



Case Study

## Physical therapy prehabilitation on a reverse total shoulder replacement candidate: a case study

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**Abstract.** [Purpose] The purpose of this report is to describe the PT evaluation, prehab interventions, and outcomes of a patient pursuing reverse total shoulder replacement (rTSR) for pain reduction and functional gains. [Participant and Methods] A 62-year-old male self-referred to PT two months before his right rTSR. His chief complaints were right shoulder pain, stiffness, and functional impairment due to rotator cuff tendon tears and shoulder arthritis. He demonstrated poor posture, limited ROM, decreased strength, and diminished function. The PT prehab program consisted of an initial encounter followed by six treatment sessions across approximately one month. [Results] On the last visit, the patient's pain had meaningfully decreased along with improved posture, AROM, and muscle strength producing a clinically significant improvement in function resulting in the postponing of his rTSR. On a three months follow-up, the patient had maintained or improved in his test and measures and functional outcomes. He expressed satisfaction with the prehab outcomes and that he had indefinitely postponed his rTSR. [Conclusion] PT prehab program improved pre-operative measures on pain, posture, joint mobility, muscle strength, and function on a patient who had been scheduled for rTSR surgery. PT prehab program may delay the need for rTSR surgery.

**Key words:** Physical therapy, Prehabilitation, Total shoulder replacement

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### INTRODUCTION

Prehabilitation (prehab) or preoperative rehabilitation is the process of physical, psychological, or nutritional intervention for patients in anticipation of surgical procedures<sup>1)</sup>. The central premise is that optimizing patients' wellness to prepare them for surgery and to expedite the recovery after surgery<sup>2)</sup>. Prehab may also decrease post-surgical complication rates, shorten the length of hospital stay, reduce costs of healthcare, and improve patient perceived health-related quality of life<sup>3-5)</sup>. Prehab has been applied to several surgical populations including cardiopulmonary, abdominal, oncology, and orthopedic surgeries<sup>4, 6-11)</sup>.

Physical therapy (PT) prehab has promising benefits to patients undergoing orthopedic surgeries. Existing evidence suggests that preoperative exercise training reduces length of stay and improves pain and functional outcomes on patients undergoing total hip or knee arthroplasty and anterior cruciate ligament (ACL) reconstruction<sup>12-14)</sup>. In addition, one systematic review found that prehab intervention reduced the total cost of healthcare spending associated with spinal surgery<sup>3)</sup>.

The use of total shoulder replacement (TSR) has doubled in the last decade with up to 70,000 surgeries performed annually in the United States of which one-third are reverse TSR (rTSR)<sup>15-17)</sup>. The reversed articular surfaces allows the deltoid muscle to become a primary elevator of the shoulder, thus, making it suited for individuals with advanced osteoarthritis (OA) and massive rotator cuff tears<sup>18)</sup>. There is no published research documenting the use of prehab in individuals electing for

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rTSR. Therefore, the purpose of this case study is to describe the PT evaluation, prehab interventions, and outcomes of a patient pursuing rTSR for pain reduction and functional gains. The findings of this study may trigger future investigations in the benefits of prehab in an rTSR population.

## PARTICIPANT AND METHODS

The patient of this case study provided written informed consent to Angelo State University for the examination, intervention, and publication of the results. The patient was a 62-year-old, left handed, Caucasian male employed as a university professor. His primary MRI diagnoses in the right shoulder were complete tears with retraction of the supraspinatus, infraspinatus and long head of the biceps; partial tear of the subscapularis; tear of the anterior labrum, subacromial bursitis, glenoid chondromalacia; and hypertrophic changes of the acromioclavicular joint with narrowing of the subacromial space. Based on the MRI findings and clinical examination, his orthopedic surgeon recommended an rTSR. The patient self-referred approximately two months prior to the scheduled surgery date expressing an interest in prehab.

The patient sustained initial injury to the right shoulder 20 years ago, but did not seek medical attention or treatment. Since the onset, he described transient pain with overuse of the right shoulder. Six months prior to the PT visit, the patient suffered traumatic damage to the right shoulder when he attempted to lift and flip a heavy object. He had immediate onset of intense pain with the inability to lift his right arm. A few days later, he developed a large area of ecchymosis in the right upper medial arm. Medical attention was sought at an urgent care clinic eight weeks after the incident. The evaluating family nurse practitioner ordered a MRI and referred him to his current orthopedic surgeon.

During the prehab initial evaluation, the patient's chief complaint was sharp pain in the right shoulder with overhead activities, especially with the addition of weight. He also reported painful donning/doffing of upper body clothing, lifting larger pots and pans, and sleeping on his right side. In the morning, he experienced pain and stiffness which resolved by the afternoon. In general, resting the shoulder in a neutral position relieved his symptoms and over the counter non-steroidal anti-inflammatory medication would aid in sleeping.

The patient's past medical and surgical history were reviewed and found to be noncontributory to his current chief complaint nor limiting to his prehab participation. The patient's stated goals were: 1) pain control, 2) increase active mobility, 3) regain ability to play golf, and 4) use of a mechanical drill for wood working or home improvements.

The PT initial evaluation was focused on the mobility, stability, and strength of the shoulder complex (glenohumeral/scapulothoracic joints), cervicothoracic junction (CTJ), and thoracic spine. Prior to the physical examination, functional outcome measures were recorded for pain and the function of the right shoulder and upper limb.

The functional outcome assessments (Table 1) consisted of: Numeric Pain Rating Scale (NPRS), Shoulder Pain and Disability Index (SPADI), and Quick Disability of Arm, Shoulder, and Hand (QuickDASH). The NPRS is a reliable and valid instrument for scoring pain<sup>19</sup>. The patient is requested to select a whole number that best reflects his or her pain on an 11-point numeric scale with the anchors 0 no pain and 10 worst pain imaginable. Pain was rated in four categories: 1) current, 2) usual pain during the last week, 3) best level of pain during the last week, and 4) worst pain during the last week. The patient scored his current and pain at best 0/10 and pain at worst 8/10. In a shoulder pain population, a 2-point reduction represents the minimally clinically important difference (MCID)<sup>20</sup>. The SPADI is joint specific measure focusing on pain and functional activities involving the shoulder<sup>21</sup>. It has been shown to be valid and reliable, as well as responsive to change and able to differentiate patients who are improving or worsening<sup>22, 23</sup>. SPADI scores range from 0% to 100% with higher scores designating greater disability. Three categories are scored on the SPADI: pain, disability, and total. The patient recorded a pain score of 46%, disability 30%, and total 36%. The minimal detectable change (MDC) ranges from 18.1 to 21.5.<sup>24, 25</sup> The MCID ranges from 13.2 to 15.4<sup>24, 26</sup>. The QuickDASH is an upper extremity, region specific self-reported outcome measure that assesses areas such as functional mobility, life participation, and social functioning. A strong correlation has been reported between the DASH and QuickDASH, but QuickDASH is preferred in order to reduce patient burden<sup>27-29</sup>. Disability is rated from 0% to 100% with higher scores indicating greater functional limitations. A disability of 61% was reported by the patient. The MDC for QuickDASH range from 11 to 17.18, and MCID range from 9.0-11.3<sup>30, 31</sup>.

Upon observation (Table 2), there was visible atrophy in the right infraspinatus, supraspinatus, and teres minor as compared to left side. The patient demonstrated an "upper-crossed" posture: forward head, rounded shoulders, and thoracic kyphosis<sup>32</sup>. The right scapula was minimally elevated at rest with the superior angle positioned between T1 and T2. The scapulae were slightly abducted, 3.25 inches vertebral border from spine. No evidence of scapular upward or downward rotation was identified. Assessment of the patient's pectoralis minor (Pm) and deep neck flexors (DNF) were performed secondary to his upper crossed posture. Pm length was measured per previously described methods<sup>33</sup>. The length measurement results were 4 inches on the right and 3.25 inches on the left. These results indicated bilateral Pm muscles tightness based on the norm of 1 inch<sup>33</sup>. To assess the performance of the DNF, endurance testing was completed per Domenech et al<sup>34</sup>. The result on the DNF endurance test was 8.79 seconds and the norm for males is suggested as 38.9 seconds<sup>34</sup>. These results indicated an impaired flexibility of Pms and poor endurance of DNF, which could be associated with patient's poor posture.

The mobility of CTJ and thoracic spine were assessed as a possible contributing source of shoulder pain. Passive accessory intervertebral movement (PAIVM) assessment in a posterior to anterior (PA) direction indicated hypomobility throughout the thoracic spine with severe limitations at the CTJ. The restricted PAIVM PA findings were consistent with the observed

**Table 1.** Functional outcome measures

Measures	Initial evaluation (Day 1)	Fifth visit (Day 18)	Final evaluation (Day 32)	Three months follow-up
NPRS	Right now: 0	Not scored	Right now: 0	Right now: 0
	Usual pain over last week:		Usual pain over last	Usual pain over last
	Not recorded		week: 0	week: 1
	Pain at best: 0		Pain at best: 0	Pain at best: 0
	Pain at worst: 8		Pain at worst: 8	Pain at worst: 4
SPADI	Pain: 46.0%	Pain: 52.0%	Pain: 34.0%	Pain: 20.0%
	Disability: 30.0%	Disability: 20.0%	Disability: 12.5%	Disability: 3.75%
	Total: 36.0%	Total: 32.0%	Total: 20.8%	Total: 18.2%
QuickDASH	Total: 61.0%	Total: 36.0%	Total: 29.5%	Total: 27.2%

**Table 2.** Postural tests and measures

Test	Initial evaluation (day 1)	Final evaluation (day 32)	Three months follow-up
Distance from medial border of scapula to spine	R: 3.25 inches	R: 3.0 inches	R: 3.0 inches
	L: 3.25 inches	L: 3.0 inches	L: 3.0 inches
Scapular positioning	R: 1/2 segment high	R: 1/2 segment high	R: 1/2 segment high
	L: 1/2 segment high	L: 1/2 segment high	L: 1/2 segment high
Pec Minor tightness test	R: 4.0 inches	R: 3.0 inches	R: 3.5 inches
	L: 3.25 inches	L: 2.75 inches	L: 2.75 inches
DNF endurance test	8.79 seconds	16.80 seconds	15.05 seconds

DNF: Deep neck flexors.

**Table 3.** Active range of motion

Movement	Initial evaluation (day 1)	Second visit (day 4)	Final evaluation (day 32)	Three months follow-up
R GHJ				
Flexion	60° (with onset of 4/10 pain)	150°	163° (0/10 pain)	166° (0/10 pain)
Abduction	75° (with onset of 1/10 pain)	153°	168° (0/10 pain)	180° (0/10 pain)
Extension (standing)	63°	63°	77° (0/10 pain)	75° (0/10 pain)
External rotation (scapular plane)	68°	62°	66° (0/10 pain)	77° (0/10 pain)
Internal rotation (scapular plane)	50°	67°	72° (0/10 pain)	75° (0/10 pain)
Horizontal adduction	23°	Not measured	45° (1/10 pain)	43° (0/10 pain)
Scapular upward rotation during flexion	45°	Not measured	55°	58°

R GHJ: Right glenohumeral joint.

kyphotic posture.

Glenohumeral joint (GHJ) active range of motion (AROM) was measured by a standard goniometer per Norkin and White (Table 3)<sup>35</sup>. The patient was significantly limited in all planes. When performing shoulder flexion at 60 degrees, pain was reported to be 4/10 on the NPRS. The patient reported at times during overhead reach pain could increase to 8/10. At 75 degrees of shoulder abduction, pain was rated at 1/10. All other movements were pain free. During active elevation, a deficit in right scapula upward rotation was noted. Forty five degrees was recorded with measuring the vertebral border of the scapula to a vertical axis, lacking 15 degrees from the normal of 60 degrees<sup>36</sup>.

Right GHJ passive range of motion (PROM) was assessed in a supine position. PROM was found to be normal in all planes except internal rotation (IR) were 60 degrees was noted. Passive accessory motion (PAM) testing in an anterior to posterior (AP) glide confirmed the IR limitation a mild capsular end feel. Patient denied any production of pain with PROM testing. With AROM and PROM, there was palpable crepitus noted in the right GHJ throughout movements.

Strength tests (Table 4) were performed via manual muscle testing on selected scapulo-humeral and scapulo-thoracic muscles<sup>37</sup>. Overall, the patient demonstrated decreased muscle strength on the right when compared to his left upper extremity. Pain and rotator cuff pathology was a limiting factor in the performance of the scapulo-humeral muscles with flexion, abduction, and ER. Weakness of the scapulo-thoracic stabilizers was consistent with the scapular upward rotation deficit and upper cross syndrome posture.

To clinically confirm the MRI findings, the following special tests were completed. The rent test was found to be positive

**Table 4.** Manual muscle tests

Muscles	Initial evaluation (day 1)	Final evaluation (day 32)	Three months follow-up
R middle trap	3-/5	4+/5	5/5
R internal rotation	4/5	4/5	4+/5
R external rotation	3+/5	3+/5	3+/5 (pain reproduced)
R lower trap	3+/5	4/5	4+/5
R serratus anterior	3+/5	5/5	5/5
R shoulder flexion	2+/5	4+/5 (pain reproduced)	5/5
R shoulder abduction	3+/5	4+/5	4+/5

suggesting a rotator cuff tear (SP 97, +LR 32)<sup>38</sup>). The lack of integrity of the supraspinatus and infraspinatus were confirmed by weakness and pain during the external rotation lag sign (SP 90, +LR 4.20)<sup>39</sup>. Labrum pathology and glenoid chondromalacia were suggested during completion of a crank test (pooled SP 75) with detected crepitus and clicking<sup>40</sup>. Biceps load I testing (SN 97) was negative for labrum pain<sup>41</sup>. It was reasoned that, the full tear with retraction of the long head of the biceps failed to provide tension on the labrum resulting in the negative test.

The prehab program consisted of an initial encounter (evaluation and treatment) followed by six treatment sessions spread across 32 days. The impairment-based interventions were developed based on the findings during the initial evaluation and the patient's responses during each subsequent visit. Six therapeutic exercises were prescribed to the patient as his home exercise program (HEP). The specific exercise prescription during each session is summarized in Table 5. Please refer to supplementary document for detailed instructions.

(1) Supine on towel roll with sequential setting of transversus abdominis (TA), DNF, and scapular retractors for a 5 second hold (Fig. 1). The purpose of this exercise was to address the physical impairments that were contributing to his postural abnormalities, thus promoting normal scapular resting positioning.

(2) Y's on a wall (Fig. 2): at the end range of elevation, scapular upward rotation was emphasized by completing a shoulder shrug and then moving hands from the wall by scapular retraction. This exercise focused on establishing normal scapulohumeral rhythm.

(3) GH internal rotation (IR) and external rotation (ER) in prone and standing. To insure pure rotation, the patient was cued to imagine a dowel was running through his elbow to his shoulder, thus only allowing a spinning motion at the shoulder. The goals of this exercise were to increase the strength and endurance of the rotator cuff muscles and scapular control by activating the lower trapezius during prone ER<sup>42</sup>.

(4) Prone Scapular Y's: the emphasis of this exercise was to increase the strength and endurance of the scapular stabilizers, specifically the lower trapezius.

(5) Scaption flies with elbow flexed to 90 degrees in front of a mirror (Fig. 3). With visual feedback provided by a mirror, the patient was instructed to only raise his arms as high as he could without compensatory right shoulder hiking. The function of this exercise was to retrain normal scapulohumeral rhythm and to strengthen GH elevators. To progress this exercise, the patient gradually extended his elbows while avoiding excessive elevation of the right scapula.

(6) Wax on/wax off on a horizontal surface (Fig. 4). By introducing compression through the GHJ, muscular co-contraction was enhanced leading to improved stability of the GHJ. To progress this exercise, the patient leaned further over the table, performed larger clockwise and counterclockwise circles, or a combination of those two methods.

During each treatment session, the patient reported how he had tolerated the HEP and if he had noted any changes in pain or function. As indicated, the patient was instructed on means to progress his exercises and on any new exercises. In order to determine his mastery of the HEP, he was asked to perform each assigned exercise. Patient compliance with the HEP was evaluated by considering the patient's ability to accurately describe and perform the exercises without assistance or cuing and self-reported compliance. He demonstrated excellent skill level with his HEP with a self-reported compliance rate  $\geq 90\%$  on his 4th and 6th visits.

Therapist delivered spinal mobilization (SM) was completed outside of the HEP. To improve CTJ and thoracic extension mobility, posterior to anterior (PA) mobilization was performed as part of the first and the third visits. SM was completed in prone and consisted of progressive PA oscillations from I-IV grades to the targeted segments. To further enhance thoracic mobility and produce neurophysiological pain reducing effects, the SM session was ended with a grade V impulse to the mid-thoracic region<sup>43</sup>.

## RESULTS

On the last visit of the program (Day 32), a reassessment was performed. The NPRS at worse continued to be as the baseline 8/10. While the patient did not have a reduction in his NPRS at worse, he reported complete relief of night pain and pain with usual daily activities. The patient's overall score on the SPADI decreased from 36.0% at baseline to 20.8% (Table

**Table 5.** Home exercise program

Exercise	Day 1	Day 4	Day 6	Day 11	Day 18	Day 25	Day 32
Supine on towel roll with TA activation, DNF activation, and scapular retraction	3 sets of 10 with a 5 second hold 2× per day **	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day
Scapular Y's while standing facing a wall	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day	3 sets of 10 with a 5 second hold 2× per day Add 2 pound weight	3 sets of 10 with a 5 second hold 2× per day 2 pound weight	3 sets of 10 with a 5 second hold 2× per day 2 pound weight	3 sets of 10 with a 5 second hold 2× per day 2 pound weight
GH internal rotation and external rotation in prone and standing	2 sets of 10 2× per day	2 sets of 10 2× per day	2 sets of 10 2× per day	3 sets of 10 2× per day Add 1 lbs. weight	3 sets of 10 2× per day 1 lbs. weight	3 sets of 10 2× per day **^	3 sets of 10 2× per day **^
Prone isometric scapular Y's	Not given	1 sets of 10 with a 5 second hold 2× per day	1 sets of 10 with a 5 second hold 2× per day	1 sets of 10 with a 5 second hold with 1 lbs. weight *** 2× per day	1 sets of 10 with a 5 second hold ^^^ 2× per day	1 sets of 10 with a 5 second hold 2× per day	1 sets of 10 with a 5 second hold 2× per day
Scaption fly's with elbow flexed to 90° in front of a mirror	Not given	1 set of 10 ^^ 2× per day	1 set of 10 ^^ 2× per day	1 set of 10 ^^ 2× per day	1 set of 10 ^^ 2× per day	1 set of 10 ^^ 2× per day	1 set of 10 ^^ 2× per day
Wax on/Wax Off	Not given	Not given	Not given	Not given	30 seconds CW 30 seconds CCW 3 sets through-out the day	30 seconds CW 30 seconds CCW 3 sets through-out the day	30 seconds CW 30 seconds CCW 3 sets through-out the day

\*\*On the second treatment session, patient reported performing this exercise with 30-second holds instead of 5 second holds. Patient was reeducated to only perform for 5 second holds.

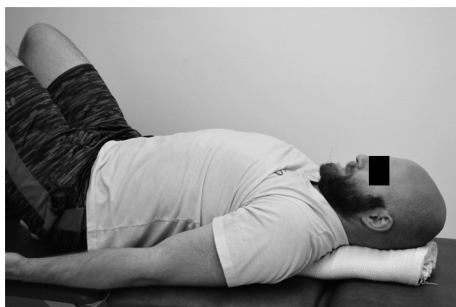
\*\*\*Patient instructed to add extra thoracic extension to the isometric hold in order to address impaired thoracic extension mobility.

^^Patient was instructed to only continue this exercise until onset of pain or patient was unable to maintain scapular depression.

^^^Patient reported increased pain from using weight, so weight was removed from HEP for this exercise.

\*\*Exercise changed to standing ER/IR with resistance band tied to stable surface secondary to patient's reported difficulty with not having a stable surface to perform it on.

TA: Transversus Abdominis; DNF: Deep Neck Flexors; GH: Glenohumeral; CW: Clockwise; CCW: Counter-clockwise.



**Fig. 1.** Supine on towel roll with transversus abdominis (TA) and DNF activation, and scapular retraction.



**Fig. 2.** Scapular standing facing a wall. Y's while.



**Fig. 3.** Scaption fly's with elbow flexed to 90 degrees in front of a mirror.



**Fig. 4.** Wax on/wax off.

1). The 15.2% represented a clinically significant change, obtaining the MCID range of 13.2% to 15.4%<sup>24, 26</sup>). The patient's overall score on the QuickDASH decreased from 61.0% at baseline to 29.5%. This 31.5% reduction exceeds the MCID range by 2 to 3 times (MCID 9–11.3%)<sup>30, 31</sup>).

The patient displayed improved posture as confirmed by reduced resting scapular abduction and Pm tightness, and two fold increase in DNF endurance (Table 2). His scapular upward rotation of 55 degrees was approaching the normal of 60 degrees<sup>36</sup>). The patient exhibited substantial gains in pain free active elevation of the right shoulder with AROM of flexion to 163 degrees and abduction to 168 degrees (Table 3). The patient through his strength gains in the GHJ elevators and scapular stabilizers was able to resist moderate to strong (4+/5) manual resistance with shoulder flexion and abduction (Table 4).

The patient expressed that he had elected to postpone his rTSR surgery, which was scheduled in about three weeks. He reported that his goals had been met for pain control and mobility of his arm. The goals of golfing and use of a mechanical drill had not been attempted. He was advised that he could gradually try these activities to determine his shoulder's tolerance. The patient reported that he no longer had pain on a daily bases or pain with his usual daily activities. He was able to sleep throughout the night without awakening due to pain. He had a self-assessed 95% improvement in overall shoulder function. Based on the patient's improved test and measures and self-reports, a three-month follow-up was recommended. In the interim, the patient was encouraged to continue daily with his prescribed HEP. The patient agreed to the recheck and acknowledge the importance of follow through with his HEP.

On the three months follow-up, the patient demonstrated maintained or improved test and measures and functional outcomes. He demonstrated compliance with his HEP and a good self-management strategy. Pain at worse on the NPRS, was now rated at 4/10 compared to previous levels of 8/10, a twofold MCID<sup>20</sup>). He denied any pain except when lifting heavy objects in an upright row position (GHJ 90 degrees abduction with IR). The patient shared a picture taken a few days prior to the follow-up of him repairing his house roof gutter with a mechanical drill. Due to his schedule, he still had not attempted to golf. The patient's goals of pain control, increase active mobility, and use of a mechanical drill had been met. The determination was made no additional follow-ups were indicated. He expressed his satisfaction with the prehab outcomes and that he had indefinitely postponed his rTSR.

## DISCUSSION

The role of PT has been evolved from postoperative rehabilitation care to prehab management on several surgical populations. Recently, Paterson et al. reported a multimodal preoperative intervention including instruction was beneficial for patients opting for radical prostatectomy due to localized prostate cancer<sup>44</sup>). Existing literature also suggests that preoperative inspiratory muscle training may prevent pulmonary complications and improve postsurgical outcome on esophageal cancer patients undergo esophageal resection<sup>45–47</sup>). In a lumbar surgical population, a tailored made prehab program has been shown to reduce post-surgical pain, risk of avoidance behavior, worsening of psychological health and improves quality of life and functional activity levels<sup>48</sup>).

PT prehab has been commonly applied on patients undergoing total hip and knee arthroplasty even though the evidence

supporting the efficacy remains inconclusive<sup>49, 50</sup>). Wang et al. refuted the use of prehab finding it to have an early and small positive effect on pain and function, but did not improve cost, hospital length of stay, or quality of life<sup>51</sup>). In contrast, Santa Mina et al. found the use of total body prehab improved the length of stay, pain, and function<sup>52</sup>). PT prehab, may also improve pre-surgical outcomes and influence patient expectations prior to surgery. Clode et al. reported a PT prehab program including exercise and education session twice weekly for eight weeks improved patients' pain and function before hip or knee arthroplasty and had a positive influence on patient expectations and higher satisfaction levels post-surgery<sup>49</sup>).

There is support that a prehab program may defer the need for surgery. Holmgren et al. found in individuals with subacromial impingement that a strengthening program to the rotator cuff and scapular stabilizers improved pain and function, thus reducing the need for subacromial decompression surgery<sup>53</sup>). In a 12-week total knee arthroplasty (TKA) prehab program, 19.4% of the participants elected to cancel surgery due to improved pain<sup>54</sup>).

In this case report, completion of five weeks of PT prehab combined with excellent HEP compliance resulted in the patient obtaining his goals of pain control, increase active mobility, and regaining functional activities, which lead the patient to defer his rTSR. Although avoiding surgery was not an initial goal, the prehab program positively negated the need for surgery. The patient recognized the values of PT as a conservative option over the invasive surgical approach for his shoulder pain and dysfunction.

The primary limitation of this case study is that we only conducted one follow-up assessment three months after the PT prehab program concluded. Since the patient decided to postpone his rTSR surgery, we were not able to determine the effect of the PT prehab on the postsurgical outcomes. In addition, an assessment on patient's quality of life could have been recorded.

In summary, a five-week PT prehab program improved pre-operative test and measures on pain, joint mobility, muscle strength and function on a patient who had been scheduled for an rTSR surgery. The conservative PT approach delayed the need for surgery.

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None.

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