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The Study of Joint Hypermobility and Q Angle in Female Football Players

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Abstract: Patellar alignment is commonly determined by the measurement of the quadriceps (Q) angle. The aim of this study was to investigate the Q angle difference in female football players with and without joint hypermobility. The prevalence of hypermobility in females with sport injuries also was studied. One hundred and thirty female football players were examined for hypermobility and sport injury. According to the Beighton scoring system, three groups (n=15) were formed and Q angle was measured in 45 individuals. Results showed that the mean Q angle values in hypermobile athletes were significantly higher than non-hypermobile group ($p<0.05$). The most common injury of anatomic site was lower extremity. In conclusion, the Q angle evaluation among hypermobile individuals may have a prognostic value for probable knee pathologies that may appear in the future. Therefore, specific musculoskeletal profiling and routine screening is needed.

Key words: Q angle % Beighton score % Female athlete % Injury

INTRODUCTION

Football is one of the most popular sports worldwide. Recently, the number of female football players has increased in the world. Football is now a popular female team sport played by approximately 40 million women in over 100 countries all over the world. Despite the perception that soccer is a relatively safe sport, it is considered as one of the most common causes of sport injuries among the youth. Numerous authors have described incidence rates of soccer injuries among the youth ranging from 2.3 to 6.4 injuries per 1000 athlete-exposure hours[1]. It is an intermittent sport that uses walking, jogging, running and sprinting. Previous studies have shown that football has a high injury rate and injury percentage [2]. Physical activity and work time will be lost in addition to substantial medical costs [3, 4]. The most common injury mechanisms were tackling, running, being tackled, shooting, twisting and turning and jumping and landing [2]. There are many factors that affect injury incidence. According to a classical model of injury prevention [5], the first step should be the investigation of the incidence of the injury with regard to the population of interest. Thereafter, it is necessary to identify the risk factors and injury mechanisms in order to be able to introduce and establish adequate preventive intervention strategies. Finally, the intended prophylactic measures should be validated by repeating step one. These factors include over training, imbalance training, inappropriate warm up / strength and flexibility exercises, high stress competition, nature of skills and movement patterns, faulty technique, unsuitable equipment, facilities and surface, primary malposture and maladaptation, potentiality of overload injury and maladaptation and lack of specific musculoskeletal profiling and routine screening [6].

Joint hypermobility is a condition characterized by an excessive range of motion in joints and has been linked to some kind of musculoskeletal pain and osteoarthritis that may be developed in the future [7, 8]. Joint hypermobility occurs at an incidence of 4%-7% in general population and women have been reported to demonstrate greater joint hypermobility than men [9]. This condition may lead to arthralgia associated with trauma or excessive use, to soft tissue lesions, to recurrent dislocation, to low-grade inflammatory arthritis, or to degenerative arthritis [9]. When hypermobility becomes symptomatic, the "hypermobility syndrome" is said to exist. Individuals with generalized joint hypermobility may be at an increased risk of sport-related injuries. Generalized joint hypermobility has been proposed as a risk factor for injuries to the ankle, knee and shoulder joints [10]. The Q angle is intended to provide some indication of the net lateral force applied to the patelafemoral joint by contraction of the quadriceps muscle. Normal values, gender differences and differences in the Q angle between

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symptomatic and asymptomatic patients have been repotted [11]. Both an in vitro experimental study and a theoretical modeling study have shown that increasing the Q angle tends to increase the lateral patelafemoral contact pressure, while decreasing the Q angle tends to increase the medial patelafemoral contact pressure [9]. A stronger vastus lateralis pulls the patella laterally, resulting in a larger Q-angle, while a stronger vastus medialis pulls the patella medially, resulting in a smaller Q-angle. Therefore, the Q-angle is an indicator of the imbalance between components of the quadriceps muscle [12].

Epidemiological data of injuries in female football players are rare [13]. No study has so far investigated joint hypermobility and Q angle in female football players. In this study, our primary aim was to investigate the Q angle difference between hyper mobile and non-hyper mobile individuals. The other goals of this study were to determine the frequency of joint hypermobility in female football players and to investigate the prevalence of sport injuries in this population.

MATERIALS AND METHODS

One hundred and thirty female football players volunteered to participate in this study. All subjects played at the club level and at least had 4 years of athletic history. After informed consent was obtained, the subjects' age, height, activity history and injury history were recorded. The recognition of joint hypermobility rested on the ability of the person to perform a series of passive joint maneuvers and was assessed using the Beighton and Horman joint mobility index [14]. Each participant was assessed for trunk flextion, for left and right fifth finger hyperextension (=90°), elbow hyperextension (=10°), thumb opposition (ability to touch forearm) and knee hyperextension. Trunk flextion was examined by asking participants to touch the floor with the palms of their hands while keeping their knees extended. For fifth finger extension, the participants used the thumb of their opposite hands to stabilize the fifth metacarpal while the index finger of the opposite hand gently extended the fifth metacarpophalangeal joint as far as possible without pain. Thumb opposition was assessed by asking the participants to stabilize the distal portion of their forearm with their opposite hand, while the thumb of the stabilizing hand passively abducted the thumb towards the volar aspect of the forearm while flexing the wrist. Elbow hyperextension was performed by asking the subjects to actively extend their elbow as far as possible with the forearm supinated and the shoulder positioned in approximately 90° of flextion. Knee hyperextension was measured with the subjects in supine and a bolster positioned under the distal tibia. The goniometer axis was positioned over the lateral joint line, the stationary arm aligned with the greater trochanter and the movable arm aligned with the lateral malleolus. The measurement was recorded while the examiner applied a posteriorly directed force to the anterior knee until passive resistance was achieved. Subjects received a score of 1 for each criterion met [15] and the total score ranging from 0 to 9 was recorded. The Beighton score of at least 4 was considered as a joint hypermobility [9]. Three groups were formed randomly on the basis of the values that were obtained according to Beighton scoring system. Group 1 consisted of 15 individuals with a Beighton score of 0; and group 2, 15 individuals with a Beighton score of 2, 3 and group 3, 15 individuals with a Beighton score of = 4. Q angle of these selected 45 individuals were goniometrically measured in upright positions. The Q angle is defined as the angle between a line connecting the center of the patella and the patellar tendon attachment site on the tibial tubercle and a second line connecting the center of the patella and the anterior superior iliac spine on the pelvis when the knee is fully extended [16]. All measurements were performed in laboratory of Physical Education and Sport Sciences Faculty of Guilan University. The examiner who performed Q angle measurements did not know to which group each individual belonged. Results were expressed as mean ±SD. The mean Q angles among the groups were compared by an ANOVA test. Differences were accepted as significant at $p=0.05$.

RESULTS

Mean age, height, weight, athletic history and Beighton score of the participants are listed in Table 1. Frequencies and percentage of the established Beighton scores are shown in Table 2. The rate of joint hypermobility (Beighton score of 4 or more) was found as 46.7% in this population. The most common injuries were contusions (32%), sprains (25%), strains (17%) and tendinitis (9%). According to body regions, 52% belonged to the lower extremity, 27% to the head and neck, 11% to the upper extremity and 9% to the trunk. The most common injury sites in lower extremity were ankle and knee. The results of ANOVA test showed a significant difference between group 1 and 3 in terms of the mean Q angle measurement ($p=0.05$) (Table 3).

Table 1: Characteristics of subjects (N=130)

Variable	Mean	SD
Age (yr)	23.30	3.60
Height (cm)	166.05	5.75
Weight(kg)	60.88	5.58
Beighton score	2.80	2.54
Athletic experience	5.42	3.50

Table 2: Frequencies of Beighton score values of all subjects

Beighton	N	Frequency(%)
0	15	11.5
1	22	16.9
2	22	16.9
3	10	7.6
4	15	11.5
5	12	9.2
6	20	15.3
7	14	10.7
8	0	0
9	0	0
total	130	100

Table 3: The results of ANOVA and Post Hoc Tests ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	177.644	2	88.822	12.261	.000
Within Groups	304.267	42	7.244		
Total	481.911	44			

Post Hoc Tests Dependent Variable: Q Test: Scheffe

group	group	Mean difference	Std. Error	Sig.
1	2	-2.46667	.98282	.053
	3	-4.86667	.98282	.000*
2	1	2.46667	.98282	.053
	3	-2.40000	.98282	.062
3	1	4.86667	.98282	.000*
	2	2.40000	.98282	.062

DISCUSSION

In this study, the prevalence of hypermobility was 46.7%. The high general joint laxity score may be a valuable indicator of potential risk in athletes [17]. Our results also showed that the rate of ankle injuries was higher in athletes with general joint hypermobility than in athletes with normal joint mobility. Previous investigations indicated that greater knee laxity and generalized joint laxity are more prevalent in adolescent girls than in their male counterparts [8]. Decoster *et al*. found that ankle injuries in athletes with hypermobility were 26% higher than in athletes with normal joint mobility [18]. The demands placed on the joints of an athlete with joint hypermobility are important to be considered prospectively, because the joints generally may tolerate repetitive activity better than tasks requiring stabilization. Athletes with joint hypermobility also may develop compensatory mechanisms such as premature recruitment of hip muscles, when faced with ankle perturbation. These athletes, particularly females, face greater risk than other athletes for developing halluxvalgus deformity, because correlation between hypermobility and increased first metararsal-phalangeal angles has been found [17]. Uhorchak *et al*. reported that female athletes with greater passive joint restraint indicated by generalized joint laxity greater than one standard deviation of the mean, had increased risk of ACL injury [19]. Similarly, Daneshmandi and Saki found that general joint laxity was higher in female athletes with ACL injury than in non-injured athletes [20]. Dynamic knee stability is affected by both passive (ligamentous) and active (neuromuscular) joint restraints [8]. In general, the passive joint restraints are not readily modifiable by nature. Flexibility training may offer some potential for modification to the passive restraint system [17].

The finding of ANOVA test showed a significant difference between group 1 (Beighton score of 0) and group 3 (Beighton score of =4) in Q angle. As a result of our study, the Q angle values were found to be greater in individuals who had higher Beighton scores. The primary cause of joint hypermobility is ligamentous laxity [21]. Therefore, the Q angle value may be expected to be higher in hypermobile individuals. This situation may lead to more knee symptoms and pathologies in future life.

Q-angle has been found to influence lower extremity kinematics. Alteration in the Q-angle changes the pattern of stress experienced by the patella cartilage [22] and thereby is the precursor to many knee injuries. Imbalance of components of the quadriceps muscle, which is inserted on the patella, can displace the patella, thereby effectively altering the Q-angle. Hart *et al*. [23] found that fatigue of the lumbar paraspinal muscles reduced vastus lateralis activation. Noakes [24] suggested that a pronated foot due to hypermobile feet could be implicated in knee problems. Because the Q-angle is formed between the vectors for the combined pull of the quadriceps femoris and the patella tendon [25], the strength of the quadriceps muscle is important. As for the Q angle, the lack of agreement within the literature as to what might be considered its “pathologic” limits is problematic. Some researchers regard Q angles greater than 20° to be pathologic, while others have suggested that values as low as 10°-14° are problematic in females [9]. This lack of consensus may be due in part to the absence of a standardized measurement position [26]. Methods often differ with respect to whether the subject is standing or supine.

We observed that the most common injury sites in lower extremity were ankle and knee. A possible reason for the vulnerability of the ankle to injury is its close proximity to the ball, which is the focus of activity in this sport. Therefore, the chances of ankle injury are highest when dribbling, shooting and tackling. Previous studies also showed that non-body contact is a primary mechanism of injury. Hawkins and Fuller [27] reported that injuries caused by non-body contact (59%) were more prevalent than injuries caused by body contact (41%). There seems to be a difference between male and female players in the body parts most often injured, the former having more ankle injuries and the latter having more knee injuries. The results of the National Collegiate Athletic Association [28] show that the three most commonly injured body parts for male players were ankle (20%), upper leg (17%) and knee (15%) and those for female players were knee (24%), ankle (21%) and upper leg (16%). Lindenfeld and Schmitt [29] found that the most commonly injured body part of male and female indoor soccer players were the ankle (23%) and the knee (23%) respectively. Hawkins *et al.* [30] suggested that the knee is very susceptible to injury from large forces produced by kicking the ball. It also is the centre of the lever arm of the leg, so it is susceptible to greater forces being transmitted from the trunk through the hip and from the ground through the foot and ankle.

Because Q angle is a composite measure of pelvic position, hip rotation, tibial torsion, patella and foot position, future research should focus on these variables. In addition, our subject number was relatively small. Future studies with a large scale, different sports, different age groups and activity levels are needed.

CONCLUSION

Joint hypermobility is an important factor in musculoskeletal pathologies. Q angle measurements may be partially definitive to reveal the relation between knee pain and joint hypermobility. Correlation between joint hypermobility and Q angle measurements proportionally with increasing Beighton score values was determined. Thus, it can be suggested that evaluation of Q angle measurement among hypermobile individuals may have prognostic value for probable knee pathologies which may appear in future. Clinically, this has implication for both preseason screening and clinical treatment of subjects or patients and corrective and prevention program from coaches is needed. Therefore, it may be appropriate to individualize training programmes for injury prevention as it is already recommended for other training contents-for example, conditioning training.

REFERENCES

1. Schiff, M.A., C.D. Mack, N.L. Polissar, M.L. Levy, S.P. Dow and J.W. Okane, 2010. Soccer Injuries in Female Youth Players: Comparison of Injury. Surveillance by Certified Athletic Trainers and Internet. J. Athletic Training, 45(3): 238-242.
2. Wong, P. and Y. Hong, 2005. Soccer injury in the lower extremities. Br J. Sports Med., 39: 473-482.
3. Pritchett, J.W., 1981. Cost of high school soccer injuries. Am. J. Sports Med., 9: 64-6.
4. Yde, J. and A.B. Nielsen, 1990. Sports injuries in adolescents' ball games: soccer, handball and basketball. Br J. Sports Med., 24: 51-4.
5. Bahr, R. and T. Krosshaug, 2005. Understanding injury mechanisms: a key component of preventing injuries in sport. Br J. Sports Med., 39: 324-9.
6. Daneshmandi, H. and C. Shacklady, 2002. Hip Rotation flexibility in professional athletes. Intl. J. Collected Academic Articles, pp: 80-86.
7. Larsson, L.G., J. Baum, S. Govind, M. Kollia and G.D. Kollia, 1993. Benefits and disadvantages of joint hypermobility among musicians. N. Engl. J. Med., 329: 1079-1082.
8. Myer, G.D., R.F. Kevin, M.V. Paerno, T.G. Nick and T.E. Hewett, 2008. The effect of general joint laxity on risk of anterior cruciate ligament injury in young female athletes, Am. J. Sports Med., 36: 1078-1080.
9. Sendur, O.F., G. Gulcan, T. Yildrim, E. Ozturk and A. Aydeniz, 2006. Relationship of Q angle and joint hypermobility and Q angle values in different positions, Clin. Rheumatol., 25: 304-308.
10. Cameron, K.L., M. Duffey, T.M. DeBerardino, P.D. Stoneman, C.J. Jones and B.D. Owens, 2010. Association of Generalized Joint Hypermobility with a History of Glenohumeral Joint Instability, J. Athletic Training, 45(3): 253-258.
11. France, L. and C. Nester, 2001. Effect of errors in the identification of anatomical landmarks on the accuracy of Q angle values. Clin. Biomech., 16: 710-713.

12. Grelsamer, G.P. and C.H. Weinstein, 2001. Applied biomechanics of the patella. Clin. Orthop., 389: 9-14.
13. Faude, O., A. Junge, W. Kindermann and J. Dvorak, 2006. Risk factors for injuries in elite female soccer players, Br J. Sport Med., 40: 785-790.
14. Beighton, P., 1993. The Ehlers Danlos syndromes. In: Beighton P (ed) McKusick's heritable disorders of connective tissue, 5th edn. Mosby, St. Louis, pp: 206.
15. Shultz, S.J., A.D. Nguyen and R.J. Schmitz, 2008. Differences in lower extremity anatomical alignment and postural characteristics in male and females between maturation groups, JOSPT, 38: 137-149.
16. Pefanis, N., X. Papaharalampous, G. Tsiganos, E. Papadakou and P. Baltopoulos, 2009. The effect of Q angle on ankle sprain occurrence, Foot and amp; Ankle Specialist, 2: 22-26.
17. Barber, K.D., K.R. Kevin, G.D. Myer and T.E. Hewett, 2009. General joint laxity associated with increased medial foot loading in female athletes. Athletic Training, 44(4): 356-362.
18. Decoster, L.C., J.C. Vailas, R.H. Lindsay and G.R. Williams, 1997. Prevalence and features of joint hypermobility among adolescent athletes. Arch Pediatr Adolesc Med., 151: 989-992.
19. Uhorchak, J.M., C.R. Scoville, G.N. Williams, R.A. Arciero, S.T. Pierre and D.C. Taylor, 2003. Risk factors associated with noncontact injury of the anterior cruciate ligament: a prospective 4-year evaluation of 859 West Point cadets. Am. J. Sports Med., 31: 831-842.
20. Daneshmandi, H. and F. Saki, 2009. The study of static lower extremity posture in female athletes with ACL injuries. Sport Medicine, 1: 75-91.
21. Grahame, R., 1999. Joint hypermobility and genetic collagen disorders: are they related? Arch Dis. Child., 80: 188-191.
22. Pukree, T., A. Govender, K. Govender and P. Naidoo, 2007. The quadriceps angle and incidence of knee injury in Indian long distance runners, SAJSM, 19(1): 9-11.
23. Hart, J.M., J.M. Fritz, D.C. Kerrigan, E.N. Saliba, B.M. Gansneder and C.D. Ingersoll, 2006. Reduced quadriceps activation after lumbar paraspinal fatiguing exercise. J. Athletic Training, 41(1): 79-86.
24. Noakes, T., 2003. The Lore of Running. Leeds, UK: Human Kinetics.
25. Livingston, L.A., 1998. The quadriceps angle: A review of the literature. J. Orthop Sports Phys. Ther., 28: 105-9.
26. Caylor, D., R. Fites and T.W. Worrell, 1993. The relationship between Q angle and anterior knee pain syndrome. J. Ortho Sports Phys. Ther., 17: 11-16.
27. Hawkins, R.D. and C.W. Fuller, 1999. A prospective epidemiological study of injuries in four English professional football clubs. Br J. Sports Med., 33: 196-203.
28. Soccer injury rates continue five-year climb, 1993: 5. The NCAA News.
29. Lindenfeld, T.N. and D.J. Schmitt, 1994. Incidence of injury in indoor soccer. Am. J. Sports Med., 22: 364-71.
30. Hawkins, R.D., M.A. Hulse, C. Wilkinson, *et al.*, 2001. The association football medical research program: an audit of injuries in professional football. Br J. Sports Med., 35: 43-7.