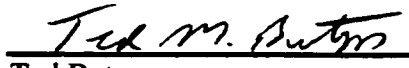
APPROVED FOR THE DEPARTMENT OF HUMAN PERFORMANCE

Leamor Kahanov



Ted Butryn

Barbara Conry

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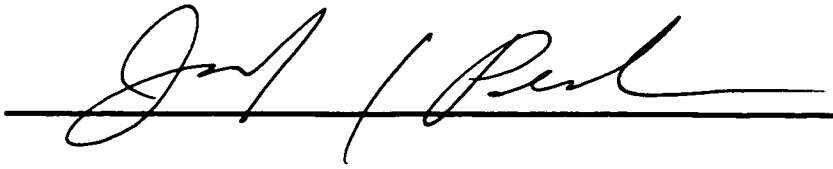

Abstract

Near Avulsion Amputation of the Left Forearm in A Rock Climber

A Case Study

by Jennifer K. Pease

Athletic trainers are a unique health care provider responsible for the care and treatment of athletes and their injuries on a daily basis. Over the last 10 years extreme sports, such as rock climbing, have emerged requiring knowledge of biomechanics and injuries atypical to traditional sport settings. Athletic trainers obtain education based on traditional sports that may not prepare individuals to handle injuries common with extreme sports. The purpose of this case study is to present a unique injury incurred by a rock climber, in order to provide literature in an area that has received little exposure and better prepare athletic trainers to provide medical coverage for rock climbers. The athlete in this case study underwent five surgeries to repair the extensive damage to soft tissue of the forearm and two years of rehabilitative therapy to restore normal function. Currently, the athlete is fully functional in all activities of daily living, but will never physically be able to participate in rock climbing again. The athlete continues to compete in bicycle road races and intends to begin training for an upcoming adventure race. Knowledge of rock climbing techniques/skills required of the sport and common injuries can assist the athletic trainer in prevention and treatment of this extreme sport.

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I would like to give a big "Thank You" to my dad for sending me an article he found "interesting." Dr. Kahanov for her patience and humor. Dr. Butryn and Dr. Conry for braving being a part of my committee and their endless support. To my family, going above and beyond the call of family duty by continually encouraging and supporting me the past two years. Lastly, to Glynis and Matthew for keeping me grounded and providing much needed humor.

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A CASE STUDY

By

Jennifer K. Pease ATC
San Jose State University

Leamor Kahanov, Ed.D., ATC
San Jose State University
Program Director-Graduate Athletic Training
One Washington Square
San Jose, CA 95192-0054
408-924-3040
leamor@email.sjsu.edu

Ted M. Butryn, Ph.D.
San Jose State University

Barbara Conry, Ph.D.
San Jose State University

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Jennifer K. Pease, ATC

Leamor Kahanov, Ed.D., ATC

Ted M. Butryn, Ph.D.

Barbara Conry, Ph.D.

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I, _____ freely give my consent for the release of information regarding my medical history, illness, surgery, and outcome for use in the following case report, which is being submitted to the *Journal of Athletic Training*.

Author(s): Jennifer K. Pease, Leamor Kahanov, Ted M. Butryn, Barbara Conry

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Contributors who do not meet the criteria for authorship should be thanked in the Acknowledgements section.

	Contribution*										
Author's Last Name	conception & design	acquisition of data	analysis & interpretation of the data	drafting of the article	critical revision of the article for important intellectual content	final approval of the article	provision of study materials or patients	statistical expertise	obtaining of funding	administrative, technical, or logistic support	collection & assembly of data
Pease	X	X	X	X	X	X	X			X	X
Kahanov	X		X	X	X	X				X	
Butryn					X	X				X	
Conry					X	X				X	

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Near Avulsion Amputation of the Left Forearm in A Rock Climber

A Case Study

Abstract

Objective – The objective of this study was to present the unique injury of one rock climber thereby providing literature in an area with little exposure and better preparing athletic trainers to provide medical coverage for rock climbers.

Background – As a first responder and therapist, the athletic trainer plays a vital role in returning athletes to competition after an injury. Rock climbers use unique tools to hang on ledges that may be as shallow as 5 mm. Locking hands and fingers into cracks of varying dimensions is common and may result in minor injuries or disability to soft tissue. To best rehabilitate and treat rock climbing injuries, medical personnel, specifically athletic trainers, must have a good working knowledge of hand and finger injuries with specific treatment and rehabilitation for these atypical injuries.

Differential Diagnosis – Comminuted fractures of the radius and ulna, transection of the median and ulnar nerves and ulnar artery, transection of all flexor tendons except the radial wrist flexor and approximately a 25 x 10 centimeter volar wound defect with significant skin loss.

Treatment – The radius was shortened and plated volarly and the ulnar fracture was plated distally. Sutures were used to repair all four FDP and FDS tendons. The ulnar artery was repaired with nylon and a fasciocutaneous flap was constructed since tissue transfer could interrupt blood flow.

Uniqueness – The injury was neither biomechanical nor typical. The severity and cause of injury is unforeseen in traditional sport settings. The team of physicians consisted of an orthopaedic and plastic surgeons utilizing professional experience to develop surgical procedures that would save the arm. Lastly, the outcome also makes this case study quite unique because after 5 surgeries and two years of rehabilitation the athlete will be able to return to her sport.

Conclusions – As athletic trainers begin to provide medical coverage for rock climbers, knowledge and understanding of rock climbing mechanics can better assist the athletic trainer in evaluating injury pathology and instituting appropriate therapeutic exercises.

Key Words – forearm avulsion/amputation, forearm fractures, rock climbing injuries

INTRODUCTION

Rock climbing is a relatively new or extreme sport requiring a unique set of skills and biomechanics that consequently results in uncommon injuries, particularly to the upper extremity.[10-12] Haas and Meyers reported that 44% of all rock climbing injuries occurs to the hand and wrist region of the body, with 61% to the shoulder and elbow.[7] In addition to unique skills, rock climbers' equipment is specific to the sport, such as belay devices, carabiners, and harnesses. Rock climbers use unique tools to hang on ledges that may be as shallow as 5 mm thereby contributing to common rock climbing injuries.[8, 13] Locking hands and fingers into cracks of varying dimensions along with the specialized equipment commonly results in minor injuries or disability to the soft tissue.[7-9, 13] More typical types of injuries encountered during rock climbing include: bowstringing at the proximal interphalangeal (PIP) joint and proximal phalanx, PIP collateral ligament laxity and tenderness, loss of active range of motion of the PIP joint and strength of the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) muscles were the specific pathologies found.[1-2, 6-8, 11]

Rock climbing has become popular in the last ten years, thus injuries associated with these athletes are less common to traditional sports and may leave the athletic trainer unprepared to treat and rehabilitate rock climbers.[2] The following case study details the near avulsion amputation of a rock climber, the five reconstructive surgeries that followed, and the four phases of rehabilitation, which returned the athlete, back to activity.

CASE REPORT

This case study involves a 33 year-old healthy, female rock climber with more than 10 years experience as member of an adventure racing team. At the time of the injury, the adventure racing team was practicing ascending on a sheer, craggy cliff on a 1,520-foot mountain for an upcoming race. The athlete was ascending up the rock face when her teammate signaled for her to pause. A boulder came loose and fell upon the athlete's arm as she placed her left arm against the rock face to deter spinning. She knew she had to survive and in order to survive she had to stay conscious and focus her energy on getting down the mountain.

The athlete's husband ascended up the free line and released her from her equipment. Another rock climber, at the bottom of the climb, set up a Firemen's belay (belaying a rappelling rock climber from the bottom of a climb) and assisted her down the mountain. Once down from the climb they wrapped her arm in a T-shirt, splinted with branches and constructed a sling out of another shirt for immobilization. An hour later the athlete was rushed to the local hospital where medical personnel took x-rays of the area and decided to airlift her to a different hospital where an attending Orthopaedic hand surgeon was on-call. The surgeon (2.5 hours later) moved her into the operating room for evaluation and surgery. From the time the injury occurred till time of surgery the athlete lost consciousness only while in flight to the second hospital. Some aspects of the event were unclear but the athlete's husband and fellow rock climber were able to clarify any misunderstandings.

Initial and immediate physical examination identified a numb hand with poor capillary refill and comminuted and displaced fractures of the forearm. Lacerations of

the FDS, FDP, ulnar artery/nerve, median nerve, and multiple lacerations over the dorsum of the hand and radial forearm were observed. A proximate 25x10 centimeter volar wound defect existed with significant skin loss and laceration of the flexor pollicis longus with loss of the flexor pollicis longus muscle belly. The hand was attached to the forearm solely by the flexor carpi radialis tendon, the radial artery, dorsal skin flap and some extensor tendons.

TREATMENT PLAN

Immediately following injury and rescue, the athlete was transported via helicopter to a nearby hospital to undergo surgery. Starting radially, the radial artery was intact along with the vena. A comminuted fracture of the radius was present and the entire distal radius was stripped (all soft tissue was removed) volarly. The ulna fracture was also a comminuted fracture and was stripped distally. The ulnar head was dislocated out of the distal ulnar joint (Figures 1 & 2). Contents of the carpal tunnel were lacerated including the median nerve at the level of the distal wrist flexion crease. The flexor digitorum superficialis tendons were also lacerated at the wrist flexion crease. The flexor pollicis longus was lacerated and the proximal aspect could not be identified. Guyon's tunnel and the flexor carpi ulnaris were lacerated. The extensor tendons were grossly intact, however, significant injuries to the dorsum of the wrist were present.

The orthopaedic surgeon first performed a primary shortening osteotomy of the radius and inserted a volar plate in order to repair all soft tissue. The ulnar fracture was plated proximally and the head of the ulna was smoothed off and then screws, K-wires, and an external fixator were placed for skeletal fixation of the wrist for tendon, nerve, and vessel repair. Sutures were used to repair all four flexor digitorum superficialis and

FDP tendons. A plastic surgeon was consulted for arterial reconstruction and coverage of exposed arteries, tendons, and nerves. Initially, the surgeons were unsure if their efforts would save the arm or result in an amputation. Despite the possibility of amputation the athlete had a positive outlook and never believed that she would lose her arm.

The first aspect of the second surgery was to reconstruct the ulnar artery. The proximal and distal ends of the ulnar artery were trimmed and reconstructed with nylon. An ipsilateral groin flap was designed to limit interrupted blood flow which may occur with a tissue transfer (Figures 3 & 4). The groin flap was dissected to the level of muscle fascia with the axial artery housed within the tissue. The athlete's arm was placed inside the flap and closed with skin staples (Figure 5). Twenty days after the initial surgery a third procedure to contour the redundant portion of the groin flap inset at the hand, and irrigation of the area was performed.

One month after the third surgery the external fixator and deep hardware were removed. Upon hardware removal, the athlete had approximately 40 degrees of supination and pronation as well as 40 degrees of wrist extension and flexion with no tendency for ulnar translocation or volar subluxation. Eight months after the initial surgery the athlete had her first stage of scar revision. The skin graft was carefully, sharply dissected from the muscles in the proximal half of the forearm in an elliptical fashion. The distal third of the skin graft was left in place for future scar revision. Throughout the treatment phase the athlete maintained a mental state of pure survival. The athlete knew this was something she had to do and knew in the back of her mind that all of the surgeries were part of the process to return her to her sport.

Eighteen months post injury physical examination; a linear contracture from the base of the thumb to the flap was identified. There were defects with the skin graft and flap site. The Orthopaedic hand surgeon planned to perform a thumb arthrodesis which required that the patient have a release of the linear scar of the web space and resection of the skin graft with primary closure. At that time this surgery and future surgeries were post-poned till after the birth of her child. The athlete still holds a passion for her sport and desires to compete again but her commitment now is to her family first and then her sport.

REHABILITATION

The following section has been divided into two rehabilitation portions, an early and intermediate/advanced phase. Early Phase – The athlete at this period (4.5 weeks post injury) presented with a "stiff" left hand and a resting position of the PIP and distal interphalangeal's (DIP) in flexion. The MCP joints were in a neutral resting position. The athlete had an external fixator and volar distal sutures intact on the left upper extremity. The skin graft was healing well with the distal aspect scabbed over with black necrotic tissue. Severe sensation impairment of the volar left forearm/wrist and hand existed; in addition, active range of motion of left digits and thumb were severely impaired (greater than 50% loss of function) compared to the right hand.

Short-term goals were to promote wound healing, increase range of motion (ROM) of digits through active/active assistive/passive ROM exercises, heat modalities, and elbow/shoulder A/PROM exercises. One additional goal was to fit the athlete with a splint once the external fixator was removed. Long-term goals were to resume activities

of daily living (ADL's) with use of left upper extremity as a gross assistant to dominant right hand/upper extremity.

The athlete's initial rehabilitation, 13 days after the third surgery consisted of necrotic tissue debridement and passive range of motion exercises of digits II – V. Exercises expanded to include passive range of motion of the left digits, thumb, elbow, and shoulder. Pain increased considerably with all motions of the shoulder especially at mid-range. Approximately 1 month after the beginning of rehabilitation, the athlete was fitted with a wrist cock-up splint for day use and a forearm based digital extension splint for night wear. The athlete was performing active range of motion exercises of all motions for the wrist and shoulder, forearm supination/pronation, and joint blocking to all digits and thumb. The athlete displayed intermittent feelings concerning her recovery. Rehabilitation began to become monotonous and re-examinations revealed little or no progress which discouraged the athlete further.

Within two months of surgery the athlete was performing strengthening exercises against gravity in a seated position as well as performing shoulder flexion and abduction with a weighted coban. Forearm supination/pronation and elbow extension/flexion were still difficult. Though she remained positive and motivated toward her recovery there were times when she experienced frustration with pain and lack of functional progress.

Intermediate/Advanced Phase

Continued active and passive range of motion exercises for the digits, thumb, wrist, and forearm. Strengthening with free weights for the shoulder and progressive resistive exercises (PRE) and Baltimore Therapeutic Equipment (BTE). Due to the severity of the injury the entire left upper extremity was addressed during rehabilitation.

The athlete first presented with a decrease in active range of motion of the left shoulder and complaints of pain which were managed with range of motion and stretching exercises initially and later PRE's. The BTE program helped the athlete to perform resistive exercises and simulations of ADL's. At 6 months post injury the athlete utilized a rice box with objects to enhance fine motor skills. The athlete noted intermittent feelings of numbness/tingling in her hand. Additional fine motor exercises involved clothespins, flipping cards, pegs, nuts/bolts board and wringing a water soaked sponge. Eight months after the initial surgery the athlete was able to perform more functional daily activities when she directed herself to use her left forearm. At time of release (from her physician and physical therapist) the athlete had a decrease in left grip, index pinch, in forearm supination (13 degrees). Wrist ROM and PIP/DIP flexion were all within functional limits.

Fourteen months post surgery the athlete still experienced intermittent numbness/tingling in her left digits and palm. The athlete had no limitations in the home environment in regards to self-care or household activities. No significant changes were noted with wrist ROM; metacarpophalangeal (MCP) flexion had minimally decreased overall and PIP/DIP flexion was within functional limits. After years of rehabilitation she still has the desire to return to her sport and has realized through this experience that there is nothing that she cannot accomplish.

Presently the athlete still experiences intermittent numbness/tingling of her left forearm yet is functional with daily activities. She still has not been released to participate in any adventure racing or rock climbing, but 33 months after injury she maintains physical activity via road biking and a gym. Once medically released, there is

no hesitation concerning participation in adventure racing but she has realized that she will not be able to resume participation in rock climbing due to the permanent impairment of her left forearm. She cannot distinguish between hot and cold, but can feel texture. She is also lacking strength and dexterity in her forearm which is critical in the sport of rock climbing.

DISCUSSION

Early accounts of rock climbing injuries ranged from broken bones and severe lacerations to fatalities.[1-3, 7] Injuries were mostly due to faulty equipment, falling, or elements of nature.[10, 11] Most rock climbing injuries are chronic in nature, caused from repetitive performance forces that require power, skill, and technique.[7, 13] The upper extremity supports most of the bodyweight in rock climbing; and is thus predisposed to injury due to steep vertical angles.[7, 10] Knowledge of the mechanism of injury is a vital area of injury assessment. The sport of rock climbing encompasses moves and body positions unique only to these athletes. Knowledge and understanding of rock climbing mechanics can better assist the athletic trainer in evaluating injury pathology and instituting appropriate therapeutic exercises.

Prior to competitive rock climbing, researchers focused on accidental injuries due to rock climbing falls, exposure to the elements, and high altitude.[8] Recently, the studies on rock climbing and the demands placed on the body from the sport have increased. Several studies have examined the presence and type of overuse injuries associated with the high torque movements in rock climbing by surveying and examining rock climbing athletes.[10] Within the last ten years, studies on rock climbing injuries have begun to focus on specific injuries inherent to the sport, such as the disruption of the finger flexor pulley[6]

and fractures of the middle phalanx.[4] While the area of injury is consistent with the most common area of overuse injuries; literature to date that addresses the mechanism of injury or the type of rehabilitation found in this study is lacking.

This particular case study was unique because the injury that occurred was of a violent nature, over a large area of the arm with neural and vascular compromise as well as muscular and ligamentous avulsions. In addition the surgeries conducted to correct damage was unique to orthopaedics since a combination of several surgical techniques were used as well as a team of surgeons (hand specialist and plastic/vascular surgeon). Initially rehabilitation consisted of passive range of motion exercises conducted in the clinic, as well as at home. As time progressed active range of motion exercises from the shoulder complex down to the fingers were initiated; but a critical component was to monitor pain as activities were performed. The athlete did not experience a return of sensation until 6 months after her injury and currently no literature is available to support whether or not this is normal for the type of injury incurred. Throughout recovery it is critical to introduce exercises gradually, allowing the athlete and the athlete's body time to adapt

Legend of Figures

1. Figure 1: Post-Injury X-ray – Lateral View
2. Figure 2: Post-Injury X-ray – Anterior View
3. Figure 3: Anterior View of Left Forearm Post-Initial Surgery
4. Figure 4: External Fixator of Left Forearm Post-Initial Surgery
5. Figure 5: Posterior View External Fixator Post-Initial Surgery

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Figure 1: Post-Injury X-ray – Lateral View

Figure 2: Post-Injury X-ray – Anterior View

Figure 3: Post-Initial Surgery

Figure 4: Post-Initial Surgery

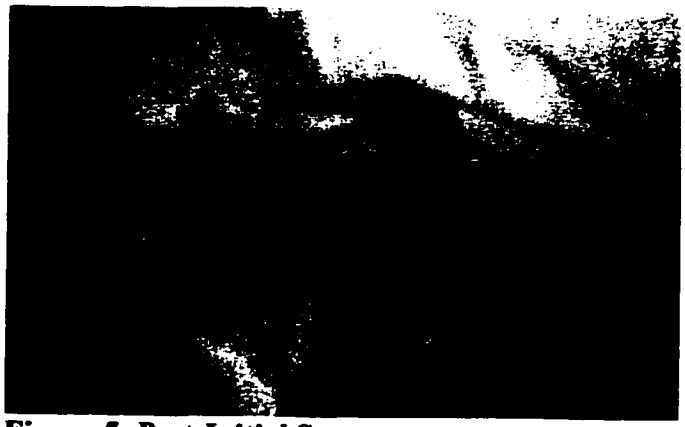

Figure 5: Post-Initial Surgery

Expanded Support Material

Project Proposal

Chapter 1

Introduction

Rock climbing as a sport has increased in the past decade to over 100,000 participants (Haas & Meyers, 1995). Rock climbing is a relatively new or extreme sport requiring a unique set of skills, biomechanics, and consequently uncommon injuries, particularly to the upper extremity. Current literature summarizes common injuries in rock climbing, but is based on questionnaires that lack depth, rehabilitation, or follow-up. In order for athletic trainers, who specialize in sport specific medical treatment, to best attend to rock climbing injuries, an in depth understanding of the demands and biomechanics of the sport are required. Therefore, the purpose of this project is to present a case study detailing one specific rock climbing injury so that athletic trainers can gain a better understanding of medical needs, treatment and rehabilitation of the sport and its injuries.

Rock climbers use unique tools to hang on ledges that may be as shallow as 5 mm. Locking hands and fingers into cracks of varying dimensions is common and may result in minor injuries to or disability of the soft tissue. Hand injuries can cause difficulties with activities of daily living, an also compromise rock climbing, thereby reducing the athlete's overall ability and security in rock climbing (Shea, Shea, & Meals, 1992). To best rehabilitate and treat rock climbing injuries, medical personnel, specifically athletic trainers, must have a good working knowledge of hand and finger injuries with specific treatment and rehabilitation for these injuries.

Prior to competitive rock climbing, researchers focused on accidental injuries due to rock climbing falls, exposure to the elements, and high altitude (Holtzhausen & Noakes, 1996). Recently, the studies on rock climbing and the demands placed on the

body from the sport have increased. Several studies have examined the presence and type of overuse injuries associated with the high torque movements in rock climbing by surveying and examining rock climbing athletes (Maitland, 1992). The majority of overuse rock climbing injuries occur in the upper extremity, particularly in the proximal interphalangeal (PIP) joint of the hand (Rohrbough, Mudge, and Schilling, 2000). Improvements in rock climbing equipment, development of indoor facilities, year-round training and competition has increased the occurrence of acute injuries becoming chronic problems. (Rooks, Johnston, Ensor, McIntosh & James, 1995). Cutts and Bollen (1993) demonstrated that forces as much as 6.5 kN act on the body during rock climbing, which results in ligamentous sprains of the back, overuse injuries of the hands, and thoracic injury.

Within the last ten years, studies on rock climbing injuries have begun to focus on specific injuries inherent to the sport, such as the disruption of the finger flexor pulley (Gabl, Rangger, Lutz, Fink, Rudisch, & Pechlaner, 1998) and fractures of the middle phalanx (Chell, Stevens, Preston, and Davis, 1999). A lack of research exists addressing issues of rehabilitation associated with hand injuries. Rehabilitation refers to the restoration of the athlete to a pre-injury level of physical and psychological competitive fitness (Arnheim & Prentice, 1993). The most effective way to address the apparent gap in the athletic trainer's knowledge in regard to extreme sports such as rock climbing is through education. Education can be accomplished through a case study analysis, examination of injuries, surgeries, and rehabilitation protocols. In order to provide medical care for athletes in extreme sports, athletic trainers must be knowledgeable in sport movements, forces acting on the body, injuries related to the sport, risk management of these injuries, and rehabilitation. This case study may aid in educating

athletic trainers on treatment, evaluation, and rehabilitation related to one rock climber's injuries.

A first responder and therapist, the athletic trainer plays a vital role in returning athletes back to competition after an injury. The athletic trainer is responsible for all phases of health care including prevention and evaluation of injuries, first aid upon injury, evaluation, treatment, as well as, rehabilitation for return to participation in a timely fashion. Medical knowledge, as well as knowledge of specific sport techniques, is necessary to assess associated injuries and take appropriate measures to insure proper management and care. Athletic trainers must maintain current medical research and practices in order to provide the best medical care to athletes as well as comply with national certification requirements of continuing education. Without continued education the athletic trainer can become ineffective in treating athletes particularly in new sport arenas. Rock climbing has only become popular in the last ten years, thus, injuries associated with these athletes are less common in traditional sports and may leave the athletic trainer unprepared to treat and rehabilitate subsequent injuries.

Statement of Purpose

The purpose of this study is to present one case study of a rock climber's unique athletic injury of the forearm involving a near avulsion amputation. Presentation of the case study will heighten awareness and expand the prevention and evaluation skills of athletic trainers in the area of rock climbing.

Significance of the Problem

Athletic trainers may not be equipped with the necessary medical information and training to effectively assess and rehabilitate a rock climbing injury (NATABOC Role Delineation Study, 1999). Rock climbing injuries are not required competencies in

athletic training education (NATABOC Role Delineation Study) (see Appendix A). Injuries within the sport involve biomechanical forces that are uncommon in the traditional athletic training setting. Typically, athletic trainers provide medical coverage and support on the professional, college, high school, and clinical levels. The development and increasing participation in extreme sports and challenge races has removed the athletic trainer out of his/her traditional confines and into a new sport realm. The education of athletic trainers spans a vast area comprising of prevention of injuries, signs/symptoms of injuries, assessment, treatment, and rehabilitation. As extensive as the athletic training education may be, it is based on traditional sports such as baseball, basketball, football and hockey. The role delineation study conducted by the National Athletic Trainers' Board of Certification identifies skills and knowledge needed to perform competently in professional practice yet only outlines general treatment/rehabilitation and evaluation (NATABOC). Thus athletic training education does not encompass specific competencies related to rock climbing therefore education in this area must be learned outside the traditional or educational setting.

Limitations

The study is limited to the following factors:

1. The inability to be present during time of original case may limit the researcher's ability to obtain complete medical records.
2. The retrospective nature of this study may preclude the subject from the ability to recall all events.
3. The injury was sustained by one person, therefore the case study is not generalizable.

Delimitations

The study is delimited to one 30 year-old rock climber who sustained a near avulsion amputation of the left forearm. The injury resulted in multiple fractures of the radius and ulna with bone lose, transection of the median and ulnar nerves and ulnar artery and transection of the flexor tendons.

Definition of Terms

Rock Climber. An individual skilled in rock climbing techniques and knowledgeable in the nomenclature and rating systems standard in the United States.

Anchor. Any tree, nut, bolt or other protection device that holds the rock climber or team to the wall, slope or cliff with ropes, slings, and carabiners.

Aid Climbing. Making use of rope or gear to support weight while ascending up a rock face.

Rappelling. Descending a rope by means of a mechanical brake device.

Sport Climbing. Rock climbing routes on which pre-placed bolts are used for protection as the climber ascends up the rock face.

Carabiner. Aluminum alloy rings equipped with a spring-loaded snap gate.

Open Grip. The open grip is used when grasping wide or large handholds.

Cling Grip. A grip where the distal interphalangeal joint hyperextends as force is exerted downward and the rock climber pulls his or her body upward.

Pocket Grip. A grip involving the placement of one or two fingers into small holes.

Pinch Grip. A grip used to grasp a projection of rock between the thumb and fingers.

Distal Interphalangeal Joint. The distal interphalangeal joint is the end joint of the four fingers of the hands.

Proximal Interphalangeal Joint. The proximal interphalangeal joint is the knuckle of the four fingers of the hands.

Epidemiology. A branch of medicine science that deals with the incidence, distribution, and control of a pathogen in a population.

Comminuted Fracture. A fracture that consists of three or more fragments at the fracture site. Generally due to a hard blow or fall in an awkward position.

Summary

The sport of rock climbing has increased in popularity over the last 10 years yet associated injuries have only recently received medical attention and research. Athletic trainers are an immediate source of care for athletes, thus specific knowledge and skills are needed to assess injuries properly. With the formation of new sporting events/competitions, athletic trainers must be aware of the biomechanical demands of the sport, movements of the sport, and overall objective of the sport. The purpose of this study is to present the case of one rock climber who sustained a near avulsion amputation of the left forearm in order to educate athletic trainers on one specific injury and rehabilitation associated with this sport.

Athletic trainers must be prepared to provide proper medical coverage and care to an athlete regardless of sport. Therefore, pursuing research in the area of rock climbing injuries will better prepare the athletic trainer to evaluate, treat, and rehabilitate these athletes. Continuing education aids athletic trainers in remaining a vital part of the athletic community. This case study will be submitted to the *Journal of Athletic Training* for publication, according to recommended policies and procedures (see Appendix B).

Chapter 2

Review of Literature

Introduction

Increases in the population of rock climbers in the past decade, coupled with an increase in skill-level and additional hours required for training on difficult routes creates a greater potential for injury. A rock climber's weight is distributed mostly through the forearm, wrist, and hand with fingers bearing most of the stress (Haas & Meyers, 1995). Fundamental understanding of the biomechanics of the sport and associated injuries enables the athletic trainer to assess and treat the injury accordingly. This case study will provide literature in an area that has received little exposure and will better prepare athletic trainers to provide medical care for rock climbing athletes. This chapter will be presented in five sections: 1) case study criteria, 2) anatomy of the elbow, forearm, wrist and hand, 3) rock climbing injuries, 4) athletic training education and 5) athletic training and sport psychology.

Case Study Characteristics

Case study research is descriptive in nature (Thomas & Nelson, 1996). The case study focuses on a single situation and expands all elements. Through an in-depth analysis of a single situation an understanding of similar situations can be achieved (Thomas & Nelson). Merriam (1988) stated that case studies are often conducted when it is not possible to manipulate the causes of behavior, the variables are not easily identified, and the researcher accepts the situation as it appears. Conducting case study research exhausts all aspects of one situation in order to understand case specifics, not differences. Case study research seeks to promote understanding through an interpretation of an individual instance and through aggregation of instances until a larger

scale research can be investigated (Stake, 1995). Merriam (1988) states that case studies are the best methodology for addressing problems in which understanding is sought in order to improve practice. Case studies are chosen because there is an interest in discovery or interpretation, rather than hypothesis testing.

Case studies have four characteristics. The first characteristic is particularistic. Case studies focus on a particular situation, event, program, or phenomenon. The case is important for what it reveals about the phenomenon and what it might represent (Merriam, 1988). The next characteristic is description. The end product of a case study is a full description of the phenomenon. Heuristic, another characteristic, increases the reader's understanding of the phenomenon; providing discovery of the new meaning and extending or confirming a reader's experience (Merriam). Case studies rely on inductive reasoning, the last characteristic, and a discovery of new relationships, concepts, and understandings rather than verification or predetermined hypotheses (Merriam).

Stake (1995) states that case study designs are not chosen to optimize production of generalizations, but presses for an understanding of the complex interrelationships. The aim of the case study is to eliminate erroneous conclusions so the most compelling interpretation is rendered (Merriam, 1988). Case study research design is needed to make familiar the strange and interesting, achieve specific understanding through documentation of concrete details of practice, consider local meanings of events that people are involved in, engage in comparative understanding of different social settings and engage in comparative understanding beyond immediate circumstances of local setting. The current project meets the requirements of a case study, in that one specific rock climbing injury is detailed in order to gain understanding of the sport and associated injuries so athletic trainers can render appropriate medical care.

Anatomy of the Elbow, Forearm, Wrist, and Hand

The elbow joint consists of three bones: the humerus, radius, and ulna (see Figure 1). The distal end of the humerus forms two articulating condyles. The lateral condyle is the capitulum and the medial condyle is the trochlea. The capitulum articulates with the head of the radius while the trochlea fits into an articulating groove called the semilunar notch (Arnheim & Prentice, 1993). Flexion and extension occur through the articulation of the trochlea with the semilunar notch on the ulna. Pronation and supination is possible due to the position of the head of the radius resting against the capitulum without any bony limitations (Magee, 1997).

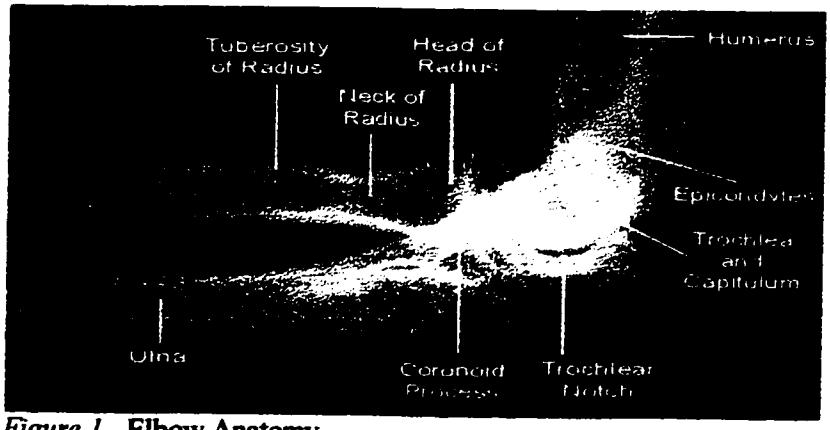

Figure 1 Elbow Anatomy
Note: Retrieved September 4, 2001, from the World Wide Web: *www.medic.uth.tmc.edu/inline/inlnimg/00000790.gif*

Three ligamentous structures are associated with the elbow, the ulnar collateral ligament, the radial collateral ligament and the annular ligament (see Figure 2). The ulnar collateral ligament is composed of a strong anterior band with weaker transverse and middle sheets (Arnheim & Prentice, 1993). The radial collateral ligament does not attach to the radius, thereby allowing free movement of the radius; unlike, the annular ligament which encircles the head and neck of the radius acts to stabilize the radial head.

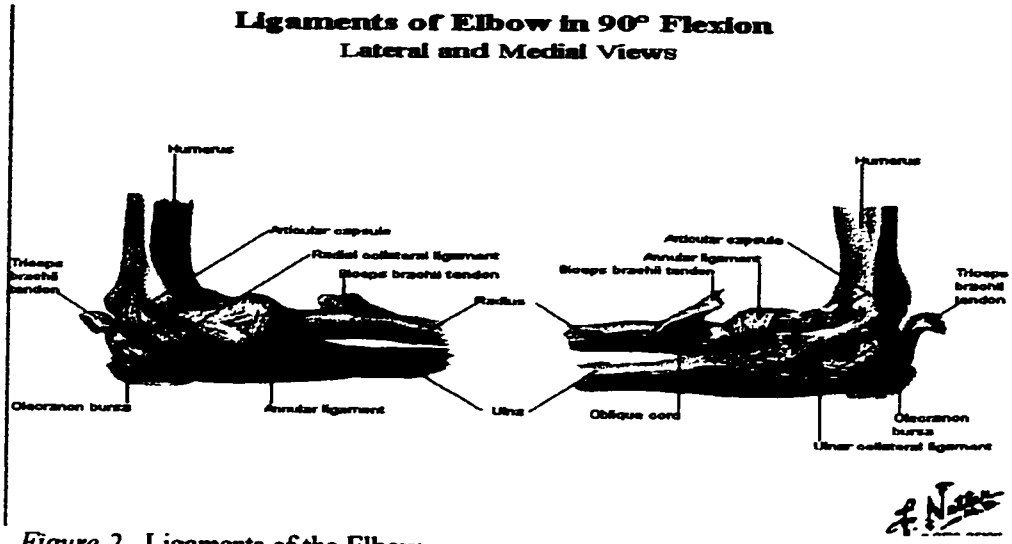

Figure 2. Ligaments of the Elbow
Note: Retrieved September 4, 2001, from the World Wide Web:
www.ma.psu.edu/~pt/384elb5.gif

The forearm consists of the radius and ulna with three articulations at the superior, middle, and distal radioulnar joints. The superior radioulnar joint is a pivot joint that moves in a ring formed by the ulna and annular ligament. The middle radioulnar joint provides a surface for muscle attachments and the superior radioulnar joint. The distal radioulnar joint, is also a pivot joint formed by the articulation of the head of the ulna with a small notch on the radius (Magee, 1997). Flexors and pronators of the forearm originate from the medial epicondyle and insert on the digits of the hand palmarly (see Figure 3). Flexor pollicis longus and brevis flex the interphalangeal and metacarpophalangeal joints of the thumb, while finger flexion occurs from the flexor digitorum profundus and superficialis. Wrist flexion is achieved by the palmaris longus, flexor carpi radialis and ulnaris. The extensors and supinators are on the backside (dorsum) of the hand and originate off of the lateral epicondyle inserting into the digits. Extensor pollicis longus and brevis assist in thumb extension and the extensor digitorum

extends the remaining four digits. Wrist extension involves the extensor carpi radialis longus and brevis as well as extensor carpi ulnaris.

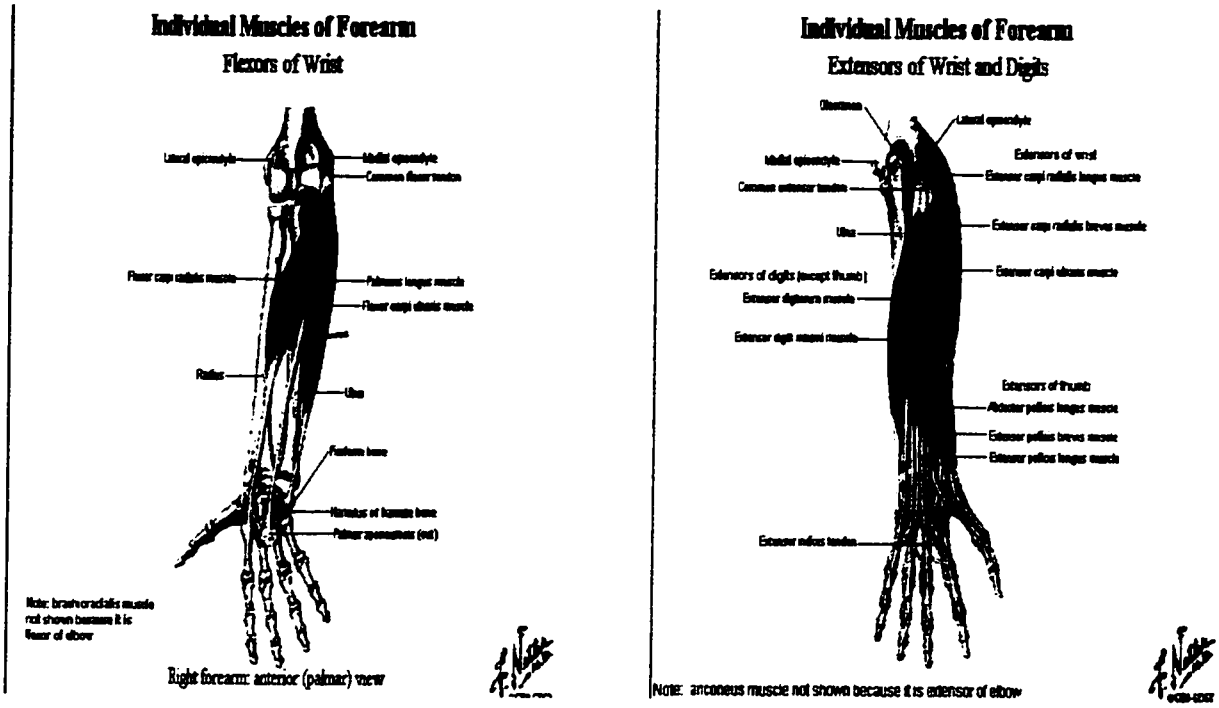

Figure 3. Muscles of the Forearm
Note: Retrieved September 4, 2001 from the World Wide Web:
www.ma.psu.edu/~pt/Wrstpost.gif & *www.ma.psu.edu/~pt/Wrstflx.gif*

The wrist is formed from the distal end of the radius, the articular disk of the ulna, and three of the eight carpal bones form the wrist. The rest of the bony structure originates from the metacarpal bones and the phalanges of the fingers (see Figures 2 & 3). Each digit has three joints (metacarpophalangeal joint, proximal interphalangeal joint, and distal interphalangeal joint), whereas the thumb is comprised of two joints (metacarpophalangeal joint and interphalangeal joint) (see Figures 2 & 3). Blood supply to the hand comes from the radial and ulnar arteries, which supply the forearm and elbow. Nerve innervation originates from the ulnar, radial, and median nerves. The injury sustained in this case study consisted of multiple fractures of the radius and ulna with bone lose, transection of the median, ulnar nerves, and ulnar artery, as well as

transection of all flexor tendons. The upper extremity distal to the elbow is the most intricate of any extremity; therefore injury to this part of the body influences the entirety of the upper extremity and body function. In the general sport population, the forearm, wrist, and hand is second in injuries to the lower extremity (Arnheim & Prentice, 1993). Typical injuries include fractures, sprains and strains; however, climbing injuries are atypical to the general sport population and require separate study to improve medical attention.

Rock Climbing Injuries

Early accounts of rock climbing injuries ranged from broken bones and severe lacerations to fatalities (Bollen, 1988). Injuries were mostly due to faulty equipment, falling, or the elements of nature. Most rock climbing injuries are chronic in nature, caused from repetitive performance forces that require power, skill, and technique. Haas and Meyers (1995) reported that 44% of all rock climbing injuries occurs at the hand and wrist region of the body, with 61% at the shoulder and elbow region. The upper extremity supports most of the bodyweight in rock climbing; this area is predisposed to injury due to steep vertical angles. The flexor digitorum profundus and superficialis tendons are exposed to a greater risk of injury as rock climbers become stronger and there is an increase in difficult routes and holds. Several studies on rock climbers have investigated the injury patterns associated with the hands and fingers.

To determine the patterns of rock climbing injuries, Maitland (1992) distributed questionnaires to rock climbers registered at the University of Calgary Outdoor Pursuits Centre climbing wall. The respondents categorized their injuries as a result of trauma, overuse, or exposure and labeled the body part on the supplied anatomical diagrams. Rating of injuries was based on the degree of pain, duration of symptoms, and level of

disability. Twenty-two traumatic injuries were incurred; injuries to the hand were the most common (28%), followed by the elbow and shoulder (19% and 8%) respectively. Traumatic injuries occurred at one-fifth the rate of overuse injuries. Sudden, uncontrolled forces, such as foot slippage, can result in sudden rotational torques on the interphalangeal joints or high forces on the finger pulleys. Overuse and traumatic injury were also common among those surveyed. In Maitland's study, injuries to the hand were due in large to uncontrolled and traumatic forces which make education in administration of immediate care and management critical.

In April 1984, 222 rock climbers seen at the Yosemite Medical Clinic or rescued by the US National Park Service's Search and Rescue team were questioned in regard to their rock climbing injuries (Bowie, Hunt, & Allen, 1988). Questionnaires solicited personal information, the route and difficulty of the climb, and details of the accident, including cause, length of fall, and mechanism of injury. The authors reported that in 3.5 climbing seasons, 222 injured rock climbers were treated for 451 injuries, an average of two injuries per rock climber. Most of the injuries occurred on rock ledges or the rock face (47%), while falls to the ground and falling rock caused 27% and 10 % of the injuries respectively. Half (50%) of the injuries were to the skin or subcutaneous tissues. Injury type ranged from external injuries (lacerations & abrasions) (53%), fractures (29%), and sprains (10%). Results in this study correlated with those in studies on the Grand Tetons and Sierra Nevada where lower extremity injuries constitute the majority of rock climbing injuries.

Biomechanics of Rock Climbing

Knowledge of the mechanism of injury is a vital area of injury assessment. The sport of rock climbing encompasses moves and body positions unique only to these

athletes. Knowledge and understanding of rock climbing mechanics can better assist the athletic trainer in evaluating injury pathology and institute appropriate therapeutic exercises. Due to the mechanical demands of rock climbing and handgrip types, certain injuries have been associated with movements in rock climbing. Four basic handgrips are used in the sport: 1) open grip, 2) cling grip, 3) pocket grip, and 4) pinch grip. The flexor tendons are susceptible to injury during the cling and pocket grips (Jebson & Steyers, 1997). The majority of weight bearing stress is transferred from the hyperextend DIP joint to the flexed PIP joint along the flexor digitorum superficialis tendon with the cling grip. Injuries associated with climbing range from flexor tendonitis or tenosynovitis, which may result in pain and swelling along the palmar surface of the digit, to flexor tendon avulsion and ruptures with similar signs of pain and swelling with an absence of active flexion of either the DIP or PIP joints.

Holtzhausen and Noakes (1996) described several rock climbing injuries detailing biomechanics as a predisposition to rock climber injury. In the static holding-on position in rock climbing, the forearm is in full pronation, the wrist in slight extension, and the fingers in flexion. The flexor digitorum superficialis and profundus transfer power generated at the muscle belly to the finger joints in order to grip small edges of rock in the static hold position. The action of pulling up towards the hold enacts the brachialis and biceps brachii into flexion of the elbow, keeping the forearm in pronation. As these movements occur, the cubital fossa, medial epicondyle, and the lateral epicondyle become areas of pain (Holtzhausen & Noakes). Thus, injuries such as tendonitis, avulsions/ruptures, and sprains of the ligamentous structures hinder the rock climber and can become progressively worse without medical attention. High compressive tensile forces are imposed upon structures such as the flexor digitorum superficialis and

profundus due to bearing the bodyweight of the rock climber in the cling grip. Thirty percent of European rock climbers suffer from interphalangeal joint effusions following extensive bouts of high-grade climbing (Holtzhausen & Noakes). Another condition that exposes rock climbers to osteoarthritis is fixed flexion deformities. Awareness of the distribution of force over the fingers can enable the athletic trainer to take preventative measures to ensure the safety of the athlete and decrease the incidence of injury.

Shea, Shea, and Meals (1992) surveyed forty-six rock climbers of varying skill levels with a questionnaire to introduce medical personnel to the manual demands and consequences of rock climbing. The survey instrument contained 60 questions concerning different aspects of rock climbing, training, injuries, and days per year spent rock climbing. An average of 118 days are spent climbing per year with three fourths (35 of 46) of the respondents reporting rock climbing-related injuries and almost one half (17 of 35) reported hand or wrist injuries. The authors outlined one case of a 21 year-old rock climber who sustained a crush injury to the right hand while shielding her head from a falling rock. She had an open fracture of the middle phalanx of the right ring finger and surgery was performed to pin the phalanx. Six years after the surgery the rock climber had no sensation distal to the old fracture and her DIP joint was stiff in full extension. Her rock climbing ability was not impaired. To prevent, treat, rehabilitate, and reduce the complications from hand injury due to rock climbing, athletic trainers must have an understanding of the manual demands of rock climbing.

Hand and Finger Rock Climbing Injuries

At times hands and fingers are the only body part in contact with rock while rock climbing. Hands and fingers contain an extensive muscular system which at times must bear the weight of the climber either in a hold position or ascending to the next hold.

Forty-two contestants of the 1995 American Sport Climbing Federation National Championships were evaluated by an injury questionnaire and a hand and upper extremity examination. Rohrbough, Mudge and Schilling (2000) investigated the nature and location of pain, type and difficulty of movement causing injury, and duration and intensity of the pain. Bowstringing at the PIP joint and proximal phalanx, PIP collateral ligament laxity and tenderness, loss of active range of motion of the PIP joint, and strength of the FDS and FDP muscles were the specific pathology tested during the examination. Of the 126 injuries among the 42 rock climbers, 63% involved the hand and 37% involved other regions of the upper extremity. Researchers also identified that the participants who sought medical advice felt that the doctors held no appreciation for the demands of rock climbing. Thus to provide efficient care medical personnel must have a working understanding of the sport to appropriately evaluate injuries.

Gabl, Rangger, Lutz, Fink, Rudisch and Pechlaner (1998) was one of the first researchers to establish protocols to diagnosis and treat disruptions to the flexor tendon pulley system of the fingers, as well as to evaluate results after nonoperative and operative treatment. Over four years, researchers treated 13 elite rock climbers for isolated disruptions of the flexor tendon pulley system of the fingers. Upon examination, palpation revealed swollen, painful finger sections and tenderness of the injured flexor tendon pulley system. Range of motion in the PIP joint was restricted and forced flexion caused protrusion of the flexor tendons. Indication for nonoperative and operative treatment was based on clinical findings of bowstringing, functional disability, persistent pain, failure of nonoperative treatment, and amount of bowstringing in involved flexor tendons. During follow-up, the nonoperative group had a reduction of 5.6° of PIP joint range of motion while all other finger joints moved freely. The operative group had a

reduction of 4° PIP joint range of motion. Both groups were able to return to their previous level of rock climbing. All patients noted a decrease in grip strength. Outlining signs and symptoms associated with climbing injuries can aid in determining the correct rehabilitative process thereby decreasing time off from the sport.

Swelling of the interphalangeal joints of the fingers is common among more experienced rock climbers and is usually diagnosed as tendonitis or tensynovitis. A case report by Chell, Stevens, Preston and Davis (1999) examined a 15 year-old male rock climber who originally went to the hospital with bilateral painful swelling of the proximal interphalangeal joints of the middle fingers. A spontaneous occurrence decreased range of motion bilaterally; pain and tenderness were also identified. Radiographs revealed bilateral Salter-Harris type III fracture of the base of the middle phalanges. The Salter-Harris type III fracture is a partial or complete rupture of the annular pulley of the flexor sheath that leads to bowstringing of the tendons or fixed flexion deformity. Mobilization was encouraged along with rest from activity. The extensor apparatus, in this case, attaches at the epiphysis and with the trauma of rock climbing can result in the splitting of the epiphysis (Salter-Harris type III fracture). Six weeks post x-rays revealed that the patient had regained full range of motion, but still experienced swelling and pain. For three months the symptoms remained the same; a MRI scan identified the fractures along with some edema. Within a year the patient was pain free. Diagnosis in this case was later confirmed as congenital split epiphyses. This type of injury is commonly found in the great toe and due to the location in the fingers, was initially misdiagnosed. This injury occurred in the hand because the strong ligamentous structures and musculature pull on the bone resulted in an epiphyseal separation. Case studies such as the one

mentioned above help to increase awareness among the medical community so that assessments do not result in miss-diagnosis and return from injury is not prolonged.

Rooks, Johnston, Ensor, McIntosh and James (1995) used the same questionnaire structure for previous studies, but the athletic population in this study was recreational rock climbers. In September 1993, a group of rock climbers were asked to respond to a questionnaire detailing previous rock climbing injuries, rock climbing experience and ability, medical illnesses, occupation, and other demographic data. Each rock climber had a complete musculoskeletal history and physical examination directed at the upper extremity. Either an orthopaedic resident or a qualified hand therapist performed all examinations. Thirty-nine rock climbers completed the questionnaire and 36 had physical examinations. Rock climbing experience averaged 5 years with more than half having less than three years. Half of the participants had histories of significant injuries, usually a pulled muscle or laceration. Six of the 39 rock climbers suffered a major injury from a fall ranging from ankle fractures, a broken finger, rib fractures, and quadriceps rupture. Conditions most commonly found (17 of the 36) involved the digital flexors and wrist tendons. Elite rock climbers appear to sustain more PIP joint or digital pulley injuries (50% to 69%) compared with only 19% in this study's recreational rock climbing group. Regardless of rock climbing ability, injuries sustained are in the same region of the hand and wrist and similar in severity.

Much of the focus on rock climbing injuries revolves around the hand and fingers and the overuse injuries that take place at these areas from continuous loading and unloading of the digits in certain movements. During a rock climbing competition, Bollen and Gunson (1990) had 67 male competitors participate in a pre-competition medical check-up. The athletes were examined and in each case a history of previous

injury including mechanism and relevant clinical findings were recorded. Eighteen rock climbers had previous acute injuries to the proximal phalanx occurring from falling or slipping while holding onto a small hold or pulling up on a small hold with one or two fingers. These rock climbers experienced pain and swelling and at the time of the examination displayed bowstringing of the flexor tendons.

Another common injury identified was fixed flexion deformity of the PIP joints. Sixteen rock climbers had bilateral deformities that fixed the finger in 10 to 15 degrees of flexion. Currently no precise reason for the fixed flexion deformity exists. One theory is that the deformity occurs from inflammation in the joint due to abnormally high loading of the fingers while rock climbing or training. Fingers, generally, are in a state of rest as the inflammation settles eventually resulting in a joint contracture. Literature has not thoroughly or conclusively addressed the issue; therefore, no other rationale for the deformity exists. Due to the lack of research in the area of rock climbing injuries, medical personnel cannot effectively assess and treat injuries which arise, leaving the athlete in a continuous state of pain.

The British Mountaineering Council was formed to investigate training methods in rock climbing. Bollen (1988), a member of the British Mountaineering Council investigated the soft tissue injuries sustained during intensive periods of training or rock climbing in order to identify the problem areas and formulate an appropriate training regimen. A questionnaire with diagrams was circulated at the "Rock Symposium" at the National Centre for Outdoor Activities at Plas-Y-Brenin. Interviews supplemented the questionnaire. Seventy-six males and 10 females responded to the questionnaire; these respondents were classified as elite athletes who rock climbed at "extreme" standards. A total of 115 injuries were symptomatic for 10 days or longer. The majority of the injuries

(89%) were to the upper extremity with nearly half of these occurring during training. Injuries to the lower extremity varied from sprains of the ligamentous structure of the knee to tendonitis of the patella. Bollen also discovered that in the upper extremity, 50% of the injuries were confined to the hand and wrist region. The mechanisms of injury were falls while gripping small holds; a painful PIP joint was commonly reported (69%).

The purpose of this study was to examine the increasing number of injuries by rock climbers preparing for their sport. The number of injuries identified among rock climbers and apparent lack of related research necessitate the need for further study of the sport, mechanism of injuries, and best treatment protocols. Studies presented in this section represent the small number of research studies that have been conducted on rock climbing injuries. The large number of injuries sustained and the type of injuries warrants further education on the subject in order to better prepare the athletic trainer to care and treat these athletes.

Athletic Training Education

The athletic trainer is a unique health care provider responsible for the care and treatment of athletes and their injuries on a daily basis. Athletic trainers prevent injuries, administers first aid and injury management, evaluate injuries, and design rehabilitation programs for the athletes' timely return (Arnheim & Prentice, 1993). The governing body of athletic trainers in 1999 extensively defined the practices of an athletic trainer by assessing competencies deemed necessary to practice. These competencies comprise the national certification exam by outlining an educational system. The National Athletic Trainers' Association Board of Certification (NATABOC, 1999) national certification examination serves as a primary means to document that an individual possesses the knowledge and skill required for competent performance within the profession

(NATABOC). The NATABOC national certification examination serves as a source of protection for the public, ensuring that those individuals who have passed the examination have met specific criteria and have proven to be competent. Six domains outlined in the Role Delineation Study define the athletic trainers' duties and areas of educational competency (NATABOC): 1) risk management; 2) assessment and evaluation; 3) acute care, general medical conditions and pathology of injury and illness, pharmacological aspects of injury and nutritional aspects of injury; 4) therapeutic exercise and modalities; 5) health care administration; professional development and research; and 6) psychosocial intervention (see Appendix A). Treatment of the injury incurred by the climber, near avulsion amputation of the left forearm, encompasses all six domains set by the NATA. Therefore it is essential that the athletic training professional be competent in treatment of this injury from both a legal and ethical perspective.

The first delineated domain is risk management. Risk management as defined for athletic training is the ability to recognize risks associated with injury and implementing a plan to minimize any adverse effects. In order to devise this plan, certified athletic trainers must understand the demands and affects of each particular sport on the anatomy, physiology, and biomechanics of the body. The certified athletic trainer must be able to design conditioning programs, nutritional programs, fit protective equipment, and perform pre-participation screenings which are required to understand intricacies of each sport. Within the domain of assessment and evaluation an understanding of the pathomechanics and predisposing factors of an injury must be mastered in order to properly evaluate an injury or illness. Upon injury, a certified athletic trainer must be able to obtain a thorough history of the injury, visually inspect the injured area, determine pertinent bony landmarks and soft tissue structures, and perform the correct special tests.

After completion of these actions, the athletic trainer must formulate an impression of the injury and decide what further actions are to be taken to ensure the athlete's health and well-being.

Due to the nature of sports, certified athletic trainers must be capable of performing standard measures of care that include CPR and first aid for life-threatening and other emergency conditions (Domain 3). Emergency plans must be devised and practiced and techniques such as equipment removal and spine boarding/immobilization are also a part of the competency of an athletic trainer. The certified athletic trainer has the necessary skills and knowledge to assess the status of injuries, illnesses, or conditions in order to determine the appropriate treatment, rehabilitation, and/or reconditioning. Administering therapeutic exercise and modalities for treatment facilitates recovery and function. Health care administration and professional development, the fifth domain, consists of possessing the abilities to plan, write policies and procedures, comply with standards, manage finances and personnel, and maintain records. The last domain within the profession of athletic training focuses on the continuing education and practices of the athletic trainer, thereby continuing development of the profession. In this area, the athletic trainer must keep up to date on research, and adhere to statutory, regulatory, and case laws related to the practice. The current case study seeks to address all domains of athletic training by increasing knowledge through one particular injury to better treat, evaluate, rehabilitate, and record such an injury particularly since the specifics of the sport of rock climbing (i.e. mechanism of injury, equipment, and special rehabilitation needs) are not specifically taught in athletic training education programs (NATABOC 1999).

Athletic Training and Sport Psychology

Athletic participation has been a part of society since the Greeks, but little has been focused on the preparedness of the entire athlete. An athlete is comprised not only of the physical self, but also the mental and emotional self. Sport psychology examines those psychological factors influencing participation and performance in sports as well as the effects from these factors (Williams, 1998). Studies in this area of research have examined motivation, personality, violence, leadership, group dynamics and numerous other dimensions of participation (Williams). Sport psychology also uses interventions to enhance mental health of the athlete thereby increasing exercise participation. In the late 70's the field of sport psychology devoted its attention to an athlete's thought and images. It was believed that how athletes think could influence how they perform (Williams). With today's technology, athletes are stronger and quicker than ever before. Physical dominance has become a possibility for all athletes, but despite physical prowess no athlete is immune to injuries. An injury, regardless of severity, is difficult for any athlete to handle; not being able to train or play can scar an athlete emotionally and mentally. Rehabilitation focuses on the repair of the injured body part; performing exercises which will aid in the healing of the bone or tissue. Little attention is placed on the mental and emotional concerns of the athlete (Williams, Rotella, & Heyman, 1998).

An injured athlete can experience fears of reinjury, injury to another body part, lowered confidence resulting in a decrease in performance and even depression none of which are addressed during the rehabilitation process (Williams et al., 1998). As the primary health care provider, athletic trainers are in the ideal position to help athletes heal both psychologically and physically.

Larson, Starkey, and Zaichkowsky (1996) mailed 1,000 surveys to practicing athletic trainers to compare their perceptions of attitudes, beliefs, and application of a variety of psychological techniques used with injured athletes. The majority of athletic trainers surveyed were employed at the high school level (38.2%) with the rest comprising of employment at the clinical (25.9%), college/university (24.7%) and professional (11.2%) levels. The athletic trainers answered nine-questions which revealed that 261 (54.1%) had taken a formal sport psychology course, with close to half (51.7%) taking a course in their undergraduate studies. Many of the athletic trainers (47%) reported that athletic injuries affected an athlete psychologically and recognized the need to address these issues during rehabilitation. Feelings of anxiety was encountered by 71% of the athletic trainers with over half stating that anger was most often encountered with the athlete. Intervention techniques used were keeping the athlete involved with the team, developing short-term goals, encouraging positive self-thoughts, creating variety in rehabilitation exercises and encouraging effective communication skills.

At a large regional meeting of athletic trainers, 49 males and 66 females were surveyed by Wiese, Weiss and Yukelson (1991) to present their attitudes and beliefs on the application of psychological techniques in injury rehabilitation. The first question entailed identifying characteristics of athletes who had coped most and least successfully with injury rehabilitation, the second question asked for a list of techniques used to facilitate psychological coping with rehabilitation and the last question rated 12 psychological strategies that athletic trainers should have knowledge about. It was found that athletes who were willing to listen to the athletic trainer, held a positive attitude, willing to learn about the injury, determination and used goal setting were successful in

their rehabilitation. The numerous strategies used by the athletic trainers were positive reinforcement, focus on short-term goals, realistic timeline to recovery and variety in rehabilitation exercises. The results of this study revealed that athletic trainers feel that psychological skills and techniques are important to the injury rehabilitation program but most psychological techniques are not employed by the athletic trainer.

Crossman and Jamieson (1985) had 43 athletes, 30 males and 13 females, complete questionnaires while waiting to undergo treatment at the Sports Medicine Clinic. The questionnaires included a state anxiety questionnaire, mood scale, and a set of questions on how the athlete perceived the effects of injury. Injuries ranged from tears or sprains of ligaments or muscle, separations, dislocations and fractures. There was also another questionnaire completed by the athletic trainer to provide an objective assessment of the seriousness of the injury. The athletes rated the seriousness of the injury significantly higher than the athletic trainer. There was also a correlation between the overestimation of the seriousness and the amount of pain, duration of pain, and state anxiety. Those athletes who overestimated the seriousness of the injury as well as the pain also experienced more anxiety, feelings of loneliness, anger and apathy. Athletic trainers play a critical role in the recovery of athletic injuries. In the sport of rock climbing traumatic injuries such as the one in this particular case study are possible at any moment, addressing the physical as well as psychological needs of the athlete can make the recovery process a success.

Summary

Rock climbing is a sport that emphasizes both physical and emotional challenges. Repetitive, high-torque movements have been associated with a unique distribution of overuse injuries in this population (Maitland, 1992). An understanding of the manual

demands of rock climbing leads to several recommendations. Rock climbers and medical personnel need to be informed of possible injuries associated with rock climbing maneuvers that place much, if not all, of the body weight on one or two fingers (Shea et al., 1992). Presently there is a lack of hand injuries reported in the medical literature, despite the apparent increase in participation (Bollen & Gunson, 1990). Little guidance on appropriate training methods, prevention of injuries, and rehabilitation of injuries exist for rock climbers.

Current literatures summarizes different and common injuries in rock climbing, but are based on questionnaires and lack depth, rehabilitation, or follow-up. In the last ten years, studies have been conducted to identify specific injuries such as flexor disruption or phalanx fractures, but do not define the treatment or rehabilitation program utilized to return the rock climber back to his or her previous level of competition.

In the NATABOC (1999) role delineation study, under the first domain of risk management, the certified athletic trainer must understand the demands of a sport as they affect anatomical, physiological, and biomechanical structure and function. Rock climbing is a sport that has become popular due to the development of the indoor rock climbing facility and the popularity of competitions such as the X-games. More individuals are rock climbing and more individuals are getting injured from the sport yet medical coverage remains in traditional arenas of football, baseball, and basketball. The domains of athletic training are the working structures of the profession forming the criteria that all athletic trainers must demonstrate to be a professional in this setting. An athletic trainer cannot efficiently assess and evaluate an injury if there is a lack of understanding of the sport and the stresses placed on the body when the athlete moves from hold to hold as the rock climber does (Domain 2). Rock climbing is an outdoor and

indoor sport in which rock faces hundreds of feet high are scaled leaving the rock climber exposed to environment conditions as well as internal conditions of rock climbing. Should a life-threatening emergency occur the athletic trainer is neither familiar nor able to use the equipment of the sport in order to institute emergency plan measures (Domain 3). The fourth domain, therapeutic exercise and modalities, is used to return the athlete back to sport. The athletic trainer is not knowledged in the particular movements of rock climbing therefore will not be prepared to develop therapeutic programs which will aid recovery and function within the sport. This case study encompasses several of the domains and will better aid the athletic trainer in obtaining knowledge about rock climbing injuries.

Current methods of medical care from athletic trainers need to be enhanced and expanded to include extreme sports such as rock climbing. Therefore, new areas of research may be necessary to find more efficient measures of treating and rehabilitating rock climbing injuries and returning the athlete back to play within a timely fashion. A comprehensive case study on a particular rock climbing injury focusing on treatment and rehabilitation utilized to regain function of the forearm, wrist, and hand region after a life-altering accident is one way to address the lack of athletic training exposure to rock climbing injuries. The following chapter outlines the methodology used to conduct the proposed case study.

Chapter 3

Method

The X-games and similar competitions have increased in popularity and athletic participation. A new venue of medical coverage for athletic trainers has been created with these new types of extreme athletes, like rock climbers. A foundation in extreme sport biomechanics can better assist athletic trainers to evaluate and rehabilitate injuries. The purpose of this study was to describe a rock climber's near avulsion amputation of the left hand to heighten awareness and increasing the knowledge of medical personnel in providing care and coverage for athletes of extreme sports. This chapter outlines the methodology for this study in three sections:

1) research design, 2) participant, and 3) procedure.

Research Design

The case study design was selected as an appropriate research method for several reasons. Case studies center on an in-depth analysis of one particular situation that leads to a greater understanding of an issue (Thomas & Nelson, 1996). First, this study involved one participant who sustained a unique injury with multiple factors. Secondly, the extensiveness and rarity of the injury best suit the descriptive feature of case studies. Lastly, the rarity but increasing popularity of rock climbing and apparent needs for increased education on rock climbing injuries supported the design choice. Case studies allow for the reporting of atypical situations that tend to give insight to specific instances without making generalizations to typical cases (Merriam, 1988). Case studies according to Stake are both a process of inquiry about the case and the product of that inquiry. Stake (2000) says the aim of the inquiry is towards understanding of what is important about the case within its own world. The design develops what is perceived to be the

case's own issues, contexts, and interpretations, its thick description (Stake). Thus describing the case in an in-depth descriptive narrative aids the reader to experience these happenings and draw conclusions (Stake). Through the development of a case study, athletic trainers can apply knowledge of this study involving a particular rock climber to similar situations. Education and applied knowledge acquired from the case study will better prepare athletic trainers to administer proper medical care and coverage for rock climbers.

Participant

The rock climber proposed for case study sustained comminuted fractures to the radius and ulna, ruptured the tendons of the flexor digitorum profundus (FDP) and superficialis (FDS) and pollicis longus, and severed the ulnar artery and nerve. In the two years that followed, the athlete underwent several surgeries and extensive rehabilitation to regain motion and function of the arm. A 30 year-old healthy, female rock climber participated in this study. The participant has been rock climbing for more than ten years and is a member of an adventure racing team. At the time of the injury, the team was practicing ascending at the Delaware Water Gap (New Jersey) for an upcoming race. The participant was asked to participate in the study in the summer of 2001 and voluntarily agreed to take part in the study.

Procedures

Upon approval from Human Subjects, contact was made via letter to the participant (see Appendix C). The letter detailed the background of the researcher; explained the reason for contact, and requested permission to contact physicians and physical therapist involved with the participant's treatment (see Appendix D). The researcher sent a signed (by the participant) authorization letter to the doctors and

physical therapist involved with her recovery (see Appendix E) granting a release of all medical information requested to the researcher for the purpose of this case study. Medical information requested included the patient's ER trauma report, operative reports, post-surgical reports, inter-office memos, and rehabilitation program. A phone interview was also conducted between the researcher and participant in order to gain insight into the emotional and mental recovery of the participant during her rehabilitation (see Appendix F).

Research of the literature was conducted in order to obtain a better understanding of the injury and the course taken towards recovery. Research covered forearm, wrist, and hand injuries in sports; rock climbing injuries, and finger and hand injuries in rock climbing. Medline Internet Explorer and Google were used to find information on forearm, wrist, and hand injuries in sports and rock climbing. Research was derived from medical journals such as, but not limited to: *Clinical Journal of Sport Medicine*, *Sports Medicine*, *Journal of Hand Surgery*, *British Journal of Sports Medicine* and *The American Journal of Sports Medicine*. Information from the doctors and physical therapist was evaluated and placed into a timeline to determine treatment and rehabilitation.

A peer debriefer assisted the researcher in evaluating the timeline of treatment and rehabilitation by offering a professional opinion on any significant trends apparent in the timeline. The peer debriefer was a certified athletic trainer with 10 years of experience at the college setting and a doctorate in education. The peer debriefer suggested dividing the rehabilitation into two phases: early and intermediate/advance. Two years worth of rehabilitation was condensed into the two phases and it was decided to split the focus between the exercises, goals, and progress of the athlete throughout that time.

Professional experience of the researcher and peer debriefer aided in the decisions of which exercises were critical to include. The peer debriefer also guided the researcher in implementing the athlete's mental/emotional status throughout the article. Evaluation, treatment, and rehabilitation was richly described and intertwined with pertinent research. The case study was compiled into a journal article for the *Journal of Athletic Training* according to the *AUTHOR'S NOTES* (see Appendix B).

Summary

One rock climbing injury was presented in a case study format to educate athletic trainers about one specific injury in the sport of rock climbing to better administer medical care. Tools used to collect data for the case study included medical journals, the athlete's medical history forms, x-ray's, and rehabilitation notations from the doctors and physical therapist. Once all materials were compiled and assessed, information was presented as a case study; an article was submitted to the *Journal of Athletic Training* for publication.

Early accounts of rock climbing injuries ranged from broken bones and severe lacerations to fatalities. Injuries were mostly due to faulty equipment, falling, or elements of nature. Most rock climbing injuries are chronic in nature, caused from repetitive performance forces that require power, skill, and technique. The upper extremity supports most of the bodyweight in rock climbing; and is thus predisposed to injury due to steep vertical angles. Knowledge of the mechanism of injury is a vital area of injury assessment. The sport of rock climbing encompasses moves and body positions unique only to these athletes. Knowledge and understanding of rock climbing mechanics can better assist the athletic trainer in evaluating injury pathology and instituting appropriate therapeutic exercises.

Prior to competitive rock climbing, researchers focused on accidental injuries due to rock climbing falls, exposure to the elements, and high altitude. Recently, studies on rock climbing and the demands placed on the body from the sport have increased. Several studies have examined the presence and type of overuse injuries associated with the high torque movements in rock climbing by surveying and examining rock climbing athletes. Within the last ten years, studies on rock climbing injuries have begun to focus on specific injuries inherent to the sport, such as the disruption of the finger flexor pulley and fractures of the middle phalanx. While the area of injury is consistent with the most common area of overuse injuries, literature to date that addresses the mechanism of injury or the type of rehabilitation found in this study is lacking.

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APPENDIX A

ATHLETIC TRAINING COMPETENCIES

Risk Management and Injury Prevention

Teaching Objective 1:
The student will perform anthropometric measurement techniques and other appropriate examination and screening procedures.

Specific Outcomes

1. The student will assess the following:
   a. height
   b. weight
   c. blood pressure
   d. pulse
      manual
   e. limb girth
   f. limb length
   g. using a Snellen eye chart
   h. body composition, using a skinfold caliper and appropriate formulas

Teaching Objective 2:
The student will perform fitness tests and record and interpret the data using accepted procedures and equipment.

Specific Outcome

1. The student will demonstrate the ability to perform and evaluate the results of the following tests:
   a. flexibility tests
   b. strength (repetition) testing
   c. agility tests
   d. speed tests

Teaching Objective 3:
The student will demonstrate the ability to 1) obtain and interpret environmental data, 2) recognize potential hazardous conditions and situations in the activity setting, and 3) make the appropriate recommendations for activity.

Specific Outcomes

1. The student will
   a. use a sling psychrometer
   b. use a wet bulb globe index
   c. interpret and present environmental data for the following conditions: heat; wind; humidity; potential for lightning strike; cold; poor air quality
   d. check an activity setting for physical and/or environmental hazards
   e. use and interpret weight charts

Teaching Objective 5:
The student will demonstrate the ability to select and fit standard protective equipment that provides safe and healthy participation in physical activity.

Specific Outcomes

1. The student will select and fit the following protective equipment:
   a. protective helmet and head gear
   b. protective shoulder pads
   c. footwear for physical activity
   d. mouth guard
   e. rib brace/guard
   f. prophylactic ankle brace
   g. prophylactic knee brace

Teaching Objective 6:
The student will operate and instruct the use of isometric, isotonic, and isokinetic weight training equipment.
Specific Outcomes

1. The student will demonstrate the ability to establish repetition maximum tests.
2. The student will demonstrate the ability to perform an isokinetic test for the knee and shoulder.
3. The student will demonstrate the ability to interpret data obtained from isokinetic testing and to use this information to determine appropriate follow-up care.
4. The student will perform isometric tests for the following parts of the body:
   a. ankle
   b. foot/toes
   c. knee
   d. hip
   e. trunk/torso
   e. shoulder
   f. elbow
   g. wrist
   h. hand/fingers
5. The student will perform the following tests:
   a. upper body strength test
   b. lower body strength test
   c. upper body power test
   d. lower body power test
   e. upper body muscular endurance test
   f. lower body muscular endurance test

Teaching Objective 7:
The student will instruct and demonstrate for the client specific flexibility exercises and activities.
Specific Outcome

1. The student will select range-of-motion exercises and activities for all major muscle groups and their associated joints and instruct a client to perform these exercises. The exercises must include the following body regions and joints:
   a. cervical region
   b. shoulder: joint and girdle
   c. elbow
   d. wrist
   e. hand and fingers
   f. lumbar region
   g. hip and pelvis
   h. knee
   i. leg
   j. ankle
   k. foot and toes

Teaching Objective 8:
The student will demonstrate the ability to instruct and establish a safe environment for the use of strength and conditioning equipment.
Specific Outcomes

1. The student will demonstrate the proper lifting technique for the following exercises:
   a. parallel squat
   b. heel raises
   c. power clean
   d. bench press
   e. shoulder press
   g. arm curl
   h. triceps extension
   i. knee curl (flexion)
   j. knee extension
   k. leg press

f. dead lift

2. The student will demonstrate the proper spotting technique for the following exercises:
   a. parallel squat
   b. shoulder press
   c. dead lift
   d. bench press
   e. power clean

Teaching Objective 9:
The student will demonstrate the ability to construct custom protective devices. These devices include, but are not limited to, those that protect contusions, sprains, strains, wounds, and fractures from further injury.

Specific Outcomes

1. The student will construct, apply, and remove the following protective devices:
   a. bony prominence pad
   b. muscle contusion pad
   c. soft playing cast (e.g., silicone, thermofoam)
   d. hard, immobilization splint or cast (e.g., thermoplastic, plaster, fiberglass)
   e. friction pad ("doughnut" pad)
   f. checkrein device

Teaching Objective 10:
The student will demonstrate the ability to select and apply preventative and protective taping, wrapping, splinting, bracing, and rehabilitative devices in order to prevent further injury.

Specific Outcomes

1. The student will demonstrate the ability to tape, splint, wrap, pad or brace the following joints to limit motions:
   a. cervical spine
   b. shoulder joint and girdle
   c. elbow
   d. wrist
   e. hand and fingers
   f. lumbar spine
   g. hip and pelvis
   h. knee
   i. leg
   j. ankle
   k. foot and toes

Assessment and Evaluation

Teaching Objective 1:
The student will conduct static and postural evaluation and screening procedures.

Specific Outcomes

1. The student will recognize the following postural deviations and predisposing conditions:
   a. kyphosis recurvatum
   b. lordosis
   c. scoliosis
   d. pelvic obliquity
   e. tibial torsion
   f. hip anteversion and retroversion
   g. genu valgum, varum, and
   h. rearfoot valgus and varus
   i. forefoot valgus and varus
   j. pes cavus and planus
   k. foot and toe posture
2. The student will perform a postural assessment of the following:

a. cervical spine and head
b. shoulder
c. lumbo-thoracic region
d. hip and pelvis
e. knee
f. ankle, foot, and toes

3. The student will identify and classify body types as
   a. endomorph
   b. ectomorph
   c. mesomorph

Teaching Objective 2:
The student will perform record keeping skills while maintaining patient confidentiality.
Specific Outcomes
1. The student will
   a. use standardized record keeping methods (e.g., SOAP, HIPS, HOPS)
   b. select and use injury, rehabilitation, referral, and insurance documentation
   c. use progress notes

Injury Evaluation and Physical Examination Skills
Teaching Objective 3:
The student will demonstrate the ability to palpate anatomical structures.
Specific Outcomes
1. The student will identify and palpate the following:
   a. bony landmarks of the head, trunk, spine, scapula, and extremities
   b. soft tissue structures of the head, trunk, spine, and extremities
   c. abdominal and thoracic structures
   d. primary neurological and circulatory structures

Teaching Objective 4:
The student will assess neurological responses.
Specific Outcomes
1. The student will identify and assess the following:
   a. cranial nerves
   b. dermatomes
   c. myotomes
   d. deep tendon reflexes
   e. pathological reflexes

Teaching Objective 5:
The student will perform proper clinical evaluation techniques, including range-of-motion testing (active, passive, assisted).
Specific Outcomes
1. The student will qualitatively assess active, passive, resistive range of motion for the following:
   a. temporomandibular joint
   b. cervical spine
   c. shoulder
   d. elbow
   e. wrist and hand
   f. thumb and fingers
   g. hip
   h. lumbar spine
   i. thoracic spine
   j. knee
   k. ankle
   l. foot and toes

Teaching Objective 6:

The student will perform clinical evaluations of major body areas to assess and interpret for injury and illness.

Head and Face Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual.
2. observe and identify the clinical signs and symptoms associated with head injury:
   a. amnesia (retrograde or post-traumatic)
   b. levels of consciousness
   c. orientation (person, time, place orientation)
   d. intracranial hematoma
   e. balance and coordination
   f. pupil and eye movements
   g. pulse
   h. blood pressure
   i. facial postures
3. observe and identify the clinical signs and symptoms associated with eye injuries and illnesses:
   a. orbital blowout fracture
   b. conjunctivitis
   c. corneal abrasion
   d. corneal laceration
   e. detached retina
   f. hyphema
   g. stye
4. observe and identify the clinical signs and symptoms associated with an ear injury or illness:
   a. pinna hematoma ("cauliflower ear")
   b. impacted cerumen
   c. otitis externa
   d. otitis media
5. observe and identify the clinical signs and symptoms associated with nose injury:
   a. deviated septum
   b. epistaxis
   c. nasal fracture
6. observe and identify the clinical signs and symptoms associated with jaw, mouth, or tooth injury or illness:
   a. gingivitis
   b. mandibular fracture
   c. maxilla fracture
   d. periodontitis
   e. temporomandibular joint dislocation
   f. temporomandibular joint dysfunction
   g. tooth abscess
   h. tooth extrusion
   i. tooth fracture
   j. tooth intrusion
   k. tooth luxation
7. administer appropriate sensory, neurological, and circulatory tests
8. administer functional tests and activity-specific tests
9. identify, palpate, and assess the integrity of bony landmarks
10. identify, palpate, and assess the integrity of soft tissue
11. administer commonly used special tests to make a differential assessment of the following:
    a. cranial nerves (e.g., eye motion, facial muscles)
    b. cognitive tests (e.g., recall, serial 7s, digit span)
    c. cerebellar function (e.g., Romberg's test, finger-to-nose test, heel-toe walking, heel-to-knee standing)
    d. spinal nerve roots (e.g., upper quarter screen)

Cervical Spine Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. atrophy
   b. dislocation or subluxation
   c. vertebral fracture
   d. head and neck posture
   e. intervertebral disc herniation
   f. nerve root compression or stretch
   g. ischemia
   h. torticollis
3. administer active and passive range-of-motion tests using quantifiable techniques (e.g., tape measure, goniometer, and inclinometer)
4. use manual muscle-testing techniques
5. administer appropriate sensory, circulatory, and neurological tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and assess the integrity of bony landmarks
8. identify, palpate, and assess the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following:
   a. nerve root compression (e.g., distraction/compression test, Spurling's test, shoulder depression test)
   b. brachial plexus neuropathy (e.g., brachial tension test, Tinel's sign)
   c. cervical disc herniation (e.g., Valsalva's maneuver)
   d. neurovascular dysfunction (e.g., vertebral artery test)

Shoulder Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active ndividual
2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. atrophy
   b. bursitis
   c. dislocation or subluxation
   d. efficiency of movement
   e. fracture
   f. sprain
   g. nerve injury
   h. positioning (Sprengel's deformity)
   i. strain
   j. scapulohumeral rhythm
   k. scapular winging
   l. step deformity
   m. symmetry
   n. tenosynovitis and tendonitis
3. administer active and passive range-of-motion tests using standard goniometric techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify and palpate bony landmarks
8. identify and palpate soft tissue landmarks

9. administer commonly used special tests to make a differential assessment of the following
   a. glenohumeral instability (e.g., anterior drawer test, posterior drawer test, relocation test, apprehension test, clunk test, sulcus sign)
   b. acromioclavicular instability (e.g., shear test, compression test)
   c. rotator cuff impingement/inflammation (e.g., Speed's test, drop arm test, empty can test, impingement test, Hawkins-Kennedy impingement test, Neer impingement test, pectoralis major contracture test)
   d. biceps and biceps tendon pathology (e.g., Yergason's test, Ludington's test)
   e. thoracic outlet syndrome (e.g., Adson'smaneuver, Allen test, military brace position)

Elbow Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. symmetry
   b. carrying angle (cubital valgus and varus)
   c. dislocation or subluxation
   d. fracture
   e. atrophy
   f. efficiency of movement
   g. bursitis
   h. epicondylitis
   i. tenosynovitis and tendonitis
   j. osteochondritis dissecans
   k. sprain
   l. strain
   m. nerve injury
3. administer active and passive range-of-motion tests using standard goniometric techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following
   a. joint instability (e.g., valgus stress test, varus stress test)
   b. inflammatory conditions (e.g., tests for lateral epicondylitis, tests for medial epicondylitis)
   c. neuropathy (e.g., Tinel's sign, pronator teres syndrome, pinch grip test)

Forearm, Wrist, and Hand Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with the following
   a. fracture (Colles' fracture, Bennett's fracture, carpal fracture ["boxer's fracture"], metacarpal fracture, phalanges fracture)

   b. dislocation or subluxation
   c. disease states (e.g., clubbed nails, spoon-shaped nails)
   d. soft tissue pathology (e.g., sprain, flexor tendon avulsion [jersey finger sign], extensor tendon avulsion [mallet finger], extensor tendon rupture [boutonniere deformity], volar plate rupture [pseudo-boutonniere deformity], Dupuytren's contracture, ganglion, swan neck deformity, trigger finger)
   e. neurovascular involvement (e.g., carpal tunnel syndrome, bishop's or benediction deformity, ape hand, claw fingers, drop-wrist deformity, Volkmann's contracture)
3. administer active and passive range-of-motion tests using standard goniometric techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following:
   a. inflammatory conditions (e.g., Finkelstein test)
   b. joint instability (e.g., valgus stress test, varus stress test, glide tests)
   c. neurovascular pathology (e.g., Tinel's sign, Phalen's test)

Thoracic/Lumbar Spine Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. café au lait macules (spots)
   b. dislocation or subluxation
   c. spina bifida occulta
   d. facet syndrome
   e. intervertebral disc pathology
   f. spinal posture (kyphosis/ lordosis)
   g. leg length discrepancies
   h. nerve root compression
   i. sacroiliac dysfunction
   j. scoliosis
   k. vertebral pathology (e.g., spondylitis, spondylolysis, spondylolisthesis)
   l. sprain
   m. stenosis
   n. step deformity
   o. strain
3. administer active and passive range-of-motion tests using standard qualitative and quantitative techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory and neurological tests

6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following:
   a. intervertebral disc herniation (e.g., Valsalva's maneuver)
   b. neuropathy (e.g., straight leg raise test, well straight leg test, Babinski's reflex test, Oppenheim's gait test, Kernig's sign, Brudzinski sign test, bowstring test, Hoover sign test)
   c. vertebral defects (e.g., stork standing test/spondylolisthesis test)
   d. joint instability (e.g., spring test)

Hip/Pelvis Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. leg length discrepancies
   b. hip retroversion
   c. hip anteversion
   d. Legg-Calve-Perthes disease
   e. apophysitis
   f. slipped capital femoral epiphysis
   g. dislocation or subluxation
   h. fracture
   i. stress fracture
   j. osteitis pubis
   k. athletic pubalgia
   l. bursitis
   m. piriformis syndrome
   n. iliotibial band syndrome
   o. contusion
   p. sprain
   q. strain
   r. tendonitis
3. administer active and passive range-of-motion tests using standard goniometric techniques and/or a tape measure
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following:
   a. sacroiliac dysfunction (e.g., Patrick's/FABER, Gaenslen's test, pelvic compression/distraction test)
   b. neuropathy (e.g., femoral nerve traction test)
   c. neuromuscular pathology (e.g., Trendelenburg test, Thomas test, rectus femoris contracture test, Ober test, Noble's test, piriformis test)

Knee Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual

2. observe and identify the clinical signs and symptoms associated with common injuries, illnesses, and predisposing conditions:
   a. bursitis
   b. chondromalacia patella
   c. dislocation and subluxation
   d. fat pad contusion
   e. fracture
   f. leg length
   g. meniscal tear
   h. Osgood-Schlatter disease
   i. osteochondritis dissecans
   j. patellar alignment (e.g., patella alta, patella baja, squinting patella, Q angle)
   k. patellar tendon rupture
   l. peroneal nerve contusion or palsy
   m. popliteal cyst
   n. sprain
   o. strain
   p. tendonitis
   q. tibial torsion
   r. tibiofemoral alignment (e.g., genu recurvatum, genu valgum, genu varum)
3. administer active and passive range-of-motion tests using standard goniometric techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer commonly used special tests to make a differential assessment of the following:
   a. uniplanar stress tests (e.g., valgus stress test, varus stress test, Lachman test, anterior drawer test, posterior drawer test, posterior sag sign)
   b. multiplanar (rotational) stress tests (e.g., Slocum test, Hughston's test, lateral pivot shift maneuver)
   c. meniscal tears (e.g., McMurray's test, Apley's test)
   d. patellofemoral dysfunction (e.g., grind test, apprehension test)
   e. intra-extracapsular swelling (e.g., sweep test, ballottable patella)

Leg, Ankle and Foot Evaluation

The student will

1. obtain the medical history of an ill or injured athlete or other physically active individual
2. observe and identify the clinical signs and symptoms associated with the following common injuries, illnesses, and predisposing conditions:
   a. overuse injures (e.g., bursitis, exostosis, fasciitis, stress fracture, tarsal tunnel syndrome, tendonitis and/or tenosynovitis, tibial stress syndrome)
   b. Achilles tendon rupture
   c. compartment syndromes

d. apophysitis
e. dislocation or subluxation
f. foot type/structure (e.g., forefoot varus/valgus, equinus deformity, pes cavus/planus, plantar flexed first ray, rearfoot [hindfoot] varus/valgus)
g. fracture
h. deep vein thrombosis (e.g., Homans' sign)
i. neuroma
j. osteochondritis dissecans
k. sprain
l. strain
m. toe structure/alignment (e.g., bunion, claw toes, hallux rigidus, hallux valgus, hammer toes, mallet toe, Morton's foot syndrome)
n. weight-bearing versus non-weight-bearing alignment
o. gait

3. administer active and passive range-of-motion tests using standard goniometric techniques
4. use manual muscle-testing techniques
5. administer appropriate sensory, neurological, and circulatory tests
6. administer functional tests and activity-specific tests
7. identify, palpate, and interpret the integrity of bony landmarks
8. identify, palpate, and interpret the integrity of soft tissue
9. administer the following commonly used special tests to make a differential assessment:
   a. compression test (e.g., Pott's fracture)
   b. percussion test
   c. anterior drawer test
   d. Kleiger's test
   e. talar tilt test
   f. Thompson test
   g. Tinel's sign
   h. Homans' sign

Acute Care of Injury and Illness

Teaching Objective 1:
The student will demonstrate the ability to implement an emergency action plan (EAP).
Specific Outcomes
1. The student will demonstrate the ability to implement an EAP for an activity, setting, or event.
2. The student will correctly triage emergency situations.

Teaching Objective 2:
The student will demonstrate the ability to apply first-aid techniques using universal precautions.
Specific Outcomes
1. The student will demonstrate the ability to
   a. manage open and closed wounds
   b. apply direct and indirect pressure to control bleeding
   c. clean, debride, and protect an open wound
   d. apply superficial skin closures

e. properly apply and remove gloves and other personal protective equipment
f. properly dispose of biohazardous waste
g. apply appropriate dressings
h. apply ice, compression, and elevation to an acute sprain, strain, or contusion

Teaching Objective 3:
The student will demonstrate the ability to apply immobilization devices to applicable body parts.
Specific Outcomes
1. The student will demonstrate the ability to
   a. select and apply an appropriate splint to a sprain, strain, fracture, subluxation, and dislocation
   b. stabilize and spine board or body splint an adult or child with a suspected spinal injury

Teaching Objective 4:
The student will recognize and manage environmentally related injuries and illnesses and, when indicated, refer the patient to the proper medical professional.
Specific Outcomes
1. The student will evaluate and manage the following:
   a. heat exhaustion
   b. heat syncope
   c. heat stroke
   d. hypothermia

Teaching Objective 5:
The student will demonstrate the ability to perform basic life-support techniques.
Specific Outcomes
1. The student will demonstrate the ability to
   a. establish and manage an airway
   b. establish and manage an airway in an athlete wearing protective headgear
   c. perform CPR on an adult or child with or without a spinal injury
   d. use a bag-valve-mask (BVM) on an adult or child for rescue breathing
   e. use a protective pocket mask/shield on an adult or child for rescue breathing

Teaching Objective 6:
The student will demonstrate the ability to use various methods of stabilization and transportation to facilitate the movement or ambulation of the injured person.
Specific Outcomes
1. The student will demonstrate the ability to
   a. stabilize and transport an adult or child with a head and/or spinal injury
   b. stabilize and transport an adult or child with a fracture and/or dislocation
   c. select, fit, and instruct the patient in the use of crutches
   d. select, fit, and instruct the patient in the use of a cane
   e. transport an injured adult or child using a manual conveyance technique
   f. perform two-person CPR

g. assist a drowning victim

Pharmacology

Teaching Objective 1

The student will locate and utilize pharmaceutical products, storage, dispensing, and tracking information.

Specific Outcomes

The student will

1. Use the PDR or another drug reference to search for information on the medications commonly prescribed to athletes and others involved in physical activity and to identify the following facts:
   a. generic and brand names
   b. indications for use
   c. contraindications
   d. warnings
   e. dosing
   f. other notes (e.g., banned substance)
   g. side (adverse) effects
2. Document, or simulate the documentation of, the tracking of medications by recording the following information about the medication:
   a. name
   b. manufacturer
   c. amount
   d. dosage
   e. lot number
   f. expiration date
3. Locate the policies-and-procedures manual, identify the section on medications, and replicate the procedures for administering medications to athletes and others involved in physical activity, which include the following:
   a. determine type of over-the-counter (OTC) medication to be used according to the physical ailment and established protocols
   b. identify the precautions, expiration date, lot number, and dosage for the medication as provided on the package and individual dose packets
   c. administer OTC medication by providing verbal and written instruction for its use to the patient and then recording and documenting the administration

Teaching Objective 2

The student will activate a poison control service.

Specific Outcome

1. Locate the phone number and address of the nearest poison control center and replicate the reporting of a drug overdose or poisoning situation. The report should state the following information:
   a. name and location of person making the call
   b. name and age of person who has taken the medication
   c. name and dosage of the drug taken
   d. time the drug was taken
   e. signs and symptoms associated with overdose or poison situation, including vital signs

Teaching Objective 3
The student will demonstrate the ability to instruct the use of and administer bronchodilators and epinephrine.
Specific Outcome

1. Replicate the following procedures for using an emergency epinephrine injection to prevent anaphylaxis:
   a. identify indications for an epinephrine injection
   b. demonstrate proper use through verbal and nonverbal instruction
   c. identify signs and symptoms that might indicate an allergic reaction to or overdose of epinephrine
   d. demonstrate proper storage of epinephrine injectable
   e. demonstrate proper disposal of used injection system
2. Replicate the following procedures for using an emergency bronchodilator (inhaler) to prevent asthma attacks:
   a. identify indications for use of a bronchodilator
   b. demonstrate proper use through verbal and nonverbal instruction
   c. identify signs and symptoms that might indicate an allergic reaction to or overdose of a bronchodilator
   d. demonstrate proper storage of a bronchodilator

Therapeutic Modalities

Teaching Objective 1:
The student will relate the findings of a physical examination to determine the appropriate course of treatment.
Specific Outcomes

1. The student will perform a physical examination to identify the current inflammatory stage.
2. The student will perform a physical examination and interview to identify the indications, contraindications, and precautions to various treatment protocols.

Teaching Objective 2:
The student will demonstrate the ability to apply therapeutic modalities.
Specific Outcomes
Cryotherapy

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply the following:
   a. cold whirlpool treatment
   b. controlled cold therapy unit
   c. ice pack
   d. vapo-coolant spray
   e. ice immersion
   f. ice massage
   g. cryokinetics

Thermotherapy

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply the following:
   a. moist heat pack
   b. paraffin treatment
   c. contrast bath
   d. warm whirlpool treatment

Electrotherapy

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply the following:
   a. sensory-level pain control treatment
   b. noxious-level pain control treatment
   c. motor-level pain control treatment
   d. muscle re-education treatment
   e. muscle pumping treatment
   f. muscle atrophy retardation treatment
   g. acute edema treatment
   h. muscle splinting/spasm treatment
   i. iontophoresis treatment
2. The student will set-up and apply the following types of electrical stimulation units:
   a. monophasic stimulator (e.g., high volt stimulation)
   b. biphasic stimulator (e.g., Transcutaneous Electrical Nerve Stimulation [TENS], Neuromuscular Electrical Stimulation [NMES])
   c. direct current (e.g., iontophoresis)
   d. alternating current (e.g., interferential, NMES)
   e. multifunction electrical stimulation devices

Ultrasound

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply the following:
   a. thermal ultrasound treatment
   b. non-thermal ultrasound treatment
   c. combination electrical-stimulation/ultrasound treatment
   d. phonophoresis treatment
   e. indirect application of ultrasound treatment (underwater, bladder)

Traction

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply the following:
   a. mechanical traction
   b. manual traction
   c. positional traction

Intermittent Compression

1. The student will demonstrate the ability to select the appropriate parameters for and then prepare and apply intermittent compression to the upper and lower extremities.

Therapeutic Massage

1. The student will demonstrate the ability to prepare and apply a massage treatment.
2. The student will demonstrate the ability to properly perform the following therapeutic massage strokes:
   a. effleurage
   b. petrissage
   c. friction (circular, transverse)
   d. tapotement
   e. vibration
   f. myofascial release techniques

Therapeutic Exercise

Teaching Objective 1:
The student will demonstrate the ability to perform therapeutic exercises.
Specific Outcomes

1. Exercise to improve the range of motion of the upper extremity, lower extremity, trunk, and cervical spine.

The student will demonstrate the ability to instruct the following exercises:

a. passive range-of-motion exercises
b. active range-of-motion exercises
c. active-assisted range-of-motion exercises
d. joint mobilization
e. self-mobilizations

2. Exercise to improve muscular strength.

The student will demonstrate the ability to instruct exercises for the following parts of the body using isometric and progressive resistance techniques:

a. lower extremity
b. upper extremity
c. cervical spine
d. trunk and torso

3. Exercise to improve muscular endurance.

The student will demonstrate the ability to instruct the following exercise modalities:

Upper body
a. aquatic
b. UBE/stationary bicycle
c. physioballs

Lower Body
a. aquatic
b. stationary bicycle
c. stair
d. physioballs
e. treadmill

4. Exercise to improve muscular speed.

The student will demonstrate the ability to instruct the following activities:

Upper body
a. reaction drills

Lower Body
a. reaction drills
b. sprint work
c. Fartlek training

5. Exercise to improve muscular power.

The student will demonstrate the ability to instruct plyometric exercises for the upper and lower extremities.

6. Exercise to improve neuromuscular control and coordination.

The student will demonstrate the ability to instruct the following activities:

Upper body
a. PNF patterns
b. rhythmic stabilization

Lower Body
a. PNF patterns
b. proprioception board or balance

c. double- and single-arm balancing
d. wobble board or balance apparatus
e. weighted-ball rebounding or toss

Neck

a. stabilization
b. postural correction

apparatus
c. incline board
d. Single-leg balancing

Trunk

a. stabilization
b. postural correction

7. Exercise to improve agility.

The student will demonstrate the ability to instruct the following activities:

Upper body

a. throwing
b. catching

Lower Body

a. Carioca
b. cross-over
c. figure eight (8)

8. Exercise to improve cardiorespiratory endurance.

The student will demonstrate the ability to instruct the following activities:

Upper body

a. upper-body ergometer
b. stationary bicycle
c. aquatic
d. stair climber

Lower Body

a. bicycle ergometer
b. treadmill
c. stair climber
d. aquatic

9. The student will demonstrate the ability to assess joint end point and to select and perform appropriate joint mobilization techniques for the appendicular and axial skeleton, including the following:
   a. long-axis distraction
   b. appropriate glides (e.g., anterior/posterior, superior/inferior)
10. The student will demonstrate the ability to instruct and perform exercises to improve activity-specific skills (running, striking, throwing, catching, swimming, biking, climbing, etc.).

General Medical Conditions and Disabilities

Specific Outcomes

The student will

1. Obtain a basic medical history that includes the following components:
   a. previous medical history
   b. previous surgical history
   c. pertinent family medical history
   d. current medication history
   e. relevant social history
   f. chief medical complaint
2. Ascertain body temperature via the following:
   a. oral temperature
   b. axillary temperature
   c. tympanic temperature
3. Ascertain the following vital signs:
   a. blood pressure
   b. pulse (rate and quality)
   c. respirations (rate and quality)

4. Palpate the four abdominal quadrants to assess for the following:
   a. guarding and rigidity
   b. pain
5. Use a stethoscope to identify the following:
   a. normal breath sounds
   b. normal heart sounds
   c. normal bowel sounds
6. Identify pathological breathing patterns to make a differential assessment for the following respiratory conditions:
   a. apnea
   b. tachypnea
   c. hyperventilation
   d. bradypnea
   e. dyspnea
   f. obstructed airway
7. Demonstrate proficiency in the use of an otoscope to examine the nose and the outer and middle ear.
8. Measure urine values with Chemstrips (dipsticks)
9. Recognize the signs, symptoms, and predisposing conditions associated with the following diseases and conditions:

The Skin

   a. abscesses
   b. acne vulgaris
   c. carbuncle
   d. cellulitis
   e. molluscum contagiosum
   f. dermatitis
   g. eczema
   h. folliculitis
   i. frostbite
   j. furunculosis
   k. herpes simplex
   l. tinea versicolor
   n. pediculosis
   o. herpes zoster
   p. hives
   q. impetigo
   r. psoriasis
   s. ringworm
   t. scabies
   u. sebaceous cysts
   v. tinea cruris
   w. tinea pedis
   x. verruca plantaris
   y. verruca vulgaris
   z. tinea capitis

The Eyes, Ears, Nose, and Throat

   a. common cold
   b. conjunctivitis
   c. laryngitis
   d. pharyngitis
   e. rhinitis
   f. sinusitis
   g. tetanus
   h. tonsillitis

Respiratory System

   a. asthma
   b. bronchitis
   c. hyperventilation
   (URI)
   d. hay fever
   e. influenza
   f. pneumonia
   g. upper respiratory infection

Cardiovascular System

a. hypertension
b. hypertrophic myocardiopathy
c. hypotension
d. migraine headache
e. shock
f. syncope

Endocrine System

a. diabetes
b. hyperthyroidism
c. hypothyroidism
d. pancreatitis

Gastrointestinal Tract

a. appendicitis
b. colitis
c. constipation
d. diarrhea
e. esophageal reflux
f. gastritis
g. gastroenteritis
h. indigestion
i. ulcer
j. irritable bowel syndrome

Eating Disorders

a. anorexia
b. bulimia
c. obesity

Sexually Transmitted Diseases/Diseases Transmitted by Body Fluid

a. HIV/AIDS
b. hepatitis
c. chlamydia
d. genital warts
e. gonorrhea
f. syphilis

Genitourinary Tract and Organs

a. kidney stones
b. spermatic cord torsion
c. candidiasis
d. urethritis
e. urinary tract infection
f. hydrocele
g. varicocele

Gynecological Disorders

a. amenorrhea
b. dysmenorrhea
c. oligomenorrhea
d. pelvic inflammatory disease
e. vaginitis

Viral Syndromes

a. infectious mononucleosis
b. measles
c. mumps

Neurological Disorders

a. epilepsy
b. syncope
c. reflex sympathetic dystrophy
d. meningitis

Systemic Diseases

a. iron-deficiency anemia (systemic)
b. sickle cell anemia (systemic)
c. Lyme disease

Nutritional Aspects of Injury and Illnesses

Teaching Objective 1

The student will demonstrate the ability to design general nutrition programs for athletes and others involved in physical activity.

Specific Outcomes

1. The student will demonstrate the ability to access and recommend nutritional guidelines for the following:
   a. pre-participation meal
   b. weight loss
   c. weight gain
   d. fluid replacement
2. The student will demonstrate the ability to use the nutritional food pyramid.
3. The student will demonstrate the ability to access and assess the following nutritional intake values:
   a. RDA or equivalency
   b. protein intake
   c. fat intake
   d. carbohydrate intake
   e. vitamin intake
   f. mineral intake
   g. fluid intake
4. The student will demonstrate the ability to determine energy expenditure and caloric intake.
2. The student will demonstrate the ability to calculate the basal metabolic rate of energy expenditure.
3. Simulate intervention with an individual who has the signs and symptoms of disordered eating.
   Identify proper referral sources for disordered eating.

Psychosocial Intervention and Referral

Teaching Objective 1

The student will demonstrate the ability to intervene and make the referral to appropriate medical or allied medical professional.

Specific Outcomes

The student will

1. Simulate intervention with an individual who has a substance abuse problem and recommend appropriate referral
2. Simulate a confidential conversation with a health care professional concerning suspected substance abuse by an athlete or other physically active individual
3. Locate the available community-based resources for psychosocial intervention

Teaching Objective 2

The student will integrate motivational techniques into the rehabilitation program.

Specific Outcome

The student will

1. Simulate the following motivational techniques used during rehabilitation:
   a. verbal motivation
   b. visualization
   c. imagery
   d. desensitization

Health Care Administration

Teaching Objective 1:
The student will demonstrate appropriate communication skills.
Specific Outcomes
1. The student will
   a. calm, reassure, and explain a potentially catastrophic injury to an injured adult or child, athletic personnel, and/or family member
   b. effectively communicate and work with physicians, emergency medical technicians (EMTs), and other members of the allied health care community and sports medicine team
   c. appropriately communicate with athletic personnel and family members
   d. use ethnic and cultural sensitivity in all aspects of communication
   e. communicate with diverse community populations

Teaching Objective 2:
The student will use contemporary multimedia, computer hardware, and software as related to the practice of athletic training.
Specific Outcomes
1. The student will access information and manage data using contemporary multimedia, computer equipment, and software. This should include, but not be limited to, use of the following:
   a. word processing software
   b. file management systems
   c. spreadsheets
   d. budgeting software
   e. injury tracking software
   f. the World Wide Web
   g. communication (e-mail)
   h. presentation software

Teaching Objective 3:
The student will demonstrate the ability to perform record keeping skills with sensitivity to patient confidentiality.
Specific Outcomes
1. The student will
   a. use standardized record keeping methods (e.g., SOAP, HIPS, HOPS)
   b. select and use injury, rehabilitation, referral, and insurance documentation
   c. use progress notes
   d. organize patient files to allow systematic storage and retrieval

Teaching Objective 4:
The student will demonstrate the ability to develop athletic training facilities and administrative plans.
Specific Outcomes
1. The student will demonstrate the ability to develop facility design plans that include, but are not limited to, the following components:

a. basic floor plan design
b. facility evacuation
c. basic rehabilitation and treatment area plans

2. The student will demonstrate the ability to develop administrative plans that include but are not limited to, the following components:
   a. risk management
   b. developing policies and procedures
   c. developing budget (expendable and capital)
   d. addressing facility hazards

Teaching Objective 5:
The student will demonstrate the ability to prepare and interpret sample design for scientific research.

Specific Outcomes

1. The student will interpret the following basic literature:
   a. case study
   b. outcome measurement, including statistical interpretation
   c. literature review

Professional Development and Responsibilities

Teaching Objective 1
The student will demonstrate the ability to disseminate injury prevention and health care information.

Specific Outcomes

1. The student will develop a presentation outline for an athletic training topic. The outline may include, but is not limited to, the following audiences:
   a. peer athletic trainers
   b. physicians
   c. parents
   d. athletic personnel
   e. general public
   f. athletes and others involved in physical activity
2. The student will develop a professional resume.

APPENDIX B

AUTHOR NOTES FOR THE *JOURNAL ATHLETIC TRAINING*

Appendix B: Authors notes for the Journal of Athletic Training

Authors' Guide
(Revised January 2001)

The mission of the Journal of Athletic Training is to enhance communication among professionals interested in the quality of health care for the physically active through education and research in prevention, evaluation, management, and rehabilitation of injuries.

Submission Policies

1. Submit 5 copies of the entire manuscript (including tables and figures) to Journal of Athletic Training Submissions, Hughston Sports Medicine Foundation, Inc 6262 Veterans Parkway, PO Box 9517, Columbus, GA 31908-9517. The term "figure" refers to items that are not editable, either halftones (photographs) of line are (charts, graphs, tracings, schematic drawings), or combinations of the two. A table is an editable item that needs to be typeset.
2. All manuscripts must be accompanied by a letter signed by each author and must contain the following statements: "This manuscript 1) contains original unpublished material that has been submitted solely to the Journal of Athletic Training, 2) is not under simultaneous review by any other publication, and 3) will not be submitted elsewhere until a decision has been made concerning its suitability for publication by the Journal of Athletic Training. In consideration of the NATA's taking action in reviewing and editing my submission, I the undersigned author hereby transfer, assign, or otherwise convey all copyright ownership to the NATA, in the event that such work is published by the NATA. Further, I verify that I have contributed substantially to this manuscript as outlined in item #3 of the current Author's Guide." By signing the letter, the authors agree to comply with all statements. Manuscripts that are not accompanied by such a letter will not be reviewed. Accepted manuscripts become the property of the NATA. Authors agree to accept any minor corrections of the manuscripts made by the editors.
3. Beginning with volume 36, the contribution of each author will be specifically identified in the published manuscript, in accordance with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals: "Authorship credit should be based only on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting article or revising it critically for important intellectual content; and 3) final approval of the version to be published. Conditions 1, 2, and 3 must all be met. Acquisitions of funding, the collection of data, or general supervision of the research group, by themselves, do not constitute authorship." For additional information, please visit the Uniform Requirements website: HTTP://WWW.ICMJE.ORG/INDEX.HTML.
   The authorship form, which is available at HTTP://WWW.JOURNALOFATHLETICTRAINING.ORG, Should be completed and submitted with each new manuscript. Contribution categories include conception and design; acquisition of data; analysis and interpretation of the data; drafting of the article; critical revision of the article; provision of study materials or patients; statistical expertise; obtaining of funding; administrative, technical, or logistic support; and collection and assembly of data. (Categories borrowed with the permission of the Annals of Internal Medicine). Contributors to the manuscript who do not qualify for authorship should be thanked in the Acknowledgments section.
4. Financial support or provision of supplies used in the study must be acknowledged. Grant or contract numbers should be included whenever possible. The complete name of the funding institution or agency should be given, along with the city and state in which it is located. If individual authors were the recipients of funds their names should be listed parenthetically.
5. Authors must specify whether they have any commercial or proprietary interest in any device, equipment, instrument, or drug that is the subject of the article in question. Authors must also reveal if they have any financial interest (as a consultant, reviewer, or evaluator) in a drug or device described in the article.
6. For experimental investigations of human or animal subjects, state in the Methods section of the manuscript that an appropriate institutional review board approved the project. For those investigators who do not have formal ethics review committees (institutional or regional), the

principles outlined in the Declaration of Helsinki should be followed (41st World Medical Assembly. Declaration of Helsinki: recommendations guiding physicians in biomedical research involving human subjects. Bull Pan AM Health Organ. 1990;24:606-609). For investigations of human subjects state in the Methods section the manner in which informed consent was obtained from the subjects. (Reprinted with permission of JAMA 1997;278:68, copyright 1997, American Medical Association).

7. Signed releases are required to verify permission for the Journal of Athletic Training to 1) reproduce materials taken from other sources including text, figures, or tables; 2) reproduce photographs of individuals; and 3) publish a Case Report. A Case Report cannot be reviewed without a release
8. The Journal of Athletic Training uses a double-blind review process. Authors should not be identified in any way except on the title page.
9. Manuscripts are edited to improve the effectiveness of communication between author and readers and to aid the author in presenting a work that is compatible with the style policies found in the AMA Manual of Style, 9th ed. (Williams & Wilkins), 1998. Page proofs are sent to the author for proofreading when the article is typeset for publication. It is important that they be returned within 48 hours. Important changes are permitted, but authors will be charged for excessive alterations.
10. Published manuscripts and accompanying work cannot be returned. Unused manuscripts will be returned if submitted with a stamped, self-addressed envelope.

Style Policies

11. Each page must be printed on 1 side of 8 1/2-by-11-inch paper, double-spaced, with 1-inch margins in a font no smaller than 10 points. Each page should include line counts to facilitate the review process. Do not right justify pages.
12. Manuscripts should contain the following, organized in the order listed below, with each section beginning on a separate page:
    a. Title page
    b. Acknowledgments
    c. Abstracts and key words (first numbered page)
    d. Text (body of manuscript)
    e. References
    f. Tables (each on a separate page)
    g. Legends to figures
    h. Figures
13. Begin numbering the pages of your manuscript with the abstract page as #1; then, consecutively number all successive pages.
14. Units of measurement shall be recorded as SI units, as specified in the AMA Manual of Style, except for angular displacement, which should be measured in degrees rather than radians. Examples include mass in kilograms (kg), height in centimeters (cm), velocity in meters per second (m • s-1 or m/s), angular velocity in degrees per second (° • s-1), force in Newtons (N), and complex rates (mL/kg per minutes).
15. Titles should be brief within descriptive limits (a 16-word maximum is recommended). If a disability is the relevant factor in an article, the name of the disability should be included in the title. If a technique is the principal reason for the report, it should be in the title. Often both should appear.
16. The title page should also include the name, title, and affiliation of each author, and the name, address, phone number, fax number, and e-mail address of the author to whom correspondence is to be directed. No more than 3 credentials should be listed for each author.
17. A structured abstract of no more than 250 words must accompany all manuscripts. Type the complete title (but not the author's names) at the top, skip 2 lines, and begin the abstract. Items that are needed differ by type of article. **Literature Reviews**: Objective, Data Sources, Data Synthesis, Conclusions/Recommendations, and Key Words; **Original Research** articles: Objective, Design and Setting, Subjects, Measurements, Results, Conclusions, and Key Words; **Case Reports**: Objective, Background, Differential Diagnosis, Treatment, Uniqueness, Conclusions, and Key Words; **Clinical Techniques**: Objectives, Background, Description,

Clinical Advantages, and Key Words. For the Key Words entry, use 3 to 5 words that do not appear in the title.

a. Begin the text of the manuscript with an introductory paragraph or two in which the purpose or hypothesis of the article is clearly stated and developed. Tell why the study needed to be done or the article written and end with a statement of the problem (or controversy). Highlights of the most prominent works of others as related to your subject are often appropriate for the induction, but a detailed review of the literature should be reserved for the discussion section. In a 1-to 2-paragraph review of the literature, identify and develop the magnitude and significance of the controversy, pointing out differences among others' results, conclusions, and /or opinions. The introduction is not the place for great detail; state the facts in brief, specific statements and reference them. The detail belongs in the discussion. Also, an overview of the manuscript is part of the abstract, not the introduction. Writing should be in the active voice (for example, instead of "Subjects were selected," use "We selected subjects") and in the first person (for example, instead of "the results of this study showed," use "Our results showed").

18. The body or main part of the manuscript varies according to the type of article (examples follow); however, the body should include a discussion section in which the importance of the material presented is discussed and related to other pertinent literature. When appropriate, a discussion subheading on the clinical relevance of their findings is recommended. Liberal use of headings and subheadings, charts, graphs, and figures is recommended.
    a. The body of an Original Research article consists of a methods section, a presentation of the results, and a discussion of the results. The methods section should contain sufficient detail concerning the methods, procedures, and apparatus employed so that others can reproduce the results. The results should be summarized using descriptive and inferential statistics and a few well-planned and carefully constructed illustrations.
    b. The body of a Literature Review article should be organized into subsections in which related thoughts of other are presented, summarized, and referenced. Each subsection should have a heading and brief summary, possibly one sentence. Sections must be arranged so that they progressively focus on the problem or question posed in the introduction.
    c. The body of a Case Report should include the following components: personal data (age, sex, race, marital status, and occupation when relevant – not name), chief complaint, history of present complaint (including symptoms), results of the physical examination (example: "Physical findings relevant to the rehabilitation program were ...."), medical history (surgery, laboratory results, examination, etc.), diagnosis, treatment and clinical course (rehabilitation until and after return to competition), criteria for return to competition, and deviation from expectations (what made this case unique).
    d. The body of a Clinical Techniques article should include both the how and why of the technique: a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations, and an explanation of why the technique should be used. The discussion concerning the why of the technique should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison with other techniques.
19. Percentages should be accompanied by the numbers used to calculate them. When reporting nonsignificant results, a power analysis should be provided.
20. Communications articles, including official Position Statements and Policy Statements from the NATA Pronouncements Committee; technical notes on such topics as research design and statistics; and articles on other professional issues of interest to the readership are solicited by the Journal. An author who has a suggestion for such a paper is advised to contact the Editorial Office for instructions.
21. The manuscript should not have a separate summary section – the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.
22. References should be numbered consecutively, using superscripted arabic numerals, in the order in which they are cited in the text. References should be used liberally. It is unethical to present others' ideas as your own. Also, use references so that readers who desire further information on the topic can benefit from your scholarship.

23. References to articles or books, published or accepted for publication, or to papers presented at professional meetings are listed in numerical order at the end of the manuscript. Journal title abbreviations conform to *Index Medicus* style. Examples of references are illustrated below. See the *AMA Manual of Style* for other examples.

Journals:

1. vanDyke JR III, Von Trapp JT Jr, Smith BC Sr. Athroscopic management of postoperative arthrofibrosis of the knee joint: indication, technique, and results. *J Bone Joint Surg Br.* 1995; 19: 517-25.
2. Council on Scientific Affairs. Scientific issues in drug testing. *JAMA.* 1987;257: 3110-3114.

Books:

3. Fischer DH, Jones RT. *Growing Old in America.* New York, NY: Oxford University Press Inc; 1977:210-216.
4. Spencer JT, Brown QC. Immunology of influenza. In: Kilbourne ED, Gray JB, eds. *The Influenza Viruses and Influenza.* 3rd ed. Orlando, FL: Academic Press Inc; 1975: 373-393.

Presentations:

5. Stone JA. Swiss ball rehabilitation exercises. Presented at 47th Annual Meeting and Clinical Symposia of the National Athletic Trainers' Association; June 12, 1996; Orlando FL.

Internet Sources:

6. Knight KL, Ingersoll CD. Structure of a scholarly manuscript: 66 tips for what goes where. Available at http://www.journalofathletictraining/org/jat/66tips.html. Accessed January 1, 1991.
7. National Athletic Trainers' Association. NATA blood borne pathogens guidelines for athletic trainers. Available at http:www.journalofathletictraining.org. Accessed January 1, 1991.

25. Table Style: 1) Title is bold; body and column headings are roman type; 2) units are set above rules in parentheses; 3) numbers are aligned in columns by decimal; 4) footnotes are indicated by symbols (order of symbols: *,); 5) capitalize the first letter of each major word in titles; for each column or row entry, capitalize the first word only. See a current issue of the *Journal* for examples.
26. All black-and-white line art should be submitted in camera-ready form. Line art should be of good quality; should be clearly presented on white paper with black ink, sans serif typeface, and no box; and should be printed on a laser printer -no dot matrix. Figures that require reduction for publication must remain readable art their final size (either 1 column or 2 columns wide). Photographs should be glossy black and white prints. Do not use paper clips, write on photographs, or attach photographs to sheets of paper. On the reverse of each figure attach a write-on label with the figure number, name of the author, and an arrow indicating the top. (Note: Prepare the label before affixing it to the figure.) Authors should submit 21 original of each figure and 4 copies for review.
27. Authors must request color reproduction in a cover letter with the submitted manuscript. Authors will be notified of the additional coast of color reproduction and must confirm acceptance of the charges in writing.
28. Legends to figures are numbered with arabic numerals in order of appearance in the text. Legends should be printed on separate pages at the end of the manuscript.
29. The *Journal of Athletic Training* follows the redundant publication guidelines of the Council of Science Editors, Inc (*CBE Views.* 1996;19:76-77; also available on the *JAT* website at http://www.journalofathletictraining.org). Authors found in violation of redundant publication will have sanctions invoked by the Journal Committee of the National Athletic Trainers' Association, Inc.

Publication Policies

24. Original Research manuscripts will be categorized under the following table of content subheadings: clinical studies, basic science, educational studies, epidemiologic studies, and observational/informational studies.

25. Only Case Reports and Clinical Techniques that define and establish the optimal standard of care or the practice of athletic training will be considered for publication in *JAT*. All other Case Reports and Clinical Techniques will be considered for publication in the *NATA News*.
26. Media Reviews will appear in the *NATA News*.

APPENDIX C

CONSENT FORM

San José State
UNIVERSITY

College of Applied Sciences and Arts
Department of Human Performance
One Washington Square
San Jose, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Appendix C: Agreement to Participate in Research

Responsible Investigator: Jennifer Pease
Title of Protocol: A Case Study: Near Avulsion Amputation of the Left Forearm in a Rock Climber

1. I have been asked to participate in a research study investigating an injury that I sustained while participating in rock climbing at the Delaware Water Gap. The injury that the research will focus on is the near avulsion amputation of the left hand and the recovery process.

2. I grant the investigator access to all medical reports related to the near avulsion amputation. The medical records will be kept secure at the researcher's home and all identification that relates them to me will be removed. I also grant permission to participate in an audiotaped interview that will take approximately two hours.

3. No risks are anticipated and no benefits are expected.

4. There will be no compensation awarded for participation.

5. The results of the study may be published but no information that could identify me will be included

6. Any questions about the research may be addressed to Jennifer Pease at (408) 376-0656. Complaints or comments about the research may be presented to Greg Payne, P.E.D at (408) 924-3028. Questions about the research, subjects' rights, or research-related injury may be presented to Nabil Ibrahim, Ph.D at (408) 924-2480.

7. I voluntarily give consent to participate in this study. I may refuse to participate in the study or in any part of the study. I am free to withdraw at any time without prejudice to my relations to San Jose State University and I will not lose any services in which I am entitled.

8. I have received a signed and dated copy of the consent form.

_____ _____
Signature Date

_____ _____
Investigator's Signature Date

APPENDIX D

LETTER OF CONSENT TO CONTACT MEDICAL PERSONAL

Appendix D: Letter of Consent to Contact Medical Personal

San José State
UNIVERSITY

College of Applied Sciences and Arts
Department of Human Performance
One Washington Square
San Jose, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

January ___, 2002

Participant's Name
Participant's Address
Address

Dear Mrs. _____:

This letter is written to request permission to contact your doctors and physical therapist in regards to the treatment measures taken in your recovery. As you know, I would like to conduct a case study on your injury and in order to do so need to be able to contact the medical personnel involved with any questions regarding the surgeries or therapy. All information received from the medical personnel will be kept private and used only for the purpose of the case study.

Please contact me if I can answer any further questions.

Jennifer Pease A.T., C
399 N 14th Street
San Jose, CA 95112
408-971-4877

Sincerely,

_____
Jennifer Pease A.T., C

APPENDIX E

MEDICAL RECORD RELEASE TO DOCTORS AND PHYSICAL THERAPIST

San José State
UNIVERSITY

College of Applied Sciences and Arts
Department of Human Performance
One Washington Square
San Jose, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Appendix E: Medical Records Release to Doctors and Physical Therapist

To: Medical Records

_____

From: _____

SSN: _____

DOB: _____

I, _____, give _____ Hospital and _____ Hand Center the right to release a copy of my entire medical file (from July 1999 to present) related to my left hand to Jennifer Pease, Graduate Assistant for San Jose State University. Please include, but do not limit to, doctor reports, operation reports, X-rays, MRI's, and bone scans.

Please mail them to: Jennifer Pease A.T., C
399 N14th Street
San Jose, CA 95112

If you have any questions please do not hesitate to call _____. Thank you for your assistance and prompt attention to this request.

Sincerely,

_____
Signature

APPENDIX F

INTERVIEW QUESTIONS

Appendix F: Interview Questions

1) What was going through your mind when the injury occurred?

2) What's the first thing you remember?

3) When did you realize the extent of your injury?

4) What was that like?

5) What coping strategies if any did you use to handle your injury?

6) Anytime throughout your rehabilitation did you notice you redefining yourself?

7) Did you feel others defined you differently or respond to you differently?

8) What do you feel was the greatest challenge in your recovery?

9) Was there any point in your rehabilitation when you just wanted to give up?

10) Was there a point in your rehabilitation that you began to take an active role?

11) When you overcame your obstacles did you feel empowered?

12) What have you learned about yourself from this experience?

13) What in your life has changed, if anything, due to the injury?

14) Tell me about how you see your identity now with respect to athletics/sports?