

The Failing Medial Compartment in the Varus Knee and its Association with CAM Deformity of the Hip

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Introduction

Osteoarthritis (OA) of the knee is a major health concern with over 6 million people in the UK suffering from painful osteoarthritis in one or both knees (1). Since 2011, the knee service at the Nuffield Orthopaedic Centre has been offering a neutralising medial opening wedge high tibial osteotomy to a group of patients presenting with the following characteristics:

- Early medial osteoarthritis of the knee (Kellgren-Lawrence <3)
- Pain and dysfunction for more than 2 years
- A weightbearing axis (WBA) running through the medial compartment of the knee that could be corrected to neutral using an opening wedge high tibial osteotomy.

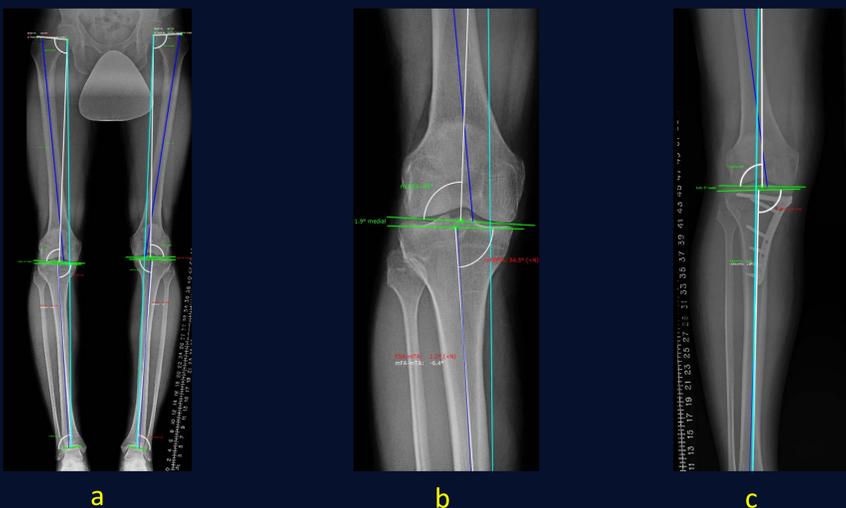


Figure 1: a) Pre-operative measurement, b) Pre-operative measurement enlarged, shows weight-bearing axis (light blue line) in the medial compartment. c) Post-operative measurement shows the WBA has now shifted centrally. (All measurements taken using MedCAD® Classic Version 3.0.2.2)

During the development of this practice the following observation was made. There appeared to be an association between this phenotype of knee osteoarthritis and the presence of CAM deformity at the hip. We are not aware that this association has been made before.

The aim of this study is to establish whether or not any association exists between the OA phenotype shared by our HTO group and the prevalence of CAM deformity at the hip joint.



Figure 2: AP pelvis portion of limb-alignment radiographs performed on a patient who underwent a right knee opening wedge high-tibial osteotomy. There are bilateral cam deformities with elevated alpha angle measurements.

Methods

A retrospective, case-controlled study was performed with 70 participants divided into three groups. Ethical approval was granted by the local ethics committee (London Bloomsbury REC, ref: 15/LO/0701) and (NRES Committee South Central-Oxford A, ref: 12/SC/0006)

Patient Selection: HTO group (n=30), Control group (n=20), Pre-unicompartamental arthroplasty group (n=20)

Radiological assessment: Bilateral standing AP radiographs were obtained from all subjects (70 subjects, 140 limbs available for analysis)

Radiological Analysis: Alpha angle (figure 2) was measured to describe the presence of a CAM deformity using an in-house developed Matlab®-based software package. Lower limb alignment was measured using MedCAD® (Hectec GmbH, Germany).

Statistical Analysis:

Multilevel mixed-effect regression analysis was performed to detect differences, where they existed, between the patient groups.

Pearson's correlation was performed to explore the relationships between lower limb alignment measurements and measurements at the hip.

All statistical analyses were performed using Stata/IC 13.1 (StataCorp, Inc).

Results:

Group characteristics: A total of 140 limbs from 70 subjects were available for analysis (HTO n=30, Pre-arthroplasty n=20, Control n=20). 67 subjects were male and 3 subjects were female. There was no significant difference in gender across the groups. The pre-arthroplasty group were significantly older than both the control (p=0.004) and HTO groups (p=0.008). There was no significant difference in age between the HTO and control groups (p=0.47).

Hip measurements: The HTO group have a higher prevalence of CAM lesions defined by an Alpha angle >65° than both the pre-arthroplasty and control groups [HTO vs Control, P<0.001; HTO vs Pre-arthroplasty, P<0.001]. They also have a significantly greater mean alpha angle [HTO (Avg. 68.3 (±16.1)) vs Pre-arthroplasty (Avg. 61.3 (±15.9)) P=0.01; HTO vs Control (Avg. 58.2 (±13.9)) P=0.007] (Figure 3).

Lower limb alignment: Both the pre-arthroplasty and HTO groups demonstrated a significantly more varus alignment than the control group. Pearson Correlation demonstrated no significant relationship between any lower limb alignment measurements (HKA, MAD, WBA, mPTA, mLPGA, mLDF, mLDTA, JLCA) and the presence of CAM deformity (alpha angle and alpha>65°)

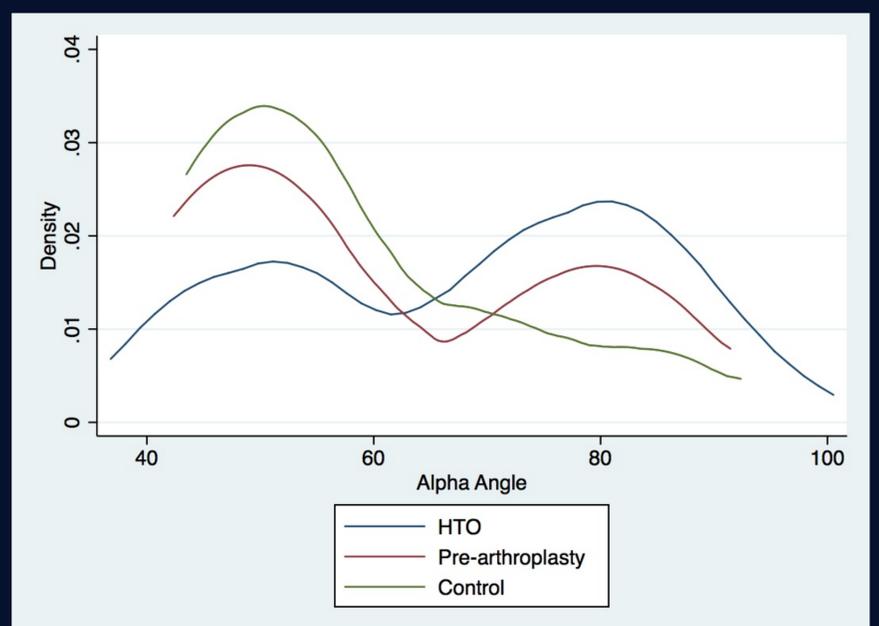


Figure 3: Kernel Density Plot Graph illustrating the bimodal distribution for alpha angle in the observed population. The graph demonstrates the higher prevalence of subjects with a larger alpha angle in the HTO group compared to the other two groups.

Discussion and Conclusion

Our study confirms that patients with symptomatic early knee OA and varus deformity of the knee have a high prevalence of CAM deformity in the hip. This is a significant finding supported by the fact that similar results are not seen in either the control or the pre-arthroplasty groups. Our HTO group, therefore, demonstrate independent predictors for progression of OA in both the hip and the knee.

Both CAM deformity in the hip and constitutional varus deformity in the knee have been linked to disruption of the physal growth plate in youth (2,3). A compelling hypothesis is that some of our HTO group have experienced epiphyseal disruption at the proximal tibia and at the proximal femur leading to early onset OA of the knee and a future risk for development of OA in the hip. Future work should focus on applying these findings to the general population in order to determine the exact nature of the relationship concerning malalignment and hip joint pathology

References

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