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The Relationship Between Scapular Dyskinesis and Generalized Joint Hypermobility in Young Women

Afsun Nodehi Moghadam[1*], Maryam Moghadam Salimi[2], Enayatolah Bakhshi[3]

Abstract

Objectives: Individuals with generalized joint hypermobility (GJH) have motions beyond the normal range in the shoulder, and less shoulder stability. Scapular dyskinesis is likely to be a consequence of weakness in scapular stabilizer muscle. This study intended to identify the relationship between GJH and scapular dyskinesis in young women.

Materials and Methods: One hundred women (47 hypermobile and 53 non-hypermobile) participated in this case control study. The Beighton score was used to diagnose GJH. Visual scapular dyskinesis test (proposed by Uhl et al) was used for the evaluation of scapular dyskinesis. Scapular winging and/or dysrhythmia is observed during a set of bilateral, active, shoulder flexion, abduction and scaption (40° anterior to the frontal plane) for 5 times while having the thumbs pointed up. These movements were performed, bearing the weight on their hands. Generalized estimating equations were used in order to compare the scapular dyskinesis prevalence during shoulder flexion, abduction and scaption between the females with and without GJH.

Results: The prevalence of scapular dyskinesis in the females with GJH was twice more than that in the females with no hypermobility [OR = 2.18(95% CI: 1.18-4.03)]. It was also found that there were not any significant differences in the prevalence of scapular dyskinesis between shoulder elevation planes (flexion, abduction and scaption) in the females with and without GJH ($P > 0.05$).

Conclusions: Higher prevalence of scapular dyskinesis in the females with GJH may place them at the risk of future shoulder pain and pathology, which should be considered in the evaluation and management of hypermobile individuals.

Keywords: Joint hypermobility, Joint laxity, Scapula, Shoulder injuries

Introduction

Generalized joint hypermobility (GJH) is a term used when most of the synovial joints in the body have an increased range of motion due to excessive connective tissue extensibility and/ or capsular or ligamentous laxity (1,2). GJH is a feature present in various rheumatologic diseases, including Marfan syndrome and Ehlers-Danlos syndrome, but it is known as a benign joint hypermobility syndrome that can also be present in the absence of rheumatologic diseases (3,4). GJH is most often seen in the females and among African and Asian descents, and its prevalence rate is reported from 5% to 43 % (5,6). Several studies have shown that the individuals with GJH have widespread joint pain and musculoskeletal and non-musculoskeletal complaints (1,,7-9). Approximately 3.3% of females suffering from GJH have tendency to develop pain in the legs and shoulder joint (10) . The result of Trudelle-Jackson and colleagues' study showed that hypermobility appears to place women at increased risk of musculoskeletal injury while participating in physical activity (11).

In the individuals with GJH, lower joint stability along with muscle weakness can be a major risk factor in the development of upper extremity disorders (12) .

Arm elevation requires coordinated motions of glenohumeral and scapulothoracic joints (13). Shoulder girdle stability is provided by static stabilizers (such as capsule, ligaments), dynamic stabilizers (including rotator cuff and scapular stabilizers), as well as proprioceptive information emerging from mechanoreceptors in muscles, tendons, joint-capsule ligaments, and skin, which are centrally integrated (13). Optimal scapular position and motion depend on normal function of the scapular stabilizer muscles such as trapezius, rhomboids, and serratus anterior muscles (13).

Scapular dyskinesis is a change from normal scapular position and motion and is characterized by prominence of scapular medial border and/or inferior angle, early scapula elevation or shrugging and reduced upward rotation of the scapula during arm elevation (14). Scapular

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[1]Department of Physiotherapy, Rofeideh Rehabilitation Hospital, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. [2]Department of Physiotherapy, Tabriz University of Medical Sciences, Tabriz, Iran. [3]Department of Statistics, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.
*__Corresponding Author:__ Afsun Nodehi Moghadam, PhD PT; Tel: (98)-21-22180084, Email: afsoonnodehi@gmail.com

dyskinesis is observed among the individuals suffering from various shoulder disorders such as glenohumeral instability, rotator cuff disorders, and labrum tears (15-19). Since scapula has limited bony attachment, its mobility and stability depends on muscle activation especially serratus anterior and upper and lower trapezius muscles(13). Alterations of periscapular muscle activation such as reduced strength of lower trapezius and serratus anterior muscles are common among the individuals with scapular dyskinesis (15). It has also been found that women with GJH show physical fitness at lower levels, poor joint proprioception, and decreased muscle strength (20-22). Thus, since scapular dyskinesis is a consequence of weakness in scapular stabilizer muscle, it is possible that women with GJH have higher prevalence of scapular dyskinesis (12,15). Therefore, this study tried to identify the relationship between GJH and scapular dyskinesis among young women.

Materials and Methods

Subjects

One hundred women (47 hypermobile and 53 nonhypermobile) participated in this case control study. The Beighton score was applied to diagnose GJH with a scoring range from 0 to 9. Beighton scoring system consists of four bilateral tests including (*a*) passive hyperextension of little finger beyond 90º, (*b*) passive reaching of the thumbs to the flexor aspects of the forearms, (*c*) elbows hyperextension beyond 10º, (*d*) knees hyperextension more than10º, and one unilateral test: (*e*) trunk flexion so that the palms can easily touch the floor. A cut point of 4-9 or higher can meet the Beighton score for GJH (23). In this study, participants with score of 5 or higher were considered as hypermobile subjects. The participants in non-hypermobile group (with a Beighton score lower than 5) were matched in age, height, and weight with GJH group. The subjects with a history of shoulder pain, dislocation, fracture, or surgery as well as neurologic or rheumatologic diseases and scoliosis or excessive kyphosis were excluded (17). All subjects showed their agreement by signing the consent form which was approved by the Human Subjects Committee of University of Social Welfare and Rehabilitation Sciences.

Scapular Dyskinesis Test

In this study, visual method (proposed by Uhl et al) was used for the evaluation of scapular dyskinesis (24). The participants stood with their arms resting next to their bodies, while the examiner stood behind them at 1.5-meter distance. Each participant performed a set of bilateral, active, shoulder flexion, abduction and scaption (40° anterior to the frontal plane) for 5 times while having the thumbs pointed up. These movements were performed, bearing the weight on their hands. The participants were required to raise their arms as far as possible over a count of 3 seconds and then descend them over a count of 3 seconds. The movements were performed while holding dumbbells on the basis of their body weight as 1 kg for less than 60 kg and 2 kg for 60 kg or more (25). A pilot study was performed so as to choose the weights. Presence or absence of scapular dyskinesis (winging and/or dysrhythmia) was observed during bilateral weighted shoulder elevation (24,25).

Statistical Analysis

The statistical analysis was conducted using SPSS statistical software version 19.0. Based on the Beighton score (A cut point of 5-9 or higher), the participants were grouped as hypermobile or non-hypermobile. Descriptive statistics was expressed as mean and standard deviation (SD) for participants' age, weight, height and Beighton score, or as percentages for the scapular dyskinesis prevalence. Independent *t* test was used in order to compare the participants' characteristics in the 2 groups. Moreover, because of repeated measurements and correlated observations, generalized estimating equations were used to compare the scapular dyskinesis prevalence during shoulder flexion, abduction and scaption between the females with and without GJH. For all statistical analyses, a significance level of 0.05 was used.

Results

There were no statistically significant differences regarding the participants' age, weight, and height between the two groups with and without hypermobility ($P > 0.05$) (Table 1). The mean (SD) of Beighton score in the females with GJH and control subjects was 5.87±95 and 2.19±1.37, respectively. The prevalence of scapular dyskinesis during shoulder flexion, abduction and scaption in the females with and without GJH are shown in Table 2. During dominant side flexion, scaption and abduction, scapular dyskinesis was seen in 68.1%, 78.7%, and 68.1% of the participants in the hypermobile group, while its prevalence in the control group was 31.9%, 21.3%, and 31.9%, respectively. Moreover, the prevalence of scapular dyskinesis during non-dominant side flexion, scaption and abduction in the females with GJH was more than that in the females with no hypermobility (Table 2).

Furthermore, the results of generalized estimating equations showed that the prevalence of scapular dyskinesis in the females with GJH was twice more than

Table 1. Demographic Characteristics of Females With and Without Generalized Joint Hypermobility

Variables	Mean ±SD		*P* Value
	Hypermobile	Non-hypermobile	
Age (y)	22.11 ± 2.52	22.75 ± 2.61	0.21
Weight (kg)	56.27 ± 6.33	56.42 ± 6.15	0.90
Height (cm)	161.91 ± 5.70	162. 09 ± 5.62	0.87
Beighton score	5.87 ± 95	2.19 ± 1.37	0.00

Table 2. The Prevalence of Scapular Dyskinesis During Shoulder Flexion, Abduction and Scaption in Dominant and Non-dominant Sides in Females With and Without Generalized Joint Hypermobility

Scapular Dyskinesis No. (%)		Dominant Side		Non-dominant Side	
		Hypermobile	Non-hypermobile	Hypermobile	Non-hypermobile
Flexion	Yes	32(68.1)	28 (52.8)	35 (74.5)	33 (62.3)
	No	15(31.9)	25 (47.2)	12 (25.5)	20 (37.7)
Scaption	Yes	37(78.7)	25 (47.2)	38 (80.9)	33 (62.3)
	No	10(21.3)	28 (52.8)	9 (19.1)	20 (37.7)
Abduction	Yes	32(68.1)	29 (54.7)	34 (72.3)	31 (58.5)
	No	15(31.9)	24 (45.3)	13 (27.7)	22 (41.5)

that in the females with no hypermobility (OR [odds ratio] =2.18 [95% CI: 1.18-4.03]). However, it was found that there were not any significant differences in the prevalence of scapular dyskinesis between shoulder elevation planes (flexion, abduction and scaption) in the females with and without GJH ($P > 0.05$).

Discussion

As the result of this study showed, the prevalence of scapular dyskinesis in the females with GJH was twice more than that in the females with no hypermobility. The primary characteristic of the females with GJH is the excessive range of joint motions (1). Hypermobile joint is likely to be less stable, to be subject to subluxation or dislocation, and more susceptible to musculoskeletal injuries (26). It has already been proven that GJH is a significant risk factor for traumatic anterior shoulder dislocation and acute and chronic shoulder injuries (7, 27). The result of a longitudinal cohort study in children suggests an association between GJH in childhood and resulting adolescent joint pain, so that they had three times increased risk of inflicting pain at the age of 14 (9). Moreover, the result of Trudelle-Jackson and colleagues' study showed that the women with multiple joints hypermobility who participate at any level of physical activity are more in danger of musculoskeletal injury (11).

The results of some studies have shown that the individuals with GJH have decreased physical fitness and muscle weakness (20,22). The results of Scheper et al (28) and Jindal and colleagues' (29) studies showed decreased grip, shoulder abductor and elbow extensor strengths in the individuals with GJH. On the other hand, Jeremiah and Alexander (30) suggested that the increased laxity along with GJH can lead to poor neuromuscular control (proprioception). The results of some previous studies indicate that the individuals with GJH demonstrate reduced proprioception than those without joint hypermobility (21,31). It seems that since the females with GJH have more range of shoulder motion and reduced joint stability due to lax static stabilizers, they may rely more on muscle force and neuromuscular mechanisms (proprioception) (30). Thus, according to the results of previous studies which have shown the individuals with GJH have decreased physical fitness and muscle weakness, higher prevalence of scapular dyskinesis in the females with GJH looks reasonable (20,22).

The prevalence of scapular dyskinesis has been observed in 68%-100% of individuals suffering from shoulder disorders, such as rotator cuff tears, glenohumeral instability, and labral tears (17,32). The findings of this study regarding the association of scapular dyskinesis with GJH are in line with the results of shoulder instability studies (7,27). In agreement with our result, it was shown that scapular dyskinesis was often seen in unstable glenohumeral joint such as multidirectional instability and recurrent types of shoulder instability (14,33,34). It has been suggested that the lax capsular tissue and altered biomechanics and muscle activation in the individuals with multidirectional instability may lead to scapular dysrhythmia, excessive protraction of scapula and so-called scapular dyskinesis (14). Nodehi Moghadam and Salimee (35) showed that compared to non-hypermobile subjects, females with GJH exhibited a more protracted and downward-rotated scapula on their dominant side with the arm at rest beside the body. Moreover, in agreement with our result, Alibazi et al (36) investigated the impact of shoulder muscle fatigue on shoulder kinematic in the females with GJH and found that before fatigue, 55% of GJH women had subtle or obvious scapular dyskinesis while, in control group it was 31.3%. Another mechanism that may justify higher prevalence of scapular dyskinesis in the females with GJH is abnormal neuromuscular control (21). The presence of connective tissue laxity and poor proprioception in the females with GJH may result in compensatory strategies such as co-contraction or excessive activation of specific shoulder girdle stabilizer muscles, which could lead to muscles fatigue and weakness, altered scapulohumeral rhythm and scapular dyskinesis (14,28). The evidence shows that upper limb muscle fatigue can result in scapular dyskinesis (37,38). It has been suggested by some researchers that fatigue-induced scapular dyskinesis may be an etiological factor in the reduction of subacromial space and impingement syndrome (38). While, some others have shown that alteration in scapular orientation has minimal effect on subacromial space width; thus, can be considered as a compensatory motion to offset superior humeral head translation, subsequent to rotator cuff fatigue (37,39).

This study has some limitations. First, in our study only a homogeneous group of healthy and non-symptomatic women was assessed. Considering such a limitation, applying these findings to the symptomatic and male population should be proceeded with caution; so more studies in these areas are necessary. Second, the probable weakness of scapula muscles in the individuals with scapular dyskinesis as assessed using strength tests or electromyography data was not included in this study.

Conclusions

According to the results of this study, the prevalence of scapular dyskinesis in the females with GJH was twice more than that in the females with no hypermobility (OR=2.18 [95% CI: 1.18-4.03]). It was also found that there were not any significant differences in the prevalence of scapular dyskinesis between shoulder elevation planes (flexion, abduction and scaption) in the females with and without GJH.

Conflict of Interests

None declared.

Ethical Issues

This study was approved by Ethics Committee of University of Social Welfare and Rehabilitation Sciences (code of ethics: IR.USWR.REC.1396.275).

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