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The Effects of an Early Motion Protocol for Rehabilitation Following a Massive Rotator Cuff Tear Repair: A Case Report

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THE EFFECTS OF AN EARLY MOTION PROTOCOL FOR REHABILITATION FOLLOWING A MASSIVE ROTATOR CUFF TEAR REPAIR: A CASE REPORT

By

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This Scholarly Project, submitted by Kody Strum in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical therapy under whom the work has been done and is hereby approved.

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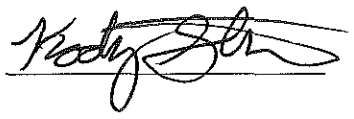
Signature 

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Kody Strum

ABSTRACT

Background and Purpose: Rotator cuff tears are one of the most common musculoskeletal injuries to occur in the United States. Following a surgical repair, there are two main rehabilitation protocols: early motion and delayed motion. Despite the large number of patients in need of rehab following a rotator cuff tear surgical repair, there is not yet a definitive answer in the literature as far as the best protocol to use.

Case Description: The patient was a 68-year-old male who injured himself while slipping and attempting to catch himself with his right arm. He presented to physical therapy following a surgical repair of a massive rotator cuff tear. His active range of motion and strength were within normal limits on his non-involved upper extremity, though severely limited on the surgical side due to a combination of pain and post-surgical precautions.

Interventions: The patient received therapeutic exercise, ultrasound, E-stim, patient education, and trigger point release manual therapy over the course of physical therapy.

Outcomes: The patient had 18 sessions of physical therapy. By the end, his active range of motion on the surgical arm equaled that of his non-involved extremity, and his strength was making rapid gains as well.

Discussion: Research regarding early versus delayed motion protocols is limited. Further research should be performed studying different patient demographics to see if factors such as age, various pathologies, size of tear, etc., can affect which protocol would provide the most benefits and least risk for them. The patient in this case report demonstrated significant improvements over the course of therapy utilizing the early motion protocol.

CHAPTER I

BACKGROUND AND PURPOSE

Rotator cuff tears are one of the most frequent musculoskeletal injuries to occur, affecting more than 40% of United States citizens over the age of 60.[1] An estimated total of over 250,000 rotator surgical cuff repairs are performed annually in the United States alone.[1]

Methods for diagnosing a rotator cuff tear include but are not limited to: Magnetic Resonance Imaging (MRI), orthopedic special tests, functional and clinical assessments. In this particular case report, the patient was diagnosed via MRI with a massive rotator cuff tear. According to DeOrio and Cofield[2], the accepted values for the different sizes of tears are defined as: small being no greater than 1 cm, medium being 1–3 cm, large being 3–5 cm, and massive being anything greater than 5 cm.

Despite a large number of studies, there is still a lack of definitive research to promote a conservative (prolonged immobilization) rehabilitation program compared to an aggressive (early passive motion) approach. The literature is divided on which protocol is superior in regards to risk versus benefit. More aggressive protocols increase the risk of re-tear, while the conservative approach increases the chance of shoulder stiffness, range of motion (ROM) loss, and muscular atrophy/fatty degeneration. All of these could impair a patient's ability to return to normal function.[3]

According to Mollison et al,[4] a recent study revealed that around 70% of surgeons begin their patients, who have rotator cuff tear repairs, with passive range of motion (PROM) activities within two weeks post-surgery. They additionally found significant trends regarding protocol

prescription based on size of the tear. For small and partial-thickness tears, around 70% and 55% of surgeons opt for an accelerated rehab protocol respectively[4]. For massive tears such as the patient in this study, around 75% of surgeons choose a delayed motion rehabilitation.[4]

Before the discussion of when the optimal time is to initiate motion after a surgical repair, one must thoroughly understand the goals of a protocol and the tissue healing process. The goals of a rotator cuff rehabilitation protocol are to minimize the risk of re-tear, restore maximum ROM as safely as possible, promote the return of strength, and restore the shoulder to a functional level. The success of a protocol relies on several different factors. These include protection of the repair, allowing adequate tissue healing time, endurance training, restoring and maintaining normal flexibility of the repaired tissues, and promoting proper posture for the thoracic spine and scapula to allow for an ideal scapulo-humeral rhythm during motion.[5]

Next, the tissue restoration process must be considered for optimal healing. The three phases applicable to post-op repairs include inflammatory, proliferative, and maturation/remodeling in that order. The inflammatory stage is dependent on external stresses to determine how long it persists. If there is non-compliance with rehabilitation restrictions, such as over-extending weight or motion limitations, the inflammatory state is bound to persist longer than the optimal time of around seven days. The early passive motion protocol must carefully consider shoulder movement to restore ROM and prevent capsular tightness and the inflammatory process. These limitations must be followed obediently and cautiously if a rehabilitation therapist is to successfully promote restoration of motion as well as avoid prolonging the duration of the inflammatory stage.[5]

The proliferative stage of healing starts to occur around day 5-6 post-surgery given that the tissues were not stressed too vigorously during the inflammatory phase. The proliferative stage

typically lasts anywhere from one to two months. It is defined as the period where immature type III collagen fibers are laid down in the area of an injury to form scar tissue.[5] If left unchecked, this scar tissue can form in random directions instead of laying in unison with the existing muscle fibers. When the collagen fibers align perpendicular to the existing muscle, significant limitations in movement, strength, and tissue integrity can develop unless corrected quickly. A delayed motion rehabilitation protocol must have the correct balance between allowing for adequate tissue healing time but not allowing so much time that scar tissues can form incorrectly and inhibit a patient's ability to regain functional ROM.[1,5]

The maturation phase is the final stage in the tissue healing process. This is when the type III collagen (immature) fibers become type I (mature) fibers. This phase typically begins towards the end of the first month following surgery and can continue for upwards of one to two years. With the new mature fibers, the scar tissue becomes stronger and more durable. However, if the collagen fibers are aligned perpendicular to the rest of the muscle when the change from type III to type I occurs, it becomes more difficult to correct their alignment. In cases of extreme scar tissue adhesions when non-invasive techniques are unsuccessful, surgical manipulation is required to correct this issue.[5]

The typical conservative approach to rotator cuff tear repair rehabilitation involves patients being immobilized in a sling for six weeks or longer depending on different variables such as: the size of the tear, method of repair, surgeon preference, amount of degeneration that has occurred, and the age, goals, and level of physical activity of the patient. As explained above, it is evident that the period of immobilization with this protocol extends well into the timeframe of the maturation phase. This can lead to an undesirable formation of type III collagen fibers maturing into type I in a direction which inhibits ROM from being restored to a functional level.

Conversely, this protocol does allow for adequate tissue healing time to provide a minimized risk of re-tear.[6]

The more aggressive protocol can start passive motion of the shoulder at two weeks post-op or even earlier in some cases. Initiation of movement during the proliferative stage helps to properly align the newly developed collagen fibers. This decreases the likelihood of requiring a surgical manipulation to regain adequate shoulder ROM. However, because the passive motion is being initiated during the beginning of the proliferative stage, the repair has not had an adequate period of healing. This early motion could disrupt the healing process or cause a re-tear if performed inappropriately.[6]

The ultimate goal for either protocol is to return the patient to a level as close to, if not equal to or better than, his/her prior quality of life. Individuals with a rotator cuff tear experience decreased ability to perform work/hobbies that require use of the affected shoulder. There will be difficulty reaching overhead and increased incidence and intensity of pain. Immediately following surgical repair, patients have lifting and motion restrictions, are unable to drive, and often have difficulty sleeping on a flat surface.[1,7] All of these reduce a patient's sense of independence and lead to an overall decrease in their quality of life. These are all examples for why it is essential to find the ideal protocol for each patient to allow them to get better as quickly and with as little risk as possible.

As previously stated, there is a lack of evidence to support one protocol over the other. Both have their respective risks and benefits, and neither have been proven to have a statistically significant advantage when compared to the other.

The purpose of this case report is to describe the effectiveness of an early passive motion protocol following a massive rotator cuff tear repair, explore any adverse effects that came forth

during the course of rehabilitation, and review patient satisfaction with the protocol itself. Additionally, this report should encourage further research on the subject to determine if there are specific items in a patient's examination/evaluation (i.e. past medical history of failed rehab following one version of a protocol for another joint) performed by their physician which would lead to a preference of one protocol being selected over the other.

CHAPTER II

CASE DESCRIPTION

This case follows a 68-year-old male who was injured after slipping and catching himself with his right (R) arm in order to prevent a fall. He states that he was in his garage with a smooth floor and there was a puddle of water which he walked through. This caused him to slip, and he caught himself using his R arm to grab onto a nearby workbench. He immediately felt extreme pain and went to the doctor the following day for examination. After the physical assessment by the physician, an MRI test was performed. The MRI confirmed a massive tear in his R rotator cuff. Prior to participating in this study, the patient gave both written and verbal confirmation of informed consent.

The patient underwent a rotator cuff repair and was referred to physical therapy (PT) two days post-op for evaluation and treatment per surgeon protocol. The only significant past medical history, relevant to this case, was a previous left (L) total knee arthroplasty (TKA). The protocol for his knee was too conservative of an approach, and the result was significant stiffness/ROM loss in that knee. After several months of trying to correct this with PT interventions, he ultimately had to go in and have a surgical manipulation performed to break up the adherent scar tissues. Even at the time of shoulder rehabilitation, four years later, he still had trouble with increased stiffness in that knee. The patient's current surgeon for his shoulder understood that the typical conservative approach did not work well for the patient in the past, and therefore decided to undergo an early PROM protocol following the rotator cuff repair.

The patient's chief complaint was pain (4/10 at rest on the Visual Analog Scale [VAS]) in his R shoulder and reported diminished activities of daily living (ADL) performance with activities involving use of R shoulder, as he is R hand dominant. The patient reported that he was reacting poorly to the pain medication prescribed to him after surgery and was only taking Advil to manage pain at the time of initial PT evaluation. The patient reported that he was only able to sleep in the recliner, as laying flat increased shoulder pain. Icing helped with pain, but no other modalities at home had been attempted at the time of evaluation. The surgical site was cleanly bandaged with no evidence of excessive fluid built up underneath the bandage. The patient was retired but had a passion for golfing. He traveled south for the winters which allowed him to golf year-round approximately 4-5 times per week. Returning to this activity was the primary personal goal for this patient.

Evaluation of strength and ROM was based on Van Ost's orthopedic evaluation of the shoulder and elbow.[8] Upon observation, the patient presented to therapy wearing an abduction sling and was in a guarded posture noting significant tightness in the upper trapezius muscles bilaterally. Palpation revealed several trigger points located in bilateral upper trapezius muscles, right-sided infraspinatus, rhomboids, and lateral scapular border regions. Cervical ROM was within normal limits throughout, however moderate discomfort (4/10 pain on the verbal 0-10 pain scale with 0 being no pain, 10 being the worst pain) was noted with side-bending bilaterally. L shoulder active range of motion (AROM) and R shoulder PROM was measured with patient in supine using a goniometer and is reported in Table 1.

Table 1.

Initial Shoulder Range of Motion (Degrees)

	Left (AROM)	**Right (PROM)**
Flexion	134	50
Extension	30	10
Abduction	151	38
Adduction	To neutral	---
Internal Rotation (at 90°)	70	45
External Rotation (at 90°)	34	To neutral

Shoulder strength was also assessed via Manual Muscle Testing of the nonsurgical shoulder and elbow (performed in sitting for all motions). Results were as follows:

Table 2.

Initial Non-Surgical Shoulder and Elbow Strength (numerical 0-5 scale)

	Left
Shoulder Flexion	4
Shoulder Extension	5
Shoulder Abduction	4
Shoulder Internal Rotation	5
Shoulder External Rotation	4+
Elbow Flexion	5
Elbow Extension	5

Evaluation of R shoulder strength measurements and special tests were deferred due to recent surgery.

Transfers, balance, gait, cognitive function, and ADLs were assessed at the initial evaluation. Balance, gait, and cognition were deemed to be within normal limits. Transfers were also normal with the exception of sit to/from supine, which was independent but was very slow due to R shoulder pain and guarding. ADLs were assessed via the Upper Extremity Functional Index (UEFI). The patient scored a 3/80 (96% impairment) on this functional assessment.

The physical therapy plan of care was set to see the patient twice a week for nine weeks until he traveled south for the winter months. Long term goals for this patient included restoration of active range of R shoulder flexion to 135 degrees, abduction to 150 degrees while lifting moderate weight such as a half gallon of milk with a pain rating of no greater than 2/10 on the verbal 0-10 scale. The patient's personal long-term goal was to return to playing golf within 9-12 months pending surgeon approval.

The patient was given a fair prognosis for recovery. This decision was based on several factors including social and family support, strong motivation to return to recreational activities, compliance with previous therapies, good physical and cognitive health, and previous soft tissue restrictions following his TKA.

CHAPTER III

INTERVENTIONS

In order to fully understand the accelerated nature of this patient's particular protocol, one must first know the typical timeline for a more conservative rehabilitation protocol following a rotator cuff tear repair of this size. As mentioned earlier, the typical conservative approach to rotator cuff tear repair rehabilitation involves patients being immobilized in a sling for six weeks or longer depending on a number of different factors. Furthermore, the protection phase often lasts between 8-12 weeks. During this time, lifting of the arm is limited to passive or active assistance, because it is too heavy to support itself without increased risk of tissue injury at this point.

The patient in this case report was seen for 60 minutes, twice a week for nine weeks. He followed a more aggressive/accelerated protocol. PT interventions began two days post-op. The patient's first week's interventions included PROM for shoulder flexion, abduction to 35 degrees, and external rotation to neutral. All motions were performed with patient in supine, pillow to support (R) shoulder, 15 times in each direction. Patient was also instructed on a home program including: AROM for elbow flexion/extension, wrist flexion/extension, ulnar/radial deviation, finger abduction/adduction, finger flexion, and pronation/supination with elbow bent to 90 degrees. Finally, the patient was instructed in Codman's pendulum exercises to be performed within his sling.

Weeks two and three included the same PROM as week one with the addition of R shoulder internal rotation. Also, a grade II distractive force was combined with the PROM activities. The

patient was progressed to performing Codman's exercises outside of his sling. Seated upper extremity pulleys were started at the beginning of week three for shoulder forward flexion to 95 degrees, restricted by protocol rather than pain. The patient purchased a set of pulleys and was instructed in home use. The Upper Body Ergometer (UBE) was also initiated at this time for passive motion only. This means that there was no added resistance and the L shoulder was doing the entirety of the work while the R side was strictly hanging on. Additionally, shoulder isometrics in all planes were started this week using submaximal (<50%) force.

Week four was the beginning of active assistive range of motion (AAROM) exercises. Patient was instructed in standing wall slides for R shoulder into flexion, scaption, and abduction, as well as wand activities for AAROM in shoulder flexion, scaption, external rotation, and internal rotation. Patient also began using a finger ladder at the clinic for both R sided forward flexion and abduction. Some modalities were also performed due to muscle tightness and pain in R shoulder. 1.0MHz, 1.2W/cm2 continuous ultrasound (US) was performed to reduce trigger points along R infraspinatus and rhomboid regions. Seven minutes was spent at each location with the patient in sitting. In addition, biphasic, 10 seconds on 10 seconds off, dual circuit, four electrode neuromuscular electrical stimulation (E-stim) was applied to the R upper trapezius and infraspinatus areas for 15 minutes. The intensity was strong enough to produce a tetanizing contraction to fatigue the underlying musculature and reduce muscle tightness.

Weeks five and six continued the use of previous AAROM exercises/modalities and focused on adding more stretching activities. The patient demonstrated a difficult time relaxing during passive stretching. Therefore, the patient was instructed on active assistive self stretches using non-involved upper extremity to assist surgical side into end range flexion, horizontal adduction, shoulder flexion with ER behind head, shoulder extension with IR and abduction behind back. At

this point, the patient was weaning off of modalities and wanted to focus more on exercises that he could perform at home. Therefore, during his first session of the 6th week he trialed the use of E-stim without receiving therapeutic ultrasound that day, and at his second session of the week it was vice versa. It was determined by the patient that E-stim was much more effective on its own for reducing his painful trigger points, so US was discontinued.

Gentle strengthening of the shoulder was introduced during weeks seven and eight. Several supine light (Level 1) theraband exercises were added to promote strengthening while keeping the scapula stabilized against the plinth. Exercises performed were: unweighted scapular protraction, diagonal shoulder flexion with level 1 theraband, and tricep extensions at 90 degrees of shoulder abduction with level 1 theraband. The patient was also instructed on ball on wall exercises for up/downs, lateral motions, both diagonals, and clockwise/counterclockwise motions. The active assistive self and wand stretches were completed as in previous weeks. E-stim was also kept the same. These were the final weeks at therapy before the patient traveled for the winter months. He planned to seek therapy at his winter location for a few additional sessions to progress his home exercise program (HEP) if/when appropriate.

CHAPTER IV

OUTCOMES

Chan et al.[3] published a meta-analysis using several randomized controlled trials with patients who participated in delayed and early motion protocols for rotator cuff repairs. The purpose of that study was to determine if there is a significant difference in outcomes with patients following the delayed motion protocol vs the early motion protocol. Patients who underwent the accelerated protocol were found to have a statistically significant increase in shoulder forward flexion when compared to the delayed motion group (MD, -1°; 95% CI, -2° to 0°; P = 0.04, I(2) = 0%). However, this finding was deemed clinically unimportant. In fact, there were no clinically significant findings that proved one protocol to be superior to the other. Regardless of the therapy timeline, the patients' ROM, strength, and pain levels were found to be statistically similar. These outcomes were consistent with those of the patient in this case report.

No adverse events were experienced throughout the course of this patient's accelerated rotator cuff tear repair protocol. The patient met several personal milestones week by week as a means of assessing functional capability of the surgical shoulder. For example, after week one of PT intervention, the patient's pain at rest went from a 4/10 to a 0/10. This could have been due to the patient being educated on the importance of compliance with pain medications. By the end of week three, the patient reported that he was able to dress himself and don/doff his sling independently. The patient's pain with motion had also decreased at this time to a mild (3-4/10) rating.

Week four was the official beginning of AAROM exercises, where there were some flare-ups of pain initially, but with time and the use of ultrasound and electrical stimulation, these diminished and became much less frequent. After the use of the two modalities mentioned previously, the patient reported significant reduction in muscle tightness. By the end of week six, the patient reported that he was able to comb his hair, shave, and wipe his back with a towel all with minimal difficulty.

Large gains in strength and ROM were made during weeks seven and eight. Bilateral shoulder motion was again measured with the patient in supine using a standard goniometer. Initial and final measurements of ROM and strength can be found in Tables 3 and 4 below.

Table 3.

Initial and Final Shoulder Range of Motion (Degrees)

	L (AROM) Initial	R (PROM) Initial	L (AROM) Final	R (AROM) Final
Flexion	134	50	134	135
Extension	30	10	30	30
Abduction	151	38	151	150
Adduction	To Neutral	---------	To Neutral	To Neutral
Internal Rotation	70	45	70	70
External Rotation	34	To Neutral	34	45

Table 4.

Final Bilateral Shoulder and Elbow Strength (Numerical 0-5 scale)

	Left	Right
Shoulder Flexion	4	3+
Shoulder Extension	4	3
Shoulder Abduction	5	5
Shoulder Internal Rotation	4+	4+
Shoulder External Rotation	5	4+
Elbow Flexion	5	5
Elbow Extension	5	5

The patient was discharged from our care after the ninth week of physical therapy due to him meeting all long term goals, personal goals, and the fact that he was traveling to his time-share location for the winter. He was given an extensive HEP upon discharge with instructions of how long to continue. If questions were to arise, contact information was given to clarify HEP instructions, general questions, etc. The patient reported that he had readily accessible gym equipment via his time-share location. Patient also reported that he had the names of several PT clinics within a 30-mile radius of his winter home if he felt that he was significantly regressing.

CHAPTER V

DISCUSSION

This case has shown how an accelerated rotator cuff tear repair protocol supervised by a physical therapist was used to rehabilitate a 68-year-old male. The accelerated protocol was ideal because the patient had a past medical history of excessive scar tissue adhesions following a delayed motion protocol utilized after a TKA. Early motion protocols have been shown to be effective in treating post-op rotator cuff repairs[3,6,9,10,11,12,13,14]. Delayed motion protocols also have been proven to be successful in this area. [7,15,16] However, it is still unclear whether there is strong evidence supporting the use of one protocol over the other.[17,18,19]

As shown in Tables 3 and 4, the patient made significant gains in both ROM and strength throughout the course of physical therapy. However, his strength was not restored to a level equal to that of the non-surgical shoulder prior to discharge. This was possibly due to the surgical protocol and the short time that had elapsed since surgery rather than due to pain or other adverse reactions. As previously noted, this patient was unable to continue physical therapy until full strength was achieved due to a previously scheduled time-share move for the winter months. Age may have also been a factor limiting his strength outcomes. Older individuals tend to have longer tendon healing times and poorer outcomes on average when compared to middle aged or young adults due to significantly decreased blood flow to the peritendonous area.[5]

This patient also had significant improvements in regards to pain. Resting pain levels in this patient decreased in the first week of therapy from 4/10 on the VAS to a 0/10 following patient education on the importance of compliance with pain medications. The patient did experience

minor flare-ups with initiation of new activities such as beginning AAROM, gentle strengthening, etc. However, this pain was minor and was quickly relieved with the use of therapeutic agents such as E-Stim and US.

This case report adds to the existing studies which have shown favorable outcomes when utilizing an early motion protocol following a rotator cuff tear repair. However, this report has several limitations, such as a lack of a short term follow up with the patient due to his winter travels and the inability to determine long-term effects of this treatment. The most substantial limitation is that this case follows just one patient. There is no control group or delayed motion protocol group in this case report, nor is there any means of determining if this patient was an outlier compared to the average individual who utilized the same protocol aside from relying on outside literature.

Future studies are needed to determine if there is any significant benefit to using one protocol (early motion) over the other (delayed motion) across a multitude of different populations. For example, there may be a specific age group which would benefit from using the accelerated protocol, while a different age group would see an increased number of adverse effects from that protocol and would benefit greater from utilizing the delayed motion protocol. Age is just the beginning of an endless list of possible variables to study. Gender, Body Mass Index (BMI), size of the tear, presence of pathologies such as osteoarthritis (OA), Diabetes Mellitus (DM), etc. all could be influencing factors on which protocol would work best for a patient. All of these can impact wound healing time, an example being diabetes mellitus. Patients with DM who have undergone an orthopaedic surgery are more likely to have adverse effects and to experience delayed tendon healing time.[20] Investigation of the long term effects of the two protocols on these variables could finally lead to definitive answers for which form of protocol is best for

different populations. Research in this area could have the potential to improve the rehabilitation process for countless individuals by giving them the best protocol using statistics for their population.

REFLECTIVE PRACTICE

After reviewing this case following an additional year of schooling and clinical experience, there are definitely a few things which I would have changed regarding the interventions used with the patient in this report. Changes to therapeutic exercises, muscle relaxation techniques, and modalities would all be implemented if I were to see this patient today as compared to my interactions with him previously.

First and foremost, I would have given the patient an earlier opportunity to do more at home on his own (staying within his surgical protocol). We did a lot of PROM exercises initially, but almost entirely in the clinic. It can not be ruled out that if this patient was given a structured home program to follow from the beginning of therapy, either with family or self assistance, he may have progressed more quickly with R shoulder strength and ROM gains as well as pain reduction.

Additionally, muscle relaxation techniques such as trigger point release and cross fiber friction massage were strictly done in the clinic. If I had the knowledge I have now, I would have given the patient some instruction for how to achieve a similar effect at home with a tennis ball against a wall, mat, or floor. Allowing a patient to become as independent as possible with their therapy and less reliant on a therapist to execute every aspect of their care for them can really speed up the progression in their rehabilitation.

One last detail that I would change about the way this patient's therapy was structured is that we utilized modalities such as NMES and US for quite a long time. It would have been nice to

wean off of at least one a little more quickly in order to promote that patient independence mentioned previously.

That being said, there were definitely some positives to come out of this experience as well. I grew much more proficient in all of the areas mentioned above. My level of comfort with manual therapy, modality usage, on the spot thinking for adaptations to home and clinic exercises significantly increased over the course of this patient's therapy.

One final thing worth noting about this experience is that this accelerated motion protocol worked remarkably well for this patient. I am confident that under ideal conditions and a longer duration of PT, the patient could have regained full strength in the involved shoulder to make a complete recovery. This early passive motion protocol is one which I would definitely advocate for using with my future patients whom show potential to benefit from it.

Through reviewing and researching for this case, I have definitely grown as a student. I am able to recognize areas which could use some improvement and identify the means of making those changes. Additionally, I am able to acknowledge areas of this treatment which went exceptionally well and will be sure include them in my future practice wherever I see appropriate.

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