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Active Boutonniere Deformity In A Collegiate Football Player

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ACTIVE BOUTONNIERE DEFORMITY IN A COLLEGIATE FOOTBALL PLAYER

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ABSTRACT

Background: A healthy 21 year old male football player with no history of finger injury or deformity presented to a team athletic trainer with a proximal and distal phalanx deformity of the left fourth digit immediately after jamming his finger while making a block in practice. Flexion deformity of the proximal interphalangeal (PIP) joint and extension deformity of the distal interphalangeal (DIP) joint were immediately present. Significant swelling was also noted. No pain existed upon palpation of the PIP joint. Varus and valgus ligamentous tests were negative. Passive range of motion was fully intact, and active flexion was available within a reduced range compared to the opposite side. The athlete was able to fully actively extend the PIP joint. **Differential Diagnosis:** Possible diagnoses were boutonniere deformity, volar plate tear, and lateral collateral ligament sprain. **Treatment:** Fluoroscopy was negative for fracture or bony deformity. Final diagnosis by the team physician was central slip injury based on presentation of boutonniere deformity. The team orthopedist specializing in hand conditions was contacted following the injury to determine initial treatment procedure. The physician indicated that the injury should be treated with full finger splinting for approximately four weeks, during which time full participation would be allowed. **Uniqueness:** Boutonniere deformity typically occurs chronically and once developed, precludes active PIP extension. In this case, the boutonniere deformity both developed acutely and retained active PIP extension. **Conclusion:** Boutonniere deformities have the potential for permanent disfigurement and dysfunction, particularly when chronic. Acute boutonniere deformity treatment and return to play guidelines are lacking in the

literature; yet outcomes for the current case suggest that regardless of onset or available motion, suspected closed central slip injuries should be treated conservatively with splinting in order to prevent boutonniere deformity.

PREFACE

As an athletic trainer I am very interested in unique injuries. While providing coverage at a football practice, I encountered an acute boutonniere deformity with active PIP extension. I conducted a literature search and found that there was nothing in the literature describing this particular injury, so I decided to write this case report to share my findings.

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Abstract

A 21 year old male football player presented with an acute boutonniere deformity. The athlete was able to fully actively extend the proximal interphalangeal joint. The athlete's finger was splinted into full extension for five weeks, after which time a rehabilitation program was initiated.

Introduction

Hand injuries account for up to 9% of athletic injuries across sports, and up to 20% of emergency department visits.[1,2] Only a fraction of hand injuries develop into a boutonniere deformity (4%). However, occurrence rates of boutonniere deformity in sport are not available and active boutonniere deformities are not present in the literature.

A boutonniere deformity is a disfigurement of the finger characterized by flexion of the proximal interphalangial joint (PIP) coupled with hyperextension of the distal interphalangial joint (DIP).[3-5] The deformity is the result of a disruption of the central slip of the extensor mechanism. Typically the injury may be difficult to diagnose, as the characteristic boutonniere deformity does not often develop acutely.[2,3,6] Acute deformity, as in the current case, may occur, yet an understanding of treatment is currently based off of chronic boutonniere deformity due to a lack of published literature. The standard boutonniere deformity has a chronic onset, therefore

a thorough history and evaluation is essential in the prevention of boutonniere deformity.[2,6] Many surgical techniques exist for the treatment of central slip injuries, however conservative treatment is still preferred.[4] A lack of early treatment may result in a rigid boutonniere deformity resistant to correction, making early recognition essential, as the extension deformity of the DIP prevents proper grasping and could permanently impede sports performance as well as activities of daily living. However, empirical evidence on treatment of an acute boutonniere deformity is lacking.[2,3,6] Thus the purpose of the current case report is to detail the etiology, treatment and resolution of an acute boutonniere deformity.

Case Development

Case Presentation

A healthy 21 year old male football player with no history of finger injury or deformity. presented to the athletic trainer with a boutonniere deformity of the left fourth digit immediately after "jamming" his finger during a block in practice. He indicated only minimal pain, but expressed concern because of deformity. Flexion deformity of the PIP and extension deformity of the DIP were immediately present. Significant swelling was also noted.

Clinical Evaluation

Evaluation by the athletic trainer identified no pain with palpation of the PIP joint. Varus and valgus ligamentous tests were negative. Passive range of motion was fully intact, and active flexion was available within a reduced range compared to the opposite side. However, the athlete was able to fully actively extend the PIP joint. The athlete's finger was splinted into full PIP and DIP extension using a foam covered, aluminum finger splint taped onto the palmar side of the finger.

Patient Laboratory/Diagnostic Tests

Diagnostic imaging was not deemed immediately necessary by the athletic trainer since the athlete would have been splinted regardless of the result. A fluoroscopic image was taken one day post injury to rule out fracture. Since there was no evidence of fracture or bony deformity, the athletic trainer and team physician did not pursue a radiograph. No other diagnostic imaging was performed to assess the integrity and positioning of the soft tissues of the finger.

Differential Diagnosis

The injury in this case had to be differentiated from various PIP injuries. Possible injuries were boutonniere deformity, volar plate tear, and lateral collateral ligament sprain. Lack of joint laxity and lateral pain eliminated lateral collateral ligament injury. PIP flexion deformity indicated either boutonniere deformity or volar plate injury, but DIP extension deformity eliminated the volar plate as a potential injury. Therefore, after consulting the team physician, the diagnosis of active boutonniere deformity was made based on the presence of PIP flexion and DIP extension.

Treatment/Rehabilitation

The team orthopedist specializing in hand conditions was contacted following the injury to determine initial treatment procedure. The orthopedist indicated that the injury should be treated with full splinting for approximately four weeks, during which time full participation would be allowed.

Five weeks post injury, the athlete was advised by the team physician to discontinue use of the splint. The physician suggested buddy taping for outside practice, and use of an oval-8 splint in combination with buddy taping for in practice. He instructed that the full splint be used

while sleeping and to begin ROM exercises for the next four weeks. The athlete began a rehabilitation program consisting of paraffin wax, joint mobilization, active-assisted flexion and extension, passive flexion and extension, web resisted flexion and extension, isometric flexion and extension, squeezing putty, and flexion and extension in a bucket of rice. Exercises were completed for each joint, DIP and PIP, and in combination.

Nine weeks post injury, the athlete was advised by the team physician to discontinue use of the oval-8 splint and to continue buddy taping for practice. He advised continued ROM and strengthening exercises. However, the athlete chose not to attend any further rehabilitation sessions.

Approximately three months post injury, the athlete completed his final season of football and discontinued sports participation. He had not yet been able to participate without buddy taping for support. At approximately seven months post injury the athlete was evaluated by the athletic trainer. The boutonniere deformity was considered fully resolved and function was fully restored.

Discussion

Injuries to the central slip typically occur via attenuation, rupture, or avulsion fracture.[7] Forceful flexion of the PIP against an extension force, volar dislocation of the PIP, or a dorsal blow to the PIP causes a central slip injury, which over time can lead to boutonniere deformity.[1-3,5,6] In extremely rare cases, significant central slip and triangular ligament trauma allows for immediate lateral band displacement and acute development of boutonniere deformity.[6] In the current case the athlete described "jamming" his finger, but was unable to identify the exact mechanism. Boutonniere deformity was immediately present, which suggested central slip and triangular ligament trauma and lateral band displacement.

Central slip injuries are frequently misdiagnosed as a sprained finger, making effective evaluation a key to the prevention of chronic boutonniere deformity.[5] Typically, the lateral bands initially maintain a dorsal position and extend the PIP, so no deformity exists to indicate central slip damage.[2,3] Local swelling, ecchymosis, and tenderness are usually the only signs and symptoms present after injury.[2,3,6] Thus a proper history is essential to an accurate diagnosis. Several special tests have been described for the evaluation of central slip injuries; however, the diagnostic utility of these tests has not been evaluated on living subjects or acute boutonniere deformity. In the current case, symptoms were typical; however, deformity was immediately identifiable, allowing for a quicker diagnosis. Presence of boutonniere deformity indicated volar displacement of the lateral bands, however availability of active PIP extension indicated dorsal positioning of the lateral bands. This suggests that there may be multiple etiologies for boutonniere deformity, meaning that additional diagnostic imaging may be necessary to accurately identify which structures are damaged.

Standard treatment for closed central slip injuries requires splinting of the PIP in extension to prevent boutonniere deformity.[1,3-8] The recommended length of splinting ranges from four to eight weeks, followed by an additional four to six weeks of night splinting. [1,3-8] Leaving the DIP free to actively and passively flex is extremely important for proper healing.[3,5-7] Movement of the DIP produces tendon gliding that assists in preventing adhesions throughout the extensor mechanism.[5] Flexion of the DIP also pulls the lateral bands into the anatomical dorsal position and prevents volar subluxation.[6,7] Proper correction of DIP extension deformity is essential to regaining the ability to grasp normally. Empirical evidence that this treatment is preferential is lacking in the literature. All references to splinting are anecdotal. In the current

case the injury was splinted within the standard time range, however, the DIP was splinted into extension along with the PIP.

Return to Participation

Few guidelines exist to guide return from a central slip injury, let alone an acute deformity. When surgical intervention is not required, athletes typically return immediately with use of splinting.[6,8] Buddy taping, or some form of additional support such as a digital sleeve, is recommended.[7,8] In this case the athlete was allowed to return one day following injury while wearing a full finger splint, also buddy taped to the adjacent finger. After five weeks he transitioned to an oval-8 splint in combination with buddy taping, and to only buddy taping after nine weeks. The athlete may have progressed to full participation without any support but he graduated and discontinued his sports participation prior to the resolution of the case.

Uniqueness

Boutonniere deformity typically occurs chronically and once developed, precludes active PIP extension. In this case, the boutonniere deformity both developed acutely and retained active PIP extension. This may indicate that an untypical etiology lead to the boutonniere deformity.

Clinical Implications

Since it appears that multiple etiologies may lead to boutonniere deformity, diagnostic imaging should be compared between injuries to identify what is actually causing the boutonniere deformity. However, regardless of onset or available motion, boutonniere deformities should be treated conservatively with splinting. Because of the purely anecdotal support for use of this protocol, it is extremely important that future research directly compares treatment options in order to establish evidence based treatment standards.

Due to the minimal number cases of boutonniere deformity in sport, case study publication should be encouraged in order to increase the body of knowledge related to boutonniere deformity presentation, evaluation, and treatment, particularly in unique cases such as acute deformity with active PIP extension.

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CHAPTER 2

CASE DEVELOPMENT

Introduction

Hand injuries account for up to 9% of athletic injuries across all sports, and up to 20% of emergency department visits.[1,2] Of these, only a fraction will develop into a boutonniere deformity. A review of 43 of 71 emergency room patients diagnosed with a jammed or sprained finger over a 14-month period revealed that only 2 of the 43 patients went on to develop a boutonniere deformity.[9] Occurrence rates of boutonniere deformity in sport are not available.

The boutonniere deformity is a disfigurement of the finger characterized by flexion of the proximal interphalangial joint (PIP) coupled with hyperextension of the distal interphalangial joint (DIP).[3-5] This deformity is the result of a disruption of the central slip of the extensor mechanism. Typically the injury may be difficult to diagnose, as the characteristic boutonniere deformity does not often develop acutely.[2,3,6] Yet, acute deformity, as in the current case, may occur; however, an understanding of treatment is currently based off of chronic boutonniere deformity due to a lack of published literature. The standard boutonniere deformity has a chronic onset, therefore a thorough history and evaluation is essential in the prevention of boutonniere deformity.[2,6] In any instance, it is vital to either prevent or correct boutonniere deformity, as the extension deformity of the DIP prevents proper gripping. Many surgical techniques exist for the treatment of central slip injuries, however conservative treatment is still

preferred.[4,10] A lack of early treatment may result in a rigid boutonniere deformity resistant to correction, making early recognition even more important. Empirical evidence on treatment of an acute boutonniere deformity is lacking.[2,3,6,11]

In this case, an athlete developed a boutonniere deformity immediately upon injury, and was able to actively extend and minimize the deformity. Acute development of boutonniere deformity is exceedingly rare, with no cases or treatment regimens reported in the literature. Thus the purpose of the current case report is to detail the etiology, treatment and resolution of an acute boutonniere deformity.

Patient Information

The patient is a healthy 21 year old male football player with no history of finger injury or deformity. He presented to a team athletic trainer with a boutonniere deformity of the left fourth digit immediately after making a block in practice. We approached the participant to determine if he would be willing to allow his case presented and potentially published. The participant agreed and signed a consent to participate form and a form to allow access to his medical records.

Case History

The athlete reported jamming his finger while making a block during practice. He indicated only minimal pain, but expressed concern because of deformity. Flexion deformity of the PIP and extension deformity of the DIP were immediately present. Significant swelling was also noted.

Clinical Evaluation

There was no pain with palpation of the PIP joint. Varus and valgus ligamentous tests were negative. Passive range of motion was fully intact, and active flexion was available within

a reduced range compared to the opposite side. However, the athlete was able to fully actively extend the PIP joint. No special tests specific to the central slip were utilized. The athlete's finger was then splinted into full PIP and DIP extension using a foam covered, aluminum finger splint taped onto the palmar side of the finger.

Patient Laboratory/Diagnostic Tests

Diagnostic imaging was not deemed immediately necessary since the athlete would have been splinted regardless of the result. A fluoroscopic image was taken one day post injury to rule out fracture. Since there was no evidence of fracture or bony deformity, a radiograph was not ordered. No other diagnostic imaging was performed to assess the integrity and positioning of the soft tissues of the finger.

Differential Diagnosis

The injury in this case had to be differentiated from various PIP injuries. Possibly involved structures were the central slip, volar plate, and lateral collateral ligaments. Lack of joint laxity and lateral pain ruled out lateral collateral ligament injury. PIP flexion deformity indicated either central slip or volar plate injury, but DIP extension deformity ruled out the volar plate. Therefore, the central slip was determined to be the injured structure.

Referral

A team physician specializing in hand conditions was contacted following the injury to determine initial treatment procedure. The physician indicated that the injury should be treated with full splinting for approximately four weeks, during which time full participation would be allowed.

Five weeks post injury, the athlete was advised by the team physician to discontinue use of the splint. The physician suggested buddy taping for outside practice, and use of an oval-8

splint in combination with buddy taping for in practice. He instructed that the full splint be used while sleeping and that ROM exercises begin.

Nine weeks post injury, the athlete was advised by the team physician to discontinue use of the oval-8 splint and to continue buddy taping for practice. He advised continued ROM and strengthening exercises.

Course of Treatment/Rehabilitation

The athlete was allowed to return to participation the day following injury, wearing the splint for protection. The athlete was splinted using a padded, aluminum finger splint secured with athletic tape. The finger was splinted into full extension of the PIP and full extension of the DIP.

After meeting with the team physician five weeks post injury, the athlete began a rehabilitation program consisting of use of paraffin wax, joint mobilization, active-assisted flexion and extension, passive flexion and extension, web resisted flexion and extension, isometric flexion and extension, squeezing putty, and flexion and extension in a bucket of rice. Exercises were completed for each joint, DIP and PIP, and in combination.

After meeting with the team physician nine weeks post injury, the athlete did not attend any further rehabilitation. However, he had been advised by athletic trainers on how to complete several home exercises.

At approximately seven months post injury the athlete was seen by his athletic trainer. The boutonniere deformity was nearly fully resolved and functionality was fully restored.

CHAPTER 3

LITERATURE REVIEW

Background

Anatomy

The palm of the hand is comprised of 5 bones called metacarpals. Each finger projects from a metacarpal. With the exception of the thumb, each finger is comprised of three bones: the proximal phalanx, the middle phalanx, and the distal phalanx. The thumb has no middle phalanx. The articulation between the metacarpal and the proximal phalanx is called the metacarpal-phalangeal joint, the articulation between the proximal phalanx and the middle phalanx is called the PIP, and the articulation between the middle phalanx and the distal phalanx is called the DIP.[12]

The extensor mechanism of the fingers is a complex interworking of both dynamic and static components.[3] The dynamic component is provided by the intrinsic and extrinsic tendons of the hand, and the static component is provided by a retinacular system.[3,11] The extrinsic tendon originates in the forearm and continues distally to its first insertion at the base of the proximal phalanx.[3] As the tendon continues distally, it diverges into three separate tendons just proximal to the PIP.[2,3,5] The middle tendon, known as the central slip, inserts into the base of the middle phalanx where it functions as the prime extensor of the PIP.[3,5,6] The other two tendons, known as the lateral bands, pass distally and converge at the base of the distal phalanx where

they insert.[2,3] The convergence is called the terminal tendon, which acts to facilitate DIP extension.[3] The intrinsic tendons enter the finger from the volar side and join with the lateral bands over the proximal phalanx.[3,5]

The retinacular system is comprised of two parts. The transverse retinacular ligament originates at the volar plate of the PIP and attaches to the lateral bands on either side, which prevents excessive dorsal migration of the lateral bands during extension.[3,5] The oblique retinacular ligament originates on the volar side of the distal proximal phalanx and inserts dorsally at the base of the distal phalanx, along with the terminal tendon.[3,5] As the PIP extends, tension in this tendon assists with extention of the DIP.[3]

The triangular ligament bridges the lateral bands over the middle phalanx, proximal to their convergence at the terminal tendon. The ligament functions to limit excessive volar migration of the lateral bands during joint flexion, and promotes the return of the lateral bands to their dorsal position as the finger extends out of flexion.[3,5]

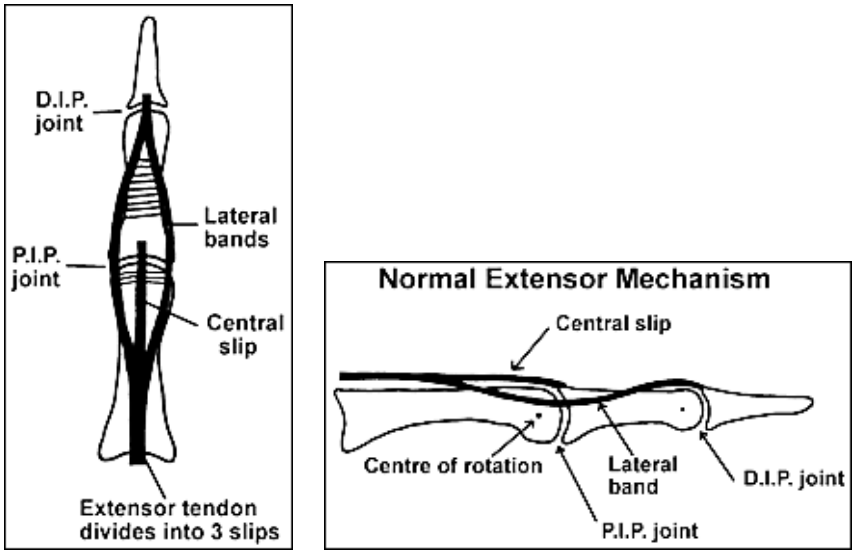

Figure 1. Anatomy of uninjured extensor mechanism.

In an uninjured state, the central slip functions to actively extend the PIP, and when relaxed, maintain a balance of tension with the flexor tendons. The lateral bands extend the DIP via the terminal tendon, and are held in a dorsal position by both the central slip attachment and the triangular ligament.

Pathoanatomy

Ultimately, the cause of a boutonniere deformity is a disruption of the central slip. Without the central slip, unopposed tension in the flexor tendons gradually flexes the PIP.[5,13] Continual flexion leads to volar migration of the lateral bands, which are no longer held dorsally by the central slip attachment, placing additional stress on the triangular ligament which will attenuate or even rupture.[3-6] Upon rupture, the lateral bands move below the axis of the PIP, where they functionally become flexors.[3] The altered position increases tension in the lateral bands, which not only increases PIP flexion but also forces the DIP into hyperextension, producing the boutonniere deformity.[3,6] Over time, contracture of the transverse retinacular ligament and the oblique retinacular ligament worsen the deformities of both the PIP and DIP.[3,4,6] Prolonged lack of treatment can result in a rigid boutonniere deformity that is resistant to conservative measures. [2,3,6,11]

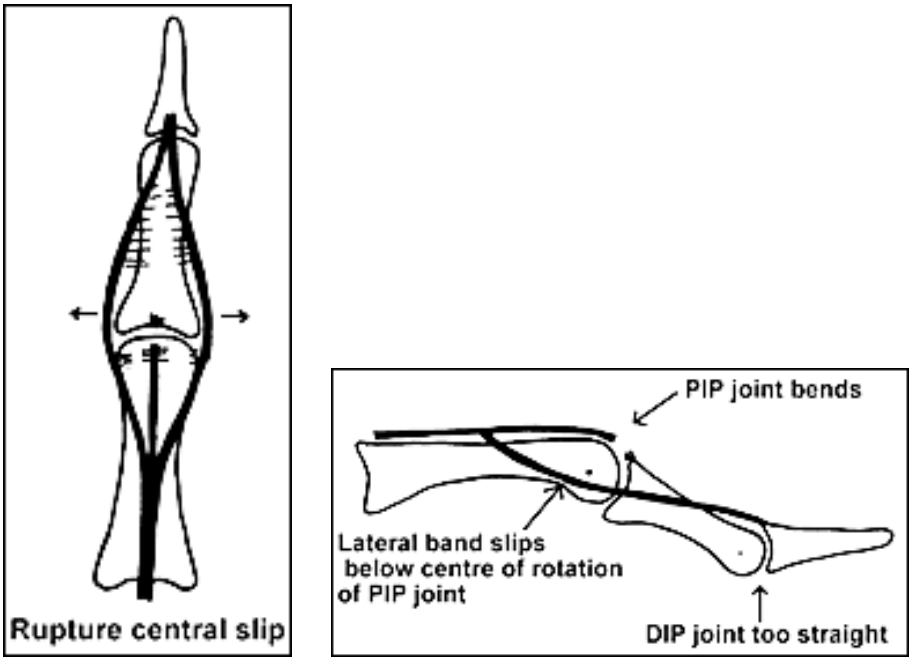

Figure 2. Anatomy of boutonniere deformity

Etiology

Injuries to the central slip typically occur via attenuation, rupture, or avulsion fracture.[7] These varied injuries may result in different categories of boutonniere deformity, including: closed injury, open injury, infection, and inflammation.[3] Forceful flexion of the PIP against an extension force, volar dislocation of the PIP, or a dorsal blow to the PIP causes a closed central slip injury, which over time can lead to boutonniere deformity.[1-3,5,6,11,13,14] In extremely rare cases, significant central slip and triangular ligament trauma allows for immediate lateral band displacement and acute development of boutonniere deformity.[6]

Open injuries to the central slip include lacerations, open wounds, and burns.[3,6,14] Boutonniere deformity is common in severe burn victims.[15] Considering the superficial nature of the extensor mechanism, thermal wounds can expose the PIP joint and destroy the extensor

tendons.[16-18] The burn itself may not be the cause of the deformity. Secondary necrosis can damage the central slip.[15]

Subcutaneous and intra-articular infections may also cause boutonniere deformity through disruption of the central slip.[3] Open wounds and burns that become infected can lead to central slip disruption.[15] Lastly, inflammation such as arthritis, particularly rheumatoid, commonly leads to boutonniere deformity.[2,19-21] Approximately 24% of arthritis patients will develop boutonniere deformity in the first 10 years after central slip disruption.[20] In this case, joint swelling disrupts the central slip and triangular ligament which displaces the lateral bands and leads to deformity.[2,19-21] The current case, although not associated with burns manifests due to the same mechanism of central slip damage. The mitigating factor in burns that increases difficulty in treatment is the concomitant infection. The current case may be more simple to treat yet still presents a unique case of acute boutonniere deformity.

Pseudo-boutonniere Deformity

Pseudo-boutonniere deformity is similar to boutonniere deformity, but it is characterized by flexion contracture of the PIP only, without hyperextension of the DIP.[3] In this case PIP flexion is the result of fibrosis of the volar ligamentous complex.[3] DIP motion remains unaffected. Pseudo-boutonniere deformity occurs following a hyperextension injury to the PIP.[3] Distinguishing between pseudo-boutonniere and true boutonniere deformity is important since the two injuries do not have the same treatment protocol.[3,5] The current case was diagnosed as a true boutonniere deformity where the deformity is impacted by the central slip, therefore the treatment regimen is different from a pseudo-boutonniere.

Evaluation

Central slip injuries are frequently misdiagnosed as a sprained finger, making effective evaluation a key to the prevention of chronic boutonniere deformity.[5,22] Initially, the lateral bands maintain a dorsal position and extend the PIP, so no deformity exists to indicate central slip damage.[2,3,13,14] Local swelling, ecchymosis, and tenderness are usually the only signs and symptoms present after injury.[2,3,6,14] This means that a proper history is essential to an accurate diagnosis. Determining the specific mechanism in particular can help identify central slip injury.[2,6] For example, hyperflexion versus hyperextension of the PIP is indicative of dorsal rather than volar damage. Care during evaluation is necessary since initial pain and swelling will make manipulation difficult.[13]

Table 1

Symptom comparison of various PIP injuries.

Symptom	**Central Slip**[2,3,6,14]	**Volar Plate**[3]	**Collateral Ligament**[2]
Dorsal PIP pain	X		
Palmar PIP pain		X	
Lateral PIP pain			X
PIP joint instability			X
Swelling	X	X	X
Ecchymosis	X	X	X
PIP flexion deformity	X	X	
DIP extension deformity	X		

Special Tests

Several special tests have been described for the evaluation of central slip injuries. The Stark test (intrinsic-intrinsic test) is performed by holding the PIP in extension and passively flexing the DIP. A loss of DIP flexion is an indication of central slip injury.[3,5,6,13,22] However,

the Stark test is not useful in an initial assessment because secondary changes must occur in order to elicit a positive test.[13] The Carducci test is performed by passively flexing the wrist and metacarpalphalangial joint (MP). If there is a 15-20 degree loss of active PIP extension in this position, central slip injury should be suspected.[3,13,22] The Elson test is performed by bending the patients PIP to 90 degrees and holding it there. The patient is instructed to straighten his/her finger; if the DIP is rigid in extension a central slip injury is indicated. Weakness of extension at the PIP is also indicative of central slip injury.[6,13,22,23] The tendonesis test is also performed by flexing the wrist and MP and noting the position of the PIP. If the central slip is intact, the finger will fully extend in this position, if not, it will remain bent.[13,24] The tendonesis test will only be positive if secondary changes have occurred, as the lateral bands will initially compensate for a torn central slip.[13] Central slip injuries can also be assessed by holding the MP in hyperextension and requesting the patient attempt to actively extend the PIP. If the patient is able to fully extend, the central slip is intact.[6] The application of any test with the PIP extended does not rule out lateral band compensation, and therefore cannot be used to rule out central slip injury.

Table 2

Special tests for assessing central slip rupture.

Special Test	Procedure	Positive Finding
Stark Test	Hold PIP in extension and passively flex DIP	Loss of DIP flexion
Carducci Test	Passively flex wrist and MP	15-20 degree loss of PIP extension
Elson Test	Hold PIP in 90 degrees flexion and have patient attempt PIP extension	DIP is rigid in extension
Tendonesis Test	Passively flex wrist and MP	Patient unable to fully extend PIP
Test described by Marino	Hold MP in hyperextension and have patient attempt PIP extension	Patient unable to fully extend PIP

Diagnostic Imaging

A radiograph should be used to rule out fracture, avulsion, and dislocation.[6] If the radiograph is negative, Magnetic Resonance Imaging is usually forgone as it is no more reliable than a thorough exam.[6] Diagnostic ultrasound, however, may be an effective tool to identify central slip rupture. In a cadaver study of 12 fingers, a blinded ultrasonographer correctly identified all central tendons as either torn or intact.[25]

Treatment

Conservative Treatment

Standard treatment for central slip injuries requires splinting of the PIP in extension to prevent boutonniere deformity.[1,3-8,26-29] In fact conservative treatment reportedly produces better results than surgery if initiated within six weeks after injury.[4,10] The recommended length of splinting ranges from four to eight weeks, followed by an additional four to six weeks of night splinting. [1,3-8,26-29] Leaving the DIP free to actively and passively flex is extremely important for proper healing.[3,5-7,26] Movement of the DIP produces tendon gliding that assists in preventing adhesions throughout the extensor mechanism.[5] Flexion of the DIP also pulls the lateral bands into the anatomical dorsal position and prevents volar subluxation.[6,7] Empirical evidence that this treatment is preferential is lacking in the literature. All references to splinting are anecdotal.

Surgical Treatment

In cases of tendon laceration, displaced fracture, open dislocation, or ineffective splinting regimens, surgery is the preferred method of treatment.[4,6-8] Many surgical treatments have been proposed, with reasonable success, for the correction of central slip disruptions; however, no clearly preferred method exists.[3-5,30-32] Common surgical techniques include central slip reconstruction via lateral band graft, palmaris longus graft, tendon grafting, terminal tenotomy, direct repair of central slip, reinsertion of central slip, lateral band relocation, and transverse retinacular ligament inversion.[3-5,10,30-39] A novel technique exists that involves relocation of the flexor digitorum superficialis tendon.[33] Another new procedure involves incising the lateral bands, suturing the medial portions together, and anchoring them to the base of the middle phalanx to simulate the central slip.[40] Surgical technique literature is sparse, mostly comprised of technique descriptions with no control or randomization.[32] A difficulty in assessing and

comparing literature on boutonniere deformity relates to author creation of their own unique rating scales to define successful treatment.[32]

Regardless of surgical technique selected, recovery and rehabilitation typically follows the same splinting protocol used for conservative treatment.[39] The PIP is splinted in extension with the DIP free to flex.[1,5,7,26-28] In some cases, wire fixation of the PIP joint in extension is performed during the surgery to further ensure proper positioning.[30,39-41] However, wire fixation does not appear to correlate to improved patient outcomes.[39] Several alternative splinting methods have been proposed but there is minimal research to support their use.[33,42-44]

Return To Participation

Few guidelines exist to guide return from a central slip injury. In the case of surgical repair, return to participation is delayed until sutures are removed and soft tissues heal, which typically occurs within two weeks.[8] Removal of a pin when used to fix the joint must occur prior to returning, requiring a longer period of 4 to 6 weeks.[8] In the case of nonsurgical treatment, athletes typically return immediately with use of splint.[6,8] Buddy taping, or some form of additional support such as a digital sleeve, is recommended.[7,8] Juvenile athletes, however, should refrain from activity even when splinted.[7]

a)  b) 

Figure 3. a) Padded aluminum finger splint; b) Buddy taping

Case Report

Case reports detail unique injuries that are either not seen or are overlooked in large clinical trials. Case reports are essential components of evidence based practice because they address unique injuries that would otherwise not be acknowledged in the literature.[45] Although a single case generally should not shape clinical practice, when caring for a large patient base, injuries often do not fit the generally accepted format for patient care.[45] Thus, case reports can be used to provide insight into unique or rare conditions. Case reports also help guide future research by providing direction for clinical trials that can eventually influence evidence-based practice and improve patient care.[45]

CHAPTER 4

METHODS

The purpose of the study is to present a unique case report on active boutonniere deformity, treatment, and return to participation.

Literature Search

A literature review was conducted by searching MEDLINE via EBSCOhost. Key terms of boutonniere, central slip, sport, and athlete were used. Articles published prior to 1990 on treatment and outcomes were excluded to ensure only relatively current information was used. Only articles pertaining to boutonniere deformity of the hand were included. Articles discussing treatment and outcomes specific to non-traumatic etiology where excluded. Of 246 total search results, 43 articles met these criteria.

Participant

The participant is a 21 year old male football player with no history of finger injury or deformity. He presented with a boutonniere deformity of the left forth digit after making a block in practice. We approached the participant to determine if he would be willing to allow his case presented and potentially published. The participant agreed and signed a consent to participate form and a form to allow access to his medical records.

Procedures

Consent for release of medical records was obtained both verbally and via signed document, allowing disclosure of medical records, diagnostic images, and photos of the injury. The following medical records will be assessed: pre-participation physical exam, pre-participation health history, returning athlete health questionnaire, injury evaluation record, daily treatment records, and copy of initial fluoroscopic image. Records will be reviewed to generate the case report. A timeline of events will be constructed detailing etiology, assessment, diagnosis, treatment, and return to play. A narrative based off the timeline will be developed and assessed based on the literature. The narrative will be reviewed by two other reviewers juxtaposed to the medical records to triangulate the data. Once the reviewers have agreed the narrative represents the medical records, the patient will be asked to review the narrative as a part of member checking. Any inconsistencies will be modified based on feedback.

Case Report

The case report will emphasize the unique and rare nature of the injury. A chronology of the case will address the patient's diagnosis, treatment, rehabilitation, and return to participation. The case report will also provide recommendations for clinical practice based on the unique properties of the case, in conjunction with future research needs.

Publication

The case report will be submitted to Athletic Training & Sports Health Care (ATSCH) for publication.

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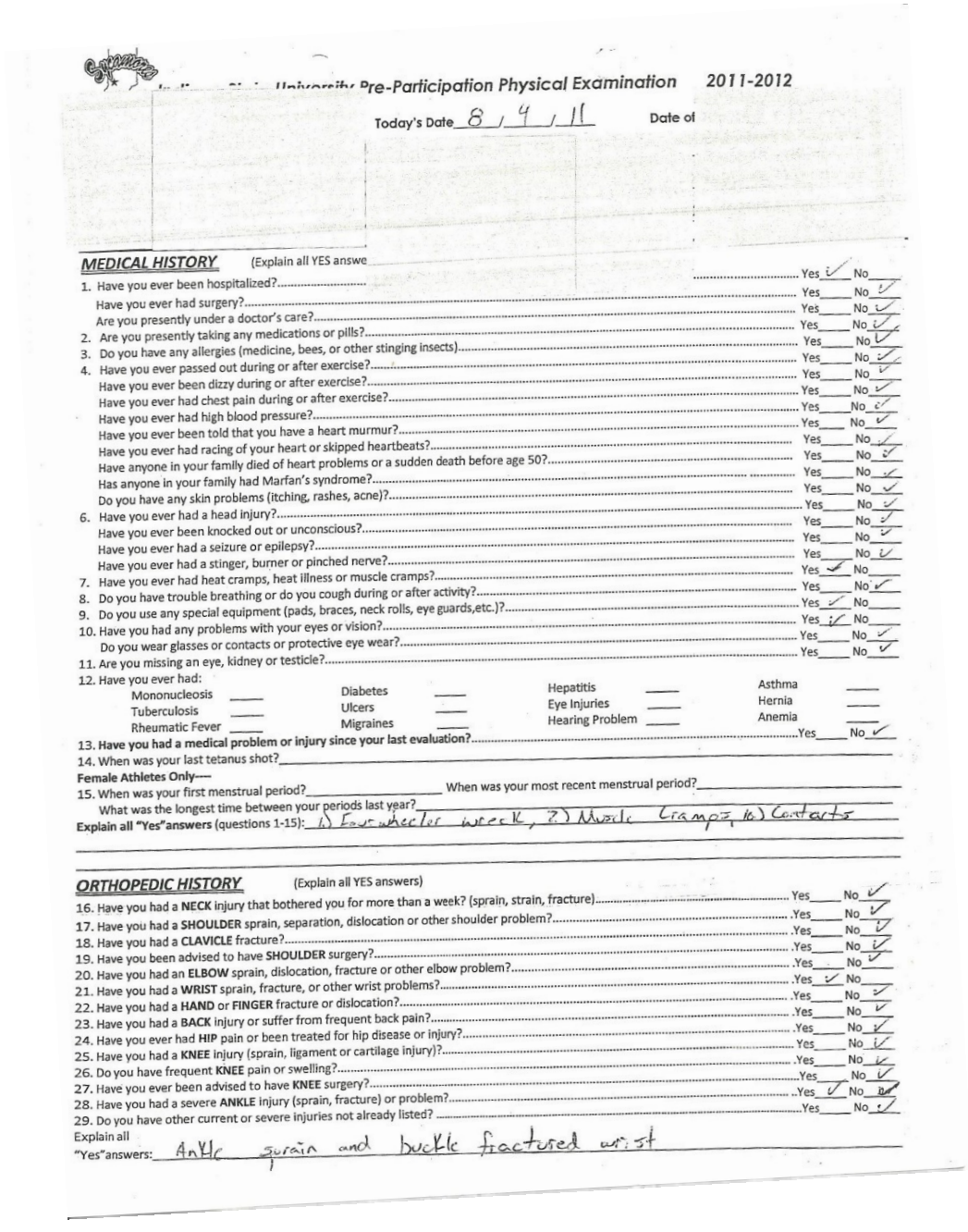
APPENDIX A: MEDICAL INFORMATION

Pre-Participation Health Questionnaire



Pre-Participation Physical Examination 2011-2012

Today's Date 8/4/11 Date of

MEDICAL HISTORY (Explain all YES answe

1. Have you ever been hospitalized? ..... Yes ✓ No
   Have you ever had surgery? ..... Yes No ✓
   Are you presently under a doctor's care? ..... Yes No ✓
2. Are you presently taking any medications or pills? ..... Yes No ✓
3. Do you have any allergies (medicine, bees, or other stinging insects) ..... Yes No ✓
4. Have you ever passed out during or after exercise? ..... Yes No ✓
   Have you ever been dizzy during or after exercise? ..... Yes No ✓
   Have you ever had chest pain during or after exercise? ..... Yes No ✓
   Have you ever had high blood pressure? ..... Yes No ✓
   Have you ever been told that you have a heart murmur? ..... Yes No ✓
   Have you ever had racing of your heart or skipped heartbeats? ..... Yes No ✓
   Have anyone in your family died of heart problems or a sudden death before age 50? ..... Yes No ✓
   Has anyone in your family had Marfan's syndrome? ..... Yes No ✓
   Do you have any skin problems (itching, rashes, acne)? ..... Yes No ✓
6. Have you ever had a head injury? ..... Yes No ✓
   Have you ever been knocked out or unconscious? ..... Yes No ✓
   Have you ever had a seizure or epilepsy? ..... Yes No ✓
   Have you ever had a stinger, burner or pinched nerve? ..... Yes ✓ No
7. Have you ever had heat cramps, heat illness or muscle cramps? ..... Yes No ✓
8. Do you have trouble breathing or do you cough during or after activity? ..... Yes ✓ No
9. Do you use any special equipment (pads, braces, neck rolls, eye guards,etc.)? ..... Yes ✓ No
10. Have you had any problems with your eyes or vision? ..... Yes No ✓
    Do you wear glasses or contacts or protective eye wear? ..... Yes No ✓
11. Are you missing an eye, kidney or testicle? .....
12. Have you ever had:

Mononucleosis	___	Diabetes	___	Hepatitis	___	Asthma	___
Tuberculosis	___	Ulcers	___	Eye Injuries	___	Hernia	___
Rheumatic Fever	___	Migraines	___	Hearing Problem	___	Anemia	___

13. **Have you had a medical problem or injury since your last evaluation?** ..... Yes No ✓
14. When was your last tetanus shot? _____

Female Athletes Only----

15. When was your first menstrual period? _____ When was your most recent menstrual period? _____
    What was the longest time between your periods last year? _____

Explain all "Yes" answers (questions 1-15): 1) Four wheeler wreck, 2) Muscle Cramps, 10) Contacts

ORTHOPEDIC HISTORY (Explain all YES answers)

16. Have you had a **NECK** injury that bothered you for more than a week? (sprain, strain, fracture) ..... Yes No ✓
17. Have you had a **SHOULDER** sprain, separation, dislocation or other shoulder problem? ..... Yes No ✓
18. Have you had a **CLAVICLE** fracture? ..... Yes No ✓
19. Have you been advised to have **SHOULDER** surgery? ..... Yes No ✓
20. Have you had an **ELBOW** sprain, dislocation, fracture or other elbow problem? ..... Yes ✓ No
21. Have you had a **WRIST** sprain, fracture, or other wrist problems? ..... Yes No ✓
22. Have you had a **HAND** or **FINGER** fracture or dislocation? ..... Yes No ✓
23. Have you had a **BACK** injury or suffer from frequent back pain? ..... Yes No ✓
24. Have you ever had **HIP** pain or been treated for hip disease or injury? ..... Yes No ✓
25. Have you had a **KNEE** injury (sprain, ligament or cartilage injury)? ..... Yes No ✓
26. Do you have frequent **KNEE** pain or swelling? ..... Yes No ✓
27. Have you ever been advised to have **KNEE** surgery? ..... Yes ✓ No
28. Have you had a severe **ANKLE** injury (sprain, fracture) or problem? ..... Yes No ✓
29. Do you have other current or severe injuries not already listed? ..... Yes No ✓

Explain all "Yes" answers: Ankle sprain and buckle fractured wrist

Pre-Participation Physical Examination

I hereby certify that , to the be ; to the above questions are correct.

Signature of Student Athlete:_____ Date: 8-4-2011

Signature of Parent/Guardian:_____ Date:_____

PHYSICAL EXAMINATION (to be completed by Physician)

Name:_____ Age:_____ Date of Birth:_____

Height: 74½" Weight: 239.4 BP: 132 / 70 Pulse: 66

Vision: R 20/ 70 L 20/ 20 Corrected: (Y) N Pupils (circle one) Equal / Unequal R>L L>R

Contact not in him — Right only

	Circle (if option given)	**********Specific Findings**********
Marfan's Syndrome Stigmata	(No) Yes	
Heart		
Rhythm	(Regular) Irregular	
Murmur (supine)	(No) ~~Yes~~	
Murmur (standing)	(No) Yes	
	Normal	**********Specific Findings**********
Lungs	Normal	
Skin	Normal	
Abdominal	Normal	
Femoral Pulses	Normal	
Genitalia/ Hernia	Normal	
Musculoskeletal:		
Neck	Normal	
Shoulders	Normal	
Elbows	Normal	
Wrists	Normal	
Hands	Normal	
Back	Normal	
Knees	Normal	
Ankles	Normal	
Feet	Normal	
Other		

Clearance:

(A.) Cleared

B. Cleared after completing evaluation/rehabilitation for:_____

C. Not Cleared

Due to:_____

Physician Signature: [illegible] Date: 8/4/11

Returning Athlete Health Questionnaire

INDIANA STATE UNIVERSITY

Age: 21

Shared Responsibility for Sport Safety

Participation in sport requires an acceptance of risk injury. Athletes rightfully assume that those who are resp reasonable precautions to minimize such risk and that their peers participating in the sports will not intentionally inflict ir

Periodic analyses of the injury patterns lead to refinements in the rules and other safety decisions. However, t equipment standards, while often necessary, seldom is effective by itself; and to rely on officials to enforce compliance with the rule book is as insufficient as to rely on warning labels to produce compliance with the safety guidelines. "Compliance" means respect on everyone's part for the intent and purpose of a rule or guideline.

This annual form must be completed and returned before the student-athlete will be permitted to practice or play. The National Collegiate Athletic Association's (NCAA) policies recommend that all student-athletes have a qualifying medical evaluation upon initial entrance into an institution's intercollegiate athletic program, and an annual "health-status" review. Indiana State University supports this NCAA policy. Further medical evaluations may be required for specific matters.

		Soph		Junior		Senior		5th	
1	Have you ever been hospitalized or had a major illness since your last Health History at Indiana State University?	Y	N	Y	N	Y	(N)	Y	N
2	Are you currently ill in any way?	Y	N	Y	N	Y	(N)	Y	N
3	Have you had a major injury (including concussion) since your last Health History at Indiana State University?	Y	N	Y	N	Y	(N)	Y	N
4	Do you currently have any incompletely healed injury?	Y	N	Y	N	Y	(N)	Y	N
5	Are you taking any medication on a regular or continuing basis?	Y	N	Y	N	Y	(N)	Y	N
6	Are you currently taking any short-course medication for a specific illness, injury, etc?	Y	N	Y	N	Y	(N)	Y	N
7	Have you had any operations or surgery since your last Health History at Indiana State University?	Y	N	Y	N	Y	(N)	Y	N
8	Have you had any accidents and/or fractures since your last Health History at Indiana State University?	Y	N	Y	N	Y	(N)	Y	N
9	Have you seen a physician for any reason in the last year?	Y	N	Y	N	Y	(N)	Y	N
10	Do you know of, or do you believe there is, any health reason why you should not participate in the Indiana State University intercollegiate athletic program at this time?	Y	N	Y	N	Y	(N)	Y	N
11	Would you like to discuss your current health history with the team physician?	Y	N	Y	N	Y	(N)	Y	N

The undersigned, herewith:

A. Understands that he/she must refrain from practice while injured, whether or not receiving medical treatment until he/she is discharged from the treatment or is given permission by the clinical practitioner to restart participation despite continuing treatment.

B. Understands that having passed the physical examination does not necessarily mean that he/she is physically qualified to engage in athletics, but only that the evaluator did not find a medical reason to disqualify him/her at the time of said examination.

C. Certifies that the answers to the questions above are correct and true.

Date:_____(Sophomore Year)

Date:_____(Junior Year)

Date: 7/24/12 (Senior Year)

k Phone:(____)_____-_____

Injury Report

Injury Date: 8/20/12

Specific Injury: Boutonniere deformity of 4th digit

Onset: Athlete made a block and jammed finger

Subjective: Athlete reported no pain. He was only concerned because the finger looked strange, not because it was truly causing him difficulty.

Objective: Severe swelling. No pain with palpation. Ligamentous tests negative. Passive ROM normal. Full active extension available. Active flexion possible but not to full range.

Plan: Splint and treat for pain and swelling.

Treatment Notes

8/20/12—Athlete was splinted into extension after practice

8/21/12—Athlete received ice.

9/27/12—Athlete out of splint. Advised by Dr. Reddig to buddy tape out of practice. Oval 8 and buddy tape during practice. Full splint at night. Begin ROM

9/30/12—Paraffin bath, joint mobs, ROM exercises

10/01/12—Paraffin wax/hot pack to heat, AAROM, PROM, green web resisted flexion/extension, buddy tape

10/02/12—Paraffin wax/hot pack, AAROM, PROM, green web resisted flexion/extension, isometric DIP/PIP strengthening

10/03/12—Paraffin wax/hot pack, AAROM, PROM, green web resisted flexion/extension, isometric DIP/PIP strengthening

10/04/12— Paraffin wax/hot pack, AAROM, PROM, green web resisted flexion/extension, isometric DIP/PIP strengthening

10/08/12—Paraffin wax/hot pack, joint mobs, AAROM, PROM, green web resisted flexion/extension, flexion/extension in rice bucket

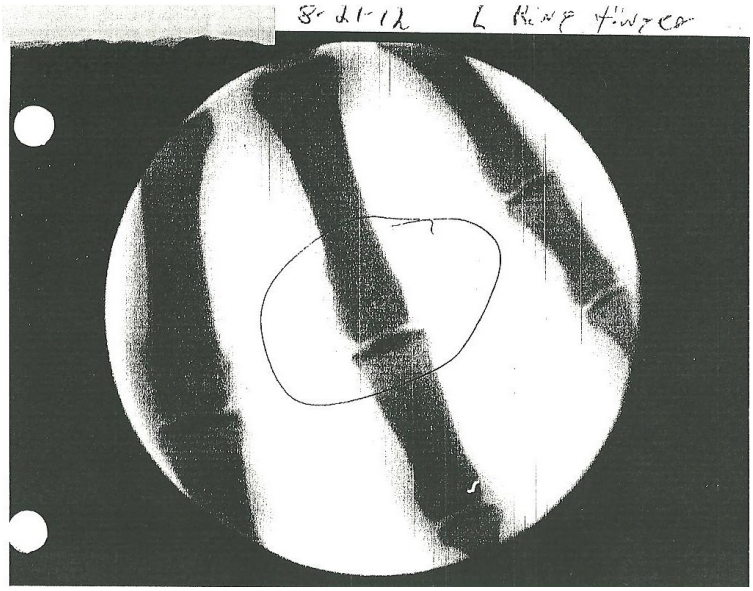
10/10/12—Paraffin bath, joint mobs, AAROM/PROM, web exercises, rice bucket

10/15/12—Paraffin bath, joint mobs, AAROM/PROM, web exercises, rice bucket

10/22/12—Paraffin bath, joint mobs, towel exercises, rice bucket, putty

10/24/12—Saw Dr. Reddig. Advised to buddy tape for practice. No more oval 8. Continue strength and ROM.

Diagnostic Imaging



APPENDIX B: CONSENT FORMS

Journal of Athletic Training

Case Report Release Form

Release of information for case report:

Date:_____

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

Author(s): _____

Title: _____

I understand that this information may be used in publication and that my name will remain confidential.

Signature:_____

Witness:_____

Please send to *Journal of Athletic Training*, 6262 Veterans Parkway, Columbus, GA 31909, fax 706-494-3348, email jathtr@mindspring.com.