Behavior of Risk Factors for ACL Injury in Amateur Soccer Players

Eduardo M. Avila1, Jacqueline V. Castro2, Kelly Scaramussa2* and Joao L. Ellera Gomes2

1Department of Orthopedics and Traumatology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil
2Department of Orthopedics and Traumatology, Hospital de Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

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*Corresponding author: Kelly Scaramussa, Departament of Orthopedics and Traumatology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, Tel: 114-156-091-617; E-mail: kellyscaramussa@yahoo.com.br

Abstract

Background: An anterior Cruciate Ligament (ACL) tear is a very common injury, especially in individuals who participate in pivoting sports like soccer. Many factors that contribute to the risk of anterior cruciate ligament injuries have been investigated, but there is no consensus among them yet.

Purpose: The goal of this study was to note the behavior of femoral intercondylar notch, posterior tibial slope and hip rotation range of motion in male patients with ACL noncontact injury, suffered while practicing soccer.

Materials and Methods: We recruited 66 male patients aged 18 to 35 who had suffered noncontact ACL injuries while playing soccer. They were assessed for intercondylar notch view at 45 degrees of flexion. An independent qualified assessor took of both knees in standing AP view, lateral view and intercondylar notch view at 45 degrees of flexion. An independent qualified assessor evaluated images.

Results: Mean NWI was 0.281(0.033), mean slope was 8.85° (2.26) and the mean sum HROM was 64.8° (10.87). 13.6% of the patients had NWI 0.25, 31.9% had a 10° slope and 60.6% had HROM below 60°.

Conclusion: The results of this study may suggest an association between decreased hip rotation range of motion with the noncontact ACL injury. Otherwise, there is no association between both intercondylar notch width and posterior tibial slope with this kind of injury.

Keywords: ACL Injury; Intercondylar Notch; Posterior Tibial Slope; Soccer Players

Introduction

ACL is a very common injury [1,2]. It is estimated that more than 80,000 individuals face this injury annually only in United States [1-3]. The highest incidence occurs in individuals who participate in pivoting sports like soccer [1,3,4]. Often more males than females sustain this injury because of the greater absolute number of male participants in sports activities [2]. With an estimated cost for these injuries of almost a billion dollars per year, the ability to identify risk factors and develop prevention strategies has widespread health and fiscal importance [1-3].

Many risk factors of an ACL injury have been investigated, but there is no a consensus yet. Some of the most highlighted anatomic risk factors [1,3,6] mentioned are intercondylar notch width [7-16] and posterior tibial slope angle [6,16-18], since that most of the ACL injuries came from noncontact situations [1-5]. Recent studies have shown that hip rotation range of motion also plays an important role in noncontact ACL injuries in soccer players [19-23].

The goal of this study was to note the behavior of femoral intercondylar notch, posterior tibial slope and hip rotation range of motion in male amateur soccer players with noncontact ACL injury.

Materials and Methods

We recruited patients, who underwent ACL reconstruction surgery, in the Knee Surgery Unit at the Department of Orthopedics of Hospital de Clínicas of Porto Alegre for this cross-sectional study. All participants signed an informed consent form in accordance with ethical standards in sports and exercise science research [24].

Inclusion criteria were male sex, self-reported habit of playing soccer at least twice a week, age from 18 to 35, noncontact ACL injury history suffered while playing soccer and no more than two years between the injury itself and the assessment. Patients were excluded from the study if they had any other sort of lower limb orthopedic pathology, including a previous ACL injury.

To avoid interference in the results from a possible degenerative joint disorder caused by aging process, data leakage and elapsed time since surgery were both controlled. No control group was used in this study because we focused on searching the most prevalent factors capable of contributing to the event in patients who already suffered the ACL injury.

The assessment of intercondylar notch width and tibial slope posterior was performed by X-ray image. For each patient, X-ray was taken of both knees in standing AP view, lateral view and intercondylar notch view at 45 degrees of flexion. An independent qualified assessor evaluated images.

The intercondylar notch was assessed using the intercondylar Notch Width Index (NWI), which is obtained by dividing the intercondylar notch width by the width of the condyles (Figure 1) [15]. The posterior tibial slope was assessed on the lateral X-ray by drawing two lines: the first one indicating the longitudinal axis of the tibia and the other line taking a tangent from the mid-tibial plateau (Figure 2) [16,25]. Besides
the knee analysis, the internal and external hip rotation range of motion of both hips were clinically measured using a goniometer and recorded in degrees, with the aid of an assistant (who supported the lower limb evaluated).

Patients were in a supine position with the knee and hip in 90°. Internal and external hip rotation was measured from the neutral point (zero degree) to the upper limit, when the pelvis started to move it 20-22°. The average for the two hips was determined for each variable in order to minimize the effects of any measurement errors.

Statistical methods

Continuous variables were expressed as mean and standard deviation. Categorical variables were expressed as absolute and relative frequencies. Pearson’s or Spearman’s rank correlation coefficients was used to test the correlation between continuous or ordinal variables.

The significance level was set at 5% (p ≤ 0.05). All data were analyzed in the software SPSS (Statistical Package for the Social Sciences – IBM Software- Armonk-NY/USA) version 19.0.

Results

Sixty-six patients were enrolled on the study. Mean age was 28.4 (4.36) years old. Mean NWI was 0.281 (0.033). Nine patients (13.6%) had NWI ≤ 0.25 and none of the participants had NWI < 0.2 (Table 1).

Mean posterior tibial slope was 8.85° (2.26) and 21 of the patients (31.8%) had slopes greater than or equal to 10°. Mean sum of hip rotations (HROM) was 64.8° (10.87). Forty patients (60.6%) had slopes greater than or equal to 10°. It seemed that both the intercondylar notch width and posterior tibial slope were variables that are difficult to be measured, as men when compared with women. This could explain the higher prevalence of ACL injury in whites and women [26,27].

Table 1 lists descriptive statistics for these parameters. There were no statistically significant correlations between NWI, slope, HROM and age.

Discussion

ACL injuries clearly came from a different number of etiologies [1,3-5]. The role of environmental factors has been well established, particularly those that interfere with the degree of the foot adherence to the ground. Preventive measures are already in place in many different sports [2,19]. Several variables like hormonal, neuromuscular and anatomic factors have also been studied and all of them predispose to ACL injuries in some way [3,13,19]. Many of these risk factors have been studied to prevent sequels, like the osteoarthritis, because of their high cost of treatment as well as physical and psychological suffering of patients [1,3,4,19].

The intercondylar notch stenosis could be a non-modifiable anatomic factor [8-10]. Some studies have associated this variable with noncontact ACL injuries [8-10], but there is no consensus about this correlation [7-15]. Intercondylar notch width might be associated with race and sex too [26,27]. African Americans, on average, have wider mean intercondylar notch widths than their white counterparts, as well as men when compared with women. This could explain the higher prevalence of ACL injury in whites and women [26,27].

In addition, there are other variables that must be taken into consideration about intercondylar notch width. Some studies have used computerized tomography, others magnetic resonance imaging and some have relied only on simple X-rays [9,13], but the measurement results may vary considerably [7,9,12]. Hoteya, etal. [12], used X-rays and two different coronal magnetic resonance imaging slices to compare patients with bilateral ACL injuries, unilateral damages and people with no previously ACL injury. All three measurement methods results diverged and there was association only between bilateral injured and no injured groups. These authors suggested a cutoff point of 0.25 for magnetic resonance imaging measured NWI [12].

This considerable variation between studies may be due to variations in the X-ray angle and the measurement technique. Even when measured in millimeters, this assessment may lead to very different results, with consequent misinterpretation [7]. In other words, the difference between a patient with stenosis of the intercondylar notch and patient without stenosis is only about few millimeters, and errors can occur due to factors that are beyond the control of the examiner, such as X-ray angle and quality material.

The use of computerized tomography could be a possible way to fix these problems. This resource could indeed minimize the often-visual variance interpretation of X-rays and those measuring angles and linear distances related issues. On the other hand, this solution would require a standardized image acquisition and measurements and it imposes a significantly higher cost, which is very undesirable when the objective is prevention and detection of risk factors.

In common with the intercondylar notch, the posterior tibial slope is an anatomic factor associated with noncontact ACL injuries [6,16-18,25]. It seems to be acceptable that an increase in the posterior tibial slope would increase anterior tibial translation when subjected to an axial load, thereby increasing tension on the ACL [17]. In the same way, there is a huge number of papers that link a slope angle rise with anatomic factors have also been studied and all of them predispose to ACL injuries in some way [6,16-18,25]. In our study, the results point out a very weak association between injury of the ACL and changes in tibial slope. One-Third of our sample has shown a posterior tibial slope equal or greater than 10°. It seemed that both the intercondylar notch width and posterior tibial slope were variables that are difficult to be measured, standardized and subject to many errors and this may restrict their reproduction.
The influence of sports activities in hip mobility and the incidence of hip osteoarthritis in sports players over time have been studied by many authors [28-31]. Even though some authors have not observed the association of certain sporting activities with the decreased hip rotation range of motion [31], some studies showed lower IR (Internal Rotation) in senior soccer players than both controls and younger soccer players. These results may suggest that playing soccer could influence the decrease of hip IR and it could be observed early [29]. The limited hip rotation could result in increased rotational stress on the knee, there by contributing to ACL rupture [20,21]. This hip mobility decrease could be consequence of structural changes [22]. It was observed that many patients with hip mobility restrictions and ACL injuries had abnormal findings when their hips were X-rayed [22], and some recent papers have confirmed those findings [19,20,23,32].

The hip range rotation mean in non-soccer players could vary according to some studies. We can find values of ER (External Rotation) from 43° to 45° and IR means from 43 to 45.5° in senior and young control groups respectively [29] or even values between 68 and 80° in the sum of rotations [33]. The current sample shows that three in each five patients had the sum of the average of the hip rotation below 60°. This variable had a higher prevalence than other investigated factors in our study.

Although the age range of the recruited patients was relatively narrow, there was no correlation between age and HROM, suggesting that mobility does not reduce with age, in opposite of previous studies [20,29]. Furthermore, it seems that there was an association between ACL injury and hip rotation restriction in soccer players. If this reduced mobility is a consequence of soccer practice, perhaps prevention programs, including stretching exercises and hip mobility exercises could prevent or delay this outcome, but we did not find a specific exercise program for this disorder [20]. Nevertheless, if someone already has a hip rotational restriction when starting to play soccer, maybe the most appropriate strategy could be counseling and perhaps reconsider the choice of the sport in order to avoid ACL injury.

Hip rotational restrictions could be easily detected with a simple physical assessment, and this seemed to be the most associated variable with ACL injury in our sample, if compared with other variables investigated. On the other hand, intercondylar notch width and the posterior tibial slope angle showed a poor association with this injury. Those last two anatomic factors require a complex measuring system and they also show reproducibility problems that make them harder to apply in clinical practice.

The small number of our sample, with no control group limits this cross-sectional study. In order to confirm the results and answer many questions that remain, a prospective study is needed, investigating multiple potential risk factors.

Conclusions

The findings of this study showed that intercondylar notch width and posterior tibial slope might not be the most indicated tools to predict the risk for ACL injuries, perhaps because of the lack of the reproducible pattern of exam.

However, results of this study suggest that hip rotation decreased could be associated with noncontact ACL injury. Furthermore, the clinical measurement of hip range of motion seemed to be the easier assessment to search for risk factors of this injury than the other ones. Future researches could focus on variables like race and sex to predict the risk of ACL tears, especially because this is a multifactorial injury.

References


*Corresponding author: Kelly Scaramussa, Departament of Orthopedics and Traumatology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, Tél: 11-156-091-67; E-mail: kellyscaramussa@yahoo.com.br

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