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Shoulder Anatomy & Injury Rehabilitation

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Senior Capstone Project

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Abstract:

The purpose of this project was to gain hands on laboratory experience in order to learn about the different anatomical components of the human shoulder, combined with research done on different injuries to the shoulder joint and their specific rehabilitation processes. Research methods included the opportunity to participate in cadaver pro-section with Drs. Olson and McGinn in the anatomy laboratory, along with individualized research using professional articles. Although my focus of this project is shoulder anatomy and rehabilitation, I was able to work on all different parts of the body while in the anatomy lab. Part one of this capstone project includes my laboratory findings through images photographed in the anatomy laboratory, and part two includes reports on the findings of my individual professional research about different shoulder injuries and their accompanying rehabilitation procedures. This work is significant as I am heading into a Doctor of Physical Therapy program at Northwestern University in the Fall, and I am hoping to specialize in shoulder rehabilitation. My findings throughout the completion of this project are something I will continue to benefit from through my entire professional career.
Part One: Laboratory Findings

Part one of my capstone project contains anatomical findings from the anatomy laboratory through the use of photographs taken during my time in the laboratory, and reference photographs found on the internet. I have included captions and arrows to further signify my work and findings.
Muscles of the Rotator Cuff: Supraspinatus

*Supraspinatus outlined in red  *Supraspinatus highlighted in green

Origin: Supraspinous fossa of the scapula

Insertion: Greater tubercle of the humerus

Action: Abduction of the humerus

Innervation: Suprascapular nerve
Muscles of the Rotator Cuff: Subscapularis

*Cadaver was worked on in prone position so no subscapularis photos were taken as it is viewed best in a supine position*

Origin: Subscapular fossa of the scapula

Insertion: Less tubercle of the humerus

Innervation: Upper and lower subscapular nerves

Action: internal rotation of the arm
Muscles of The Rotator Cuff: Teres Minor

*Teres minor is outlined in green                                    *Teres minor is highlighted in green

Origin: Lateral border of the scapula

Insertion: Inferior facet of the greater tubercle of the humerus

Innervation: Axillary nerve

Action: Laterally rotates the arm
Muscles of The Rotator Cuff: Infraspinatus

**Origin:** Infraspinous fossa of the scapula

**Insertion:** Middle facet of the greater tubercle of the humerus

**Innervation:** Suprascapular nerve

**Action:** External rotation of the shoulder
The Labrum

Description: The labrum is a piece of cartilage in between the head of the humerus and the socket of the scapula.

Function: The purpose of the labrum is to provide stability to the shoulder joint and help hold the head of the humerus in place.
Capsular Connective Tissue

Description: The capsule of the shoulder consists of strong connective tissue that surrounds the shoulder joint and rotator cuff tendons.

Function: The shoulder capsule is lubricated by synovial fluid allowing the shoulder to move freely.
Description of Laboratory Experience:

My first responsibility when entering the laboratory was performing all lab safety techniques. This included using proper personal protection such as a lab coat, gloves, and eyewear at all times along with checking to make sure I was using clean and proper tools. The tools I learned to use in the anatomy laboratory were: a scalpel, skin scissors, forceps, a prob, and a Stryker (or bone) saw. What I performed in the lab included skin pro-section, opening the skull, fat removal, internal organ removal, facial detailing, and identifying and reflecting muscles on all extremities. I spent about 20 hours in the anatomy lab over the course of the semester.
Part Two: Research Findings

Part two of my capstone projects includes my reports on three different shoulder injuries I have seen in the Physical Therapy Clinic I work at. These injuries are: torn rotator cuff, frozen shoulder syndrome, and torn labrum. The anatomy behind these injuries is addressed here in part two and also in my laboratory findings in part one. These reports also include the different rehabilitation processes I researched for each specific injury.
Torn Rotator Cuff

Introduction:

A common misconception I once carried myself is that athletes are the most common type of people to suffer from a torn rotator cuff. This misconception makes sense because torn rotator cuffs often arise from repetitive lifting and overhead activities, which would very much include athletes who play volleyball, lacrosse, baseball, basketball, football, and countless others. However, torn rotator cuffs arise just as frequently from the degeneration of the shoulder joint that accompanies aging. This means that people over 40 are just as at risk to a torn rotator cuff as the previously mentioned athletes. In the Physical Therapy clinic that I work at I have seen many people with torn rotator cuffs come in for treatment. That is where I learned that a torn rotator cuff is not injury mostly isolated to athletes.

Anatomy:

The shoulder is fascinating because it is the most free-moving joint in the body, meaning your shoulder has an extremely large range of motion compared to a joint like your knee, which is more limited. However, with a large range of motion comes limited stability, and that’s why shoulder injuries are common. The shoulder joint is what is called a ball-and-socket joint because the head of the humerus fits into a pocket in the scapula. The joint is stabilized by the four muscles that make up the rotator cuff: the supraspinatus, the subscapularis, the teres minor,
and the infraspinatus. The rotator cuff helps to lift and rotate the arm. When any one of these muscles are damaged or torn, the four muscles no longer function together correctly and the patient experiences intense pain in the shoulder. Most commonly, the supraspinatus is the muscle/tendon that is torn in a rotator cuff injury, but it can be any of the muscles/tendons previously listed. I was able to see all of these different muscles during my time spent in the anatomy laboratory. It was an amazing opportunity to be able to touch and feel all the different muscles of the rotator cuff and visualize all their origins and insertions.

Treatment:

The approach a Physical Therapist takes to treating a rotator cuff tear depends on the type of tear present in their patient. There are many different ways the rotator cuff muscles/tendons can be injured. For example, a partial-thickness or full-thickness tear. A partial thickness tear affects just a small portion of whatever muscle/tendon is it present on, and a full-thickness tear extends throughout the entire muscle/tendon. There are also acute vs. chronic tears. Acute tears occur suddenly in response to injury, and chronic tears develop slowly over time. These factors will determine if a patient with a rotator cuff tear needs surgery, or if their injury will heal from solely Physical Therapy.
If a Physical Therapist believes their patient will benefit from solely Physical Therapy, they will implement an exercise rehabilitation program. The goal of this program will be to reduce pain, restore range of motion, increase muscle strength, and build coordination so that the patient can perform regular activity without pain. According to the study “Exercise Rehabilitation in the Non-Operative Management of Rotator Cuff Tears: A Review of the Literature”, written by P. Edwards, et. Al., “This suggests that the exercise component of physical therapy is fundamental in the treatment of these tears, and most exercise protocols should demonstrate clinically important change in patient-reported outcomes by 12 weeks,” (pg. 288). So, it takes time, but exercise in Physical Therapy is proven to be effective in the treatment of certain rotator cuff injuries.

If a patient presents a rotator cuff injury that can only be healed through a surgical procedure, Physical Therapists still play an extremely active role in their rehabilitation process. Physical Therapists will work with surgeons to create a personalized post-operative plan to rehabilitate the patient as quickly and effectively as possible. From the study titled, “Rehabilitation after Rotator Cuff Repair”, by O. Nikolaidou, et. Al., “A gentle rehabilitation protocol with limits in range of motion and exercise times after arthroscopic rotator cuff repair would be better for tendon healing without taking any substantial risks. A close communication between the surgeon, the patients and the physical therapy team is important and should continue throughout the whole recovery process,” (pg. 154). If surgery cannot be avoided, Physical Therapists will still be there every step of the way as a patient heals from a rotator cuff tear. They will work closely with other medical professionals and they will be in charge of implemented post-operational exercise plans to heal the tissue, reduce pain, and restore range of motion so the patient can perform normal activity.
Frozen Shoulder Syndrome

Introduction:

Another name for frozen shoulder syndrome is adhesive capsulitis, which makes sense because when a patient is diagnosed with frozen shoulder syndrome the capsule of the shoulder joint becomes thicker and stiff, causing pain and limited range of motion in the affected shoulder. The cause of frozen shoulder syndrome remains unknown, however things like diabetes, various diseases, and immobilization have been found in association. Frozen shoulder syndrome presents itself in three different stages. Stage one, freezing, is when pain develops and a loss in range of motion presents itself. This stage can last anywhere from six weeks to nine months. Stage two, frozen, is indicated by a decrease in pain but a loss in range of motion is still prevalent. This stage lasts from four to six months. Stage three, thawing, is when motion returns slowly while strength and flexibility increase in the affected shoulder return. This stage can last from six months up to two years. Medical professionals don’t know much about what causes frozen shoulder syndrome to appear in patients, but they do know it is more prevalent in women and in adults aged 40-60 years old. In the Physical Therapy clinic that I work at I have seen one patient treated for frozen shoulder syndrome. Her treatment was excruciatingly painful and although we made progress, she ended up pursuing a surgical route of treatment.
Anatomy:

Frozen shoulder syndrome is more focused on the bone structure component of the shoulder compared to other shoulder injuries that affect the shoulder musculature. The bone structure of the shoulder is a ball-and-socket joint which is made up of the humerus, the scapula, and the clavicle. It is called a ball-and-socket joint because the head of the humerus (or the ball) fits into a depression in the scapula (or the socket). These bones are surrounded by a very strong and flexible connective tissue called the shoulder capsule, which gives the shoulder joint its strength and flexibility. When frozen shoulder syndrome occurs, adhesions and scar tissue form on the shoulder capsule causing thickness and inflexibility. There is also less synovial fluid present which is what keeps the joint moving freely, this also adds to the stiffness present in the joint. I was not able to focus on the shoulder capsule in the anatomy laboratory simply because we focused on muscular tissue.

Treatment:

Frozen shoulder syndrome is challenging to treat because the causes of the syndrome still remain largely unknown. There are a few non-operative treatment options, however these tend to take quite a bit of time to show results. The operative route tends to show greater results in a shorter period of time. At the end of the day treatment for frozen shoulder syndrome relies on doctor recommendation and patient preference. During any step of any type of treatment for this
syndrome both Physical Therapists and Orthopedic professionals are required to work hand in hand for the highest patient success rate.

To begin, physical therapy alone can be a good treatment option in treating frozen shoulder syndrome. According to the article titled “Physical Therapy in the management of frozen shoulder” by H. B. Y. Chan, et. Al, “Many physical therapy and home exercises can be used as a first-line treatment for adhesive capsulitis. Physical Therapy has been shown to bring about pain relief and return of functional motion,” (pg. 685). It is important to note that depending on which stage of frozen shoulder syndrome a patient is in (freezing, frozen, or thawing) their physical therapy treatment plan will look different. Physical therapy alone also takes longer than operative treatments to demonstrate results, but it still effective.

The first non-operative for treating frozen shoulder syndrome is called Hydrodilation. According to the article titled “Frozen shoulder: A systematic review of therapeutic options” written by H.S. Uppal, et. Al., “This treatment involves the injection of local anaesthetic into the capsule at a pressure high enough to distend and stretch the joint capsule,” (pg. 265). This technique has proven to be beneficial to improving strength and flexibility of patients diagnosed with frozen shoulder syndrome, however it has also proven to be quite a painful process. No evidence suggests that this method is superior to other methods in treating frozen shoulder syndrome. It is important to note this method still requires accompanying physical therapy.

In pursuit of a faster option for relief from frozen shoulder syndrome patients can pursue a surgery called arthroscopic capsular release. From the article titled “Frozen shoulder: A systematic review of therapeutic options” written by H.S. Uppal, et. Al., “The capsular release starts with the excision of the conjoint tendon, the release is extended inferiorly posterior to the tendon of subscapularis down to the five o’clock position,” (pg. 264). In summary a patient is put
to sleep and then surgeons go in and force range of motion back into the shoulder by breaking through adhesions on the capsular connective tissue. This technique has proven to be effective in restoring range of motion in the shoulders of patients with frozen shoulder syndrome. Physical therapy will still accompany before and after this procedure.
Labrum Tear

Introduction:

A shoulder joint tear or a glenoid labrum tear is an injury that went unnoticed and undiagnosed in the past. Thanks to new technology in the medical field, medical professionals are now able to zero-in on specific locations of shoulder injuries, which is really helpful in diagnosing a labrum tear. A labrum tear is usually caused by trauma specifically to the surrounding tissue of the shoulder socket or a repetitive motion that stresses the same area. This injury can happen to anyone but is common in athletes that consistently perform a throwing motion or weightlifters. It can be difficult to distinguish a labrum tear from other shoulder injuries because the symptoms can be so similar. For example, multiple dislocations, instability, pain, popping, and decreased motion and strength in the shoulder are all symptoms of a labrum tear. Because a labrum tear affects the soft tissue of the shoulder socket, this injury will not show up on x-rays, CT scans, or MRI’s. Usually the diagnosis of a labrum tear is made through arthroscopic surgery using miniaturized cameras to explore the affected area. At the physical therapy clinic, I work at we have seen a few labrum tears, but I am assuming more patients have labrum tears than we are aware of. Many patients are treated for shoulder pain and I can guess a few have undiagnosed labrum tears because of the amount of testing it takes to actually diagnose one.
Anatomy:

As mentioned before the three bones that make up the shoulder joint include the scapula, the clavicle and the humerus. The shoulder joint is a ball and socket joint, meaning the head (or ball) of the humerus fits into socket of the scapula. The labrum is the soft tissue that surrounds the socket in order to help the head of the humerus fit more comfortably and more securely. I wasn’t able to specifically see the labrum when working in the anatomy laboratory because we primarily focused on muscle tissue.

Treatment:

When it comes to treating labral tears, it is important to make the distinction of what kind of labral tear the patient is experiencing. Because there is also the possibility of a labral tear in the soft tissue surrounding the hip joint, medical professionals have come up with an acronym when referring to a shoulder labral tear. The acronym is SLAP, meaning superior aspect of the glenoid labrum. A SLAP tear can be difficult to rehabilitate due to how difficult it is to diagnose correctly, the complexity of the area, and other factors. SLAP tears are in fact usually treated with operative treatment, but the type of operation depends on the severity of the tear. SLAP lesions can be treated nonoperatively, but this treatment form is not usually as successful as the operative path. No matter what type of treatment is performed, physical therapists and surgeons work closely together to give patients the most effective rehabilitation process possible.
Non-operative treatment when it comes to treating SLAP lesions is not usually the most effective option, especially if the damage to the labrum is extensive. From an article studying SLAP lesions in baseball players titled “Factors influencing outcomes of nonsurgical treatment for baseball players with SLAP lesion”, written by Hashiguchi et. Al., “Inevitable factors showed high odds ratio were symptomatic period, age, duration of baseball experience and Bennett spur. Factors able to improve by nonsurgical treatment and showed high odds ration were total rotation and internal rotation of 90 degrees abduction 2 months after the treatment,” (Hashiguchi et. Al., pg. 8). It is important to note that non-operative treatment for SLAP lesions can help build strength and increase range of motion to a point, however many different factors make a surgical option more effective and realistic in the rehabilitation process.

The first type of operative treatment using in SLAP tears or SLAP lesions is called debridement. This procedure is used for type I and type III classified SLAP lesions. According to the article titled “The recognition and treatment of superior labral (SLAP) lesions in the overhead athlete”, written by Wilk, et. Al., “Type I and Type III SLAP lesions normally undergo a simple arthroscopic debridement of the frayed labrum without an anatomic repair,” (Wilk, et. Al. pg. 588). This type of surgery is very effective and aggressive in quickly rehabilitating people with labral tears because the tissue is still stable and intact after the procedure. Immediately after the procedure patients are placed into intense strengthening and range of motion exercises during physical therapy to ensure the quickest rehabilitation experience possible.

For type II SLAP lesions, the rehabilitation process for patients looks slightly different. From the same article, “Postoperative progression is slowed to allow healing of the more extensive anatomical repair required to reattach the biceps tendon anchor in a Type II lesion, in comparison to Type I and III lesions,” (Wilk, et. Al., pg. 595). This type of procedure is a bit
more intense as it requires more extensive labral repair than the procedure previously mentioned. Patients are given more time to rest and heal after this type of procedure, however still beginning isometric exercises immediately after the procedure and passive range of motion exercises two weeks post-operatively.
Works Cited

Part One:


Part Two:

Rotator Cuff Tear:


Image and Information:

**Frozen Shoulder Syndrome:**


Image and information:


**Labral Tear:**

**Works Cited**


Image and Information: