



ORIGINAL ARTICLE

Hip Alpha Angle in Asymptomatic Population

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Abstract

Purpose: Hip osteoarthritis is related to the deformity caused by femoroacetabular impingement (FAI). This lesion is related too with an increased performance of sports activities, such as soccer. Alpha angle is a possible measurement of the deformity caused by FAI, especially Cam-type lesion. The purpose of the present study is to describe the alpha angle measured in AP and axial projections in a group of soccer players, being able to compare it with the general population and populations of adult soccer players.

Methods: Alpha angle was collected in a professional group of soccer players (mean age 12.7 years old) with a minimum sports practice of 5 years, to compare to the previously published, both in the general population and professional soccer players.

Results: Alpha angles in a population of 20 soccer players show pathological values ($> 55^\circ$) in 32.5% of the players. Pathological alpha angles described in general population are around 14%, whereas the adult soccer players are over 40%.

Conclusion: Alpha angle can be an objective value to detect at-risk players of developing FAI.

Keywords

Alpha angle, Femoroacetabular impingement, Hip deformity, Soccer, Young athletes

Introduction

Degenerative hip pathology is an increasing disorder in our population that generates important alterations

in the quality of life as well as increased health care costs [1]. It is estimated that the rate of primary or secondary hip osteoarthritis in Caucasians is 3-6% [2].

Murray in 1965 had already described that morphological alterations of the femoral head, such as femoroacetabular impingement (FAI), could contribute to the degenerative changes [3-5].

FAI includes several aberrant morphological alterations in the femur and in the acetabulum and the abnormal forces that are generated can be the cause for osteoarthritis [1]. The enlarged alpha angle measured in the cervico-cephalic transition is one of the variables that are more often used to calculate the deformities of this area, Cam-type lesions if the affected bone is the femur [1]. The presence of an increased alpha angle has been related to FAI, and therefore is considered that the pathological increased alpha angle can have a causative effect on the FAI [6].

Males participating in specific high-level impact sports (hockey, basketball, and possibly soccer) have shown a higher prevalence of CAM deformity, due to an increased risk of physeal abnormalities of the antero-superior head-neck junction that may result in a CAM deformity at skeletal maturity [7].

The purpose of the present study is to describe the alpha angle measured in AP and axial projections in a

group of soccer players, being able to compare it with the general population and populations of adult soccer players.

Material and Methods

Twenty volunteer soccer players were included in the present study, aging between 12 and 14-years-old. Inclusion criteria were players who have been playing for over 5 years, with patterns of intense training, attached to an official football league and affiliated to the National Football Federation. Inclusion criteria included minimum sports practice of 5 years and being affiliated to the federation. Exclusion criteria were previously recorded hip injuries.

In order to obtain the radiological images, we collected the images made within Soccer Players Health Care Insurance, in April 2017, collected for the follow-up of volunteers, who had no history of injury in any of the hips nor did they have a problem in the hips due to this discomfort.

All patients were submitted to an image study that included a weight-bearing AP and axial (frog leg) X-rays of both hips. The alpha angle in the AP projection as well as in the axial projection was measured in all patients.

An orthopaedic surgeon, hip specialist, with over 10 years experience, performed all measurements in two separated days (one-week difference) and in different order.

Sample size was calculated to be 19 cases, with a confidence level of 95%, statistical power 90%, precision of 15% and unilateral-type test.

Results

Twenty patients (all males) were included in the present study. The average age was 12.7 years old (+/- 0.67 SD, range 12-14). None of them presented previous history related to their hips.

The study included a complete soccer team, and thus all positions in the field were included. The average years of membership was 6.9 years (+/- 2.1 SD).

The mean alpha angle in the AP projection was 50.1° (SD 8.86) and in axial projection 52.9° (SD 10.08), without statistical differences ($p = 0.094$), however, when the cut-off for pathological results was set up at 55°, it was observed that in axial projection 13/40 were pathological: 32.5% and in AP 8/40: 20%, being these differences significant ($p = 0.037$).

Measurements of alpha angle in AP view were 50.50° and 48.52° in the different days of measurement, with no significant differences ($p = 0.157$). However, measured in the axial view, alpha angles had significant differences; 53.28° and 45.75° ($p = 0.0001$).

Discussion

In a young athletic population of 20 soccer players,

with a mean age of 12.7 years old, up to 32.5% of the group had pathological values of alpha angles. These figures are greater than those described in general population, between 10 and 15% according to Leunig, et al. [8].

Different studies have aimed to define the types of deformity in the general population [9,10]. Laborie, et al. a group of 2060 patients (mean age 18.6 years old) and observed rates of CAM-type deformity around 35% in men and 10% in women, whereas “pincer” deformities were 34% and 17% in men and women respectively [9].

Gosvig, et al. on the other hand, on a population of 4151 patients, observed rates of deformity in pistol grip of 19.6% in men and 5.2% in women [10]. However, different age groups must be taken into consideration. The study by Agricola, et al. [11] already warned that in soccer players such as ours, pathological alpha angles were observed in 26% of patients. However, the same study considered a pathological alpha angle > 60°.

On the other hand, when the cut-off of pathological angle was set up at > 55°, it represents 32.5% of hips in axial and 20% in AP views, statistically significant ($p = 0.037$).

With the observed results, it should be kept in mind that the alpha angle, although within normal hips it can be obtained in AP or axial X-rays without significant differences, within pathological hips it is important to take the measurement in an axial view, as data with higher averages are found and therefore represents a more sensitive measurement. The measurement in AP in hips with angles over 55° can represent false negative rates.

The intra-observer measurement showed significant differences (53.28° vs. 45.75°), $p = 0.0001$, in axial views; however, no significant differences were observed in AP view (50.50° vs. 48.52°; $p = 0.157$).

This element insists that the no-presence of significant differences in the AP projections, which have been found in axial, follows the same line of recommendation of performing an axial view.

Carslile, et al. compared the measurements of different parameters in plain radiology among different physicians with greater and less experience, observing some high indexes of intra-observer correlation (0.76 in frog lateral view for alpha angle), but fewer inter-observer indexes, with less than 0.55 of CCI, concluding that the variability in experience influences the measurements [12].

In line with the present study, Harris showed in his study that despite AP view is common in the clinical use, it is the projection that less correlates with femoral head deformities in patients with FAI [13].

Another study group carried out a MRI on a population of 200 volunteers, showed a CAM-type deformity

in 14% of people, being 3.5% bilateral. The study group described angles of $> 55^\circ$ with a decreased internal rotation of the hip [14].

Rakhra's study calculated the alpha angle with MRI using radial images and observed that, in patients with angles $< 55^\circ$ measured with X-ray, in 54% he observed angles $> 55^\circ$ with MRI. Authors concluded that simple radiological studies could underestimate pathological angles [15].

Regarding athletic populations, Kapron, et al. revised the X-ray signs of FAI in 67 football players, finding that in 95% of them there was at least one sign of CAM or pincer and in 50% there was at least one sign of both. This same study hypothesized that an increased load on the hip joint during exercise practice or an increase of the athlete's mass could justify this increase in deformities [16]. Studies like Gerhardt's showed a prevalence of 67% of radiological deformities with pathological alpha angle in an adult population of footballers [17], and Nepple [18] arrived at rates of 94% in players of the NFL. Larson also related the increase of the alpha angle with the increase of FAI symptoms [19].

In groups of very physically active people, Heil, et al. published a review of alpha angles in the military population, with angles of 51.89° left and 52.53° right and concluding that this isolated data lacked sense without the use of a clinic [20].

The meta-analysis study published in 2015 showed a clear relation between high-energy sports and deformities of the proximal femur. The activity could assume a risk 1.9 to 8.0 times higher in athletes compared to that of the control patients [7]. This deformity even changes the biomechanics of these patients, showing how they are even capable of varying their walking method and changes in the load points on the feet [6,21].

These changes were already proposed by Williams in 1978, when he related the pathology of the pubis, caused by an excess in rotation in this area by limitations due to lack of rotation in the hip [22].

Nevertheless, these studies were performed in adult groups, without reaching a clear conclusion regarding the cases of deformity or increase of alpha angle. It seems reasonable that alpha angle increases during the development period during adolescence. Taking this into consideration, if soccer players of 12-13 years old have already an increased alpha angle (26-32%) [11], these figures would be clearly higher in adults [7,14].

The most important finding of the present study is that it allows us to assess an objective data that can help detecting players at risk of a progressive increase of their deformity and thus of developing FAI. We can confirm, in an age group of 12-13 years old, that there are significant differences with the general population and we can begin a FAI screening in a selective group of patients.

Several limitations of the study must be taken into consideration. First, ours is a single-center study.

A further limitation is the very essence of the present work, where we must keep the context in mind, just as Heil noted [20]. At any rate the explanation of measuring and the specific population groups with similar activity, provides us with information in the search of behavioral patterns, which allow for a better diagnosis and management of these patients.

In conclusion, pathological measurements are observed with respect to the alpha angle in 32.5% of physically active asymptomatic population. It seems reasonable to think that in young players from 12-years-old, differences in alpha angles can be observed. There is a lack of prospective long-term and randomized studies to see the evolution and the possible effect that a pathological alpha angle can have.

Conflict of Interests

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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