SOCIEDADE BRASILEIRA DE ORTOPEDIA E TRAUMATOLOGIA

RBO REVISTA BRASILEIRA DE ORTOPEDIA

www.rbo.org.br

Original Article

A comparison study of radiographic and computerized tomographic angles in slipped capital femoral epiphysis☆

*Iberê Pereira Datti**, *Bruno Sérgio Ferreira Massa*, *Leandro Ejnisman*, *Nei Botter Montenegro*, *Roberto Guarniero*, *Kodi Edson Kojima*

Universidade de São Paulo, Faculdade de Medicina, Departamento de Ortopedia e Traumatologia, São Paulo, SP, Brazil

ARTICLE INFO

Article history:
Received 19 June 2016
Accepted 26 July 2016
Available online 30 August 2017

Keywords:
Slipped capital femoral epiphyses/radiography
X-ray computed tomography
Hip joint/radiography

ABSTRACT

Objective: To compare proximal femur radiologic angles in patients with slipped capital femoral epiphysis and to analyze whether computerized tomography may modify the treatment.
Methods: Cross-sectional study comparing and analyzing the similarity between angles and radiologic classification of interest in slipped capital femoral epiphysis (SCFE).
Results: It was observed that the therapeutic management in slipped capital femoral epiphysis might be modified depending on the classification and radiologic acquisition method adopted.
Conclusion: Multiplanar assessment of proximal femoral deformity in patients with slipped capital femoral epiphysis is a viable option, with the potential to modify the disease classification and, consequently, the therapeutic management.

Estudo comparativo dos ângulos radiográficos e tomográficos na epifisiolistese do fêmur proximal

Palavras-chave:
Escorregamento das epífises proximais do fêmur/radiografia
Tomografia computadorizada por raios X
Articulação do quadril/radiografia

RESUMO

Objetivo: Comparar ângulos radiológicos do fêmur proximal em pacientes com escorregamento proximal da cabeça do fêmur (EPCF) e analisar se a avaliação por tomografia computadorizada pode modificar a conduta.
Método: Estudo transversal que comparou e analisou a concordância entre ângulos e classificações radiológicas de interesse no escorregamento proximal da cabeça do fêmur (EPCF).

☆ Paper developed at Universidade de São Paulo, Faculdade de Medicina, Hospital das Clínicas, Departamento de Ortopedia e Traumatologia, São Paulo, SP, Brazil.

* *Corresponding author*.
E-mail: iberedatti@hotmail.com (I.P. Datti).

http://dx.doi.org/10.1016/j.rboe.2017.08.011

Resultado: Observou-se que a conduta terapêutica na EPCF pode ser modificada a depender da classificação adotada e do método de aquisição de imagens radiológicas.
Conclusão: A avaliação multiplanar da deformidade do fêmur proximal em pacientes com escorregamento proximal da cabeça do fêmur é uma opção viável e com potencial de modificar a classificação da doença nos pacientes e, por conseguinte, a modalidade terapêutica.

Introduction

Slipped capital femoral epiphyses (SCFE) is the most prevalent hip disease in adolescence.[1] It is characterized by a disturbance in the physis, causing anterior slipping and external rotation of the femoral neck in relation to the femoral head, which remains in the acetabulum.[2] The etiology is multifactorial, with obesity being considered the main etiological factor.[1,3]

Early diagnosis and appropriate treatment may reduce the incidence of complications and functional loss.[4–11] Imaging tests are indispensable to confirm the diagnosis and classify the disease. Anteroposterior hip X-ray and Lauenstein-type profile X-ray are usually sufficient for diagnostic confirmation and classification. Computed tomography (CT) and magnetic resonance imaging (MRI) are useful in severe cases to determine physis closure, angular and torsional deviations, and indication of osteotomies.[12,13]

Mild cases are treated by the *in situ* percutaneous fixation technique with a cannulated screw.[14] However, recent literature has favored more aggressive treatment measures. Moderate and severe slipping can be treated with several techniques, such as slipping reduction followed by fixation, or corrective osteotomies in the proximal femur.[15–19]

The therapeutic management depends on the radiological classification of the severity of the disease. Important radiological ratings include the Southwick[16] slip angle and the head–neck angle described by Cohen et al.[20] Cooper et al.[21] recently demonstrated that the three-dimensional deformity caused by SCFE can be better determined with the evaluation of the deformity in the oblique plane. An optional method, which considers the slip percentage between the femur head and neck, was proposed by Wilson,[22] more indicated for small deviations.

The authors' clinical experience is in accordance with the findings by Monazzam et al.[13] and Tins et al.,[12] who described that biplanar radiographs underestimate the severity of SCFE when compared to CT. Richolt et al.[23] suggest that the radiographic evaluation overestimates angular deviations and underestimates torsional deviations. The hypothesis of the present study is that the evaluation of SCFE through CT may alter the slip classification and interfere with therapy. Our objective was to compare the angles obtained by the plain X-ray and CT, and to evaluate whether CT would alter the therapeutic management in SCFE.

Material and methods

After approval by the ethics council, a retrospective survey was performed of patients who were diagnosed as having high SCFE (ICD M93) between January 2011 and May 2014. During this period, it became routine to order at our medical facility preoperative CT and X-ray for patients admitted with the diagnostic hypothesis of SCFE, candidates for Dunn osteotomy. Next, the radiological images stored in the hospital image system were surveyed. Patients who did not have a CT or X-ray available in the system were excluded. Measurements of the angles of interest were taken by an orthopedic hip specialist, blinded to the patient's identification and clinical data. Radiographic and tomographic measurements were taken separately.

Southwick angle (femoral head-diaphysis angle – HDA)

The Southwick angle is measured between a perpendicular line of the line tangent to the proximal femoral physis superiorly and inferiorly and the anatomical axis of the femoral diaphysis[16] (Fig. 1). For measuring the FHDA in the tomographic images we adopted the method proposed by Southwick that has as standard the coronal and sagittal sections, perpendicular to each other. To evaluate the coronal plane, the section with the largest subtrochanteric diameter was taken as the reference image, and two sections of the CT were superimposed to evaluate the sagittal plane, one with the largest physis diameter and the other with the largest subtrochanteric diameter (Fig. 2). After obtaining the angles in both planes, the three-dimensional deviation of the femoral diaphysis in relation to the femoral head was estimated by trigonometry[24] (Fig. 3).

Cooper's oblique plane (femoral head–neck angle – FHNA)

FHNA is the angle between the femoral neck axis and the epiphyseal axis.[20] The femoral neck axis is determined by a line connecting three equidistant points between the lower and upper femoral neck surfaces.[25] The epiphyseal axis is determined by the perpendicular bisecting line between a point at the anterior end of the femoral epiphysis and a point at the posterior end of the femoral epiphysis.[20] We chose to compare the model proposed by Cooper et al.,[21] in which the coronal plane is determined by the AP X-ray, and the axial plane by CT, with the modification by using the coronal (Fig. 4) and axial (Fig. 5) planes of the CT. The section chosen for the