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Generalized Ligamentous Laxity: An Important Predisposing Factor for Shoulder Injuries in Athletes

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Abstract

Background: Generalized ligamentous laxity is defined as an increased range of joint motion compared to that of the general population. It is a predisposing factor for sports injuries, especially in the lower extremities. Nevertheless, there is little evidence about the relationship between generalized ligamentous laxity and sports injuries in the upper extremities.
Objectives: To evaluate the relationship of generalized ligamentous laxity with acute and chronic shoulder injuries in athletes.
Patients and Methods: Our study comprised 118 volunteer athletes with a history of at least six months of sports activities and a shoulder injury in the three years prior to participation in our study. The athletes were divided into two groups: those with or without generalized ligamentous laxity. Acute and chronic shoulder injuries, shoulder pain, shoulder instability, and functional status assessed via the QuickDASH measure were determined and compared between the two groups. A P value of less than 0.05 was considered significant.
Results: Group A (with ligamentous laxity) consisted of 43 participants (36.4%) and group B (without ligamentous laxity) consisted of 75 participants (63.6%). The athletes in group A had more shoulder pain (P = 0.016), chronic shoulder injuries (P = 0.032), and shoulder instability (P = 0.004), and less functionality (P = 0.030) than those in group B. If fracture were not considered an acute injury in both groups, the athletes with generalized ligamentous laxity would have had more acute shoulder injuries.
Conclusions: Generalized ligamentous laxity is an important predisposing factor for acute and chronic shoulder injuries in athletes. Prescreening programs for beginners and rehabilitation shoulder programs for sports athletes at high risk are strongly recommended.

Keywords: Ligamentous Laxity, Shoulder, Athletic Injuries

1. Background

In generalized ligamentous laxity, the range of motion across various joints in an individual is increased compared to the mean range of motion in the general population (1). Although this could occur as a result of genetic disorders affecting the connective tissue, in most individuals there is no genetic aberrancy and it exists in isolation (2).

The prevalence of generalized ligamentous laxity varies among different races from 5% to 57% of the general population (3). It is well known that generalized ligamentous laxity is implicated in various musculoskeletal injuries, especially in the lower extremities, such as cruciate ligament injuries, patellar instability, and ankle injuries (4, 5). Although generalized ligamentous laxity is a predisposing factor for shoulder instability (6), to the best of the authors' knowledge no study has investigated the role of generalized ligamentous laxity in acute and chronic shoulder injuries in athletes.

2. Objectives

This study aimed to determine whether generalized ligamentous laxity can be a predisposing factor for acute and chronic shoulder injuries in athletes.

3. Patients and Methods

This cross-sectional study was conducted from April to October 2015. To obtain a representative sample of athletes with shoulder injuries, we sought all athletes who had sustained shoulder injuries in Hamadan Province in Iran over the previous three years according to the documents of the local branch of the Iranian federation of sports medicine in Hamadan province. All the volunteer professional athletes of the province were included in the study. They were invited to visit an outpatient clinic at our university. All the relevant data were recorded, including demographic information, type of sport, duration of sporting activity, and the Beighton score for generalized ligamentous laxity (Table 1).

Table 1. Beighton Score to Assess Generalized Ligamentous Laxity

Joint	Evaluation	Points
Left little (5th) finger	Passive dorsiflexion > 90°	1
Right little (5th) finger	Passive dorsiflexion > 90°	1
Left thumb	Passive dorsiflexion to the flexor aspect of the forearm	1
Right thumb	Passive dorsiflexion to the flexor aspect of the forearm	1
Left elbow	Hyperextension > 10°	1
Right elbow	Hyperextension > 10°	1
Left knee	Hyperextension > 10°	1
Right knee	Hyperextension > 10°	1
Forward flexion of the trunk with knees	Fully extended, able to rest palm and hands flat on the floor	1

Our inclusion criteria were being 17 - 37 years old and having a history of sports activity for at least six months (if there was a shoulder injury, then the requirement was at least six months of sports activity before the injury). The exclusion criteria were having any deformity or disorder that interfered with the Beighton score assessment and a lack of documents proving at least six months of regular sports activity. Several athletes were excluded, mainly because of a lack of documentation proving sports participation.

Using a sampling formula for cross-sectional studies where $\alpha = 0.05$, d = 0.065, and p (ligament laxity prevalence according to other studies) = 0.15, our sample size was calculated to be 116. All the volunteers signed a consent form to confirm their participation in the study, and the study was approved by the ethics committee of Hamadan University of Medical Sciences (No.: IR.UMSHA.REC.1395.101)

We considered generalized ligamentous laxity as point 4 or more of the Beighton score and divided all the participants into two groups: the participants in group A had ligamentous laxity ("with ligamentous laxity") and those in group B did not ("without ligamentous laxity"). Any acute or chronic shoulder injuries and functional issues among the participants were also assessed according to the standard Farsi (contemporary Persian) translation of the QuickDASH measure.

4. Results

A total of 118 volunteer athletes participated in our study, which included 32 athletes with shoulder injuries and 86 athletes without shoulder injuries. They were divided into two groups according to the Beighton score: group A (with ligamentous laxity) consisted of 43 participants and group B (without ligamentous laxity) consisted of 75 participants. We then compared the following factors between the two groups: acute shoulder injury, chronic shoulder injury, shoulder instability, chronic shoulder pain, and DASH scores (Table 2). A statistical analysis was carried out using the statistical package for social sciences (SPSS) version 20 software (SPSS Inc., Chicago, IL). The chi-squared test was used to analyze the effect of the generalized ligamentous laxity on the nominal scale values, namely chronic shoulder pain, and chronic and acute shoulder injuries. Spearman's test was used to analyze the generalized ligamentous laxity effect on the last value, "successful return to sports activities," for which the DASH score was ordinal.

First, we evaluated the relationship between ligamentous laxity and chronic shoulder pain (Table 3). Sixteen participants (37.2%) in group A and 13 participants (17.3%) in group B suffered from chronic shoulder pain ($p = 0.016$). We then evaluated the number of chronic shoulder injuries in both groups (Table 4). Thirteen participants in group A (30.2%) and 11 participants in group B (14.6%) had chronic shoulder injuries, which was statistically significant ($P = 0.032$). With respect to acute shoulder injuries, 11 participants in group A (25.5%) and 19 participants in group B (25.3%) had chronic shoulder injuries (Table 5). Interestingly, the difference was not significant ($P = 0.58$). We then assessed upper limb function using the QuickDASH measure (Table 6) and found that there was a significant difference between the functional status of the two groups ($P = 0.030$). Finally, we compared the history of acute and chronic instability between the two groups based on dislocation documentation or a history of shoulder pain with at least two positive clinical tests for instability (Table 7). Eleven participants in group A (25.5%) and five participants in group B (6.6%) had instability, which was significant ($P = 0.004$).

5. Discussion

The shoulder joint gets injured frequently in sports like volleyball, handball, swimming, basketball, and overhead sports, and an abnormal increase or decrease in range of motion is an important factor in sports injuries involving the shoulder (7). Generalized ligamentous laxity refers to an increased range of joint motion compared to that of the general population. Its prevalence is 5% - 15% but varies among different race groups, with an incidence as high as 57.3% among Africans (1, 6). Although there is no standard for defining ligamentous laxity, there are several clinical

Table 2. Demographic Data of the Participants

Variables	No. (%)	Total
1. Shoulder injuries		
Without injuries	85 (72)	118
With injuries	33 (28)	118
2. Sex		118
Women	38 (32.2)	
Men	80 (67.8)	
3. Age, y		118
17 - 20	41 (34.7)	
21 - 24	22 (18.6)	
25 - 28	19 (16.1)	
29 - 33	20 (16.9)	
34 - 37	16 (13.6)	
4. Body mass index		118
Less than 18.5	13 (11.0)	
18.5 - 25	62 (52.5)	
25.1 - 30	34 (28.8)	
More than 30.1	9 (7.6)	
5. Ligamentous laxity		118
Without ligamentous laxity	75 (63.6)	
With ligamentous laxity	43 (36.4)	
6. Type of sport		118
Basketball, handball, and volleyball	19 (16.1)	
Football	9 (7.9)	
Swimming and water polo	7 (5.9)	
Mountaineering and climbing	14 (11.9)	
Fitness	19 (16.1)	
Martial arts and boxing	24 (20.3)	
Racket sports	12 (10.2)	
Boating	2 (1.7)	
Wrestling	12 (10.2)	
7. Type of acute injury		30
Fracture	11 (36.7)	
Muscle injury	2 (6.7)	
Instability	14 (46.6)	
Strain	0	
Sprain	0	
Bursa injury	0	
Joint damage	3 (10.0)	
8. Type of chronic injury		22
Muscle injury	2 (9.1)	
Instability	11 (50.0)	
Strain	0	
Sprain	2 (9.1)	
Bursa injury	0	
Joint damage	7 (31.8)	

Table 3. The Relationship Between Hyperlaxity and Chronic Shoulder Pain[a]

Ligamentous Laxity	Chronic Shoulder Pain		Total
	Without Chronic Pain	With Chronic Pain	
Without ligamentous laxity	62	13	75
With ligamentous laxity	27	16	43
Total	89	29	118

[a]The chi-squared test was used; P = 0.016.

scoring systems for measuring joint laxity in individuals and populations. The Beighton score is considered an excellent method for screening generalized ligamentous laxity (8, 9).

Bin Abd Razak et al. evaluated generalized ligamentous laxity in the musculoskeletal injuries of 100 young patients in a primary care center for comparison with a healthy control group (1). They found that the individuals who had musculoskeletal injuries were 3.35 times more likely to have generalized ligamentous laxity compared to healthy people.

Several studies have demonstrated the relationship between generalized ligamentous laxity and sports injuries in the lower extremities, including cruciate ligament injuries (4) and patellar dislocation (5). Pacey et al. found a significantly increased risk of knee joint injury among hypermobile participants who played contact sports (10). Notwithstanding, little evidence exists regarding the relationship between generalized ligamentous laxity and shoulder injuries. Chahal et al. studied generalized ligamentous laxity and increased external rotation of the shoulder as a predisposing factor for primary shoulder dislocation in young, healthy individuals. They found that men with shoulder dislocation were 6.8 times more likely to have generalized ligamentous laxity (6).

To the best of our knowledge, no study has investigated a range of shoulder injuries in athletes with or without ligamentous laxity. Hence, we evaluated the relationship between generalized ligamentous laxity and various shoulder injuries in athletes who had participated in sports activities for at least six months. There was a significant difference between our two study groups. The athletes with generalized ligamentous laxity had more chronic shoulder pain, chronic shoulder injuries, shoulder instability (acute and chronic), and less functionality according to their DASH scores compared to the athletes without generalized ligamentous laxity. Interestingly, there was no difference in the number of acute shoulder injuries between the two groups. This was because we considered fractures around the shoulder to be acute injuries in the study. If we had omitted fractures in both groups, the difference in

Table 4. The Relationship Between Ligamentous Laxity and Chronic Shoulder Injury[a]

Ligamentous Laxity	Chronic Shoulder Injuries							Total
	No Injuries	Muscle Injury	Instability	Strain	Sprain	Bursa Injury	Joint Damage	
Without ligamentous laxity	66	2	4	0	0	0	3	75
With ligamentous laxity	30	0	7	0	2	0	4	43
Total	96	2	11	0	2	0	7	118

[a]The chi-squared test was used; P = 0.032.

Table 5. The Relationship Between Ligamentous Laxity and Acute Shoulder Injury[a]

Ligamentous laxity	Acute Shoulder Injury								Total
	No Injuries	Fracture	Muscle Injury	Instability	Strain	Sprain	Bursa Injury	Joint Damage	
Without ligamentous laxity	56	9	2	5	0	0	0	3	75
With ligamentous laxity	32	2	0	9	0	0	0	0	43
Total	88	11	2	14	0	0	0	3	118

[a]The chi-squared test was used; P = 0.058.

Table 6. The Relationship Between Ligamentous Laxity and QuickDASH Scores[a]

Ligamentous laxity	0 - 100 QuickDASH Score					Total
	0.20	20.01 - 40	40.01 - 60	60.01 - 80	80.01 - 100	
With ligamentous laxity	13	2	4	0	0	19
Without ligamentous laxity	3	7	3	1	0	14
Total	16	9	7	1	0	33

[a]Spearman's test was used; P = 0.030.

Table 7. The Relationship Between Ligamentous Laxity and a History of Acute or Chronic Shoulder Instability[a]

Ligamentous Laxity	History of Shoulder Instability		Total
	Without Instability	With Instability	
Without ligamentous laxity	70	5	75
With ligamentous laxity	32	11	43
Total	102	16	118

[a]Spearman's test was used; P = 0.004.

acute injuries would have been significant.

The strength of our study was the evaluation of all the volunteer professional athletes in our province who had participated in at least six months of regular sports activity, including professional athletes with shoulder injuries. Since the treatment of injured athletes is the responsibility of the Federation of Sports Medicine in Iran, this federation had a complete list of all the injured athletes in the province. The limitation of our study was that we only evaluated athletes in one province of Iran.

Although Hamadan province is ethnically diverse and includes most Iranian ethnic groups (Azeri, Kurd, Lur, and Fars), and parallel research results will thus be quite compatible with the current research findings, it is suggested that the same study be conducted in different provinces of Iran with a greater number of athletes. A sports injury can be influenced by the athlete's level of professionalism. Although we excluded athletes who had participated in professional sports activities for less than six months, it is not clear if their knowledge and ability to prevent sports injuries would be the same as those with more experience.

This study highlights the importance of having screening programs in athletic clinics, sports clubs, and sports offices at high schools and universities to identify individuals with generalized ligamentous laxity, and emphasizes the need for physicians and surgeons to practice prophylactic measures. There may be a role for shoulder-specific proprioceptive and strength training protocols for shoulder injuries in individuals with generalized ligamentous laxity who participate in high-risk sports, especially contact sports.

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References

1. Bin Abd Razak HR, Bin Ali N, Howe TS. Generalized ligamentous laxity may be a predisposing factor for musculoskeletal injuries. *J Sci Med Sport.* 2014;**17**(5):474–8. doi: 10.1016/j.jsams.2013.11.001. [PubMed: 24315955].
2. Bird HA. Joint hypermobility in children. *Rheumatology (Oxford).* 2005;**44**(6):703–4. doi: 10.1093/rheumatology/keh639. [PubMed: 15827037].
3. Remvig L, Jensen DV, Ward RC. Epidemiology of general joint hypermobility and basis for the proposed criteria for benign joint hypermobility syndrome: review of the literature. *J Rheumatol.* 2007;**34**(4):804–9. [PubMed: 17407233].
4. Ramesh R, Von Arx O, Azzopardi T, Schranz PJ. The risk of anterior cruciate ligament rupture with generalised joint laxity. *J Bone Joint Surg Br.* 2005;**87**(6):800–3. doi: 10.1302/0301-620X.87B6.15833. [PubMed: 15911662].
5. Niedzielski KR, Malecki K, Flont P, Fabis J. The results of an extensive soft-tissue procedure in the treatment of obligatory patellar dislocation in children with ligamentous laxity: a post-operative isokinetic study. *Bone Joint J.* 2015;**97-B**(1):129–33. doi: 10.1302/0301-620X.97B1.33941. [PubMed: 25568426].
6. Chahal J, Leiter J, McKee MD, Whelan DB. Generalized ligamentous laxity as a predisposing factor for primary traumatic anterior shoulder dislocation. *J Shoulder Elbow Surg.* 2010;**19**(8):1238–42. doi: 10.1016/j.jse.2010.02.005. [PubMed: 20452244].
7. Herrington L. Glenohumeral joint: internal and external rotation range of motion in javelin throwers. *Br J Sports Med.* 1998;**32**(3):226–8. [PubMed: 9773171].
8. Boyle KL, Witt P, Riegger-Krugh C. Intrarater and Interrater Reliability of the Beighton and Horan Joint Mobility Index. *J Athl Train.* 2003;**38**(4):281–5. [PubMed: 14737208].
9. Juul-Kristensen B, Rogind H, Jensen DV, Remvig L. Inter-examiner reproducibility of tests and criteria for generalized joint hypermobility and benign joint hypermobility syndrome. *Rheumatology (Oxford).* 2007;**46**(12):1835–41. doi: 10.1093/rheumatology/kem290. [PubMed: 18006569].
10. Pacey V, Nicholson LL, Adams RD, Munn J, Munns CF. Generalized joint hypermobility and risk of lower limb joint injury during sport: a systematic review with meta-analysis. *Am J Sports Med.* 2010;**38**(7):1487–97. doi: 10.1177/0363546510364838. [PubMed: 20601606].