RESEARCH ARTICLE

Outcome of Isolated Eccentric Exercise Therapy in Sports Persons with Rotator Cuff Tendinopathy

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Abstract

Objective: To evaluate the outcome of an isolated eccentric exercise (EE) program in sports persons with rotator cuff (RC) tendinopathy.

Materials and methods: This prospective study enrolled 40 sports persons with a mean age of 26.4 years having shoulder pain with confirmed RC tendinopathy on magnetic resonance imaging (MRI) presenting to the sports injury care center, who were managed with isolated eccentric therapy and stretching exercises. These were managed by routine stretching exercises along with isolated eccentric home-based therapy for 3 months. Functional outcomes were measured as Constant-Murley score (CMS) and disabilities of the arm, shoulder and hand (DASH) score while pain was measured as visual analog scale (VAS) score considered as primary outcomes. Other outcomes were measured as secondary outcomes including a range of movements of the shoulder and isometric abduction strength at 45° in the scapular plane by manual hand dynamometer [handheld dynamometer (HHD)] and shoulder range of motion (ROM) (forward elevation, abduction, and external rotation). All the parameters were evaluated at serial intervals including at presentation and at 3 and 6 months of follow-up visits.

Results: With respect to the decline in VAS ratings and DASH score, as well as the large increase in the CMS, there was a considerable improvement in pain and functional results**.** Mild degression of functional parameters was observed between 3 and 6 months but insignificant biostatistically. Overall muscle strength was improved significantly at the final follow-up than the first presentation.

Conclusion: Isolated EE therapy along with stretching is effective in the treatment of sports persons with RC tendinopathy.

Keywords: Eccentric exercises, Rotator cuff, Tendinopathy, Shoulder, Sports persons.

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Introduction

The prevalence of shoulder injuries in overhead sports varies from 5 to 36%, respectively.[1–3] The concept of subacromial impingement syndrome was introduced by Neer in 1972 to describe a group of pathologies like tendinitis, bursitis, calcifications, and rotator cuff (RC) tears that produced pain when elevating the shoulder.[4] Shoulder cuff or RC tendinopathy, which affects roughly 30% of the population, is thought to be the most typical cause of shoulder pain. People who engage in repetitive overhead activities, such as throwing sports like volleyball, baseball, badminton, cricket, and tennis, are more likely to get shoulder pain.[5,6] RC tendinopathy has a complex etiology that includes both internal and extrinsic causes. Extrinsic mechanisms consist of both biomechanical and anatomical factors. Tendon morphology and performance are affected by intrinsic mechanisms.[7] Conservative treatment is generally used for patients with RC tendinopathy as it can speed up the tendon's healing by altering its metabolism as well as its structural and mechanical characteristics.[8] Exercise therapy is commonly used as part of conservative treatment in patients with various types of tendinopathies.[9,10] The eccentric exercise (EE) is now being increasingly reported in the literature as a specialized rehabilitative training method. The eccentric training targets the lengthening portion of the exercise and promotes a significantly greater increase in muscle strength. Because eccentric activities subject the tendon to a greater load than concentric movements, eccentric training is different from traditional training programs and generates a restorative effect after the production of muscle microruptures.[11,12]

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As a result, relatively few research has looked into how well eccentric training works for people with RC tendinopathy. Therefore, the current study's objective was to assess, through a long-term follow-up, the efficacy of isolated EE of the RC in sports persons with RC tendinopathy.

Materials and Methods

The present prospective study included 40 sports persons with RC tendinopathy [confirmed on magnetic resonance imaging (MRI)]

presenting to the sports injury care institute of North India and who were managed with isolated eccentric therapy. Prior to being enrolled in the trial, all individuals provided their written informed permission, and the Institutional Review Board gave their approval to the current study. Patients ranging from 18 to 45 years either having single-side subacromial discomfort of minimum for 12 weeks or having RC tendinopathy or its partial tear on MRI were included in the study. Patients who had clinical features of shoulder instability or complete RC tear or severe cervical radiculopathies or bursitis associated with type III acromion as per Bigliani criteria or having a history of a fractured shoulder or intervened by intraarticular steroid injection or any kind of surgery or having frozen shoulder and severe systemic diseases affecting rehabilitation of shoulder joint were excluded from the present study.

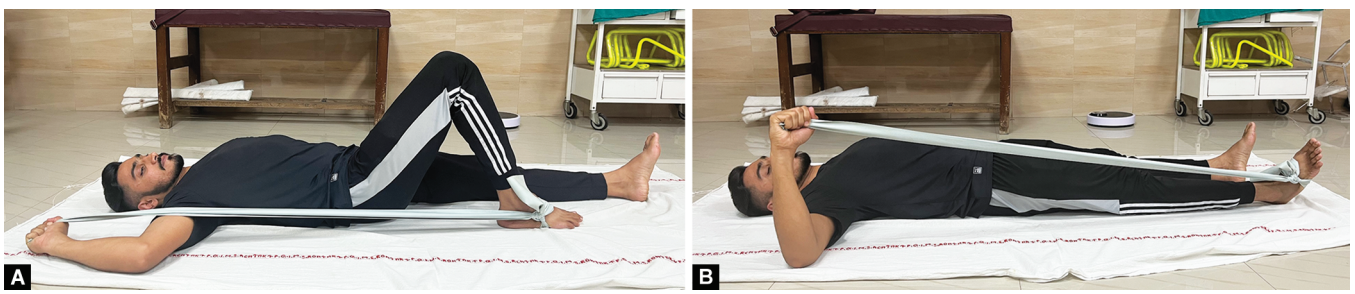
Intervention

All patients performed the isolated EEs (two types of exercises twice a day) combined with two types of stretching on a daily basis at home for 12 weeks. All patients also attended physiotherapy sessions twice in 1 week during the treatment period of 12 weeks. Physiotherapy sessions comprised of practicing the workout and accommodating the resistance load. Exercises were stopped after 3 months and thereafter, patients were allowed to accomplish their normal routine work. Patients engaged in two drills (Table 1). A supine lying EE for the external rotators is performed first (Fig. 1), with the patient's hand holding an elastic band that is wrapped around the foot on the ipsilateral side. The shoulder was externally rotated and abducted by 90°. The patient was then instructed to bend one knee, externally rotate one shoulder, then, at a speed of 6–8 seconds per repeat, extend the knee and internally rotate the forearm. Second, patients engaged in a scapular plane empty-can abduction exercise (Fig. 2). Subjects passively raised their arm using a pulley until it was 90° abducted. They were then instructed to actively lower their arm at a speed of 6–8 seconds per repeat. Initially, both the exercises were performed with three sets of eight repetitions twice a day, daily. In order to alter the load, the number of repetitions was first increased (up to a maximum of 15 repetitions) and then the resistance of the dumbbell or elastic band was varied. Patients also completed stretches for the pectoralis minor muscle and the cross-body adduction stretch for the posterior shoulder muscles and capsular structures in addition to the eccentric strengthening activities. Both the stretching exercises were performed with one set of 10 repetitions (hold the stretch for 15 seconds) twice a day, daily.

Outcome Measures

Pain in the shoulder was assessed using a visual analog scale (VAS). Two anchors are used to measure VAS along a straight 10 cm line. The right anchor.[10] denotes "the most severe agony," whereas the left (0) denotes "no pain". The VAS is a valid tool for determining how much pain a patient perceives.[13] Functional outcome was assessed using the Constant-Murley score (CMS) and disabilities of

Figs 2A and B: (A) Empty can abduction exercise with pulley (right shoulder) starting position; (B) Empty can abduction exercise with pulley (right shoulder) ending position



Figs 1A and B: (A) Supine lying EE for external rotators with elastic band-starting position; (B) Supine lying EE for External rotators with elastic band–ending position

Table 1: Eccentric exercise (EE) program

S. no.	*Exercises*	*Frequency*	*Repetition*sets*	*Rest interval between sets*	*Progression*
1	Supine lying EE for external rotators with elastic band	Twice a day, daily	Eight repetitions (6–8 seconds per repetition) three sets	1 minute	Resistance increased as tolerated
2	Empty can abduction exercise with pulley	Twice a day, daily	Eight repetitions (6–8 seconds per repetition) three sets	1 minute	Resistance increased as tolerated
3	The cross-body adduction stretches	Twice a day, daily	10 repetitions (hold the stretch for 15 seconds) one set	1 minute	
4	Stretching exercises for the pectoralis minor muscle	Twice a day, daily	10 repetitions (hold the stretch for 15 seconds) one set	5–10 seconds rest in between each stretch	

the arm, shoulder and hand (DASH) score. Pain, activities of daily life, range of movement, and strength are the four subscales of the CMS having 15, 20, 40, and 25 points, respectively, while 100 points reflected maximum and magnificent joint functions.[14] The DASH score consists mainly of a 30-item disability/symptom scale, scored 0 (no disability) to 100 (maximum).[15] Shoulder range of motion (ROM) and isometric abduction strength at 45° in the scapular plane served as secondary outcome measures (forward elevation, abduction, and external rotation). Using a handheld dynamometer (HHD), the shoulder abductors' isometric strength was determined. The participants were instructed to abduct their shoulder to 45° in the scapular plane while the HHD was positioned distally on the humerus. It was necessary to do a 5-second maximum voluntary contraction three times in a row, with a 30-second rest period in between each repeat. Each trial's peak force was recorded, and the average of three trials was utilized to analyze the results. Participants were instructed to move their arms to their fullest range while sitting in an active upright position without back support, with their feet on the ground, and a goniometer was used to quantify ROM. At the baseline, 12, and 24-weeks points, all measures were obtained.

Statistical Analysis

Data were collected on Microsoft spreadsheets and biostatic evaluation was performed with the Statistical Package for the Social Sciences 20 version software. Student *t*-tests and Chi-square tests were applied for evaluation and a *p*-value of <0.05 was accepted remarkable.

Results

A total of 40 subjects (33 males and seven females) with a mean age of 26.4 years having shoulder cuff tendinopathy were included in the study. There were 12 athletes while wrestlers, kabaddi players, boxers, basketball players, and cricketers were 8, 6, 6, 4, and 4 in number, respectively. The right side was more commonly involved (60%) as compared to the left (40%). The average duration of symptoms was 8 weeks. MRI revealed 14 patients had a partial tear of supraspinatus while patients having supraspinatus tendinitis, supraspinatus tendinitis and Infraspinatus tendinitis, supraspinatus tendinitis and subscapularis tendinitis, supraspinatus tendinitis with a partial tear, partial tear subscapularis, partial tear supraspinatus and infraspinatus tendinitis, and subscapularis tendinosis were found in 11, six, three, and one patients, respectively. Overall mean ROM forward flexion at 0, 6, 12, and 24 weeks was 123.7, 140.8, 152.75, and 153°, respectively. The mean of ROM abduction at 0, 6, 12, and 24 weeks was 110.5, 133, 148.5, and 148.75°, respectively. The mean of ROM external rotation 0, 6, 12, and 24 weeks was 60.25, 71.8, 81, and 81°, respectively. There was a significant improvement in ROM values (forward flexion, abduction, and external rotation) from baseline to 24 weeks.

A significant decrease was seen in VAS scores at the 6th week (*p*-value = 0.0001) as compared to the 0, 12 weeks (*p*-value = 0.0001) as compared to the 6th week but no significant change was seen in VAS at the 24th week as compared to 12th week (*p*-value = 0.317). There was a significant increase in the CMS scores in the 6th week (*p*-value < 0.0001) as compared to 0, the 12th week (*p*-value < 0.0001) as compared to the 6th week but no significant change was seen in CMS in the 24th week as compared to 12th week (*p*-value = 0.545). DASH scores also showed a significant decrease in the values in the 6th week (*p*-value = 0.0001) as compared to 0, 12 weeks (*p*-value = 0.0001) as compared to the 6th week in both the groups but no significant change was seen in DASH at 24th week as compared to 12th week (*p*-value = 0.680). The EE program yielded significant improvement in the VAS, CMS, and DASH scores from baseline to 24 weeks (Table 2).

Discussion

The major outcome of the current study is that isolated EE therapy significantly reduces pain and improves shoulder function in patients with RC tendinopathy (CMS and DASH score). Eccentric

Table 2: Comparison of CMS and DASH scores at different time intervals

	CMS	*DASH*	*VAS*
At 0 week			
Mean ± standard deviation	69.7 ± 14.55	21.12 ± 11.37	6.3 ± 1.45
Median (25–75th percentile)	67.5 (64–83.25)	16.66 (13.122–27.915)	6 (5–7.25)
Range	41–87	8.25–45	4–9
At 6th week			
Mean ± standard deviation	79 ± 13.43	16.78 ± 11.22	3.65 ± 1.69
Median (25–75th percentile)	82 (74.75–89)	12.5 (9.16–22.708)	3 (2–4)
Range	46–93	4.16–43.33	2–7
Intra group *p*-value with respect to 0 week	<0.0001	0.0001	0.0001
At 12th week			
Mean ± standard deviation	85.8 ± 12.04	12.45 ± 11.68	1.35 ± 1.39
Median (25–75th percentile)	89.585–93	9.16 (3.952–16.872)	1 (0–2)
Range	50–96	0.83–41.66	0–5
Intragroup *p*-value with respect to 6 weeks	<0.0001	<0.0001	0.0001
At 24th week			
Mean ± standard deviation	85.65 ± 12.33	12.41 ± 11.77	1.25 ± 1.45
Median (25–75th percentile)	90 (86–93)	9.16 (3.952–17.702)	1 (0–2)
Range	48–96	0.83–41.66	0–5
Intragroup *p*-value with respect to 12 weeks	0.545	0.680	0.317

therapy significantly improves VAS, CMS, and DASH scores (between baseline and 6 weeks, and between 6 and 12 weeks), but there is no change between 12 weeks (the point at which the intervention ends) and 24 weeks of follow-up.

Very few studies have described the approach and results of EE therapy for RC tendinopathy in the literature. Nine patients with chronic, excruciating shoulder impingement syndrome were studied by Jonsson et al.,[16] to determine the effects of eccentric training. An EE program consisting of three sets of 15 repetitions, twice daily for 12 weeks, was targeted at the supraspinatus and deltoid musculotendinous units. The authors found that after 12 weeks, five patients showed a considerably higher improvement in the CMS (pain and function) and a significantly lower VAS score. At the 52-week checkup, five patients had dropped off the waiting list for surgery because they were happy with their care. For 12 weeks, Bernhardsson et al.[17] used RC eccentric strengthening exercises to treat 10 patients with subacromial impingement syndrome. After 12 weeks, the authors found that all 10 participants had improved function and eight of the 10 subjects' pain severity had decreased significantly. Western Ontario RC Index increased in seven participants, while Constant Score increased in nine cases. The authors came to the conclusion that individuals with subacromial impingement syndrome can benefit from a 12-week eccentric strengthening program that targets the RC and incorporates scapular control and the right movement pattern in order to reduce pain and improve function.

For six consecutive weeks, twice in 1 week on alternate days, Camargo et al.[18] treated all the patients with bilateral isokinetic eccentric training at 600/seconds for shoulder abductors. A statistically notable upgrade was seen in the DASH score (p-value <0.05). In a larger sample of patients with impingement (n = 20), the authors demonstrated promising outcomes using an isokinetic eccentric training regimen.

In randomized controlled research, Holmgren et al.[19] assessed the impact of eccentric RC strengthening exercises and concentric or eccentric scapula stabilizer exercises on the necessity of surgery in 102 patients with subacromial impingement syndrome. Both the targeted exercise group and the control exercise group were randomly assigned to each subject. In the particular exercise along with manual mobilization, the group engaged in eccentric strengthening activities for the RC and concentric/EEs for the scapula stabilizers. The exercise program for the control group consisted of general neck and shoulder exercises. In comparison to the control exercise group that did not perform EEs, there was a statistically significant improvement in the CMS (pain and function) and DASH score in the EE group. The authors came to the conclusion that patients with persistent subacromial impingement syndrome respond better to particular exercises aimed at strengthening the RC, including eccentric activities for the RC and concentric/EEs for the scapular stabilizers. Additionally, they discovered that individuals with subacromial impingement syndrome who perform these exercises are less likely to require surgical intervention.

In 61 patients with subacromial pain, Maenhout et al.[20] examined the benefits of combining 12 weeks of heavy load eccentric training with resisted internal and external rotation exercises in comparison to a control group. The authors came to the conclusion that traditional RC training alone was not better than traditional RC training with heavy load eccentric training for reducing pain (VAS) or enhancing function (shoulder pain and disability index). Although strong EE added more isometric strength, it had no greater benefit for reducing discomfort and enhancing shoulder function. In randomized controlled research, Dejaco et al.[21] compared the effectiveness of isolated EE therapy and conventional exercise (CG) therapy in individuals with RC tendinopathy. A total of 36 RC tendinopathy patients were chosen and assigned to either the isolated EE group (n, 20) or the CG group (n, 16). Both groups underwent nine sessions of physiotherapy in addition to 12 weeks of home exercises. The authors found that after 26, 12 weeks EE program was no more successful at treating shoulder discomfort and function in those with RC tendinopathy than a normal exercise program for the RC and scapular muscles. Participants in the current study exhibited a considerable improvement in their ROM values compared to those in the study by Dejaco et al.[21] This difference could be explained by the fact that in our study, pain-free ROM was examined in contrast to that of Dejaco et al.[21] The present study's VAS score reduction and CMS score improvement was marginally better than those of the EE group in Jonsson's, Bernhardsson's, and Dejaco's study. The majority of this study's findings were similar to those in the literature. After 12 weeks, there was no discernible improvement in the VAS, CMS, or DASH scores in the current trial. A 12-week exercise program may be too brief for this patient population, according to Dejaco's study, where the EE group even displayed a minor, nonsignificant decline in CM score, and an increase in VAS score from 12 to 26 weeks. Because longer exercise regimens are more likely to result in tendon adaptation than shorter ones, more research on this topic is needed.

In this study, there is no control group in which all of the participants underwent the same workouts. Due to the lack of a control group, it is still possible that the condition's natural maturation affected the outcomes. Another drawback of this study is that the person in charge of data collection was also responsible for treating study participants, which could have influenced the findings. The study's strength, however, is that the diagnosis was supported by an MRI. Patients with RC tendinopathy confirmed on MRI have not been included in any solitary EE intervention trial published in the literature.

Conclusion

Patients with RC tendinopathy who receive isolated eccentric therapy have considerably improved shoulder function, less discomfort, and greater ROM. As a result, for athletes with RC tendinopathy, a 12-week isolated eccentric training program of the shoulder is a successful workout regimen. However, given that there was no change in outcome ratings from 12 to 24 weeks, the program may be too brief. Further information on the long-term efficacy of the aforementioned therapy in these individuals with shoulder injuries and RC tendinopathy can be obtained from a larger randomized prospective multicenter trial.

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