

## A comparative study on scapular static position between females with and without generalized joint hyper mobility

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### Abstract

**Background:** Generalized joint hyper mobility predisposes some individuals to a wide variety of musculoskeletal complaints. Given the critical role of scapular position in function of shoulder, the aim of this study was to compare scapular position between persons with and without general joint hyper mobility.

**Methods:** By nonprobability sampling 30 hyper mobile persons at average of  $22.86 \pm 2.77$  years of age and 30 non hyper mobile persons (age  $23.6 \pm 2.73$  years) through a case-control design participated in the study. Scapular position was assessed according to the lateral scapular slide test. Independent t test and repeated measures ANOVA were used to statistically analyze scapular position differences between groups.

**Results:** Compared to non hyper mobile persons, those with General joint hyper mobility demonstrated a significantly higher superior scapula slide in dependent arm position ( $p=0.03$ ). However, no significant difference was found between another scores between two groups ( $p>0.05$ ).

**Conclusion:** The results suggest that altered scapular position may be an important aspect of General joint hyper mobility

**Keywords:** General joint hyper mobility, Static scapular position, Scapular kinematic.

### Introduction

The subject was regarded as having generalized joint hyper mobility (GJH), where the range of motion is in excess of the accepted normal in most of the joints examined (1,2). The name of hyper mobility syndrome is used for the situation in which this joint laxity is associated with musculoskeletal complaints (2). Epidemiologic studies have shown that the incidence of joint hyper mobility is higher in woman (5-57%) than in men (2-35%) and its presence is influenced by age, gender and ethnicity (3-6).

People with GJH may have an increased

incidence of nerve compression disorders, osteoarthritis, sprains, subluxations and dislocations (7-9).

Optimal scapular position at rest and during arm movements is essential for optimal upper limb function. The muscular system is the major contributor to scapular position. In the case of altered activity of scapular muscles, the scapular position is likely to become abnormal that it has frequently been linked to shoulder and neck disorders (10). Joint instability and hyper mobility syndrome have also been associated with deficits in proprioception (11) and changes in the pattern of electromyographic activity of

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the shoulder muscles (12,13). Several investigators have found differences in scapular kinematics in people with instability, rotator cuff tears and impingement syndrome (14-18).

To develop definitive conclusion about the role of scapular kinematics in those with GJH, assessing the scapular position is considered as an essential component of their shoulder evaluation.

A wide variety of methods have been used to assess scapular position. The laboratory tests, due to the use of sophisticated and expensive equipment, have the advantage of precision but are not practical for everyday clinical use. Clinicians appear to favor methods that are quick, inexpensive and accessible such as Di Veta, (19) and Kibler (20) methods.

So far, there is still no consensus on scapular position in persons with GJH. It remains essential to characterize scapular position in hyper mobile persons because it would allow us to screen those who may be at risk for developing shoulder injuries because of abnormal scapular position. The aim of this study was to compare static scapular position between persons with and without general joint hyper mobility

## Methods

Sixty volunteers encompassing 2 groups participated in the current study. A total of 30 females diagnosed as having GJH by the Beighton method. According to Beighton method participants were given numerical scores of 0 to 9, one point being allocated for the ability to perform each of the following tests. (1) Passive extension of the little fingers beyond 90°. (2) Passive opposition of the thumbs to the flexor aspects of the forearms. (3) Hyperextension of elbows beyond 10°. (4) Hyperextension of knees beyond 10° (these four maneuvers are done on the right and left sides). (5) Forward flexion of the trunk so that the palms easily touch the floor. A score of 4 or higher meets the Beighton score for hypermobility (3). The Subjects with the Beighton score 5 or higher were included in this study. Subjects were exclud-

ed if they had a history of trauma, musculoskeletal disorders, previous shoulder surgery and any upper extremity or spine abnormality (4). The control group was age and sex matched, with same inclusion and exclusion criteria but no GJH. Before participating in the study, all subjects signed an informed consent form approved by the human subjects committee of University of Social Welfare & Rehabilitation Sciences. Physical characteristics of the subjects in each group are shown in Table 3.

*Test procedures:* Subjects were required to have their vertebrae and scapula exposed for visualization and palpation. The tester palpated the cervical spinous processes to locate C7. This landmark was determined to be the first prominent spinous process. Next the tester sequentially palpated the thoracic spinous processes to locate T3, T4, T7 and T8 and these landmarks were marked with a 1/4 -inch adhesive square. The tester then used an unmarked section of string to measure the distances from the medial root of the scapulae to corresponding thoracic vertebrae(T3or T4)(superior kibler) and from the inferior angle scapulae to corresponding spinal vertebrae(T7 or T8) (inferior kibler) (10). The tester transferred the string to a metric rule and recorded the measurement in centimeter so that the tester was blinded to the results. These measurement processes were down in 3 test positions of neutral (arms at the sides), hands on hips, and 90° of glenohumeral abduction in maximal internal rotation.

Order of test positions was randomized to minimize the effects of fatigue.

Test- retest reliability of the measurements was determined in a pilot study prior to data collection by measuring scapular position twice, conducted on one day, according to the methodology described above. Ten healthy subjects that were not included in the main study tested for reliability testing.

*Data analysis:* The data was analyzed using the SPSS statistical software version 17. The superior and inferior kibler values during three test positions were collected in cen-

Table1. Intraclass correlation coefficient (ICC) and standard error of measurement (SEM) values for intratester reliability. (n=10 subjects)

Variable		Test positions		
		Neutral	Hands on hips	90° of glenohumeral abduction
Superior kibler (right)	ICC	0.94	0.92	0.65
	SEM	0.22	0.42	0.60
Superior kibler ( left)	ICC	0.94	0.98	0.75
	SEM	0.20	0.17	0.83
Inferior kibler (right)	ICC	0.83	0.76	0.87
	SEM	0.31	0.64	0.42
Inferior kibler (left)	ICC	0.76	0.80	0.82
	SEM	0.40	0.57	0.38

timeters. Means and standard deviation were calculated. The intra-class correlation coefficient (ICC), two way mixed effect model, and standard error of measurement (SEM values) were used to assess intra-tester reliability of the measurement. We calculated the ICC (3, 1) as described by Shrout and Fleiss (21), since only one judge evaluated the same population of subjects.

Repeated measures of ANOVA accounting for scapular position (3 test positions), group (persons with and without general joint hyper mobility) and interaction of positions and group were used to assess the differences between the 3 test positions for each group and compare the differences between the two groups.

Independent t tests were performed to compare differences between scapular position (dominant and non dominant sides) in hyper mobile and non- hyper mobile persons. The significance level of 0.05 was selected.

## Results

There was no statistically significant difference in subject's age ( $p=0.39$ ), weight and height ( $p=0.79$ ) between the two groups.

Table 1 presents the ICC and SEM values for test- retest reliability of the each measurement taken in the pilot study. The ICC values for the all measurements were greater than 0.64.

The result for repeated measures of ANOVA revealed that the main effect of group, as an independent variable, was not significant ( $p>0.05$ ). The interaction of group by scapular position was not also significant for all tested variables ( $p>0.05$ ) but, the main effect of scapular position was significant ( $p=0.00$ ) (Table 2, Figs.1, 2).

Descriptive statistics for the measurement scores in two groups presented in Table 3.

The result of independent t test showed the mean for right superior kibler score in dependent arm position (neutral position) statistically was higher in hyper mobile persons than non-hyper mobile people ( $p=0.03$ ).

Table 2. Repeated measures of ANOVA comparing the scapular position within and between groups.

Variable	Source	Type III sum of squares	df	Mean square	F	Sig.
Right Superior kibler position	position	130.32	2	65.16	99.84	0.00
	Position*group	1.43	2	0.71	1.09	0.33
	group	9.34	1	9.34	3.04	0.08
Left Superior kibler position	position	135.23	2	67.61	121.16	0.00
	Position*group	1.20	2	0.60	1.08	0.34
	group	5.77	1	5.77	1.80	0.18
Right inferior kibler	position	19.05	2	9.52	9.81	0.00
	Position*group	0.09	2	0.04	0.05	0.95
	group	3.43	1	3.43	1.30	0.25
Left inferior kibler	position	22.92	2	20.46	25.46	0.00
	Position*group	0.84	2	0.42	0.52	0.59
	group	3.23	1	3.23	1.27	0.99

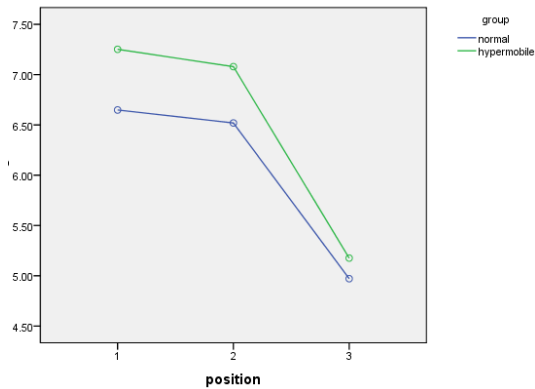


Fig. 1. Right scapular position (superior kibble test) in hyper mobile and non hyper mobile groups.

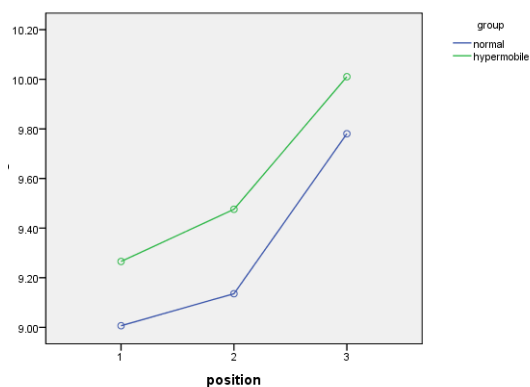


Fig. 2. Right scapular position (inferior kibble test) in hyper mobile and non hyper mobile groups.

However, no significant difference was found between other recorded scores among two groups ( $p > 0.05$ ) (Table 3).

## Discussion

The result of this study showed that the distance between the thoracic spine and the medial root of the right scapula with arms at the sides in hyper mobile persons (7.25 CM) was significantly higher than non hyper mobile people (6.64). Therefore it could infer that dominant side scapula of the hyper mobile persons was more protracted and downward rotated than non-hyper mobile people.

The differences in scapular posture in hyper mobile persons can be attributed to loss of soft-tissue strength, proprioception deficit and unstable joints.

Normally, the scapula rests at a position on thorax approximately 2 inches from the midline, between 2<sup>th</sup> through 7<sup>th</sup> ribs. The scapula also is internally rotated 30° to 45° from the coronal plane, tipped anteriorly approximately 10° to 20° from vertical and upwardly rotated 10° to 20° from vertical (10,22). The mechanism of scapular stabilization with arms at the sides appears to be passive. Therefore, the downward pull of gravity on the arm is opposed by the passive tension in the rotator interval capsule (superior capsule, superior glenohumeral ligament, and coracohumeral ligament) that are taut when the arm is at the side (23).

The GJH is a connective tissue disorder with the abnormality of type I collagen that

Table 3. Independent t test comparing the scapular position between persons with and without hyper mobility.

Variable		Group				p
		Hyper mobile		Nonhyper mobile		
	Side	Mean	S. D	Mean	S. D	
Age		22.86	2.77	23.67	2.73	0.25
Weight		55.18	6.41	56.22	6.12	0.52
Height		161.96	5.97	161.29	5.64	0.65
Superior kibler(neutral position)	right	7.25	1.03	6.64	1.08	0.03
	left	6.87	1.03	6.38	1.10	0.08
Superior kibler(hands on hip)	right	7.07	1.17	6.51	1.56	0.12
	left	6.91	1.01	6.45	1.60	0.19
Superior kibler(90°humeral abduction)	right	5.17	1.23	4.97	1.07	0.49
	Left	4.88	1.15	4.75	1.15	0.67
Inferior kibler (neutral position)	right	9.26	1.13	9	1.18	0.39
	left	8.81	1.15	8.75	1.87	0.81
Inferior kibler(hands on hip)	right	9.47	1.30	9.13	1.23	0.30
	left	9.09	1.16	8.96	1	0.64
Inferior kibler(90°humeral abduction)	right	10.1	1.35	9.78	1.19	0.48
	left	9.80	1.20	9.99	1.20	0.55

is normally abundant in tissues such as tendon, ligament, and joint capsule. This is thought to cause the decreased tissue stiffness and hyper mobility seen in persons with GJH (1-3). Connective tissue abnormality in hyper mobile persons may be a causative factor for scapular downward rotation, because passive stabilization factors cannot support the shoulder girdle against the gravity force.

Proprioception deficit may be another factor that can justify the different scapular posture in hyper mobile persons.

Several studies have demonstrated hyper mobile individuals in addition to possess hyper mobile joints, proprioceptive dysfunction and muscle weakness (11,24,25). Muscle and joint receptors are main sources for proprioception, whereas the capsule-ligamentous mechanoreceptors contribute to shoulder stability mostly at the extreme positions of movements. If the joint capsule in hyper mobile individuals is not mechanically deformed in a given position, the joint receptors will not be stimulated (11).

Hyper mobile persons are frequently observed to adapt end of range postures (1, 26). It has shown the position sense acuity near the end ranges of movements and positions is greater than the middle range as a result of greater tissue tension at the end range (11). Therefore, in GJH the intrinsic factors of the musculoskeletal system may lead to more postural deviations that making them more vulnerable to minor damage during daily activities (26).

The improper scapular position may lead to increasing the risk of shoulder instability. The hyper mobile people frequently experiences musculoskeletal pain because of increased capsular and ligaments laxity and increased demands placed on the dynamic stabilizers. This may be the result of repetitive stresses and sustained postures and may lead to the development of injuries (13, 15).

We did not find any significant difference in scapular posture in test positions 2 and 3 that place the upper extremity in 40 degrees and 90 degrees of abduction in the coronal plane.

During arm elevation stability is provided by the interaction of the static and dynamic factors, so shoulder muscles activation as dynamic stabilizers may lead to more optimal scapular position and movement (18, 23). That may be the reason it has not find any difference in scapular position in 45° and 90° of arm elevation between two groups.

Clinicians evaluating hyper mobile persons need to keep in mind that some degrees of asymmetric finding in shoulder posture are quite common, regardless of the presence of abnormalities. The differences we found between the hyper mobile and non hyper mobile persons were small. Additionally, resting scapular position is a static measurement and may not reflect scapular kinematics during functional movements. Therefore, our results need to be used with caution, and further investigation is warranted

## Conclusion

The results suggest that altered scapular position may be an important aspect of general joint hyper mobility, that should be consider in the rehabilitation of hyper mobile persons

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## References

1. Simmonds JV, Keer RJ. Hyper mobility and the hyper mobility syndrome. *Man Ther* 12, 2007; 298-309.
2. Kirk JA, Ansell BM, Bywaters EG. The hyper-mobility syndrome. Musculoskeletal complaints associated with generalized joint hypermobility. *Ann Rheum Dis*. 1967 Sep; 26(5):419-25.
3. Beighton P, Solomon L, Soskolne CL. Articular mobility in an African population. *Ann Rheum Dis*. 1973 Sep; 32(5): 413-8.
4. Larsson LG, Baum J, Mudholkar GS. Hypermobility: features and differential incidence between the sexes. *Arthritis Rheum* 1987; 30:1426-1430.
5. Rikken-Bultman DG, Wellink L, VanDongen

- PW. Hypermobility in two Dutch school populations. *Eur J Obstet Gynecol Reprod Biol* 1997; 73:189-192
6. Seckin U, Tur B, Yilmaz O, Yagci I, Bodur H, Arasil T. The prevalence of joint hyper mobility among high school students. *Reumatol int* 2005; 25:260-263.
7. Aktas I, Oflluoglu D, Albay T. The relationship between benign joint hyper mobility syndrome and carpal tunnel syndrome. *Clin Rheumatol*, 2008; 27:1283-1287.
8. Al-Rawi z, Nessian AH. Joint hyper mobility in patients with chondromalacia patellae. *Br J Rheumatol*, 1997; 36:1324-1327
9. Russek LN. Hypermobility syndrome. *Phys Ther* 1999; 79(6):591-599.
10. Nijs JN, Roussel N, Struyf F, Mottram S, Meeusen R. Clinical assessment of scapular positioning in patients with shoulder pain: state of the art. *J Manipulative Physiol Ther*, 2007; 30(1):69-75.
11. Sahin N, Baskent A, Cakmak A, Salli A, Ugurlu H, Berker E. Evaluation of knee proprioception and effects of proprioception exercise in patients with benign joint hypermobility syndrome. *Rheumatol Int*. 2008 Aug; 28(10):995-1000.
12. Kronberg M, Broström LA, Németh G. Differences in shoulder muscle activity between patients with generalized joint laxity and normal controls. *Clin Orthop Relat Res* 1991; 269:181-92.
13. Barden JM, Balyk R, Raso VJ, Moreau M, Baghal K. A typical shoulder muscle activation in multidirectional instability. *Clin Neurophysio*, 2005; 116:1846-1857.
14. Hebert LJ, Moffet H, Mcfadyen BJ, Dionne CE. Scapular behavior in shoulder impingement syndrome. *Arch Phy Med Rehabil* 2002; 83:60-69.
15. Illeys A, Kiss RM. Kinematic and muscle activity characteristics of multi directional shoulder joint instability during elevation. *Knee Surg Sports Traumatol Arthrosc*, 2006; 14:673-685.
16. Ludewig PM, Cook TM, Alteration in shoulder kinematics and associated muscle activity in people with symptom of shoulder impingement. *Phy Ther* 2000; 80(3):276-291.
17. Mell AG, Lascalza S, Guffey P. Effect of rotator cuff pathology on shoulder rhythm. *J Shoulder Elbow Surg* 2005;585-645.
18. Ludewig P, Reynolds J. The association of scapular kinematics and glenohumeral joint pathologies *J Orthop Sports Phys Ther* 2009; 39:90-104.
19. Di veta J, Walker ML, Skibinski B. Relationship between performance of selected scapular muscles and scapular abduction in standing subjects. *Phys Ther*, 1990; 70: 470-476.
20. Kibler WB. Role of the scapula in the overhead throwing motion. *Contemporary Orthopaedics*, 1991; 22:525-532.
21. Shrout PE, Fleiss JL. Intraclass correlation: use in assessing rater reliability. *Psychol Bull*. 1979; 86: 420-8.
22. McKenna L, Cunningham J, Straker L. Inter-tester reliability of scapular position in junior elite swimmers. *Phys Ther Sport*, 2004; 5:146-155.
23. Hess SA. Functional stability of the glenohumeral joint. *Man Ther* 2000; 5(2):63-71.
24. Sahin N, Baskent A, Ugurlu H, Berker E. Iso-kinetic evaluation of knee extensor/flexor muscle strength in patients with hypermobility syndrome. *Rheumatol Int*, 2008; 28(7):643-648.
25. Fatoye F, Palmer S, Macmillan F, Rowe P, Vander Linden M. Proprioception and muscle torque deficits in children with hyper mobility syndrome, *Rheumatology*, 2009,48(2):152-157.
26. Booshanam DS, Cherian B, Premkumar C, Joseph AR, Mathew J, Thomas R. Evaluation of posture and pain in persons with benign joint hyper mobility syndrome. *Rheumatol Int*, 2011; 31(12):1561-1565.