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Skin Condition Secondary to Elbow Dislocation in a Collegiate Diver

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SKIN CONDITION SECONDARY TO ELBOW DISLOCATION IN A COLLEGIATE DIVER

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In
Athletic Training

By
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Abstract

Objective: The purpose of the case study is to inform athletic trainers about complications with post-surgical athletes caused from the materials used during or after the surgery. **Background:** A nineteen year old female collegiate cheerleader with previous left elbow injuries developed a rash post-surgery to repair the elbow's instability. **Differential Diagnosis:** The differential diagnosis for this athlete included a medial collateral ligament tear, ulnar neuritis, elbow subluxation and cubital tunnel narrowing. **Treatment:** The athlete had been placed in a posterior splint for two weeks. The athlete noticed a red, itchy patch around each of the stiches which began to itch more over the course of the week. Benadryl® PO QID was prescribed. The athlete was prescribed prednisone when the rash did not resolve after 10 days of treatment with Benadryl® **Uniqueness:** When reviewing the literature, there is a small allergic reaction incidence rate, three percent of the population, associated with the Dermabond™ Protape. During the ten days of determining the problem the athlete's rehabilitation was slowed. The athlete's arm was often swollen, itching, and painful. This created a challenge in trying to perform rehabilitation. Rehabilitation still needed to be performed so the athlete did not lose the progress made. **Conclusion:** This case demonstrates the importance of the athletic trainer considering the multitude of sources involved with a rash or infection. This case also shows the challenges an athletic trainer must overcome in dealing with two separate on-going conditions. **Key Words:** Medial collateral ligament, Dermabond™ Pro-tape, allergic dermatitis, contact dermatitis

Chapter 1

Introduction:

Dermatitis is an inflammation of the skin with many causes and forms. Two specific categories of the dermatitis are contact and allergic.[1] Contact dermatitis is an inflammation reaction of the skin after it comes into contact with an irritating substance. The injury occurs due to the skins inability to resist injury due to prolonged or repeated exposure to an irritant.[1] Adults are more commonly affected then children.[2] Irritant contact dermatitis results from coming in contact with a substance that directly damages and irritates your skin. The longer the substance remains on the skin; the more severe the reaction will be for the patient.[3] Allergic dermatitis is an inflammation due to allergic response of the contact with a substance.[1]

Common symptoms include: mild redness and swelling of the skin, blistering of the skin, itching and scaling and temporary thickening of skin.[2]

Medications that can be used to treat contact dermatitis include corticosteroids, NSAIDS, and antihistamines. Corticosteroids can be taken either orally or topically depending on the severity of the reaction.[3]

The ulnar collateral ligament is the valgus support for the medial elbow. It is made up of three bundles: anterior, transverse, and posterior. To palpate the UCL, have the patient flex to between fifty and seventy degrees. The anterior band can be felt across the angle formed by the humerus and ulna.[4]

The most common cause of elbow dislocation is an axial force through the forearm while the elbow is flexed. Swelling will be immediate and could mask a deformity. Distal neurovascular function must be assessed after a dislocation due to the presence of blood vessels and nerves crossing the joint.[4]

Imaging techniques commonly used with elbow dislocations include Anterior-Posterior and lateral radiographs. MRI is also used to determine if any soft tissue injuries have occurred as well.[4]

This case demonstrates the importance of the athletic trainer considering the multitude of causes that can be involved in an infection or rash following a surgical procedure. As athletic trainers, we immediately think of methicillin-resistant Staphylococcus aureus (MRSA) as a potential cause of the infection. It is important to keep a broad look at the injury and not narrow the view of the evaluation.

Chapter 2

Case Review:

The athlete in this case is a 63 inch, 119 pound, 19 year old right arm dominant female collegiate diver. Her past medical history was significant for left upper extremity pathology.

Her past medical history for the left upper extremity included three previous elbow dislocations. The athlete's mechanisms of injury were multi-factored. In this case, injury occurred due to repeated exposure while the athlete was walking on a slippery surface, performing gymnastics, and during a hike. The first incident occurred while walking on wet tile and the athlete lost her balance and fell on an out-stretched arm. The second incident occurred while performing gymnastics and landing on an out-stretched arm coming out of a back handspring. The third incident occurred while the athlete was hiking. After each of these episodes, the athlete did not perform physical therapy. Upon attending college, she started with a standard strength and conditioning program.

Before the season started, the athlete participated in team physicals. At this time, the team physicians determined that the athlete needed to be taped or braced for weight lifting and diving activities. The athlete reported to ATC following a weight lifting session complaining of elbow discomfort.

Initial evaluation was performed after a weight lifting session. Visual inspection revealed effusion of the left elbow. Ligamentous tests performed at this time included the Valgus and Varus Stress Tests. Valgus Stress Test revealed pain and laxity at both zero and thirty degrees of flexion along the medial joint line. An abnormal end feel of no end point was also noted. The athlete guarded her elbow and was not willing move it. Athlete stated she had numbness and tingling into her hand. Tinel's Test was positive over the cubital tunnel. At this time, the

differential diagnosis of the athlete included a medial collateral ligament tear, ulnar neuritis, elbow subluxation or cubital tunnel narrowing.

Athlete was seen by team physician and diagnostic tests were performed. The tests ordered included plain radiographs and an MRI. The plain radiograph was negative for epicondyle fracture. The MRI revealed a grade three medial collateral ligament tear and ulnar nerve inflammation.

The initial treatment plan was conservative. The goals of the treatment at the time were to reduce edema and restore range of motion. Also, a main focus was to strengthen the upper extremity musculature especially forearm flexion once she was asymptomatic. Since diving is a non-contact sport, the team physician wanted to try and stabilize the elbow externally. The physician wanted her to be braced for all activities. At this time; she was not allowed to participate in diving activities.

Once athlete was asymptomatic, she began strengthening exercises. She was allowed to participate in weight lifting activities with her brace but she began experience symptoms again. At this point, the athlete was referred to the team orthopedist. The athlete was given two options: continue with rehab and strengthening her arm since she was a non-contract athlete or surgery. After discussing the options with her parents, she decided to go ahead with the surgery so she could potentially dive in the spring semester.

Surgery repaired the medial collateral ligament. Upon opening the medial aspect of the elbow, attention was directed to the ulnar nerve first. It was noted that even with the slightest touch caused flexion of the inverted muscles (see Figure 1). With this finding, the physician decided to reposition the ulnar nerve anteriorly. Next, it was noted that there was no medial collateral ligament present from the previous traumas. They proceeded with an ulnar collateral

ligament reconstruction. The palmaris longus tendon was used for the reconstruction (see Figure 2). Pain and edema control were managed.

Figure 1: Shows the incision mark along the medial aspect of the elbow joint

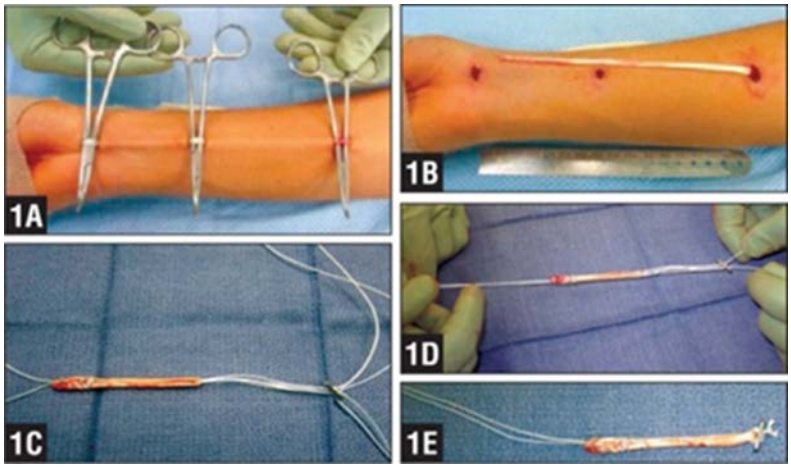

Figure 2: Shows the harvest of the palmaris longus tendon from the left forearm of the athlete

Athlete began rehabilitation exercises at two weeks post-surgery. Athlete complained of a lack of feeling in 4th and 5th digits. Later, in the week, the athlete noticed a red, itchy patch around each of the incision sites. She also noted that the itching became worse. The ATC noted elbow effusion; but believed that it was from the brace being too tight and creating pockets of swelling. The athlete was instructed to loosen the tension on her brace and to see the team physician.

Figure 3: Contact dermatitis from Dermabond™ Protape used to close sutures. The picture shows the outline of the tape and the dermatitis around it.

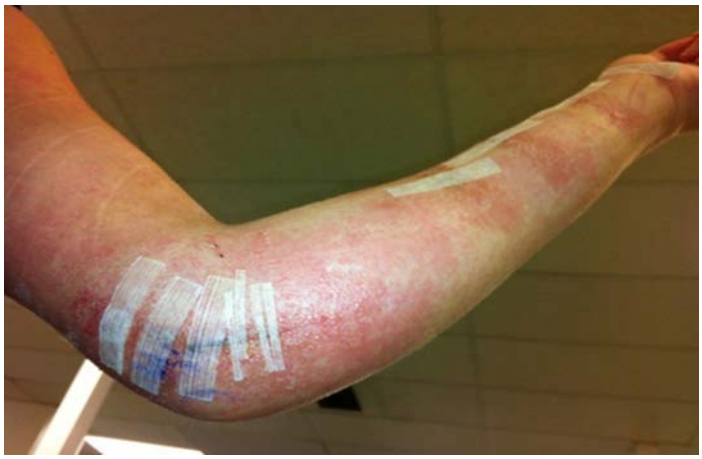

Figure 4: Additional picture of the athlete's contact dermatitis

Athlete was seen by the team physician. The evaluation revealed irritation around each of the suture sites. The skin around the posterior elbow was red, warm to touch and inflamed. A small amount of oozing coming from her wounds appeared to be clear, odorless fluid (see Figures 3 & 4). The doctor prescribed Clindamycin, 300mg TIB, for ten days. The rash did not improve over the course of the ten days; the athlete began a course of Prednisone™, 20mg BID.

The athletes arm was cleaned daily with Hibiclens, antimicrobial antiseptic skin cleanser, and the suture strips started slowly to come off and the rash began to improve. Povidone-iodine reaction could have been a cause of the rash also. The doctor determined the athlete had contact dermatitis from the Dermabond™ Pro-tape used to close the sutures. When reviewing the literature, there has been a small allergic reaction incidence rate associated with the Dermabond™ Protape (see Table 1). The incidence rate is three percent of the population (Loonen, Martijn P. J. and Depoorter, Marc A. M, 2012).

Table 1. Overview of complication rates with Dermabond™ Protape[5]

Complication	**Number of patients (%)**
Allergic reaction to Dermabond™ Protape	3 (3%)
Hyper-inflammation to polyglactin	11 (11%)
Scar formation to polyglactin	1 (1%)
Partial wound dehiscence	2 (2%)
Complete wound dehiscence	1 (1%)
Total	17

Once the contact dermatitis began to subside, the athlete moved forward with her rehabilitation as planned (see Table 2 and 3). Isometric exercises and range or motion exercises were used initially. She slowly progressed to higher level strengthening exercises. ROM was 5°-145° at her 8-week follow up. Also, at this time it was noted that she still had decreased sensation in her 4th and 5th digits. Rehabilitation was limited over the next three weeks due to it being the holidays. The athlete was out of town but she did perform limited rehab exercises on her own over this time. At week 14 she regained full range of motion.

Athlete continued with rehabilitation exercises to strengthen her arm over the course of the next month and a half. At Week 25, she started weight lifting with the team and swimming to increase arm strength and to get the arm used to the pool water again. Swim time was gradually increased over the course of the following month. Week 28 she was cleared by the team physician to begin diving. She was worked through a slow progression at first and performed no more than 10 dives a day during the first week. She slowly progressed to performing more dives each week and into her normal practice schedule. Over this time period the sensation slowly returned to her 4th and 5th digits but she still retained a twitch when the nerve was overworked or irritated. Athlete does continue to have numbness in 4^{th} and 5^{th} digits and occasional weakness in arm. Both of these characteristics are due to the surgical procedure and not the contact dermatitis.

Table 2. Timeline

2009	First elbow dislocation
2010	Second elbow dislocation
2011	Third elbow dislocation
8/27/2012	Team physicals (Doctors recommended for her to be taped or braced for all activities)
8/28/2012	Started Marshall University strength and conditioning program
9/5/2012	Initial evaluation by ATC
9/25/2012	Initial evaluation by team physician
10/1/2012	MRI
10/2/2012	Plain radiograph
10/12/2012	Surgery to repair torn ulnar collateral ligament
10/23/2012	Removed from posterior splint from surgery
10/29/2012	Rash first noticed by athlete and ATC
11/1/2012	Team physician evaluated rash and prescribed Clindamycin
11/11/2012	Prednisone™ prescribed per team physician
12/21/2012-1/11/13	10-13 weeks Post- OP Christmas break (limited rehab exercises)
1/11/13-3/29/13	14-24 weeks Post- OP / Continued rehab
4/5/2013	25 weeks Post-OP / Allowed to start weight lifting with team and swimming
4/26/2013	28 weeks Post-OP / Cleared for diving activities

Table 3. Rehabilitation Exercises

Weeks Post-OP	Range of Motion	Exercises PROM	Exercises AROM	Exercises Isometrics	Exercises PRE
0-2 weeks	Posterior splint at 90°		Wrist flexion/extension		Distal ball squeezes
2-4 weeks	Avoid end ranges	PROM / AAROM 25-100° Increase 5° ext and 10° flex weekly	Wrist flexion/extension Shoulder flexion/ extension Shoulder abduction/ adduction Shoulder protraction/ retraction	Wrist flexion/ extension Shoulder flexion/ extension Shoulder abduction / adduction Scapulothoratic protraction/ retraction	Distal ball squeezes
4-6 weeks	AROM 0-125°		Wrist flexion/extension Shoulder flexion/ extension Shoulder abduction/ adduction Shoulder protraction/ retraction	Wrist flexion/ extension Shoulder flexion/ extension Shoulder abduction / adduction Scapulothoratic protraction/ retraction	Wrsit flexion / extension-therabands Wrist radial deviation Forearm supination/pronation Shoulder shrugs Shoulder protraction/retraction Shoulder flexion/abduction
6-12 weeks	AROM 0-145		Elbow flexion/extension	Wrist flexion/ extension Shoulder flexion/ extension Shoulder abduction / adduction Scapulothoratic protraction/ retraction Wrist radial/ ulnar deviation Elbow flexion/extension	Wrsit flexion / extension-therabands Wrist radial/ulnar deviation Forearm supination/pronation Shoulder shrugs Shoulder protraction/retraction Shoulder flexion/abduction Biceps/Triceps Rows Chest Press
12-16 weeks	Full ROM			Elbow flexion/extension Shoulder ER/IR Scapulo-Thoracic	Biceps/ Triceps Rows Chest Press Shoulder ER-side lying Shoulder IR-standing Lateral raise D1/D2 patterns Rhythmic stabilization
16+ weeks	Full ROM			Shoulder ER/IR Scapulo-Thoracic	Biceps/ Triceps Rows Chest Press Shoulder ER-side lying Shoulder IR-standing Lateral raise D1/D2 patterns Rhythmic stabilization

Chapter 3

Differential Diagnosis:

The differential diagnosis for the rash included prickly heat, shingles, MRSA, irritant contact dermatitis or allergic contact dermatitis. These diagnosis share similar symptoms which need to be differentiated from each other (see Table 4).

Prickly heat or *miliaria rubra* commonly occurs in areas covered with clothing. The most common sites include the neck, face, truck and groin regions (Howe A, & Boden B., 2007; Grubenhoff, J.A. et al., 2007.) Also, it is most commonly seen in infants or young children (Grubenhoff, J.A. et al., 2007.) The major characteristic is pinpoint papular erythematous (Howe A, and Boden B., 2007). Additionally, itchy skin and redness can occur (Howe A, and Boden B., 2007). This condition is usually associated with profuse sweating causing the sweat ducts to become obstructed. When an obstruction occurs, the sweat leaks into the epidermis. The clinician needs to be concerned with secondary infections from prickly heat which could include staphylococcus if the condition persists (Howe A, and Boden B., 2007). This condition was ruled out due to the location on the athlete's body and the characteristics of the rash did not meet the above described conditions.

Shingles or *herpes zoster* comes from the same virus causing the chickenpox. It is characterized as an outbreak of blisters or a rash on the skin ("NINDS Shingles Information Page," n.d.). At first, the rash or blisters are not noticeable; but, there is burning, tingling, itching, and pain at the site ("NINDS Shingles Information Page," n.d.).It is common for the blisters or rash to only occur on one side of the body or along a certain dermatome. Individuals who have had chickenpox in the past are able to contract shingles ("NINDS Shingles Information Page," n.d.). The rash and blisters can last as long as three to five weeks ("NINDS Shingles

Information Page," n.d.). This condition was ruled out due to the athlete not having any of the preceding symptoms and the rash went across several dermatonal patterns. Also once, the athlete was given medication; the rash lasted less than three weeks.

Methicillin-resistant Staphylococcus aureus (MRSA) is a bacterium that developed a resistance to antibiotic medications (Green, B. et al, 2012). Overall, there are over 200 strains of *S aureus* (Green, B. et al, 2012). There are five main signs that can lead to an infection. These include: contact, compromised skin, contaminated items, lack or cleanliness, and crowding (Green, B. et al, 2012). Individuals with a compromised immune system and high risks for infection are also more susceptible. Typical signs and symptoms include pain and pus production from site (Green, B. et al, 2012). This condition was ruled out due to the lack of pus formation at the site of the rash and the rash responded to medication.

Irritant contact dermatitis is a breakdown of the skin caused by an irritant (Peiser, M. et al, 2012). It can be caused by having prolonged exposure time to an irritant (Peiser, M. et al, 2012). It is more common in women (Slodownik, D. et al, 2008). It presents as any common allergy with redness and inflammation (Slodownik, D. et al, 2008). This condition was part of the diagnosis due to meeting the described reaction of redness and inflammation. Also, the tape was on the athlete's skin for two weeks; so, it met the characteristic of prolonged exposure time.

Allergic contact dermatitis can be caused by either chemical or environmental substances that come in contact with the body (Kimber, I. et al, 2012). Just as with irritant contact dermatitis, it is more common in women (Peiser, M. et al, 2012). It presents with itchy skin, redness and inflammation (Bourke, J. et al., 2009). This condition was part of the diagnosis due to the presentation of the rash and symptoms that accompanied it. Also, the tape was an item the athlete had never been exposed to before the surgery.

Table 4. Differential Diagnosis Chart

Illness	Redness	Inflammation	Itchy skin	Responds to medication	Pus formation	Follows Dermatone pattern	Pain
Prickly Heat	x		x				
Shingles			x			x	x
MRSA					x		x
Irritant Contact Dermatitis	x	x		x			
Allergic Contact Dermatitis	x	x	x	x			

Chapter 4

Discussion:

Immunity

Immunity can be described as when an organism or antigen attacks a host organism and the host is able to resist the attack.[14, 15] The body's immune system identifies the antigen and works to destroy it.[14,15] An individual has two main types of immunity: innate and adaptive. Innate immunity is immunity you are born. It is a three pronged mechanism including physical, chemical, and cellular components to minimize foreign cells from invading the body.[16] The actual components are physical epithelial barriers, phagocytic, dendritic cells, lymphocytes called a natural killer (NK) cell, and circulating plasma proteins.[16] Adaptive immunity is an antigen-specific immune response. This type of immunity has to be developed through exposure to antigens. Antigens are substances which provoke an adaptive immune response causing the body to produce antibodies. If an antigen gets past the barriers, the body will destroy it. The body creates two different types of lymphocytes to help protect it. B and T lymphocytes multiply and create a memory for the immune system.[12, 14] The body will respond to protect the body if the antigen is encountered again.[12, 14]

The main response of the body when it is attacked by an antigen is inflammation. [14, 16]The injured cells release chemicals: histamine, bradykinin, and prostaglandins; which lead to the blood vessel leaking fluid into the surrounding tissues causing the inflammation.[14]

Allergic response

"Irritant contact dermatitis (ICD) is the expression of the proinflammatory (a response to injury or destruction of tissue) and toxic effects of xenobiotics (harmful lipid soluble chemicals)

able to activate the skin's innate immune system"[17] ICD is an inflammation of the skin manifested by erythema, mild edema, and scaling of the skin's surface. "Allergic contact dermatitis (ACD) requires the activation of antigen (Ag)- specific acquired immunity, leading to the development of effector T cells (TEFF), which mediate the skin inflammation." [17] Usually, ACD occurs through a two-step process. The skin is exposed to the irritants such as non-protein chemicals or haptens and then the body responds to them with an immune response. When the skin is exposed for the second time, the body responds quicker and the appearance of the ACD is noted. But in some cases the response can be generated with only one prolonged exposure.[15] "It has been demonstrated that ACD can develop after a single skin contact with a strong hapten in previously unsensitized patients."[17] This situation could explain the contact dermatitis in the athlete in this case. She was exposed to a new irritant with the Dermabond™ Protape after surgery and the area was closed off in a posterior splint for two weeks following the surgery. The splinted area did not allow for air flow and was hot due to the weather conditions around the time of surgery.

Irritant contact dermatitis

ICD usually occurs before ACD. ICD comes from a breakdown of the skin barrier after exposure to skin irritants.[10] ICD can be caused by both exogenous, external, and endogenous, internal, factors.[11] Exogenous factors include chemical and physical irritants such as: body temperature, environment, mechanical factors, chemical properties, and chemical penetration. Endogenous are linked to the individual. The factors related to endogenous factors are age, race, susceptibility, skin sensitivity, and skin permeability.[11]

Exogenous irritants can arise from several different exposure sources.[11] The most common source is called "wet working." Wet working is when the skin is exposed to liquid for

longer than two hours a day.[11] When considering the source with this case, the athlete was diving for around two hours a day for six days a week. The pool contains the chemicals: chlorine and bromine to help fight bacteria and muriatic acid and sodium bicarbonate to balance the pH. These chemicals could be a potential source contributing to the contact dermatitis. "Concentration, volume, application time and duration of irritant exposure on the skin will determine the outcome."[11] With regards to these statements this could have been the reaction that caused the rash. The athlete's skin was still chemically saturated going into surgery and when the Dermabond™ Protape was used to close the incision sites it blocked the skins mechanism of breathing and held the chemicals within the skin.

Skin irritation is has a higher prevalence in individuals under the age of twenty. ICD is like ACD where it is more common in women.[11]

Allergic contact dermatitis

Allergic contact dermatitis (ACD) is a common health care issue. ACD can occur due to a number of chemicals or environmental agents that the human body can come in contact with. Contact dermatitis is twice as likely to occur in women as in men.[10] ACD usually has two phases in which it develops. The first phase is induction. Induction is described as "skin sensitization that is initiated following topical exposure of a susceptible subject to amounts of the chemical allergen sufficient to induce a cutaneous immune response of the necessary vigor."[12] The initial ACD occurs within 24-96 hours after contact has been made with the allergen.[18] The sensitization can take up to four days to complete but the results lasts for years.[19] "The effectiveness of skin sensitization will be influenced by the inherent potency of the allergen, the amount of chemical experienced at the skin surface and the degree of trauma/inflammation induced."[12] The second phase of ACD is elicitation. Elicitation is described when the "now

sensitized individual is exposed subsequently, at the same or a different skin site, to the inducing chemical allergen with a more vigorous secondary immune response being provoked at the point of contact."[12] The body responses by sending multiple types of white cells (macrophages, basophils, mast cells and eosinophils) to the site of the challenge to defend the body.[19] Unlike with ICD which remains in the affected area, ACD can move to away from the general area affected and to distant unrelated sites on the body.[18] The athlete's rash was not only present around where the Dermabond™ Protape was located; but, also covered her entire forearm and elbow.

Chapter 5

Conclusion:

When reviewing the literature, there has been a small allergic reaction incidence rate associated with the Dermabond™ Protape. The incidence rate is approximately three percent of the population.[5] Also, with this case; you need to consider the sport the athlete was participating in. Since the athlete was a diver, she was in contact with the pool water. The pool water contains multiple chemicals that could have absorbed into her skin and caused the reaction with the Dermabond™ Protape. This case demonstrates the importance for athletic trainers in knowing about complications with post-surgical athletes and that the cause could be from the materials used during or after surgery. Also, it is important to refer early or make a physician aware of the situation that is occurring.

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Appendix A: MU Institutional Review Board Letter

MARSHALL UNIVERSITY®
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Office of Research Integrity

April 28, 2014

Brandi L. Anders
324 Woodring Cem Rd
Tuckasegee, NC 28783

Dear Ms. Anders:

This letter is in response to the submitted thesis abstract entitled *"Skin Condition Secondary to Elbow Dislocation in a Collegiate Diver."* After assessing the abstract it has been deemed not to be human subject research and therefore exempt from oversight of the Marshall University Institutional Review Board (IRB). The Code of Federal Regulations (45CFR46) has set forth the criteria utilized in making this determination. Since the information in this study does not involve human subjects as defined in the above referenced instruction it is not considered human subject research. If there are any changes to the abstract you provided then you would need to resubmit that information to the Office of Research Integrity for review and a determination.

I appreciate your willingness to submit the abstract for determination. Please feel free to contact the Office of Research Integrity if you have any questions regarding future protocols that may require IRB review.

Sincerely,

Bruce F. Day, ThD, CIP
Director