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Outpatient Physical Therapy management of a Patient with Postoperative Massive Rotator Cuff Repair, Subacromial Decompression, Distal Acromial Excision and Biciptal Tenodesis

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OUTPATIENT PHYSICAL THERAPY MANAGEMENT OF A PATIENT WITH POST-OPERATIVE MASSIVE ROTATOR CUFF REPAIR, SUBACROMIAL DECOMPRESSION, DISTAL ACROMIAL EXCISION AND BICIPITAL TENODESIS

by

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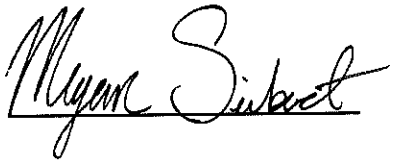
Signature 

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ABSTRACT

Background and Purpose. This case report describes the outpatient physical therapy treatment of a 49-year-old male patient with a left, post-operative, massive, rotator cuff repair involving the supraspinatus, infraspinatus, and subscapularis, subacromial decompression, distal acromial excision and bicipital tenodesis of the long head of the biceps. The purpose of this article is to showcase the importance of physical therapy in post-operative treatment of this patient and other patients with similar diagnosis. The criteria for patient selection included a post-surgical diagnosis with high potential for progression.

Description. The treatment of this patient involved manual therapy including soft tissue mobilization, dry cupping, therapeutic exercises, functional activities, range of motion, stretching, strengthening and postural re-education.

Outcomes. Following physical therapy intervention, the patient improved range of motion to almost full range, good to normal strength, and pain only with weighted overhead activities. The patient reported the ability to perform activities of daily living and home activities without pain or difficulty, however due to his occupation and continued improper scapular mechanics therapy was still needed for decreasing pain due to impingement. The patient discharged himself from therapy after completing 9 weeks of therapy for unknown reasons despite continued deficits.

Discussion. Without physical therapy, this patient would have continued to have deficits following surgery. Range of motion should have been formally measured with goniometry regularly to view improvements throughout the episode of care and patient education and understanding of the home exercise program should have been evaluated and stated in the documentation. A protocol for progression of plan of care should have also been incorporated into the plan of care despite the clinical instructor's experience.

CHAPTER I

BACKGROUND AND PURPOSE

A wide range of injuries can occur in the shoulder due to overuse, trauma, or degeneration. A rotator cuff injury is one of the most common, especially with increasing patient age. In fact, the prevalence of abnormalities in the rotator cuff increases to 62% in patients 80 years and older.[1] These injuries can be both symptomatic and asymptomatic, making it difficult to estimate the prevalence of this type of injury in the younger to middle aged population. It is estimated that about 20-34% of the general population are affected by this injury.[2]

The rotator cuff (RTC) includes the supraspinatus, infraspinatus, teres minor and subscapularis muscles, which all play a role in providing dynamic stability to the shoulder.[3] The long head of the biceps brachii also works with the rotator cuff to provide some of the stability. Dynamic stability of this joint is provided by the muscles compressing the humeral head against the glenoid fossa. Three of the muscles including the supraspinatus, infraspinatus, and teres minor originate on the posterior scapula and insert on the greater tubercle of the humerus near the humeral head. Due to the orientation of the insertions of each muscle, which is depicted in Figure 1, the supraspinatus is responsible for abduction of the arm and the infraspinatus and teres minor are responsible for lateral rotation of the arm. Subscapularis originates on the anterior scapula and inserts on the lesser tubercle which allows for the muscle to provide internal rotation of the arm.[3] Figure 2 provides a lateral view showing the relationship of the RTC tendons to each other and the acromion. Without these muscles providing adequate stability for the glenohumeral joint, the deltoid will overpower them in overhead movement and will cause impingement of the

tendons against the acromion. This impingement can cause rotator tendinopathy which is the irritation of the tendons as well as cause tearing of the tendons.

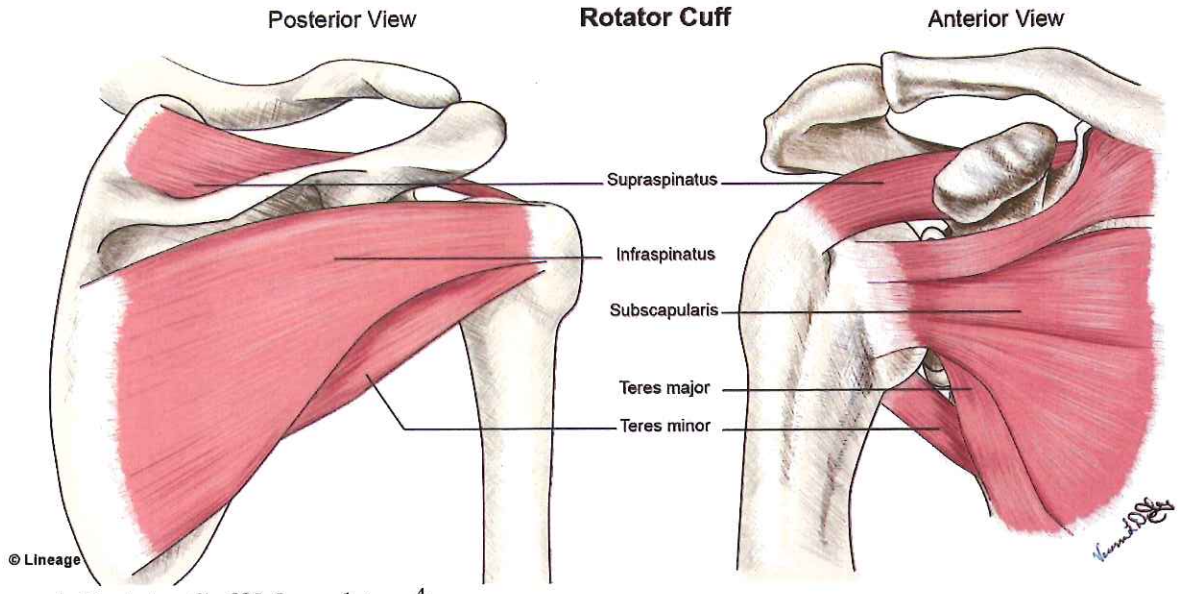


Figure 1. Rotator Cuff Musculature[4]

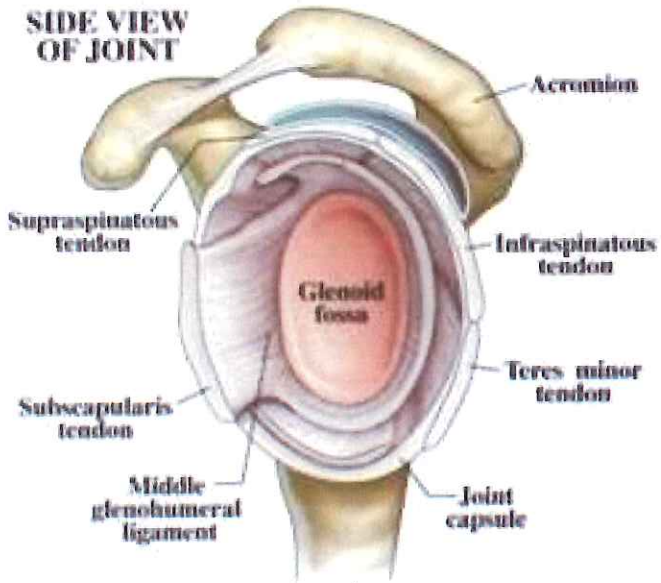


Figure 2. Interarticular Lateral View of RTC Tendons[5]

There are different types of acromion processes that cause people to have a higher risk of rotator cuff pathologies and impingement. There are three types: type 1 which is flat, type 2 curved and type 3 hooked which is shown in Figure 3. A person with a type 3 acromion process has the highest risk of rotator cuff tears, almost three times more than others, due to the decreased subacromial space where the RTC tendons pass through.[6] Surgical intervention is typically needed to protect the remaining RTC tendons or any surgical repair of the tendons. This includes subacromial decompression where any excess tissue is removed between the RTC tendons and the underside of the acromion as well as a distal acromial excision where the hooked part of the acromion is shaved off opening up more space in the joint. The goal of these procedures is to allow for more room for the RTC tendons and reduce the risk of more damage.

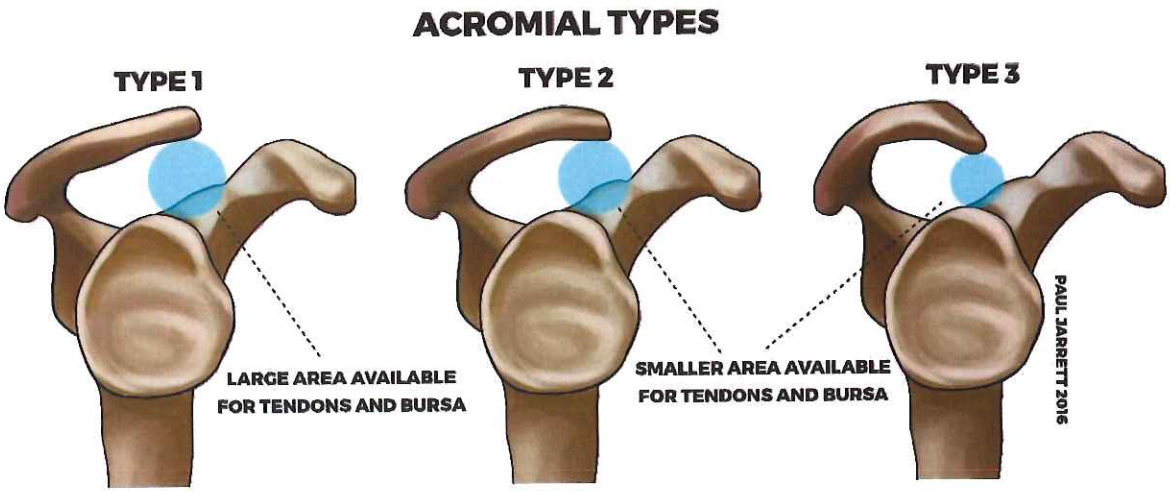
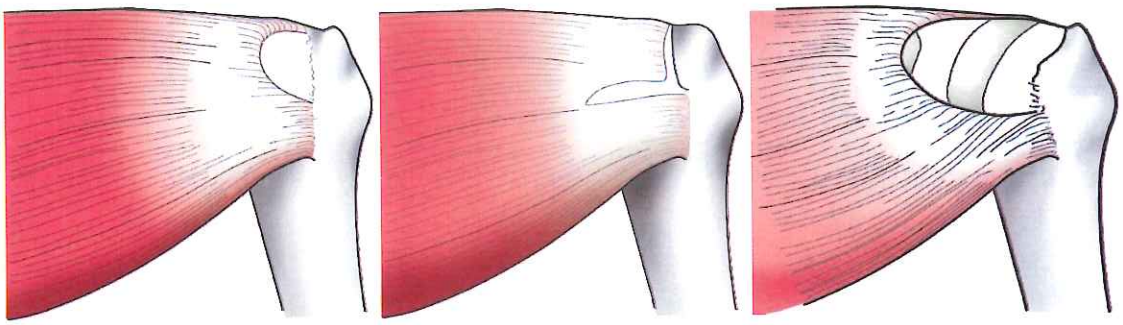


Figure 3. Acromial Types[7]

Rotator cuff injuries can vary in severity from partial tears to full thickness tears, including some or all the muscle tendons mentioned previously. A full thickness tear is a tear that goes completely through the depth of the tendon or muscle. Full thickness tears are classified by their size; small (<1cm), medium (1-3cm), large (3-5cm) or massive (>5cm).[8] The larger the

tear, the more difficult it is for the tendon to be surgically repaired as well as for the tendon to heal after surgery. It is important for all of the patient's health care team to know the extent of the tear in order to create an acceptable and safe plan of care. With full-thickness tears, it is also important to know the pattern of the tear. The possible shapes of the tears include crescent, L, reverse L, and U shaped which is shown in figure 4.[9] If the tendon is retracted all the way to the glenoid fossa it may be decided that it is irreparable. Knowing the width, shape, and degree of retraction of the tear is important for surgeons to know so they can plan an effective repair strategy.



A) Crecent Shaped B) L-Shaped C) U- Shaped

Figure 4. RTC Tear Types[8]

A partial thickness tear is a tear that goes through a portion of the depth of the tendon or muscle. As there is more tension through the muscle or increased trauma, a partial thickness tear has potential to propagate into a full thickness tear.[8] Partial thickness tears also have a grading system of severity. A grade 1 tear is <3mm, grade 2 is 3-6mm, and a grade 3 is >6mm. A grade 3 tear is considered a significant tear due to a normal rotator cuff muscle only being 10-12mm thick. Partial thickness tears are different compared to full thickness in more ways than their severity. They can be treated more effectively with conservative treatment including steroid injection and physical therapy.

Of all rotator cuff tears, 20% are massive rotator cuff tears and 80% of recurrent tears are massive as well.[10] A massive rotator cuff tear consists of a tear that is 5cm in diameter of one tendon or a complete tear of 2 or more of the rotator cuff tendons.[11] Both the U-shaped and L-shaped tears are considered massive tear due to the extent.[8] The tendons can also be completely resected from the humerus which is considered a massive tear. The more time a patient waits to have surgical intervention following a massive rotator cuff tear, they have an increased risk of the tendon retracting from the humerus. Tendon retraction makes surgical intervention difficult and less likely to be successful. The number of tendons that are affected as well as the severity of the tear are both factors that determine a patient's functional ability. Surgical repair is more likely needed for severe tears affecting a greater number of tendons.

A severe rotator cuff tear is associated with increased pain with movement and functional limitations. There are many diagnostic special tests that physical therapists can perform to evaluate the integrity of the RTC musculature. Tests including the empty can test, a resistive test for the supraspinatus, and the full can test, a resistive test for the supraspinatus and other shoulder muscles.[10] Infraspinatus and teres minor can be tested with the arm in 90 degrees flexion and half of full external rotation. Resistance is applied into internal rotation. If the patient experiences increased pain with the resistance applied, it is a sign that the integrity of those muscles is compromised.

The supraspinatus can be tested with the lift-off test with the patient sitting with the affected arm in internal rotation and the back of their hand resting on their lower back. If the patient can lift their hand off their back and maintain against resistance without pain, then the subscapularis is intact. The inability to perform this test along with increased pain signifies a tear or other pathology with that muscle. If a significant RTC tear is suspected from examination, the

patient may be referred for diagnostic imaging to determine the extent of the suspected tear. Knowing the extent of a RTC tear, through diagnostic imaging, can provide a more specific plan of care and prognosis for an individual.

Diagnostic imaging can be used to estimate the extent of a RTC tear including, magnetic resonance imaging (MRI), Magnetic Resonance Arthrography (MRA), and ultrasound.[12] An MRI will provide the most non-invasive and accurate visual and diagnostic information of a rotator cuff tear especially for partial thickness tears; however, it is an expensive image to acquire. A more cost-effective image is using ultrasound but is limited by less clarity and may not be able to detect smaller tears unless it is performed by a practitioner with extensive training.[12] Ideally and practically, an ultrasound would be used first due to the lower cost and accessibility. If a tear cannot be detected through ultrasound, an MRI should be ordered next. In the case that a questionable or unknown shoulder pathology is expected, an MRI is beneficial to be able to investigate the entirety of the shoulder including the soft tissue and body structures in detail. An MRA should be chosen last due to the risks, costs, and accessibility of the test. An MRA is more invasive involving an injection into the joint. This injection carries the risk of irritation, discomfort, and/or infection. Clinically, it is also important to consider any issues an individual may have with specific tests such as claustrophobia with an MRI and MRA.

There are many other pathologies that may accompany rotator cuff pathologies. These may include acromioclavicular impingement, long head of the bicep tendinopathy, adhesive capsulitis and more. The source of these pathologies comes from the large degrees of freedom in the shoulder joint as well as the compensation patterns that arise to maintain function despite the original pathology. Due to the proximity of the long head of the biceps tendon to the rotator cuff, it is common to be involved in more severe rotator cuff injuries about 16-75% of the time.[11] The

long head of the biceps tendon (LHBT) is a more common cause for most patients' pain in the anterior shoulder with associated rotator cuff injuries.[11] With chronic rotator cuff tears, a spontaneous rupture of the LHBT can occur, causing the patient to hear a snap during common activities or mild strenuous activities.[13] A rupture or tear of the LHBT can require a bicep tenodesis or tenotomy to provide more function for the extremity as well as improve cosmetic effects. The biceps brachii has two actions. The main action of the biceps is to supinate the forearm, so the palm faces away from the body. [14] The secondary action is to flex the elbow. It is unknown what the specific actions of each portion are, however, some believe that the long head also performs as a dynamic and anterior stabilizer for the shoulder. If the long head is torn or detached, along with a deformity, the arm may not achieve full strength and may be limited in forearm supination, and elbow flexion. This can be problematic for a person that is active and requires their full strength for those motions. In that case a person will receive a biceps tenodesis.

A biceps tenodesis is a surgical repair of the tendon fixed to a new point on the proximal humerus so that the length-tension relationship is maintained.[13] The length-tension relationship of a muscle allows the muscle to generate forces by its length and orientation of its attachments.[15] For example, if a muscle becomes detached from a bone, it can no longer contract and generate a force to move the bone, because it is now at a shortened length. By re-attaching the biceps near its original attachment after a rupture it can again create a contraction. After a biceps tenodesis a patient's upper extremity must be immobilized for a period of time to protect the new attachment of the biceps and allow it to heal.[13] A biceps tenotomy is a surgical procedure in which the surgeon detaches the ruptured/torn long head tendon. With the long head tendon now detached, the short head of the biceps will still be able to activate and perform in

upper extremity activities, however, some limitations in range of motion and strength may be present.

A tenotomy may be indicated for patients over 55-60 years old depending on the individual's activity level.[16] This procedure may result in a cosmetic deformity of the biceps, making the muscle look more pronounced. It may also result in upper arm pain and/or muscle cramps from the retracted muscle.[17] However, the recovery is generally faster, and patients can return to activity sooner. Patients that are younger than 50 years old will generally have a tenodesis performed, especially if they live an active lifestyle that requires the ability to have almost full to full function of their shoulder.[16] This allows the patient to maintain the length-tension ratio for elbow flexion and supination power. Due to the severity of a massive rotator cuff repair with a biceps tenodesis, many doctors utilize conservative protocols and treatments to protect both repairs prior to and during physical therapy to avoid re-tear of the tendons.

Prior to surgery, practitioners will potentially suggest subacromial steroid injection, physical therapy, or pain management medication for conservative treatment. Steroid injections are administered to relieve pain by reducing the inflammation in the joint, however may produce side effects.[18] These side effects include no pain reduction, fainting, blood glucose changes, and facial flushing. Steroid injections can have long term effects including decreased connective tissue and bone density as well as compromising the immune system. Due to these risks, physicians generally allow a patient to receive a limited number of injections. Patients are also required to have a certain amount of time between injections upon the physician's discretion. Nonsteroidal anti-inflammatory drugs (NSAIDs) can also be prescribed to relieve pain. These drugs also work to reduce inflammation without the side effects of steroids, however, may cause

gastrointestinal upset. These medical conservative treatments typically are not permanent treatments but provide temporary pain relief.

The purpose of this case study is to discuss and review the effect of outpatient physical therapy rehabilitation of a patient with a left, post-operative, massive, rotator cuff repair involving the supraspinatus, infraspinatus, and subscapularis, subacromial decompression, distal acromial excision and bicipital tenodesis. This study will examine how physical therapy can improve a patient's range of motion, strength, pain level and functional mobility post-operatively. The patient followed in this case study was screened and selected due to his post-operative status as well as his willingness to participate in the case study.

CHAPTER II

CASE DESCRIPTION

The patient is a 49-year-old Hispanic male with a post-operative massive rotator cuff repair, subacromial decompression, distal clavicle excision and bicipital tenodesis. He has a history of bilateral torn rotator cuffs for the past six years. His first surgery was in February of 2019 on his right shoulder. The current episode of care discussed is in regard to his left shoulder repair performed 4 months after his right shoulder surgery. The patient decided to wait to have surgery on both arms until his pain was unbearable and he was unable to keep up his performance working as a construction worker installing dry wall and other overhead activities. The previous surgery on his right shoulder was less extensive than the left. An MRI was provided showing a massive RTC and the biceps pulling away from the bone as well. The patient received physical therapy services from the same clinic and physical therapist for both episodes of care. The first visit for this episode of care began two months post-operation and concluded after 8 weeks of therapy.

His complaints at initial evaluation included the inability to sleep due to pain, work, help his wife around the house, and help take care of and play with his grandchildren. Due to the extent of his surgery, he was required to wear an arm sling with an abduction pillow for six weeks prior to starting physical therapy. He was required to wear the sling at all times except while bathing. He was also instructed to not return to work until he was cleared by his physician. During the subjective interview, the patient stated that his pain was at its highest while trying to sleep and decreased when he was sitting. Also, the patient reported independence with all

activities of daily living (ADL), however, had some pain and difficulty while performing them. He reported no significant past medical history and was no longer taking any medications. Prior to his injuries, the patient was independent in all ADL's without pain or difficulty. The patient's main goals were to return to work, complete his ADL's at his prior level without pain or difficulty, and to be able to sleep without pain.

Throughout this episode of care, the patient demonstrated motivation and compliance to get through physical therapy, so that he could be cleared for work. This was particularly important to him because he was the main source of income for his family. Due to his recent surgical procedure and physical therapy experience, as well as the patient's personality, he tended to push himself more than necessary and was at a higher risk of re-injury. He also began to work part time with his son driving dump trucks half-way through the episode of care which was an additional potential risk for re-injury.

A brief review of systems was performed throughout the history and initial examination. The integumentary system was initially affected due to the surgical repair; however, the patient's scars were evaluated and had shown to be healing nicely with no signs of infection or irritation. The musculoskeletal system was affected due to the surgical repair of multiple muscular structures and full assessment was limited at the time of evaluation due to the restrictions of the protocol. The neurological system was assessed with touch and showed full sensation. The cardiopulmonary system was not assessed, however from observation the patient showed no symptoms of distress or complications.

After the subjective interview, the patient was accepted for physical therapy care. This was due to the stable health of the patient with no known comorbidities, the patient's young age, and his willingness to participate in the physical therapy program. An examination was

performed to evaluate the patient's musculoskeletal system within the protocol to protect the vulnerable structures. The examination involved range of motion, strength, and functional mobility. The findings from the examination were used to determine an applicable and practical intervention plan that would provide a safe rehabilitation for the patient. Due to the extent of the surgical repair, the intervention plan of care was a conservative approach to protect the repaired structures and facilitate the healing process. The risk of re-tear is the greatest in massive rotator cuff tears involving three tendons, so a more conservative approach is necessary to attempt to avoid a re-tear.[19]

Examination

At initial evaluation, the patient was seated in the waiting room without wearing his arm sling. The patient had a mild forward head posture in both seated and standing along with increased thoracic spine kyphosis. He also held his left upper extremity in internal rotation with scapular protraction/internal rotation. When asked, the patient reported that the worst pain he has felt in the past week has been about a 4 out of 10 (on a scale of 0 being no pain and 10 being the worst pain imaginable), and the least amount of pain being a 0 out of 10. When he did have pain, he reported that it was located at the posterior shoulder and described it as an aching pain. The aggravating factors included moving and sleeping, while the easing factors included sitting.

After observing the patient's posture, range of motion assessment began with the cervical spine. All motions were pain free with full range of motion bilaterally. The thoracic spine mobility was also assessed and found that all motions were normal except thoracic extension, and bilateral rotation were slightly restricted. Bilateral finger, wrist and elbow range of motion was screened, and all had full range of motion. Both active and passive shoulder range of motion was assessed bilaterally using a goniometer except for shoulder internal rotation, on the left, to

protect the healing rotator cuff. Anatomical landmarks were used for alignment of the goniometer. Using a goniometer for shoulder range of motion measurements have a high inter and intra-rater reliability (inter-rater ICC= .897, Intra-rater ICC= .830).[20] Active range of motion (AROM) was performed with the patient seated, and passive range of motion (PROM) was measured with the patient in supine position on a treatment table. During AROM, the patient demonstrated thoracic extension and shoulder elevation as compensation patterns to attempt to increase ROM. This was noted and the goniometer was adjusted accordingly to maintain an accurate measurement of the glenohumeral joint. The left shoulder ROM was assessed first followed by the right. The measurements for bilateral active range of motion can be found in Table 1, and PROM in Table 2. During AROM into shoulder elevation, the patient demonstrated poor shoulder and scapular mechanics.

Table 1. Initial Shoulder Active Range of Motion

Shoulder AROM	**Left**	**Right**
Flexion	75°	155°
Abduction	70°	155°
External Rotation (behind head)	Lateral base of skull	CT junction
Internal Rotation (behind back)	Not Assessed	L4

Table 2. Initial Shoulder Passive Range of Motion

Shoulder PROM	**Left**	**Right**
Flexion	150°	160°
Abduction	150°	160°
External Rotation	45°	90°
Internal Rotation	Not Assessed	90°

The patient's strength was also tested, however only the right upper extremity was assessed due to the post-operative restriction of no resistive exercises to protect the integrity of the repair. The patient's left upper extremity strength would be tested at the next re-evaluation. All right sided manual muscle testing resulted in a 5/5 including all shoulder motions as well as elbow flexion and extension. Manual muscle testing consists of isometric holds of testing the strength of specific muscles or groups of muscles. It uses a grading scale of 0-5, 0= no muscle movement and 5= full strength and able to hold the contraction for 5 seconds. The patient is asked to place and hold their limb as instructed by the physical therapist and then asked to hold that position without moving as the therapist provides resistance manually. The patient was also asked to notify the therapist if he had any pain with the tests and would be noted in the chart. When the manual muscle testing was assessed on the right upper extremity, the patient reported that he did not have any pain.

After the manual muscle testing was completed, the patient was asked to lay supine on a treatment table. Palpation of the left shoulder showed tightness of the left upper trapezius, pectoralis major and minor, and the biceps brachii. Joint mobility of the glenohumeral joint as well as the thoracic spine were assessed and found that both joints were hypomobile. To assess the thoracic spine the patient was asked to lay prone on the treatment table and a posterior-anterior force was applied to assess the mobility of the joints.

The information gathered in the initial examination can be applied to a disablement model to determine the relatability of the patient's status to his impairments. The International Classification of Functioning (ICF) model was used to showcase the patient's impairments. (See Appendix 1. ICF Model)

Evaluation, Diagnosis, and Prognosis

The initial examination showcased the restrictions and limitations that the patient had. The most significant problems for the patient was pain with movement, limited range of motion and strength of the left upper extremity which all play a role in functional mobility. Due to the six-week immobilization in the arm sling, the patient's body had learned to adapt and developed abnormal posture, tissue tightness, and had a disruption to typical motor planning which developed into non-functional shoulder and scapular mechanics. The pain the patient experienced with movement was due to the poor mechanics of the scapula and shoulder causing impingement on the healing rotator cuff structures. The poor mechanics, as well as the decreased range of motion, were also caused by the patient unconsciously guarding due to the pain.

Utilizing the Guide to Physical Therapy Practice, he was categorized in the Practice Pattern of 4I: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated with Bony or Soft Tissue Surgery. The patient is included in this pattern due to his surgery consisting of a muscle and tendon repair as well as internal debridement. The problem list (See Table 3) consists of the limitations of the patient that coincides and identifies with the practice pattern. The patient's impairments also fall under pattern 4D: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated with Connective Tissue Dysfunction. The patient falls in this pattern because of his prolonged joint immobilization in the shoulder sling with the abduction pillow. This resulted in decreased range of motion, muscle guarding, pain and hypomobility of the glenohumeral joint which can be found in the problem list. (See Table 3).

Along with the two patterns stated above, the patient's impairments can also be considered in pattern 4B: Impaired Posture, and 4C: Impaired Muscle Performance. Under the

4B pattern, the impairments that the patient endured included impaired joint mobility, muscle imbalance and muscle weakness. The impairments for inclusion of the 4C pattern include decreased functional work capacity, inability to perform repetitive work tasks, and the loss of muscle strength, power, and endurance.

Table 3. Problem List

Problems
• Pain • Decreased ROM • Decreased Left upper extremity strength • Decreased functional mobility • Postural abnormalities • Poor shoulder and scapular motor planning and mechanics • Impaired joint mobility • Limited independence in ADLs • Decreased muscle length • Unable to return to work • Unable to help with household chores • Unable to play with grandchild • Unable to sleep without pain • Muscle guarding • Muscle imbalance

The estimated length of the episode of care was 10 weeks or more depending on the improvements of the patient's impairments. The short-term goal for 4 weeks into the episode of care included sleeping without pain for 3 consecutive nights. The long-term goals for 9 weeks into the episode of care included having no pain with overhead activities, having 5/5 strength for bilateral upper extremity manual muscle testing, clearance from physician for return to work, complete ADL's without pain or difficulty, range of motion for all motions in the shoulder are full and normal. The patient and therapist agreed with the goals set. The long-term goals were

expected to be challenging especially due to the extent of the surgery, however, at 8 weeks the patient would be re-evaluated by the therapist to determine if care needed to be continued.

The patient had good potential to reach these goals by the time set due to knowledge of his healing from his previous surgery as well as his adherence with his home exercise program. His recovery may be limited by the risk factors stated previously by trying to push himself too far too soon into recovery. In accordance with all the data from this patient collected through examination and evaluation, he was appropriate for an intervention program. This program included intervention to improve ROM, strength, endurance, functional mobility and reduce pain.

CHAPTER III

INTERVENTION

The interventions chosen for the patient's plan of care were catered to his recovery needs including, decreasing pain, increasing ROM and strength, and improving functional capabilities allowing him to return to work. The patient was seen 2-3 days per week for 1-hour sessions for 8.5 weeks. Following the six weeks of immobilization in his sling, the patient demonstrated decreased tissue extensibility with many trigger points in the left shoulder musculature which was the focus of the initial interventions. The patient also demonstrated improper scapular mechanics and timing in addition to posture abnormalities which increased impingement and pain in the shoulder especially with overhead motions. The biceps also required strengthening following the biceps tenodesis. The main goal with all interventions was to work towards the ability to perform functional activities without pain or difficulty. With every exercise, the patient was instructed to notify the physical therapist if he experienced any sharp or shooting pain.

At the beginning of each treatment session, the patient would begin by warming up on the upper body ergometer (UBE), which is similar to a stationary bike, but using bilateral upper extremities to move the machine pedals. The patient received 15-20 minutes of manual therapy and the rest of the hour session consisted of exercises and activities. The interventions were progressed through the plan of care as the patient healed and was able to perform more complex and difficult activities. The patient was seen by his primary physical therapist for the majority of his sessions. However, depending on the schedule he was occasionally seen by the physical therapy assistant (PTA). All exercises were written on a flow sheet which a technician took the

patient through and provided feedback and motivation when needed. The exercise flow sheets were reviewed and progressed every morning by the physical therapist prior to the patient's session. Depending on the schedule, the patient would be seen by the PT or PTA for manual therapy as well as checking in and discussion of progression throughout the week with his home exercise program. The plan of care, status, and progress the patient made was communicated to the PTA by the physical therapist.

The first interventions following the initial evaluation included hot pack, PROM, and manual therapy to increase tissue extensibility as well as relieve pain. The left shoulder was taken into external rotation, flexion and abduction passively going to end range and sustaining a stretch with the patient lying in supine. These motions were painful for the patient at end range due to the tightened joint capsule and musculature. Each motion was performed about five times holding for roughly ten seconds each repetition, minding the patient's tolerance and pain level. Manual therapy consisted of soft tissue mobilization (STM) to the upper trapezius, pectoralis major, and posterior shoulder muscles including the infraspinatus and supraspinatus.

The first week of sessions also consisted of scapular strengthening exercises including scapular retractions, prone rows and extension, and isometric walkouts with a yellow TheraBand. Explanations of all exercises can be found in Table 4. Bicep strengthening was also a priority after the biceps tenodesis. To begin strengthening the biceps, he was given a one-pound weight to do bicep curls.

Week two of treatment continued with PROM in all directions where he reported no pain at end range, just "tightness". STM was utilized again for the same muscles, with the addition of the biceps. The previous scapular strengthening exercises were used this week in addition to submaximal shoulder isometrics, supine shoulder ABC's. Bicep curls were continued as well

increasing the weight to two pounds. The patient also performed shoulder external rotations with a TheraBand.

In the third week of treatment, the patient's exercises were progressed by increasing repetitions as well as adding rhythmic stabilization. Different manual therapy techniques were introduced to the patient after he gave consent. These techniques consisted of myofascial decompression via dry cupping and Grade 5 manipulation to the thoracic spine. A grade 5 manipulation is a manual technique consisting of a high velocity and low amplitude thrust with the goal of a cavitation or "pop" sound. This helps manually relieve tension caused by improper posture and muscular imbalances putting tension on the spine.

Dry cupping is a manual technique that has been used since 400 BC for treating various ailments.[21] It is a non-invasive modality commonly used today for musculoskeletal pain and muscular tension. Currently there is not a lot of research showing the effects of dry cupping, however it has been shown to decrease pain and increase blood flow to the area applied.[22] The dry cupping for this patient was performed using a manual negative pump system with plastic cups that were sanitized after each use. Massage lotion was applied to the skin to protect the tissue, allow adequate suction, and prevent friction with sliding the cups. The cups were applied to the tissue around the scapula targeting muscles with known trigger points and tissue with decreased extensibility. Once the skin began to darken to a red/purple tint withing the cups, they were slid on the skin maintaining the suction. The reddening of the skin is a sign of increased blood flow and the early stage of ecchymosis or bruising. The purpose of this is to increase blood flow and facilitate healing of the tissues. The cups were slid around the shoulder area finding tight areas, allowing the suction to release the tension and trigger points.

Triceps strengthening was added in the fourth week as well as the continued scapular and biceps strengthening exercises stated previously. STM and PROM were continued as well with the addition of active trigger point release throughout PROM and for the latissimus dorsi near the lateral thorax and attachment site, and the biceps brachii. Active trigger point release is a technique used combining both STM and AROM. The trigger point is first found in the muscle belly while the muscle is relaxed. Then the patient is asked to move the part of the body that would put the muscle on stretch increasing the pressure in the trigger point. For example, for a trigger point in the latissimus dorsi, the therapist will apply pressure to the trigger point in the muscle near the axilla while the patient is relaxed laying supine on the treatment table. Then the therapist will ask the patient to slowly raise their arm overhead keeping the elbow straight and thumb up going into shoulder flexion. This is done a handful of times. The goal of this is to decrease the trigger point and increase the tissue extensibility of the muscle.

Week five of treatment consisted of STM to the upper trapezius, supraspinatus, subscapularis, latissimus dorsi and active release to the biceps, latissimus dorsi, and pectoralis major. Along with continued scapular stabilization and triceps strengthening, shoulder endurance activities were introduced starting with ball circles at shoulder height against the wall. This exercise was used to begin endurance of the shoulder muscles to eventually progress to overhead activities which is a requirement for his job. This activity was started at shoulder height to reduce impingement of the RTC tendons due to improper scapular mechanics.

Continuing the progression of his exercises in week six included adding wall ball rolls, eccentric bicep curls, wall ball taps, wall clocks, serratus glide, and modified push-ups. These exercises were more complex and difficult for the patient, however he was excited to start these exercises because to him it meant he was getting closer to return to work and he could see the

relation of these exercises to his work. STM was continued as well with active release to the latissimus dorsi, pectoralis major and PROM with scapular stabilization and overpressure.

During the seventh week of treatment, it was noticed that the patient's posture was still limiting his overhead abilities by increasing the impingement in the left shoulder. Thoracic spine extension with a half foam roller was added to promote proper posture and release some of the tension in the thoracic spine. STM was continued as the previous week. Active shoulder flexion and abduction was performed with PT assisted scapular rotation to promote correct scapular timing to reduce impingement at end-range.

The exercises added in the eighth week of treatment included latissimus dorsi pull downs, planks with shoulder taps, and weighted box lifts. The patient was educated on proper lifting biomechanics prior to performing the weighted box lifts. He reported that he had some pain in the left shoulder with the weighted box lifts overhead. STM, PROM with scapular stabilization, and grade II-III inferior glenohumeral joint mobilizations were used to increase range of motion and decrease joint capsule tightness. The inferior glides were performed for about one-minute intervals with roughly ten seconds rest for a total of 3 minutes, to promote increased tissue extensibility of the joint capsule and surrounding musculature. At eight and a half weeks, the patient discharged himself from therapy for unknown reasons.

Had the patient continued therapy as prescribed, interventions would continue to have focused on functional overhead activities and improving the scapular mechanics and timing. At the end of the treatment period, the patient reported no pain with activities except with weighted activities overhead. This was due to continued impingement from the improper scapular timing.

Table 4. Exercise Explanations

Exercise	Explanation
Scapular Retraction	Patient is seated with back straight and arms at sides. The patient is instructed to squeeze their shoulders blades together as if they are squeezing a pencil between them. Hold this position for 3 seconds and relax (3 sets of 10 repetitions)
Prone Rows	Patient lies face down with arms hanging off the treatment table. The patient will squeeze shoulder blades together and make a rowing motion with both arms. (3 sets of 10 repetitions)
Prone Extension	Patient lies face down with arms hanging off treatment table. Keeping elbows straight, patient brings both arms toward the ceiling, hold for a couple seconds and relax. (3 sets of 10 repetitions)
Isometric Walkouts	A TheraBand is attached to a stable object at the patient's elbow height. The patient stands perpendicular to the object holding the other end of the TheraBand with the elbow at 90 degrees. While they side-step away from the sturdy object putting tension through the band not letting their arm/hand move. The patient switches sides to provide both external and internal rotation isometric. (3-4 steps out, 10 repetitions, 2 times each side)
Bicep Curls	Patient will hold prescribed weight in hand with palm facing away from the body. From this position the weight is slowly lifted bending the elbow bringing the weight toward the shoulder. Once reaching the top the weight is brought back down to the original position in a slow and controlled manner. (3 sets of 10 repetitions)
Shoulder External Rotations	Patient holds a TheraBand between both hands with elbows at their sides and at 90 degrees. With thumbs facing out, the patient brings their hands out toward their sides squeezing the shoulder blades together and keeping the elbows at their side. Hold for 3 seconds and then relax bringing hands back in front of them slowly. (3 sets of 10 repetitions)
Submaximal Shoulder Isometrics	Patient holds arm out at 90 degrees of flexion with elbows straight. PT applies gradual resistance in a downward force as well as from the outside and inside for 10-15 seconds, 5 repetitions, three sets in each direction. The patient is instructed to match the resistance applied by the PT
Supine Shoulder ABC's	Patient lies face up on the treatment table with arm up towards the ceiling making a fist. The patient will write the alphabet in the air with their arm A-Z. (2 repetitions)
Wall Ball Circles	Patient stands facing the wall with the shoulder at a 90-degree angle pressing a hand sized ball against the wall. The patient is instructed to roll the ball in circular motions both clockwise and counterclockwise. (10 rotations each way, 3 sets)

Wall Ball Rolls	Patient stands facing the wall starting with the shoulder at 90 degrees pressing a hand sized ball against the wall. The patient is instructed to roll the ball straight up the wall with one hand to end range and then back down to 90 degrees. (10 repetitions up and down, 3 repetitions)
Wall Ball Taps	Patient stands facing the wall with the shoulder at roughly 140 degrees bouncing a hand sized ball against the wall. This exercise is done for a time duration vs repetition. (60 seconds, 2 sets)
Wall Clocks	Patient stands facing the wall with both shoulders at 90 degrees holding a resistance band between both hands. The right hand stabilizes the band while the left moves out to each position of a clock and back to the center. Then the left stabilizes while the right goes through the clock motions. (3 sets each side)
Eccentric Bicep Curl	The patient will be given a TheraBand. They will stand on one end and the other end will be in their hand. The patient bends the elbow putting resistance in the band and will slowly lower the hand back down to the original position. There should always be resistance in the band. A green TheraBand was used. (3 sets of 10 repetitions)
Serratus Wall Glide with Lift Off	Patient stands facing the wall with both pinky sides of their hands on the wall. The patient slides their hands up the wall. When they reach the end of their range, they are instructed to squeeze their shoulder blades together and lift their hands off the wall (3 sets of 10 repetitions)
Modified Push-Ups with a Plus	A treatment table is set to the level of the patient's hips. The patient puts their hands on the edge of the table and take steps back, so they are in a modified plank position. The patient bends the elbows lowering their chest toward the table. Once their chest is to the table they push back up to the original position. When the patient is back at the original position, they push a little extra rounding their upper back (3 sets of 10 repetitions)
Thoracic Spine Extensions	Patient is seated in a standard chair with feet on the ground. Half a foam roller is placed between the thoracic spine of the patient and the backrest of the chair. The patient is instructed to cross their arms over their chest and slowly extend back as far as they can comfortably and then back to the original position. (15 repetitions)
Latissimus Dorsi Pull-Down	Using a pulley system machine with weights, the patient stands and using both arms, pulls the bar down toward their chest pulling their shoulder blades together. (3 sets of 10 repetitions, 20 lbs)
Plank with Shoulder Taps	Patient assumes a plank position with both hands on the ground, knees straight with their body hovering above the ground. In this position the patient stabilizes with one arm using the other to cross the chest and tap the stabilizing anterior shoulder. (30 seconds, 3 sets)
Weighted Box Lifts	A plastic crate was filled with 15 lb. weight. The patient was instructed to bend with the knees pick up the box, lifting with the

	legs, step to the shelf at hip height and set the box on the shelf. Then he was instructed to take the box off the shelf and set it on the floor, keeping the box close to his body and using his legs to lower to the ground. The same process was repeated for a shelf above the patient's head. (5 repetitions each shelf, 2 sets)

CHAPTER IV

OUTCOMES

The patient made significant progress in AROM, PROM, pain, functional activities, scapular mechanics, and tissue extensibility through physical therapy interventions. By the end of treatment and self-discharge, it was recommended that he continue therapy to achieve more optimal range of motion and to achieve the ability to perform overhead activities without pain. Had he continued with therapy, the main focus of activities would be on correcting the scapular mechanics to decrease impingement as well as achieving full ROM. Prior to the patient discharging himself, the final active and passive ROM measurements were taken and can be found in Table 5 and Table 6 respectively.

During final strength testing, the patient scored a 4/5 strength for left shoulder abduction, flexion, and external rotation. This is likely due to the minimal, yet continued shoulder impingement causing him to break resistance from the pain. With shoulder internal rotation and elbow flexion and extension he scored a 5/5 strength. At the last session, the patient reported that he felt he was about 90% better and would feel like back to 100% once had no pain with lifting things overhead. When asked what level of pain he had experienced in the past week he reported that the lowest was a 0/10 and the highest was a 3-4/10 (0= no pain, 10= worst pain ever experienced).

At discharge, the short-term goal of reporting 3 consecutive nights without shoulder pain was met. The long-term goals, however, were not met. It was estimated they would have been achieved with continued therapy. The patient had continued pain with overhead activities, not all

strength testing was 5/5, he was not cleared for work and had not achieved full range of motion yet. One long term goal that he did achieve was the ability to complete ADL's independently without pain or difficulty.

The patient stated that he enjoyed the interventions and liked to be challenged. His eagerness to get back to work and get through therapy was a risk to his progress. It was a concern that he may not say anything if he experienced pain during activities and may push himself too hard and deter his progress. His experience with his previous surgery was also a motivator for him to push himself because he knew what to do with the exercises. However, through discussion and education, he was aware that each surgery is different, and the current shoulder had more damage and required a more extensive surgery. With the more complicated surgery, it required a slower and more conservative process than the other shoulder. Throughout treatment, the patient required some reminders to not push into pain, and to notify his therapist if pain was experienced.

At the end of the final day the patient came to treatment, he mentioned how happy he was with his progress and was satisfied with how much he could do with his shoulder being mostly healed. The patient also stated how happy his wife was to have help around the house again. He made no indication that he was planning to terminate his therapy.

Table 5. Final Shoulder Active Range of Motion

Shoulder AROM	**Left**	**Right**
Flexion	135°	155°
Abduction	155°	155°
External Rotation	T1	CT junction
Internal Rotation	L5	L4

Table 6. Final Shoulder Passive Range of Motion

Shoulder PROM	**Left**	**Right**
Flexion	165°	160°
Abduction	150°	160°
External Rotation	75°	90°
Internal Rotation	70°	90°

CHAPTER V

DISCUSSION

Throughout the patient's episode of care, he progressed significantly by increasing his AROM, PROM and functional mobility as well as decreasing his pain. This was due to the natural healing process of the tissues with appropriate exercises, STM, postural training and functional activity training. It is likely that if the patient had continued through the intended length of care that the patient would have achieved an optimal range of motion and functional capability. It is also speculated that he would have had no pain with work related or other overhead activities. Even though the patient had not reached full range of motion, he was happy to be able to work part time for his son driving truck in addition to helping his wife with chores around the house. Through this case study, it was found that physical therapy does positively impact and improve a patient's quality of life and functional activities post-operatively.

Had the patient not received post-operative treatment from physical therapy, he would have continued to have decreased range of motion, impaired strength, and the inability to return to work due to those restrictions. Due to the extensive surgery, the patient was at a higher risk of a RTC tendon re-tear. It is estimated that 26.6% of rotator cuff repair patients re-tear their rotator cuff and are at a higher risk if the original tear size is massive. [16] They have a higher mean infraspinatus fatty infiltration, higher global fatty degenerative index, higher percentage of biceps tenotomy, single row repair, and prolonged times to AROM and strengthening. Due to this patient having both a biceps tenotomy as well as delayed AROM and strengthening, the patient is at a higher risk of re-tear.

Achieving functional to full ROM, in addition to strength, was important for this patient. Especially without having pain at end range, to allow him to work overhead without increasing pain and risking a re-tear of the repaired structures. It was the focus and purpose of the interventions to reach these goals. Goniometry of ROM gave numerical data to track the patient's progression as well as noting pain with activities. It is standard to perform goniometry by citing bony landmarks to standardize the reliability of the measurements as much as possible.

Additional questions could have been asked in the subjective interview. They would have included how he was affected by his previous surgery and if he noticed any differences. It would have been beneficial to ask the patient if there were any possible issues with insurance or any other reason that would be an obstacle to attend therapy.

This study includes some limitations that would have been beneficial for the treatment of this patient. Having a set and clear protocol from the surgeon for the progression of this patient's therapy would have enhanced the clarity of the patient's plan of care. It would have also been beneficial to have this in place for protection of the physical therapist in case of legal matters if needed. A protocol was found from a local hospital that correlated with the plan of care of the patient, however, was not associated with the patient's surgeon. Range of motion measurements should have been taken and recorded more frequently to prove the need of continued therapy as well as showing the patient's progress with numerical data.

To ensure that the patient understood and was able to repeat his home exercise program independently, it would have been best practice to have him reiterate and demonstrate how to do the exercises without helping him. This would provide proof that the patient is receptive and adherent in performing the home exercise program. It would have also been beneficial to re-check his understanding of his exercises to ensure that he continued to perform them correctly at

home. Going this extra step potentially could have impacted his progress if he performed the exercises incorrectly or not at all when not in the presence of the physical therapist.

Based on the literature reviewed on this topic, more research needs to be done to evaluate the percentage of full ROM gained after a rotator cuff repair procedure to be able to give patient's an evidence-based answer on what to expect in their healing process. With the increase in rotator cuff surgical procedures, it is important to continue to research the rehabilitation process as the techniques and surgeons become more refined in their practices.

Referrals to additional resources were not necessary, due to the patient discharging himself from physical therapy care. It was recommended to continue therapy for at least two more weeks to work on reducing his pain with weighted overhead activities. The therapy that was provided was effective in treating the patient by improving his strength, range of motion, functional capability, and decreasing his pain.

Appendix 1. ICF Model

Health Condition: Post-operative Massive Rotator Cuff Repair, Subacromial Decompression, Distal Clavicle Excision, and Biceps Tenodesis

Body Structures/Function (Impairments)

- Decreased Strength
- Decreased ROM
- Posterior shoulder muscles, lats, pecs, neck tightness

Activity

Abilities	Limitations
• Able to communicate pain and goals	• Unable to perform all ADL's independently • Unable to sleep without pain

Participation Restriction

- Unable to work to provide for family
- Unable to help with chores at home
- Unable to play with grandchildren

Environmental Factors

Internal		*External*	
• Motivated to return to work • Experience with other shoulder rehab	• May push himself too much at home • Overconfident prom previous surgery	• Support from wife • Support from insurance company	• Stress about providing from family

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