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Relationship Between Q Angle and Knee Injuries Prevalence in Elite Volleyball Players

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Abstract: Recent study was performed to determine relationship between Q angle and knee injury prevalence in 70 elite volleyball players (35 male and 35 female, age of 26.43 ± 3.56 years old and volleyball background of 7.32 ± 1.23 years) with no musculoskeletal pathology that influence the Q angle. Participants fulfilled contest form and injury prevalence was collected by standard Australian injury questionnaire. The Q-angle was measured using a universal Goniometer with the subject in the erect weight-bearing position. Injury prevalence was reported 12.52%, 11.89%, 11.53% and 11.25% in right and left knee in male and female respectively. Mean average and standard deviation of Q angle was 12.34 ± 2.36° for right and 12.48 ± 2.62° for left leg. Results of pair t-test showed no significant differences between right and left Q angle in male and female but independent t test showed significant differences between right legs in male and female as well as left. Significant relationship was determined between Q angle and injury prevalence using chi-square tests.

Keywords: Volleyball, Q Angle, Knee Injuries

1. Introduction

Volleyball is considered as one of the most exciting sports with more than 150 countries as the member of FIVB and approximately 200 million professional players all over the world [1]. Although In volleyball two teams are separated by net and it's considered as a non-contact game, it seems that injury prevalence should be low, but fast movement, forceful jumping and landing as well as game's position of players introduce it as a high rate injury sport [2]. Studies show that injury prevalence pattern in volleyball is repetitive and similar between males and females [2-5]. The most prevalent volleyball injuries are knee and shoulder overuse injuries as well as ankle sprain [6]. The knee joint is a complex synovial joint of the condylar variety stabilized by ligaments and muscles. Almost 50% of musculoskeletal injuries in volleyball are reported in knee joint [7]. The quadriceps angle (Q angle) is an important parameter to assess patellofemoral mechanics and is thus of great interest to clinicians as well as sport trainers. Actually, it is a clinical measure of the alignment of the quadriceps femoris musculature relative to the alignment of the underlying skeletal structures of the pelvis, femur and tibia [8, 9]. First, Brattstrom (1964) described Q angle as an angle formed between the ligamentum patellae and the extension of the line formed by the quadriceps Femoris muscle resultant force with apex at the patella. The value of the Q angle is dependent on the relative positions of the ASIS, center of patella (CP) and the tibial tuberosity (TT), the three bony points used to measure it. The Q angle has come to be accepted as an important factor in assessing knee joint function [10]. An increase in the Q angle beyond the normal range is considered indicative of extensor mechanism misalignment, and has been associated with was Patellofemoral pain syndrome, knee joint hyper mobility, and patellar instability [11, 12]. It has also been suggested that an abnormal Q-angle may also influence neuromuscular response and quadriceps reflex response time, an Aetiological factor in patella femoral pain syndrome [13].

The role of Q angle in assessing lower-extremity injuries in sports has been documented [14]. There is a paucity of literature about the Q angle in Iranian populations, especially in elite athletes playing certain sport fields. The purposes of this study are threefold. First, to determine bilateral variability of Q angle, second analyzing significant differences in the Q-angle and third to determine relationship between Q angle with knee injuries in professional elite male and female volleyball players of Iran.

2. Methods

The subjects for the study were normal healthy volunteers and elite volleyball players of Iran national team. The procedure was explained for subjects who then signed an informed consent form. Ethical clearance for the study was obtained from the Institutional Ethical Review Board (IERB) and the procedures were executed according Helsinki Declaration (1957). A total of 70 subjects (35 males and 35 females) with the age of 26.43 ± *3.56* years old and volleyball background of 7.32 ± 1.23 years were included in the study. In order to collect knee injuries Australian Standard Sport injury questionnaire including anatomical position of injury, injury type and injury severity were fulfilled by participants. Any subject with a history of the following conditions was excluded from the study: 1) Fracture of the lower limb, chronic knee pain, dislocation of the patella and spinal cord pathology with lower limb involvement. 2) Anterior or re-tropatellar pain when performing at least two of the following activities: ascending stairs, being seated for long periods, upon squatting, kneeling or jumping. 3) Any history of surgery on the knee, clinical evidence of meniscal injury, ligamentous instability and patellar tendinitis.

2.1. Measurement of the Q Angle

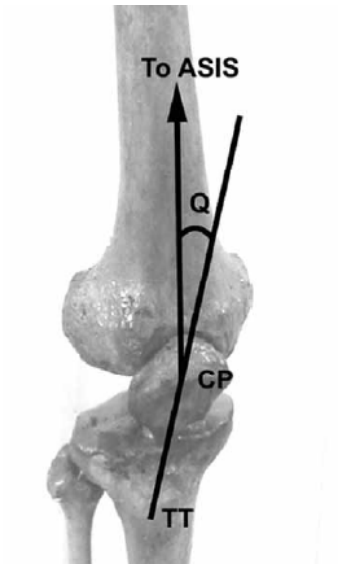

Figure 1. *Illustration of Q -angle measurement method.*

Data collection required one testing session lasting maximum 20 minutes per participant.

The measurement of the Q angle was performed with the subject supine and keeping the pelvis square. The legs were extended at the knee joint with the quadriceps muscle relaxed. The feet were placed in a position of neutral rotation, such that the toes were pointing directly upwards and the feet were perpendicular to the resting surface. The following bony landmarks were marked with a marker pen: ASIS, CP and centre of the TT. The outline of the patella was drawn with a marker pen, after palpating the borders and making sure that the skin was not stretched in doing so. The CP was defined as the point of intersection of the maximum vertical and transverse diameters of the patella. The point of maximum prominence was defined as the centre of the TT. A line was drawn from the CP towards the ASIS using the straight edge of a measuring tape. Another line joined the centre of the TT and the CP. The second line was extended upwards. The angle formed between the above two lines was defined as the Q angle and was measured with a Goniometer (Figure 1).

2.2. Statistical Analysis

The mean and standard deviation were determined for the Q angle values for males and females. To determine variability between left and right leg in males and females, differences between right leg of males and females as well as left leg of males and females and also differences between Q angle and knee injuries, Paired t-test, independent t-test and chi-square test was performed respectively in male and female. All statistical analysis was performed using SPSS version 18.0 for Windows ($p < 0.05$).

3. Results

Table 1 shows values of Q angle in all subjects with respect to right and left leg as well as gender differences. The average Q angle value of all subjects was 12.34 ± 2.36. The mean values were found to be higher in females (14.29 ± 1.88) as compared to males (10.35 ± 1.45).

Table 1. *Q angle values of left and right legs in elite volleyball players.*

Parameter	subjects (n)	Right (mean ± SD)	Left (mean ± SD)
Q angle	All (n = 70)	12.34 ± 2.36	12.48 ± 2.62
	Male (n = 35)	10.78 ± 1.45	10.35 ± 1.87
	Female (n = 35)	14.39 ± 1.88	14.38 ± 1.65

Results of paired sample t-test are shown in table 2. According to this table no significant differences were observed between right and left legs in male and female volleyball players. This table somehow investigates asymmetry of Q angle between dominant and non-dominant leg in which Q angle is symmetric in both male and female.

Table 2. *Paired sample t-test of Q angle in right and left leg in elite volleyball players.*

Parameter	T	df	Sig.
Left male-Right male	1.67	34	0.71
Left female-Right female	1.54	34	0.63

Table 3 shows results of independent t-test of male and

female volleyball players with respect to symmetric lower limbs. Significant differences were observed between right legs of male and female as well as left lower limbs.

Table 3. *Independent t-test of Q angle in male and female in elite volleyball.*

Parameter		t	df	sign
Q angle	Left male Left Female	3.54*	68	0.000
Q angle	Right Male Right Female	4.23*	68	0.000

*significant differences p<0.05

Collected injuries showed that knee injuries are of the most prevalent anatomical position prone to injuries in right and left knee of male and female 12.52%, 11.89%, 11.53% and 11.25% respectively.

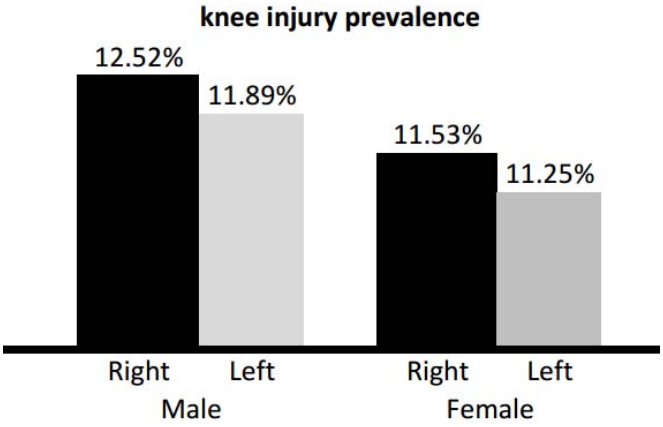

Figure 2. *Knee injury prevalence in male and female due to right and left leg.*

Result of chi-square tests showed significant relationship between Q angle and injury prevalence in right and left leg in both groups of male and female (Table 4).

Table 4. *Pearson chi-square tests of Q angle and knee injury prevalence in elite volleyball players.*

	Value	Sig.
Pearson chi-square	12.45*	0.001

*significant differences p < 0.05

4. Discussion

The purposes of this study are threefold. First, to determine bilateral variability of Q angle, second analyzing significant differences in the Q-angle and third to determine differences between Q angle knee injuries in professional elite male and female volleyball players of Iran. Though numerous studies on the Q angle have been conducted worldwide, relatively few of them have focused on its bilateral variability. Minor bilateral variations of bodily structures are a rule rather than an exception. However, significant differences warrant closer scrutiny. Hahn and Folds pang were among the first investigators to study of the bilateral variability in the Q angle [14]. Some studies have documented similar bilateral variations [9, 15-17]. Showing that the mean Q angle on the right side was greater than that on the left [14, 15, 17] and in some others Q angle was more on the left as compared to the right [9, 16]. In only two of the studies were these differences significant [15, 16]. In the present study the mean Q angle was greater on the right side as compared to the left but this difference was not statistically significant (Table 3).

There were significant differences between Q angles in right leg of male and female as well as left knee.

Women have consistently been found to have larger Q angles than men and are more often affected by patellofemoral problems [18-21]. This is possibly due to an increased pelvic width, shorter femur length, or femoral neck anterversion [12, 22]. Some investigators have found that Q angles greater than 15" for men and 20" for women are more commonly associated with pathological conditions of the Patellofemoral joint [23, 24].

A woman's wider hips create a more pronounced angle between the pelvis and the knee (called the quadriceps angle or Q-angle) because the femur (thigh bone) is positioned at a more oblique angle than the femur of a man [25]. A large Q-angle causes the knee bone (patella) to be more off center from the tibia (shin bone). Tracking of the patella against the femur is dependent on direction of the force produced by the quadriceps. With a wide Q-angle, there is more lateral movement of the patella as the quadriceps contract, which can put female runners at a greater risk for knee injuries than male runners. A larger Q-angle can also put women at a mechanical disadvantage when running.

Finally significant differences between Q angle value and knee injuries were found in both male and female groups. Perhaps it could be explained through force applied on knee during forceful jumping and landing in volleyball performances. The Q angle represents the resultant force of the quadriceps Femoris muscle group on the patella relative to the alignment of the patellar ligament [26, 27]. The Q angle creates a lateral force vector on the patella and predisposes the patella to lateral displacement during activation of the quadriceps [28]. The magnitude of this lateral force vector and the tendency for lateral displacement of the patella are believed to increase as the Q angle increase [29]. An increase in the Q angle may also cause an increase in pressure between the patella and the underlying lateral femoral condyle during activation of the quadriceps, perhaps it will be a good predictor for knee injuries specially sports with various jumping and landing [27].

5. Conclusion

According to high intensity nature of volleyball movement as well as anatomical structure of knee complex, there are great concerns about knee injuries prevalence in volleyball. Results of this article would be beneficial for volleyball players which are at great risk of knee injuries because of high impact forces resulting from forceful jumping and landing. It is recommended to volleyball coaches and players to pay attention in evaluating Q angle values with respect to gender and dominant leg to find out whether athletes are susceptible

to knee injuries. More researches are needed to investigate other risk factors in knee injuries in volleyball players.

References

[1] Beneka A, Malliou P, Gioftsidou A, Tsigganos G, Zetou H, Godilas G.. Injury incidence rate, severity and diagnosis in male volleyball players, *Sport Sci Health*, 2009, 5: 93-99.

[2] Verhagen E, Van der Beek AJ, Bouter L, Bahr R, Mechelen W. 2004. A one season prospective cohort study of volleyball injuries. Br J Sports Med, 2004, 38 (4): 447-481.

[3] Plawinski M. P. An analysis of the different spike attack arm swings used in elite levels of men's volleyball. A thesis submitted to the school of kinesiology and health studies in conformity with the requirements for the degree of master of science, Queens university kingstone, Ontario, Canada, 2008.

[4] Ferretti A, De carli A, Fontana M. Injury of suprascapular nerve at the spinoglenoid notch, the natural history of infraspinatus atrophy in volleyball players. Am J Sport Med, 1998, 26 (6): 759-763.

[5] Solgard L, Nielsen AB, Moller-Madsen B, Jacobsen B. W, Yde J, Jensen J. Volleyball injuries presenting in casualty: A prospective study. Br J Sports Med, 1995, 29: 200-204.

[6] Fattahi A, Ameli M, Sadeghi H, Mahmoodi B. Relationship between anthropometric parameters with vertical jump in male elite volleyball players due to game's position, J. Human Sport & Exercise, 2012, 7 (3): 714-726.

[7] Baker MM, Juhn MS. Patellofemoral pain syndrome in the female athlete. Clin Sports Med, 2000, 19: 315-329.

[8] Rauh MJ, Koespsell TD, Rivara FP, Rice SG, Margherita AJ. 2007. Quadriceps angle and risk of injury among high school cross country runners. J Orthop Sports Phys Ther, 2007, 37: 725-733.

[9] Livingston LA. The quadriceps angle: A review of the literature. J Orthop Sports Phys Ther, 1998, 28: 105-109.

[10] Smith TO, Hunt NJ, Donell ST. 2008. The reliability and the validity of the Q-angle: a systematic review. Knee Surg Sports Traumatol Arthrosc, 2008, 16: 1068-1079.

[11] Sendur OF, Gurer G, Yildirim T, Ozturke E, Aydeniz A. Relationship of Q angle and joint hypermobility and Q angles in different positions. Clin Rheumatol, 2000, 25: 304-308.

[12] Smith TO, Davies L, O'driscoll ML, Donell ST. An evaluation of the clinical tests and outcome measures used to assess patellar instability. J Knee, 2008, 15: 255-262.

[13] Chester R, Smith TO, Sweeting D, Dixon J, Wood S, Song F. The relative timing of VMO and VL in anterior knee pain: a systematic review and meta-analysis. BMC Musculoskelet Disord, 2008, 9: 64.

[14] Hahn T, Foldspang A. The Q-angle and sport. Scand J Med Sci Sports, 1997, 7: 43-48.

[15] Livingston LA, Spaulding SJ. OPTOTRAK Measurement of the Quadriceps angle using standardized foot positions. J Athl Train, 2002, 37: 252-255.

[16] Sra A, Ba T, Oo J. Comparison of bilateral Quadriceps angle in asymptomatic and symptomatic males with anterior knee pain. Internet J Pain Symptom Cont. Palliative Care, 2008, 6: 1.

[17] Byl T, Cole JA, Livingston LA. What determines the magnitude of the Q angle? A preliminary study of selected skeletal and muscular measures. J Sport Rehab, 2000, 9: 26-34.

[18] Fredericson M., Yoon K.. Physical examination and patellofemoral pain syndrome. Am J Phys Med Rehab, 2006; 85: 234–243.

[19] Grelsamer RP, Dubey A, Weinstein CH. Men and women have similar Q angles: a clinical and trigonometric evaluation. J Bone Joint Surg, 2005, 87: 1498–1501.

[20] Herrington L, Nester C. Q-angle undervalued? The relationship between Q-angle and medio-lateral position of the patella. Clin Biomech, 2004, 19: 1070–1073.

[21] Thomee R, Renstro¨m P, Karlsson J, Grimby G. Patellofemoral pain syndrome in young women. I. A clinical analysis of alignment, pain parameters, common symptoms and functional activity level. Scand J Med Sci Sports, 1995, 237–244.

[22] Waryasz GR, Mcdermott AY. 2008. Patellofemoral pain syndrome (PFPS): a systematic review of anatomy and potential risk factors. Dyn Med, 2008, 26: 7-9.

[23] Laura H. Lathinghouse, Mark H. Trimble. Effects of Isometric Quadriceps Activation on the Q-angle in Women before and After Quadriceps Exercise, Journal of Orthopaedic & Sports Physical Therapy, 2000, 30 (4): 211-2 16.

[24] Emami MJ, Ghahramani MH, Abdinejad F, Namazi H. Q-angle: an invaluable parameter for evaluation of anterior knee pain. Arch Iran Med, 2007, 10: 24–26.

[25] Conley S, Rosenberg A, Crowninshield R. 2007. The female knee: anatomic variations. J. Am. Acad. Orthop. Surg, 2007, 15 (1), 31–36.

[26] Dhaher YY, Kahn LE. The effect of vastus medialis forces on patello- femoral contact: a model-based study. J. Biomech. Eng., 2002, 124: 758–767.

[27] Thor F. Besier a, MichaelFredericson a, GarryE. Gold b, Gary S. Beaupre´ d, ScottL D. Knee muscle forces during walking and running in patellofemoral pain patients and pain-free controls, Journal of Biomechanics, 2009, 42: 898–905.

[28] Elias JJ, Bratton DR, Weinstein DM, Cosgarea AJ. Comparing two estimations of the quadriceps force distribution for use during patellofemoral simulation. J. Biomech, 2006, 39: 865–872.

[29] Zhang LQ, Wang G, Nuber GW, Press JM, Koh JL. In vivo load sharing among the quadriceps components. J. Orthop. Res. 2003, 21, 565–571.