Research Article

Assessment of rotator cuff muscle strength and shoulder rotation range of motion in subjects with lateral epicondylitis

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ABSTRACT

Background: Lateral epicondylitis (LE) is a common soft tissue condition treated by many physical therapists. It has poor long-term outcomes for the non-surgical management which suggests a less than optimal rehabilitation process, so there is a need to assess proximal kinetic chain. **Objectives:** The objective of the study is to compare shoulder rotator muscle strength and shoulder rotation range of motion (ROM) in patients with LE with age-matched healthy individuals. **Materials and Methods:** An observational study was conducted on 28 subjects with LE (Group A) and 28 age-matched healthy individuals (Group B), selected by convenience sampling. The strength of shoulder rotator muscles was assessed with the use of handheld dynamometer. Shoulder rotation ROM was assessed using standard goniometer. **Results:** Shoulder external rotators were 9% weaker on dominant side ($P = 0.02$) while no differences were seen for shoulder internal rotator (IR) strength ($P = 0.2$). For Group B, shoulder external rotators were 11% stronger on dominant side ($P = 0.04$), while No dominance difference was seen for shoulder IR strength ($P = 0.5$). For both Group A and Group B, shoulder rotation ROM showed no significant difference between dominant and non-dominant sides. For between-group analysis, shoulder rotation ROM and shoulder rotator strength showed no statistically significant difference between the Groups A and B. **Conclusion:** There is muscular imbalance of shoulder rotators in LE.

KEY WORDS: Lateral Epicondylitis, Shoulder Rotator Strength, Shoulder Range of Motion

INTRODUCTION

Tennis elbow, lateral epicondylitis (LE), lateral epicondylosis, and lateral epicondylalgia are all terms that have been used to describe pain in the region of the lateral epicondyle of the humerus. Early investigators believed that the pain experienced at the lateral epicondyle was a result of an acute inflammatory condition at the origin of the common wrist extensors. However, the absence of inflammatory cells during histological examination as well as evidence of wrist extensor tendon degeneration has also lead to the use of the term lateral epicondylosis. In addition to the involvement of the common wrist extensors, the lateral collateral ligament and radial nerve have also been identified as possible sources of lateral epicondylar pain. Since the pathoanatomic origin is largely unknown, it has been recently recommended to use a more general term, lateral epicondylalgia (LE), to describe the pain experienced in the region of the lateral epicondyle.[1]

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LE or tennis elbow is a common soft tissue condition treated by many physical therapists in a variety of clinical settings.[1] LE is a painful condition affecting the tendinous tissue of lateral epicondyle of the humerus, leading to loss of function of the affected limb; therefore, it can have a major impact on patient's social and personal life.[2] LE has high recurrence rate so the role of rehabilitation is important in patient with LE.[1] It is often caused by overuse or repetitive strain caused by repeated extension (bending back) of the wrist against resistance. This may be from activities such as tennis, badminton, or squash but is also common after periods of excessive wrist use in day-to-day life and it may be caused through a poor backhand technique in tennis, a racket grip that is too small, strings that are too tight, playing with wet, heavy balls, and repetitive activities such as using a screwdriver, painting, or typing.[2]

LE can be treated by many options ranging from medical interventions in the form of medications, corticosteroid injections, and surgery to physiotherapy in the form of electrotherapy, exercise, and manual therapy.[3]

Conservative management is the most frequent approach among physicians for the treatment of LE.[4] There is good evidence (grade of B according to the Centre of Evidence-Based Medicine)[5] supporting the short-term efficacy, up to 3 months in pain relief, for physical rehabilitation as a treatment strategy.[6] Modalities such as ultrasound, iontophoresis, and acupuncture have been shown to be effective in the short term (0–3 months) but no difference to placebo in the long term (>6 months).[7]

High recurrence rates and lack of long-term efficacy of conservative treatment approaches have led the authors to investigate the prevalence of regional secondary impairments in patients with LE.

High recurrence rates were observed in LE. Conservative management may or may not lead to a possitive effects on long tern outcomes in patients with LE. This suggests, some component of rehabilitation process is missing. The majority of the reported conservative treatment approaches involve localized treatment in the region of the lateral epicondyle. Interestingly, other investigators have recently begun to explore the occurrence of regional impairments in patients with LE. Despite elbow and shoulder having a close kinetic relation, there are few researches done on investigating shoulder muscles strength in LE patients. The literature suggests that the shoulder rotator muscle strength may be important components in the rehabilitation of this pathology.[8]

As reported poor long-term outcomes for the non-surgical management of individuals with LE suggest a less than optimal rehabilitation process, assessment of shoulder rotator muscles function in a working population of individuals with LE may help to further refine conservative management of this condition. Hence, the objectives of the study were to evaluate and compare shoulder rotator muscles strength in patients with LE on the dominant (affected for LE patients) and non-dominant sides and with age-matched healthy individuals and to evaluate and compare shoulder rotation range of motion (ROM) in patients with LE on the dominant (affected for LE patients) and non-dominant sides and with age-matched healthy individuals.

MATERIALS AND METHODS

Ethics committee approval was taken from the institutional ethics committee. An observational study was conducted on 28 patients with LE (Group A) and 28 age-matched healthy individuals (Group B), selected by convenience sampling at physiotherapy department Guru Govind Singh Hospital, Jamnagar, Gujarat. Patients diagnosed to have LE referred by orthopedic outpatient department to the physiotherapy department were taken for the study. As per the inclusion criteria, subjects were selected for the study, namely, Group A: Patients diagnosed to have unilateral LE by orthopedician of both gender and any age and Group B: Age-matched healthy individuals. Patients having any upper extremity musculoskeletal disorder, neck pain, upper extremity joint deformities, neurological disease, cancer, fracture of the upper extremity, cervical radiculopathy, and pregnancy and subjects who reported that they regularly exercised at high intensity 3 or more times/week for the duration of more than 30 min per session were excluded from the study. The subjects were explained the study. Written informed consent was obtained.

Shoulder rotation ranges were assessed with the use of standard goniometer in subjects of both the groups; three readings for both dominant and non-dominant sides were recorded. Shoulder rotator muscle strength was assessed in patients with LE and age-matched healthy individuals with the use of handheld dynamometer.[9,10] Three maximum voluntary contractions for both dominant and non-dominant side were recorded.

Statistics

Statistical analysis was done using the SPSS V21. To analyze shoulder rotation ROM, data within and between the group paired and unpaired *t*-test were used. Shoulder rotators strength was analyzed using Wilcoxon signed-ranks test (within group) and Mann–Whitney *U*-test (between group). Significance level was set at $P < 0.05$.

RESULTS

A total of 56 individuals were assessed. Table 1 shows demographic details of both the groups. Table 2.1 shows shoulder rotator strength for both dominant and non-dominant sides in Group A (LE), Table 2.2 shows shoulder rotator strength for both dominant and non-dominant sides in Group B (Healthy individuals), and Table 2.3 shows between-group analysis for shoulder rotator strength. For Group A, dominant side was taken to be the affected side. Shoulder external rotators were 9% weaker on dominant side. No difference was seen for shoulder internal rotator (IR) strength. For Group B, shoulder external rotators were 11% stronger on dominant side, while No dominance difference was seen for

Table 1: Demographic data and physical characteristics of all subjects

Variable	Group A	Group B
Number (Male: female)	28 (14:14)	28 (6:22)
Age (years) (Mean±SD)	45.8±7.7	47.3±10.7
Weight (kg) (Mean±SD)	67.0±14.2	66.5±12.4
Height (cm) (Mean±SD)	162.3±8.6	155.0±7.6

Table 2.1: Shoulder rotator strength – Group A

Group A					
Strength measurements	**Side**	**Strength (kg) Mean±SD**	**W**	***P***	**D/ND ratio**
Shoulder external rotators	D	7.6±5.15.1	2.24	0.02	0.96
	ND	10.3±15.7			
Shoulder internal rotators	D	6.9±4.4	1.13	0.25	0.94
	ND	7.6±4.2			

D: Dominant, ND: Non-dominant

Table 2.2: Shoulder rotator strength – Group B

Group B					
Strength measurements	**Side**	**Strength (kg) Mean±SD**	**W**	***P***	**D/ND ratio**
Shoulder external rotators	D	10.3±9.1±9.1	2.01	0.04	1.16
	ND	8.5±4.9			
Shoulder internal rotators	D	8.5±5.3	0.58	0.5	1.05
	ND	8.4±5.4			

D: Dominant, ND: Non-dominant

Table 2.3: Between-group analysis for shoulder rotator strength

Group A versus Group B					
Strength measurements	**Side**	**Mean±SD**		**U**	***P***
		Group A	**Group B**		
Shoulder external rotators	D	7.6±5.15.1	10.3±9.1±9.1	1.3	0.1
	ND	10.3±15.7	8.5±4.9	0.3	0.7
Shoulder internal rotators	D	6.9±4.4	8.5±5.3	1.1	0.2
	ND	7.6±4.2	8.4±5.4	0.1	0.8

D: Dominant, ND: Non-dominant

shoulder IR strength. Shoulder rotators showed no significant differences in strength between Groups A and B. Table 3.1 shows shoulder rotation ROM for both dominant and non-dominant sides in Group A, Table 3.2 shows shoulder rotation ROM for both dominant and non-dominant sides in Group B, and Table 3.3 shows between-group analysis for shoulder rotation ROM. For both Groups A and B, shoulder rotation ROM showed no significant difference between dominant and non-dominant sides. For between-group analysis, shoulder rotation ROM showed no statistically significant difference between the Groups A and B.

Table 3.1: Shoulder rotation ROM – Group A

Group A				
ROM measurements	**Side**	**ROM (degree) Mean±SD**	***t***	***P***
Shoulder external rotation	D	89.73±7.62	0.90	0.37
	ND	88.22±8.66		
Shoulder internal rotation	D	70.63±8.10	0.48	0.63
	ND	69.95±5.00		

ROM: Range of motion, D: Dominant, ND: Non-dominant

Table 3.2: Shoulder rotation ROM – Group B

Group B				
ROM measurements	**Side**	**ROM (degree) Mean±SD**	***t***	***P***
Shoulder external rotation	D	88.57±7.55	1.0	0.26
	ND	90±00		
Shoulder internal rotation	D	69.10±4.72	1.0	0.13
	ND	69.46±2.83		

ROM: Range of motion, D: Dominant, ND: Non-dominant

Table 3.3: Between-group analysis – shoulder rotation ROM

Group A versus Group B					
ROM measurements	**Side**	**Mean±SD**		***t***	***P***
		Group A	**Group B**		
Shoulder external rotation	D	89.73±7.62	88.57±7.55	0.57	0.5
	ND	88.22±8.66	90±00	1.0	0.2
Shoulder internal rotation	D	70.63±8.10	69.10±4.72	0.8	0.3
	ND	69.95±5.00	69.46±2.83	0.4	0.6

ROM: Range of motion, D: Dominant, ND: Non-dominant

DISCUSSION

The present study was conducted to assess the strength of rotator cuff muscles and shoulder rotation ROM in subjects with LE and age-matched controls.

The results of strength assessment for within-group analysis showed significantly weak ER (external rotators) on dominant side as compared to non-dominant side in Group A (LE), whereas no significant difference was found in strength between dominant and non-dominant side for IR. There was no significant difference found in shoulder rotation ROM for within- and between-group analyses.

A study done by Alizadehkhaiyat *et al*. found stronger internal and external rotators on dominant side as compared to non-dominant side in control group, whereas no dominance difference in tennis elbow group.[11] In the present study, Group B (healthy subjects) showed significantly stronger external rotators in dominant side as compared to non-dominant side and no significant difference was found in strength between dominant and non-dominant side for IR. In the present study, between-group analysis showed no significant difference for internal and external rotators strength on both dominant and non-dominant sides which is in contrast to the study done by Alizadehkhaiyat *et al*. who found weaker shoulder movements in LE than in control.[11] Similar to the present study, another study done by Lucado *et al*. on female recreational tennis players with and without LE showed no significant difference in strength of shoulder internal and external rotators between the groups.[12] A study done on rotator cuff strengthening in patients with LE found improvement on pain-free grip strength in experimental group who have been given additional rotator cuff strengthening. Hence, this finding explains that improvement in the imbalance of shoulder kinematics reduces the over the use of elbow.[13] In the present study, there was no significant difference found in shoulder rotation ROM for within- and between-group analyses which is in contrast to a study done by LaBan *et al*. who found that the patients presented with LE subsequently identified as having a heretofore unrecognized loss of ipsilateral shoulder internal rotation, which suggest that in this scenario, the occult shoulder periarthrosis is interlinked in a pathokinetic chain potentially predisposing to the presenting symptoms of tennis elbow.[14] However, in the present study, subjects with varying duration of LE were included and so possibly a restriction was not seen. In the previous studies, in tennis players, glenohumeral internal rotation deficit is common, where >18° loss of internal rotation in the athlete's dominant shoulder compared with the non-dominant shoulder, which changes the glenohumeral kinematics have been found.[15,16]

There are very few data on shoulder strength evaluation in LE patients. It has been noted that distal upper limb injury may be accompanied by shoulder involvement.[11] Our observation of significant external rotator weakness on dominant side (affected side) as compared to non-dominant side may be explained by considering the kinetic chain concept for LE subjects. During functional arm motions, kinetic energy is transferred from proximal to more distal segments of the arm. With an impaired ability to stabilize the scapula, increased energy demands are theoretically required of tissues in the distal upper extremity when performing a functional activity.[1] Muscular imbalance at shoulder can impair the stabilization function of shoulder resulting in overcompensation of extensors of wrist. This may lead to microtrauma of soft tissue structure present at lateral epicondyle, thus causing symptoms of LE.[13]

Duration of tennis elbow symptoms and severity of the symptoms were not considered and uneven gender distribution in control group was the limitations of the present study.

Clinical Implications

The identified muscle strength imbalance of shoulder rotators may result in disruption in normal movement patterns making the wrist extensors vulnerable to injury. Hence, the assessment of shoulder rotator muscle strength needs to be addressed in the patients with LE and its deficit should be considered in the management of LE.

Future Studies

Future studies can be done with consideration of chronicity of LE and evaluating more proximal kinetic chain.

CONCLUSION

The result of the present study demonstrated no significant difference in rotator cuff muscles strength between LE and healthy subjects, but external rotators were weaker on dominant side (affected side) as compared to non-dominant side in LE group.

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