

Possible Relationship Between an Increased Alpha Angle and the Anterior Cruciate Ligament Injury

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1. Abstract

1.1. Objective: The aim of this study is the literature review of the possible relationship between the ACL lesion and increased α angle as a possible predisposing factor.

1.2. Materials and Methods: A systematic review was performed of related articles to ACL injury and α angle measurement published between 2008 and 2018; The abstracts were processed by a single reviewer. Full text was obtained of those studies that met the inclusion criteria.

1.3. Results: 1084 studies were found which only 3 met criteria and were included in this systematic review. All the studies belonged to a level III of scientific evidence. The 3 studies reviewed, showed that patients with ACL injury presented a higher alpha angle in the ipsilateral hip to the lesion, being statistically significant in all of them.

1.4. Conclusion: In the literature, a relationship between hip α angle and anterior cruciate ligament injury was observed, instead of that results, more studies are mandatory to establish the role of the increased Alpha angle in the pathophysiology of the ACL lesion.

2. Introduction

The anterior cruciate ligament (ACL) is one of the most important ligaments of the knee [1] and provides anterior and rotational stability to the joint. It has also been seen that ACL rupture is up to three times more frequent in females, but the reason is still not well known [2].

The importance of the rupture of the ACL lies in the high incidence, being about 1 per 3000 people a year [3], occurring the 78% of these during sports practice (soccer, basketball, skiing or baseball) [4]. Anterior cruciate ligament tear tends to occur when the foot is anchored in the ground and the knee suffers a sudden internal rotation movement, losing one of the main stabilizing structures of the knee, resulting in joint instability that did not allow in many cases, to continue performing sport. ACL reconstruction is quite important because it increases the risk of meniscal tears and chondral lesions which can lead to early degenerative changes [5].

In recent years, many publications have linked certain biomechanical hip alterations related to knee injuries, in particular with the anterior cruciate ligament injury [6]. Specifically, FAI is a hip pathology that has gained importance in recent years, FAI CAM type was described as a deformity in the sphericity of the femoral head (typically assessed by the α angle), that produces pain and limited range of rotation in hip mobilization [7]. It has been seen that an increase in the alpha angle ($>55^\circ$) is related to a decrease in hip [8], but despite this, most remain asymptomatic [9]. An important association has also been found between the presence of FAI syndrome and sport practice. Continuous labrum microtrauma impact by femoral head shape shall produce the symptomatology that defines the syndrome [10].

In recent studies, an α angle $>55^\circ$ has been observed in 20% of asymptomatic volunteers who have practiced sports, objectified in an AP radiography. They also observed that in patients with anterior cruciate ligament injury, up to 70% of the ipsilateral hips to the lesion showed an alpha angle higher than normal measure-

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ment comparing opposed hip which shows up to 46%[11].

Due to the scarcity of existing literature on the subject, the increasing incidence of ACL injury and the increased interest and diagnosis of an abnormal hip alpha angle, the aim of this study is to perform a literature review of the relationship between the ACL tear and the presence of an increased angle (also known as offset or CAM type alteration).

3. Materials and Methods

A review of the literature was carried out in November 2018. PubMed and ScienceDirect databases were checked using the combination of the following keywords: alpha angle, offset, CAM, ACL. The studies published in the last 10 years (including those published in 2008) were filtered, obtaining 1084 results (41 publications in PubMed and 1043 in ScienceDirect).

We then considered all the titles and obtained 16 publications, of which 11 were removed because they were duplicated. Subsequently we made a complete review of the 5 remaining articles. After applying the inclusion and exclusion criteria described in (Figure 1), 3 articles were selected to perform this review.

The exclusion of the last two articles was due to the use of FAI clinical syndrome or the limitation in the internal hip rotation as a variable and possible risk factor for ACL injury, without taking measurements of patients' hip alpha angle.

Table 1: Principals results of bibliography.

Authors	Year	Sample	Alpha angle in ACL injury group	Alpha angle in non ACL injury group	P-value	Conclusion
OsmarValado Lopes Jr et al.	2017	80 Patients (41 ACL injury; 39 non-ACL injury)	70.31° (SD 13.92°)	58.55° (SD 13.95°)	P < 0.001	Patients with noncontact ACL injury presented a greater alpha angle when compared with the group without tear.
Marc Philippon et al.	2012	90 Patients (48 ACL injury; 42 non-ACL injury)	84° (SD 14)	59 (SD 7)	P < 0.0001	Important preliminary correlation between ACL injury and diminished femoral head-neck offset, as characterized by abnormal, elevated alpha angle.
Abolfazl-Bagherifard et al.	2017	217 Patients (127 ACL injury; 90 non-ACL injury)	56.1° (SD10.1)	49.3° (SD 9.4)	P < 0.001	The patients in ACL injured group showed a significant restriction in hip range motion and also a diminished femoral head-neck offset suggesting a possible role of these findings in the outcome assessed.

4. Results

In this literature review, 3 case-control studies are analysed. In all of them, the informed consent of all individuals participating was obtained.

Of the 2302 articles found with the first search, after making the selection by title and abstract and after applying the inclusion and exclusion criteria, 3 articles were included in our study. All of them are case-control studies, which belong to Level III of scientific evidence.

A total of 387 patients were included in this study with an average of 129 patients per study. The groups in which the study population were divided in all cases compared by age, BMI and type of injury, with no sex exceptions in 2 of them (one of the studies only included males). Referring the studied sample, 85.5% (331 patients) were men and 14.5% (56 patients) were women. The age range was between 17 and 60 years old (mean 33.5 years).

In all studies, patients with spontaneous ACL injury were considered and formed the "case group", with a total of 126 patients of our study (55.8%). The "control" group (44.2%) consisted of 175 patients, being a more heterogeneous sample: individuals with a healthy knee to patients with other injuries at knee level (meniscus injury, cartilage injury...). In all studies, those patients with previous lesion or hip surgery were excluded.

In two of the included studies, the alpha angle greater than 60° was considered pathologic, while in one of them, the minimum cut was established at 70°.

Lopes OV et al. [12], observed that 58.5% of the patients with anterior cruciate ligament injury had an alpha angle >70° (±13.92), compared to the control group, in which the 25.6% of the patients presented an alpha angle >70° (±13.95). In addition to the alpha angle, the presence of hip rotational limitation was evaluated, without revealing a significant difference between both groups (p 0.498 – p 0.685).

In the study carried out by Philippon M et al. [13], 94% of the patients with anterior cruciate ligament injury, showed an alpha angle >60° in contrast to the control group that only 35% of these patients showed this increased alpha angle.

The study realized by Bagherifard A. et al. [14], demonstrated the presence of an alpha angle >60° in 31% of patients with ACL rupture, compared to 11.1% of patients without injury. In addition to the alpha angle, the presence of hip rotational limitation was also evaluated, showing a statistically significant difference in ACL injury group (p<0.001) in all rotational directions, except in external rotation that did not show statistically significant differences.

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