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Comparison of Scapular Muscle Strength and Endurance in Subjects with Lateral Epicondylitis in Healthy Individuals

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ABSTRACT

Introduction: Lateral epicondylitis (LE) is characterized by pain in the region of the lateral epicondyle of the humerus. The effectiveness of conservative treatment approaches remains less than optimal, secondary to high recurrence, so there is a need to assess proximal kinetic chain. Objective of the study was to assess scapular muscles strength and endurance in subjects with unilateral lateral epicondylitis and compare it with the uninvolved limb and the corresponding limb of matched healthy individuals.
Methodology: An observational study was conducted on 66 subjects with unilateral LE (group A) and 66 matched healthy individuals (group B), selected by convenience sampling. The strength of scapular muscles - Upper trapezius (UT), Middle trapezius (MT), Lower trapezius (LT) and Serratus anterior(SA) was assessed with the use of hand held dynamometer. Scapular Muscle endurance was assessed in both groups with isometric hold test. Statistical analysis was done using SPSS 21. Significance level was kept at $p \leq 0.05$.
Results: Mean difference between strength (kg) of affected and non-affected sides in group A was analysed using Wilcoxon test, showed UT(0.5±0.3,W=1.9,p=0.05), MT(0.4±0.3,W=2,p=0.04), LT(0.8±01.2,W=1.8,p=0.06) and SA(0.2±0.1,W=2.1,p=0.02). Analysis of difference in means between the groups for affected side with corresponding limb of matched healthy individuals done using Mann Whitney test, showed UT(2.9±1.9,U=3.6,p=0.0001), MT(3.4±2.4,U=4.2,p=0.0001), LT(1.7±1.6,U=2.9,p=0.003) and SA(2.8±1.8,U=4.5,p=0.0001).
Conclusion: Subjects with LE demonstrated significant weakness of the MT, LT and SA and reduced endurance of scapular muscles when compared to a matched healthy control group. Assessment of scapular muscle strength and endurance is recommended in subjects with LE.

Key words: Lateral epicondylitis, Scapular muscles Strength, scapular muscles endurance

INTRODUCTION

Lateral epicondylitis (LE) is one of the most common lesions of the arm work-related or sport-related pain disorder. [1] The condition is usually defined as a syndrome of pain in the area of the lateral epicondyle [1] that may be degenerative or failed healing tendon response. [2] The dominant arm is commonly affected. [1,3] The peak prevalence of LE is between 30 and 60 years of age. [1,3] The disorder appears to be of longer duration and severity in women. [2,4] The main complaints of patients with LE are pain and decreased function. [1,2] Conservative management is the most frequent approach. [5] A wide array of physiotherapy treatments have been recommended for the management of LE. [6-10] Exercise programme is combined with other physiotherapy modalities such as soft tissue techniques, external support, acupuncture, manual therapy and

electrotherapy (low level laser, transcutaneous electrical nerve stimulation, extracorporeal shockwave therapy, pulsed electromagnetic field therapy therapeutic, ultrasound and iontophoresis), in the treatment of LE. [1,2,11-16] These treatments have different theoretical mechanisms of action, but all have the same aim, to reduce pain and improve function. This variety of treatment techniques suggests that the most proper treatment technique is not known. [1,2] There is high recurrence [17] rates and lack of long term efficacy of conservative treatment approaches which suggest less than optimal rehabilitation. So there is a need to investigate proximal kinetic chain. Overuse injuries in the elbow often occur with shoulder or scapular dysfunction. There are few researches done on investigating scapular muscles strength and endurance in LE patients. So the objectives of the study were to determine scapular muscles strength and scapular muscle endurance in subjects with unilateral LE compared to the uninvolved limb and to determine scapular muscle strength and scapular muscle endurance in subjects with unilateral LE compared to the corresponding limb of a matched healthy individual group.

MATERIALS AND METHODS

An analytical observational study was conducted on 132 subjects (66 in each group) selected by convenient sampling at physiotherapy department Guru Govind Sing hospital, Jamnagar. Ethics committee approval has been taken from institutional ethics committee. Inclusion criteria were: Patients of Unilateral lateral epicondylitis diagnosed as lateral epicondylitis from orthopaedic OPD and Presented with and at least one of the following positive clinical tests: Passive stretching of extensors (Mill's sign), Pain at the lateral epicondyle during maximal volitional contraction (MVC) of the wrist extensors (Cozen's sign),Pain at the lateral epicondyle while resisting the extension of the middle digit (Maudsley's test), age between 18 to 70, both males and females and age Matched healthy individual. As per the inclusion criteria, total 132 subjects were selected for the study with convenient sampling viz Group A: subjects with Unilateral LE (66 subjects) and Group B: Age matched healthy controls(66 subjects). Patients having any upper extremity musculo-skeletal disorder, neck pain, upper extremity joint deformities, neurological disease, cancer, fracture of the upper extremity, cervical radiculopathy, pregnancy and subjects who reported that they regularly exercised at high intensity three or more times per week for duration of more than 30 minutes per session were excluded from the study. Subjects were explained the study. Written informed consent was taken. Scapular muscle strength for UT, MT, LT and SA was assessed in subjects with LE and matched healthy individuals with the use of Hand held dynamometer {good between-day intrarater reliability (intraclass correlation coefficient = 0.75- 0.97)}. [18,19]

Each patient performed a practice trial for each test before data were recorded. The instruction was given to the participant to slowly push into the dynamometer and increase force production to the maximum force by the end of the 5 seconds used for testing. The maximal volitional contraction (MVCs) was recorded by the assessor. Three maximum voluntary contractions (MVCs) for both dominant(D) and non-dominant(ND) side were recorded in both the groups and average was used for data analysis

Scapular Muscle endurance was assessed in both groups with isometric hold test. [20] Subject was positioned in prone lying and shoulder was placed passively in 135 degrees of abduction, weight cuff (rounded to 0.5 kgs of 1% of subjects' body weight) was tied just superior to elbow. Subjects were asked to raise the arm upwards to established level and hold there for as long as possible till they can no longer sustain the pre-set level of arm raising. This time duration in seconds were recorded with use of stop watch.

Statistical Analysis:

Statistical analysis was done by SPSS 21. Tests used for Within Group analysis were Wilcoxon signed ranks test and Between Group was Mann Whitney test. Significance level was set at $p<0.05$.

RESULTS

Total 132 subjects were assessed. Demographic data and Physical characteristics of these subjects were showed in Table 1.

Table 1: Demographic data and physical characteristics of all subjects

Variable	Group A	Group B	P value
Number (Male: Female)	66(26:40)	66(25:41)	
Age (years) (Mean ± SD)	42.4±8.3	45.0±10.8	0.12
Weight (kg) (Mean ± SD)	66±14.5	67±12.3	0.20
Height (cm) (Mean ± SD)	160.5±7.9	158.6±8.6	0.65

Table 2.1 shows scapular muscle strength for dominance difference in group B (Healthy individuals), Table 2.2 shows scapular muscles strength for affected and non affected sides in group A (LE), Table 2.3 shows dominance difference for scapular muscle endurance in group B (healthy individuals), and Table 2.4 shows scapular muscle endurance for affected and non affected sides in group A (LE)

Table 2.1: Dominance difference in scapular muscle strength in healthy individuals

Group B				
Variable	Dominancy	Strength (kgs) Mean ± SD	W	p
UT	D	9.8±6.8	3.3	0.001
	ND	9.0±7.1		
MT	D	8.0±5,9	1.4	0.13
	ND	7.9±5.8		
LT	D	5.8±3.8	2.1	0.03
	ND	5.3±3.0		
SA	D	7.5±5.3	1.2	0.22
	ND	6.9±4.6		

Table 2.2: Affected vs non-affected sides difference in scapular muscle strength in subjects with lateral epicondylitis

Group A				
Variable	Dominancy	Strength (kgs) Mean ± SD	W	p
UT	A	6.3±4.5	1.9	0.05
	NA	6.8±4.8		
MT	A	5.0±3.8	2.0	0.04
	NA	5.4±4.1		
LT	A	4.1±2.1	1.8	0.06
	NA	4.9±3.3		
SA	A	4.7±3.4	2.1	0.02
	NA	4.9±3.3		

Table 2.3: Dominance difference for scapular muscle endurance in healthy individuals

Group B				
variable	Side	Endurance (seconds) Mean ± SD	W	p
Scapular muscles endurance	D	49.6±30.9	0.91	0.3
	ND	52.7±37.4		

Table 2.4: Affected vs nonaffected sides difference in scapular muscle endurance in subjects with lateral epicondylitis

Group A				
Variable	Side	Endurance (seconds) Mean ± SD	W	p
Scapular muscles endurance	A	28.1±14.4	2.32	0.02
	NA	32.2±19.9		

Table 3.1 shows between group analysis for scapular muscle strength, Table 3.2 shows between group analysis for scapular muscles endurance

Table 3.1: Between group analysis for scapular muscle strength

Variable	Mean ± SD		U	P
	Group A	Group B		
UT	6.3±4.5	9.2±6.4	3.6	0.0001
MT	5.0±3.8	8.4±6.2	4.2	0.0001
LT	4.1±2.1	5.8±3.7	2.9	0.003
SA	4.7±3.4	7.5±5.2	4.5	0.0001

Table 3.2: Between group analysis for scapular muscle endurance

Variable	Mean ± SD		U	P
	Group A	Group B		
Scapular muscles endurance	28.1±14.2	49.6±30.9	4.7	0.000

DISCUSSION

Present study was conducted to compare scapular muscle strength and endurance in subjects with lateral epicondylitis and age matched controls. The results for within group analysis for dominance difference in healthy controls i.e. group B showed statistically significant strong UT and LT on dominant side as compared to non-dominant side, whereas no significant difference was found between dominant and non dominant side for strength of MT and SA muscles and for scapular muscles endurance.

The results for within group analysis in LE i.e. group A showed statistically significant weak MT and SA and reduced endurance on affected side as compared to non affected side, whereas no significant difference was found in strength between affected and non affected sides for UT and LT muscles. The results for between group

analysis showed significantly weak UT, MT, LT and SA and reduced endurance of scapular muscles in affected limb of LE group as compared to corresponding limb of age matched healthy controls. Our results indicated that scapular muscle strength and endurance were impaired in subjects with LE compared to age matched healthy controls.

These findings are consistent with previous studies. [20,21] Joseph day et al found out significantly weak LT and SA and reduced endurance in patients with LE as compared to controls. [20] Lucado et al found significantly lower LT strength in female tennis players with LE compared to healthy female tennis players. [21] In our study there were no measurable differences between patients' affected and unaffected limbs, reason for this findings can be explained by a meta-analysis which conclude that sensory and motor system deficits are common in the non-injured limb of patients with unilateral tendinopathy, particularly in LE suggesting involvement of the central nervous system, which clearly demonstrate that the contralateral side of the body cannot be used as a reference standard for assessment, either in clinical practice or research. [22] Because a limb-to-limb comparison in the clinical setting is often the most convenient approach to assess patients, scapular muscle impairments may be missed. Therefore, to determine the presence of deficits, therapist should compare strength in subjects with LE to normative data, to our knowledge which have yet to be established.

Muscular imbalance at shoulder girdle region can impair the stabilization function resulting in over compensation of extensors of wrist. This may lead to micro trauma of soft tissue structure present at lateral epicondyle thus causing symptoms of lateral epicondylitis [25] Theoretically, the scapulothoracic muscle impairments could be a causative factor for LE or predispose patients to reinjury if left unaddressed. But the design of this study was not allowing for definitive conclusions that scapular muscle weakness is a causative factor for the development of LE. As one of the reason can be that pain of the common wrist extensors may cause the patient to use the upper extremity less and in a more guarded range of motion. Over time, disuse would result in a decrease in shoulder active range of motion and weakness of the shoulder musculature.

In a study done by Alizadehkhaiyat O et al has demonstrated that after successful remission of pain symptoms, former LE patients continue to present with shoulder weakness. [26] During functional arm motions, kinetic energy is transferred from proximal to more distal segments of the arm. The muscles within the mid back and surrounding scapular region control stability for the entire upper kinetic chain (ie. neck, shoulder and elbow). These muscles provide a strong base of support for all movements of the shoulder and 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. [23,24] so one of the possibility that this scapular muscle imbalance found in present study was not treated and could be a cause for high recurrence in LE.

There are few studies done on treating scapular muscles in patients with LE. Bhatt et al reported successful treatment of a 54-year-old woman with only strengthening exercises targeting the MT and LT muscles. [27] In another case report done by Stasinopoulos D. reported that addition of rotator cuff and scapular muscles strengthening to stretching and strengthening exercises of wrist extensors has reduced the pain and improved the function in a 47 years old male patient with LE. [28] A case series done by Randal Glaser et al on 8 patients of LE reported successful treatment of LE in terms of return to full activity with only strengthening of scapular muscles in Patients with LE which suggested that addressing scapular power

deficits may resolve signs and symptoms associated with LE. [29]

CONCLUSION

Subjects with LE demonstrated significant weakness of the MT, LT and SA and reduced endurance of scapular muscles when compared to a matched healthy control group. Assessment of scapular muscle strength and endurance is recommended in subjects with LE.

Limitation:

Blinding was not done. Because the patients had pain and no systematic differences were detected between limbs, it is possible that pain is a central driving factor for maximal volitional contraction

Future studies:

Future studies are needed to determine if treating scapular muscle deficits will improve both short- and long-term outcomes in patients with LE. Prospective studies can be done to determine if scapular muscle weakness is present prior to the development of LE and if scapular muscle weakness is a potential risk factor for LE.

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