INTRODUCTION

3D shape is essential for computer assisted surgery (CAS). CAS provides the surgeons with useful information about 3D positioning of the implant during the surgery. However, accurate 3D shape is a prerequisite. Moreover, follow up is still based on conventional 2D measurement with poor accuracy [Jiang 1989], and no axial analysis is performed without CT scan. Recent developments allow 3D reconstruction from biplanar calibrated X-rays [Laporte 2003]. The purpose of this study is to check the feasibility of this technique on arthrosic knees, in clinical environment, and to quantify 3D parameters from these reconstructions.

METHODS

7 patients were included in the present study. They all underwent a knee arthroplasty with total knee prosthesis as primary surgery.

Biplanar X rays were taken with the patient standing in a specific calibration device [Dumas 2003]. All stereo X rays (frontal and sagittal) were digitized; then all reference bone contours were identified on each X-ray. A specific algorithm [Laporte 2003] yielded the 3D reconstruction of the patients’ knees. Each 3D reconstruction obtained was analysed in order to identify the 3D gonometry (measurement of femorotibial alignment) [Ramadier 82] of the patient’s knees before surgery.

Then various 3D parameters were calculated, such as 3D Hip-Knee-Angle (HKA3d, relating the centers of the femoral head, knee joint and ankle) and axial rotation between femur and tibia. Preliminary evaluation was performed using an intra and inter observers reproducibility for all the parameters.

Two operators (1 clinician and 1 engineer) reconstructed one knee ten times each. Moreover, in order to compare our results to the conventional measurement of the femorotibial alignment, the 3D angles were projected onto a local frame defined by the frontal X view and the sagittal one. A Wilcoxon test was used.

RESULTS AND DISCUSSION

The 7 knees were reconstructed successfully, demonstrating the robustness of the method. Reconstruction had qualitatively a realistic aspect (Fig.1.). The difference between projected angles, from 3D measurements and conventional ones was not significant (p > 0.5).

Figure 1: 3D reconstruction of the knee from a pathological case.

The measurements of most angles were highly reproducible. For example ±0.6° with 95% confidence for the HKA3d, while the reported value is ±2° for conventional 2D measurement [Deltour 1998]. 3D reconstruction using stereoradiography, and standardised measurements should become a clinical evaluation tool.

SUMMARY

The aim of this study was to assess the feasibility of three dimensional (3D) reconstruction of the lower limb in real clinical situation, from a pair of conventional X rays. 3D reconstruction and numeric displays of 3D angles for seven pathological cases illustrate the feasibility of this preoperative evaluation tool.

REFERENCES