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EVALUATION OF PATELLA'S DEVIATION FROM ANATOMICAL STANDARD BY BIOMECHANICAL STUDY OF A – ANGLE

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ABSTRACT

Background: The situation of the patella to the anterior tibial tuberosity was introduced as the A- angle. If the condition of the patella or kneecap, whereby be in an abnormal position in relation to the femur or tibia it causes pain in the knee. The aim of the present study was to biomechanical evaluation of patella's deviation from anatomical standard as the knee's A – angle among football players before and 5 months after anterior cruciate ligament (ACL) reconstruction.

Materials and Methods: The method of this research is quasi experimental research. A- Angle was obtained and evaluated among forty injured (ACL tear) football players who played in clubs (leagues) of Iran. Digital X ray was done as standing position for them and the A-angle was measured and analyzed with specific software (Marco). Then data analyzed by SPSS software (Ver 19) and paired t.test was used.

Results: The results indicated that there is a significant difference between the A – angle scores in pre - test and post - test in both legs (P<0.05).

Conclusions: It seems that knee's A-Angle increases after ACL tear so other knee injuries may be impacted. Then A - angle can be a good measure of peak torque the knee's extensor that generates in order to increase intensity and power of the skills such as shooting. If A- angle adds to the medical check list of athletes, it will help to coaches and club administrators to attract and reject them.

Keywords: A-Angle, Football players, patella, Marco software.

INTRODUCTION

The knee is an incongruous joint which is supported by sub joint structures such as meniscus, and ligaments in order to keep the balance between stability and movement in the joint. The knee joint is composed of three bones in the thigh bone (femur), the main bone of the lower leg (Tibia) and knee –cap (Patella). The position of the patella in the knee joint helps to increase the torque of muscle extensors of the knee. Biomechanically the patella was established as a complex bone designed to lengthen the moment arm of the knee extensor mechanism and thus increase knee extensor torque output (1). Increasing in the knee extensor torque output is very important in some technique such as kicks or shooting in football or Futsal. If the condition of the patella or kneecap, whereby be in an abnormal position in relation to the femur or tibia it causes pain in the knee. Then typically displacing a patella at one or one-and-a-half times its length out of place or more, this condition can result in pain and additional problems, such as patellar dislocation, traumatic failure of a supporting ligament and etc. Initially, the deviation of the patella in standard position was introduced as A- angle (2). One possible etiological factor that has been identified is malaligament of the patella to the tuberosity of the tibia. Recently, a clinical method to assess patellar malaligament has been proposed – the A- angle (3). This angle measures and make by a joint of a line which divided the patella bone in two parts in length, and the line that is drawn from tibia anterior tuberiosity to the lower pole of the patella bone (see picture 1). Angles more than 35 degrees cause pain in patella bone – femur (4,5&6). The A- angle has been proposed as a sensitive quantitative measure of patellofemoral joint alignment (7). On the other hands, the complexity of the design of the knee joint and the fact that it is an active

weight-bearing joint are factors in making the knee one of the most commonly injured joints. Athletes who participate in high demand sports like soccer, football, and basketball are more likely to injure their anterior cruciate ligaments (ACL). Changing direction rapidly or landing from a jump incorrectly can ACL tear (8). Statistical results had shown that 80 to 250 thousand of ACL injuries occur yearly that the most of them have 15 to 25 years old (9).So tear of the ACL may change the kneecap or the situation of the patella or A – angle. There is little study about A – angle and effect of ACL reconstruction, so the researcher want to know that whether A – angle change in ACL tear and come back to normal position after reconstruction?

MATERIALS AND METHODS

The method of this research is quasi experimental research. Statistical population of present research includes all of the adult football players (Men) in the first league of Iran. The method of selection of samples is purposive sampling. In this way and according to aim of research, football players in the first league of Iran who have ACL tear were voluntary selected after primary visiting by a physiotherapist, orthopedic surge and radiologist. Then 40 of them (between 20 to 27 years) were chosen. Regarding to the hypothesis of the research, tools of the present study were:

1-The direct digital X-Ray machine model symphony GMI (630MA, flat panel, 17*14 inch & telescopic tube) made from Italy was used. After taking x-rays, results are analyzed by a group of specialists and were sent to the researchers.

2-Marco Pacs software; Marco (Medicine And Revolutions) founded at early 21th century, with the vision of market leadership in PACS and medical computer aided network design field.

Football players who encounter ACL tear were surged as ACL reconstruction (bundle method). The present study was performed in ***Mehragan*** *(Knee Rehabilitation Clinic, Mashhad, Iran)* in season of 2013 – 2014. Delimitations of the study consisted of ACL tear without other knee injuries and surgery method, s (bundle method). Of course all the patients were selected among men because Iran's women football league is not professional and ACL tear rarely take place among them.

METHODOLOGY

40 Injured football players (20 of them have right leg and others have left leg ACL tear) were visited by a proficient physiotherapist of the team researchers. After approving ACL tear and without other injury, he

introduced them to orthopedic surge in order to check and reconstruction them. Injured football players who accepted to contribute to present research filled of two forms and signed them. Secondly, and before surgery, they sent to the digital X ray clinic (Parsian Center) for taking pre – test X ray. Rehabilitation protocols were performed from first week to 20th week after reconstruction by proficient physiotherapist. These protocols were designed and carried out by a physiotherapist and a physical education coach. In the last, they were sent to the digital radiology center (Parsian Center). Standing X-rays were taken them in both times and analyzed by a proficient radiologist (same person). Then the results were sent to the researchers. After collecting information and data by the above method, they were analyzed by SPSS version 19. In order to analysis the data, the different statistical method was used to make appropriate conclusions from the data. In the descriptive way used statistics such as average, Standard Deviation, variance and frequency table and in the deductive way used for Klmogroph Smirnoph and paired t.test exams.

Moral consideration

Participants in this study were willing to cooperate voluntarily and with full satisfaction. For X-ray, they signed consent forms. The results of the research and the research questions related to the maintenance of a safe place and then become extinct.

RESULT

Table 1 shows mean and standard deviation of age, weight, height and BMI of subjects in the experimental group (Right and Left leg).

As they are shown in table 2 and figure 1 the mean of the right leg A – angle in experimental group pre – test and post - test are 4.91 ± 1.51 and 3.68 ± 1.12 and in left leg 5.33 ± 0.64 and 3.37 ± 0.66 respectively. The paired t. test results indicated that there is a significant difference between in the right leg A – angle and left leg A - angle of football players in the experimental group before and 5months after ACL reconstruction ($P<0.05$).

DISCUSSION

There is limited research about A – angle that has done in the past years. Some researchers were clinically studied on their samples (2,3,7&10) while a new tool to study was applied by present researcher. Based on the tables that showed, there is a significant difference in A – angle (both legs) among the football players in the experimental group (pre - test and post - test). Results of A – angle were obtained by Marco software, but other researchers (2,3,7&10) studied and measured with a goniometer about this angle. Marco software was easily provided A –

angle, but they drew the patella bone on the knee and lines in order to determine A – angle by ink marks. It is written by an investigator that "We were not able to locate the inferior patellar pole because of the thick patellar ligament attachment. Although the general identification of the inferior patellar pole was readily achieved, it was impossible, in our opinion, to locate a distinct prominence to mark for measurement purposes. Based upon findings in the study, the use of the A – angle to assess patellar position is not recommended. Because of the difficulty locating landmarks required to construct the A – angle, further study is needed before the A angle can detect changes in position postulated to occur as a result of treatment intervention" (3). Nevertheless, the results of this study were closer because the tools were precisely selected. Arno (1990), Diveta et al (1992) and Ehrat et al (1994) were studied in the past by ink marker but I used a new tool to study. Some of them (2,3&10) investigated about patients who suffer interior knee pain, but Ehrat et al (1994) and self et al (1996) studied among healthy and unhealthy people while in the present study we have evaluated this angle among football players who have ACL reconstruction. 40 men football players with ACL tear were studied in the present study while Arno (1990) presented a case study of an 11-year-old female with diffuse anterior knee pain. Self et al (1996) investigated in a healthy group (six persons) and 41 patients while other research was studied among thirty-six healthy subjects (12 male, 24 female) by Ehrat et al (1994). Thirty healthy subjects participated in research of Diveta et al (1992) that were 28 females and 2 males, as a control group and thirty patients who were 24 females and 6 males as an experimental group in that study. Arno (1990) reported that A – angle was 55 degrees and at the time of discharge it decreased to 13 degrees in his patient while the A –angle values were ranged from 11.8 to 23.5" by Ehrat et al (1994).

CONCLUSION

The standard position of the patella in the knee joint helps to increase the torque of extensor of the knee. It has explained the situation of the patella by the A – angle. Biomechanically the patella is established as a complex bone designed to lengthen the moment arm of the knee extensor mechanism and thus increase knee extensor torque output. As I showed by means before and after ACL reconstruction it is obviously determined that during the ACL tear, the A – angle was increased so other knee injuries may be impacted. Retrieval of this angle

through the surgery to normal angle is very important . Despite ACL reconstruction and changing in this angle, other angles in the knee joint biomechanically will change so the possibility of knee re-injury will be more . The A – angle of the knee can be a good measure of the healthy or unhealthy of the athlete's knee. Considering the A – Angle as one of the landmarks, club's medical team, can provide better advice to attract or reject the new players to the club administrators.

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Table 1: Statistical indexing

Group	N	Age	Weight	Height	Knee injury	BMI
Experimental Right leg	20	26.4±.7	68.05±0.78	171.1±1.8	ACL tear	23.2±1.1
Experimental Left leg	20	26.8±.9	65.1±0.82	169.3±1.6	ACL tear	22.67±1.22

Table 2: Paired t, test of the right and left leg A – angle among football players in experimental group (pre-test and post-test)

Experimental Group	Mean	SD	T	Df	P – value
Right leg Pre- test	4.91	1.51	8.081	19	0.0001
Right leg Post – test	3.68	1.12			
Left leg Pre- test	5.33	0.64	34.460	19	0.0001
Left leg Post – test	3.37	0.66			

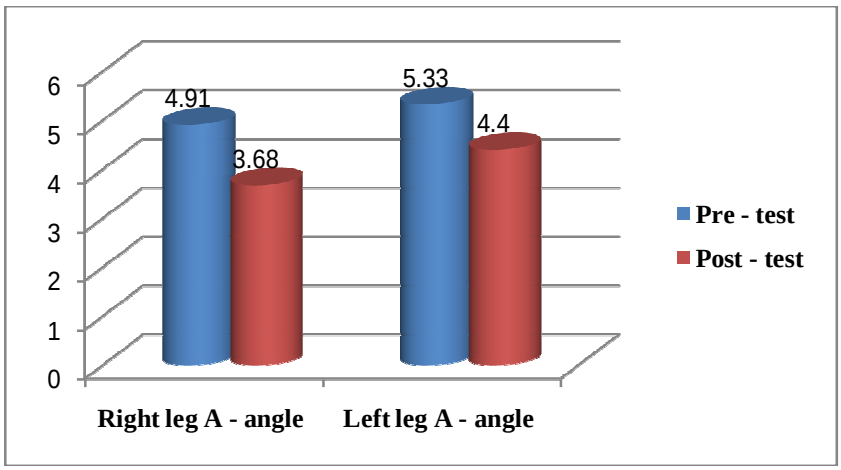
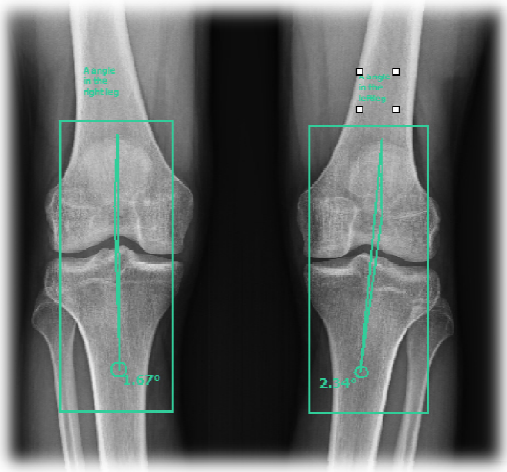


Figure 1: Means of the right and left leg A – angle among football players in experimental group (pre-test and post-test)



Picture 1: Drawing A – angle on the X ray picture through the Marco software