Association between Anterior Cruciate Ligament and Femoroacetabular Impingement. Is There A Relationship Beyond Image?

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Abstract

Introduction: Anterior cruciate ligament (ACL) rupture may reach almost 50% of knee injuries within soccer players. On the other hand, femoroacetabular impingement (FAI) has been more frequently identified in active population, finding bone abnormalities around the femoral head causing cam impingement. Alpha angle is a common measurement within cam impingement, finding that an increase is related to a decrease of range of movement, favouring cam impingement. The aim is to provide a foundation for the future body of literature regarding hip pathologic abnormalities and “at-risk” hips in athletes with specific pathologies such as ACL injuries.

Methods: We retrospectively reviewed the anteroposterior pelvis radiographs of 29 elite male soccer players to determine the alpha angles of the hip (thus, 58 hips). 15 patients completed the ACL group, whereas the remaining 14 completed the control group of soccer players undergoing meniscus surgery alone. A blinded, sports medicine fellowship-trained orthopedic surgeon conducted measurements with experience in treating hip disorders.

Results: Mean alpha angle for the meniscus group was 56.93º (SD 16.58º), whereas the mean alpha angle for the ACL group was 58.40º (SD 13.31º). Mean alpha angle of the affected side hip was 62.8º (SD 13.36º), whereas mean alpha angle of the contralateral hip was 57.20º (SD 15.14º). No significant differences were found. But, pathological alpha angles were observed in ipsilateral hips to the injured knee (ACL), in more frequency than contralateral hips with statistically significant differences.

Conclusion: A significant relationship was observed between ACL injury and increased alpha angle in the ipsilateral hip. Soccer players should be considered as an at-risk population of hip deformities even with asymptomatic patients undergoing ACL surgery.

INTRODUCTION

One of the most frequent injuries in soccer players is anterior cruciate ligament (ACL) rupture, reaching almost 50% of knee injuries within this group of patients [1]. ACL rupture complicates playing soccer and therefore frequently requiring surgery for a prompt recovery and return to play. It is estimated that only in the United States 50,000 patients per year undergo reconstruction surgery of ACL [2].

Reducing the number of ACL injuries in young active patients should be the major goal in sports medicine [3]. Several publications over the last years have pointed out the relationship between biomechanical alterations of the hip and different lesion patterns of the knee, especially with ACL injury [3-9].

Femoroacetabular impingement (FAI) has been more frequently identified in active population, finding bone abnormalities around the femoral head causing cam impingement [10]. Alpha angle is a common measurement within cam impingement [11,12]. An increase in alpha angle is related to a decrease of range of movement, favouring cam impingement [11,13-17]. Recent studies have reported on a relationship between reduced hip ranges of movement in soccer players who have suffered ACL injuries, mainly of internal rotation [18].

The aim of the present study was to collect the alpha angles in patients who had undergone surgery for ACL injury and analyze whether their data was within normal limits with the aim of providing a basis for the future body of literature regarding hip pathologic abnormalities and "at-risk" hips in soccer players with specific pathologies such as ACL lesion. To this end, a comparison between soccer players with ACL or meniscus surgery without known hip pathology was performed.

METHODS

Fifteen patients were reviewed for the present study, all soccer players competing at a national level (Tegner 9) and being part of The Spanish Soccer Delegation’s Health Insurance Company offices under the Royal Spanish Football Federation. The control group was made with soccer players undergoing surgery for meniscal injuries without hip pathology, according to their past medical history, during the same period of study time. 14 soccer players completed the control group. Patients, who required surgery of both ACL and meniscus were included within the ACL group, excluding those who combined other type of lesions such posterior cruciate ligament injury. The present study involving human subjects received the appropriate ethics approval from our hospital. Patients were informed that data related to their case would be used for further investigation and signed an informed consent to be included (Table 1).

Surgical indication for all patients was complete ruptured ACL in the first group and meniscal tear or rupture for the control group.

Both groups performed during preoperative study an AP pelvic X-ray to assess alpha angle and to compare between both groups as well as with contralateral side of the injured knee. The radiographic imaging was performed by the same team and with the same material for both groups.

Alpha angle was measured following the guidelines described by Nötzli et al., in 2002 [12]. Alpha angle was considered positive when it exceeded 55º, as defined by Nötzli in accordance to several studies [12,19,20]. Alpha angle was measured in ACL operated patients comparing them to the control group undergoing meniscus surgery. Moreover, an analysis of the angles related to the affected knee side was performed within the ACL group.

All measurements were performed by an orthopedic surgeon specialized in hip surgery with more than 10 years’ experience, unknowing the origin of the X-rays, during one afternoon and repeating the process one week later in a different order.

Kolmogorov-Smirnov test was used to assess normality of both groups, observing that the meniscus group did not follow a normal distribution, whereas the ACL did. Therefore, non-parametric tests were used for the inferential study between both groups. Mann-Whitney U test was applied, giving non-statistically significant differences between surgery performed and alpha angle observed.

Chi-squared test was performed to evaluate any existing difference within alpha angles of ACL and meniscus groups

RESULTS

29 patients were included in the present study, thus 58 hips. Mean alpha angle for the meniscus group was 56.93º (SD 16.58º). Mean alpha angle for the ACL group was 58.40º (SD 13.31).

Alpha angle variable was rewritten as normal (<55º) or pathological (≥ 55º), studying the relationship of alpha angle in each studied group.

Within the meniscus group, 42.9% of hips had a pathological alpha angle (12/28). Within ACL group, pathological alpha angles were found in 60% of hips (18/30) showing no statistically significant differences (p=0.192).

Regarding the evaluation between affected side of ACL and alpha angle, 15 patients (30 alpha angles) were studied. Mean alpha angle of the affected side hip was 62.8º (SD 13.36), whereas mean alpha angle of the contralateral hip was 57.20º (SD 15.14).

Pathological alpha angles (>55º) were observed in 11/15 (73%) of hips ipsilateral to the injured knee (ACL), whereas the contralateral hips a pathological angle was found in 7 hips (46%). These data show significant differences between both hips. Besides, the affected limb showed significant differences with respect to the control group, showing a p value<0.001 (Figure 1).

Regarding internal rotation, the healthy side presented a mean value of 40.33º (SD 2.97), whereas pathological side had an internal rotation of 37.7º (SD 5.94). Kolmogorov-Smirnov test was statistically significant (p<0.05), thus the performed test a non-parametric to compare internal rotation within both groups. Mann-Whitney U test for independent samples was the preferred test for this comparison, obtaining non-significant differences (p=0.367). Therefore, no statistically significant differences of internal rotation between healthy and pathological hips were found.

DISCUSSION

A significant relationship was observed between ACL injury and increased alpha angle in the ipsilateral hip, without significant differences within internal rotation, in line with previous studies [3,18].

Previous studies have been published reporting the consensus of leading researchers that alterations in the kinetic chain of the trunk, hip, knee, ankle and foot contribute to ACL injury [3,6]. Future studies should focalize in analyzing the role and intensity in contribution of every structure mentioned. Recent jump and landing studies examining the biomechanical relationship between hip positioning and muscular fatigue in relation to knee kinematics have improved our understanding of the possible interactions between hip biomechanics and ACL injury [3,7,21].
Within these limitations, a reduced internal rotation could contribute, as Williams pointed out in 1978 regarding the alterations of pubis and hip, and later on have been stressed by studies carried out by Vernall or Larson [22-24]. In the present series no relationship between increased deformity and internal rotation alterations were observed.

Although differences were non-significant between patients with ACL injury and the control group (meniscal injuries), if the analysis is performed separately with ipsilateral or contralateral hips we observed that the injured knees with ACL ruptures had 73% of pathological alpha angle (>55º), whereas only 27% of patients with ruptured ACL presented normal alpha angles, being statistically significant and in line with the previous published study [3], whereas that the contralateral hip (the non-affected limb) showed identical figures (43%) to the hips within the meniscal group (42.9%), with no significant differences.

This fact could be explained due to patients with abnormally elevated alpha angles who may have diminished capacity at the hip to accommodate overall lower extremity internal rotation moments, potentially exposing the knee and the ACL to greater rotational stresses [3,25].

Several limitations must be taken into consideration when reviewing the present manuscript. Ours is a single-center and retrospective study. Despite being a relative small number of patients, an important advantage of the present manuscript is the homogeneity of the sample, as all patients were professional soccer players (Tegner 9) with over 10 years’ experience.

Another limitation to consider is the alpha angle measurement. Several authors have studied the importance of the deformity’s tridimensionality and sphericity, which would be better studied with magnetic resonance imaging (MRI) [26,27]. However, the lack of this resource to assess the whole deformity led us to set out the present study based on plain radiography. Axial view is undoubtedly the most sensible for cervicocephalic deformities of the femur, although AP view has shown to be accurate in the alpha angle measurement when compared to the gold standard, MRI [26]. Radiological studies have pointed out that measurements of alpha angle with AP pelvic X-ray are very like those obtained with cross-table lateral view [3,28].

With the observed results, we can conclude that physicians should take into consideration any possible cervicocephalic hip deformity when facing ACL ruptures in soccer players, in a 2:1 proportion, considering this population as a hip pathology-risk population.

REFERENCES
