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Exercise Protocol for the Treatment of Rotator Cuff Impingement Syndrome

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Clinical Question: What is the role of exercise in the treatment of rotator cuff impingement syndrome (RCIS), and what evidence-based exercises can be synthesized into a criterion-standard exercise rehabilitation protocol?

Data Sources: Investigations were identified by PubMed, Ovid, the Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, American College of Physicians Journal Club, and Database of Abstracts of Reviews of Effects. The search terms included *shoulder*, *impingement*, *rotator cuff*, *rehabilitation*, *physical therapy*, *physiotherapy*, and *exercise*. Additional searches were performed with bibliographies of retrieved studies.

Study Selection: To qualify for inclusion, studies had to be level 1 or level 2 (randomized controlled trials); had to compare rehabilitation interventions, such as exercise or manual therapy, with other treatments or placebo; had to include validated outcome measures of pain, function, or disability; and had to be limited to individuals with diagnosed impingement syndrome. Impingement syndrome was determined by a positive impingement sign per Neer or Hawkins criteria, or both. Articles were excluded if they addressed other shoulder conditions (eg, calcific tendinosis, full-thickness rotator cuff tears, adhesive capsulitis, osteoarthritis), addressed postoperative management, were retrospective studies or case series, or used other outcome measures.

Data Extraction: An evidence-based journal club of 9 faculty members and fellows reviewed the articles and extracted and tabulated the data. Individual outcomes for pain, range of motion (ROM), strength, and function were organized. Intragroup and between-groups outcomes were assessed for the effectiveness of treatment, and statistical outcomes were recorded when available. Clinical importance was determined when statistical value was $P < .05$ and the effect size or difference between treatments was 20% or more. Six[a] major categories were created to organize the components of the physical therapy programs used in each study: ROM, flexibility and stretching, strengthening techniques, therapist-driven manual therapy, modalities, and schedule. Components from these categories were used to create a synthesized physical therapy program.

Main Results: The searches identified 80 studies, of which 11 met the inclusion criteria. In 5 studies, the diagnosis of RCIS was confirmed using an impingement test consisting of lidocaine injected into the subacromial space and elimination of pain with the impingement sign. Randomization methods were used in 6 studies, and blinded, independent examiners were involved in follow-up data collection in only 3 studies. Validated outcome measures were used in all studies. Follow-up was very good in 10 studies and was less than 90% in only 1 study. The specific exercise programs varied among studies. However, general treatment principles were identified among the different studies and included frequency, ROM, stretching or flexibility, strengthening, manual therapy (joint and/or soft tissue mobilizations), modalities, and others.

The findings indicated that exercise improves outcomes of pain, strength, ROM impairments, and function in patients with impingement syndrome. In 10 studies, investigators reported improvements in pain with supervised exercise, home exercise, exercise associated with manual therapy, and exercise after subacromial decompression. Of the 6 studies in which researchers compared pre-exercise pain with postexercise pain, 5 demonstrated that exercise produced statistically significant and clinically important reductions in pain. Two studies demonstrated improvements in pain when comparing exercise and control groups. In 1 study, investigators evaluated bracing without exercise and found no difference in pain between the brace and exercise groups. Investigators evaluated exercise combined with manual therapy in 3 studies and demonstrated improvement in pain relief in each study and improvement in strength in 1 study. In most studies, exercise also was shown to improve function. The improvement in function was statistically significant in 4 studies and clinically meaningful in 2 of these studies. In 2 studies, researchers compared supervised exercise with a home exercise program and found that function improved in both groups but was not different between groups. This finding might have resulted from a type II statistical error. In 4 studies, researchers did not find differences between acromioplasty with exercise and exercise alone for pain alone or for outcomes of pain and function.

Conclusions: Findings indicated that exercise is beneficial for reducing pain and improving function in individuals with RCIS. The effects of exercise might be augmented with implementation of manual therapy. In addition, supervised exercise might not be more effective than a home exercise program. Many articles had methodologic concerns and provided limited descriptions of specific exercises, which made comparing types of exercise among studies difficult. Based on the results, Kuhn generated a physical therapy protocol using evidence-based exercise that could be used by clinicians treating individuals with impingement syndrome. This evidence-based protocol can serve as the criterion standard to reduce variables in future cohort and comparative studies to help find better treatments for patients with this disorder.

Key Words: function, subacromial impingement, rehabilitation

[a] The number of categories was given as 5 in the article by Kuhn, but 6 categories were shown.

COMMENTARY

Rotator cuff impingement syndrome (RCIS) is a multifactored disease that can lead to functional limitations and an inability to participate in work, leisure, and sporting activities. This syndrome can be caused by many factors, such as weakness of the rotator cuff and periscapular muscles, decreased pectoral and rotator cuff muscle flexibility, abnormal motion patterns, extrinsic factors (eg, vibration exposure, use of hand tools, work-station height), and trauma. Kuhn provided a valuable synopsis of randomized controlled clinical trials in which the benefit of exercise for individuals with RCIS was examined. Substantial evidence[1] exists to support the use of exercise for the management of this patient population. In addition, manual therapy has been shown[1] to augment the effectiveness of exercise. However, we believe it is premature to label the proposed rehabilitation protocol as a *criterion standard* because of the lack of specific exercise descriptions, variability in the exercise programs, and inability to separate the effects of specific exercises on the measured outcomes that Kuhn noted. Furthermore, because RCIS is multifactored, use of the same exercise protocol to treat everyone with RCIS might not be the best standard of care.

Athletic trainers and physical therapists play important roles in the management of individuals with RCIS. When caring for this patient population, an athletic trainer or physical therapist performs a comprehensive initial examination. Information obtained from the examination is used, in part, to (1) identify impairments believed to be contributing to the individual's pain and functional limitations and (2) develop an impairment-based rehabilitation program. We believe that the prescription of specific evidence-based interventions designed to address the relevant contributory factors might be more appropriate than administering the same exercise program to everyone with RCIS. Ideally, individuals with RCIS would be classified into impairment-based subgroups and prescribed interventions specific to that subgroup. Although no treatment classification for patients with RCIS exists, this approach has been used to treat individuals with low back pain and has resulted in superior outcomes when compared with a general treatment approach.[2]

The exercises that Kuhn provided can be viewed as a partial list of exercises that might be appropriate for treating an individual with RCIS. We offer modifications to 3 of the proposed exercises and discuss factors used by athletic trainers and physical therapists to establish initial exercise selection, intensity, and periodic modification of an exercise program that were not discussed by Kuhn. Based on current evidence, the anterior shoulder stretch in the proposed protocol might not be the most effective way to stretch the pectoral muscles. When performing the stretch as described in the protocol, the individual is instructed to place his or her hands at shoulder level on either side of a door or corner and to lean forward. This might be a preferred position to initiate pectoral muscle stretch if the individual is unable to perform stretching with the arm elevated as a result of pain; however, evidence[3] indicates that changing the position of the upper extremity so that the individual's hand is above the head with the shoulder in 90° of abduction and 90° of external rotation likely provides a more effective stretch.

One of the rotator cuff strengthening exercises proposed by Kuhn is scaption performed with the thumb down or up. Clinically, this exercise is called the *empty-can* (thumb-down) or *full-can* (thumb-up) *exercise*. When prescribing this strengthening exercise, one should consider the effect that upper extremity position has on the tissues located in the subacromial space. Yanai et al[4] showed that impingement forces on the rotator cuff tendons under the coracoacromial ligament were greater with the empty-can exercise than with the full-can exercise. Therefore, the full-can exercise is more appropriate for this patient population.

Finally, although performing the lower trapezius strengthening exercise as described by Kuhn (standing with the arms at the sides and moving the shoulders into extension against resistance of an elastic band) is appropriate for individuals with moderate to high pain levels or altered scapulothoracic movement patterns, other exercises have demonstrated[5] greater electromyographic activity levels of the lower portion of the trapezius muscle. The prone "Y" exercise (arm raised in line with the fibers of the lower trapezius) produces high levels of lower trapezius electromyographic activity and might be more effective for strengthening this muscle.[5] After an individual's pain resolves and scapulothoracic movement patterns normalize, an athletic trainer or physical therapist might progress the individual to a more challenging position, such as the prone "Y" exercise.

In addition to determining the optimal position from which to initiate an exercise based on the patient's related impairments and level of pain, exercise dosage and progression are important aspects of a rehabilitation program. Intervention details, such as number of repetitions and sets, exercise order, and work-to-rest ratios, should be tailored to each patient based on his or her specific needs. The proposed protocol does not describe a method to determine the initial exercise intensity or the criteria for modification or progression. Using a criterion-based method to determine the initial intensity and progression would individualize these guidelines of the exercise program. In their randomized controlled trial designed to address the effectiveness of exercises to treat RCIS, Lombardi et al[6] used a 6-repetition maximum load to establish the starting intensity of strengthening exercises. They[6] also recommended a reevaluation every 2 weeks to make necessary adjustments to exercise intensity. Although we do not know whether the 6-repetition maximum-load criteria used in their study is optimal, it is an excellent example of a criterion-based method to determine initial exercise intensity and progression. Future research on exercise for the treatment of RCIS should include criterion-based methods to determine the optimal exercise dosage and progression.

In summary, Kuhn demonstrated substantial evidence in randomized clinical trials that exercise is effective for treating individuals with RCIS, thereby supporting its use in clinical practice. However, as Kuhn indicated, detail related to which specific exercises are best to prescribe is lacking. Thus, it might be premature to label this exercise protocol as a *criterion standard* based on current available evidence. In addition, the multifactored nature of RCIS indicates that individuals do not present with a homogeneous list of impairments. Therefore, we believe that using the same exercise program to treat everyone who has RCIS is inappropriate. An effective exercise program is derived not only from the pathoanatomic diagnosis but also from the synthesis of factors, such as pain, impairments, and functional limitations. Furthermore, we believe follow-up examinations might be necessary to modify and progress the individual's exercise program. Development of a classification-based treatment approach using evidence-based exercises with standardized exercise dosage and progression guidelines might optimize outcomes for individuals with RCIS.

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