The Journal of Arthroplasty 28 (2013) 463–468

Contents lists available at SciVerse ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Implant and Limb Alignment Outcomes for Conventional and Navigated Unicompartmental Knee Arthroplasty

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A R T I C L E I N F O

Article history:
Received 20 January 2012
Accepted 17 September 2012

Keywords:
unicompartmental knee arthroplasty
navigated
conventional
alignment
axis

A B S T R A C T

Accurate implant positioning and restoration of lower limb alignment are major requirements for successful long-term results in unicompartmental knee arthroplasty (UKA). Alignment accuracy was compared between navigated-UKA (nUKA) and conventional-UKA (cUKA) groups using a retrospective matched case–control study (n = 129, 58 nUKA, 71 cUKA). Mechanical axis (MA), hip–knee–ankle angle (HKA°), coronal implant alignment, and tibial implant posterior slope were measured. No statistically significant difference was observed when comparing MA, HKA° or coronal implant alignment ($p > 0.05$). Statistical significance was seen with tibial component posterior slope ($p = 0.04$, nUKA 4.2°, cUKA 2.9°); and between intra-operative navigationally determined HKA° and post-operative whole-leg standing (WLS) film HKA°. Navigation does not significantly improve UKA alignment compared to conventional methods. Further studies are needed to justify the use of this technology in UKA.

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Several requirements for successful long-term results in unicompartmental knee arthroplasty (UKA) have been described [1,2]; among these the accuracy of mechanical axis restoration [3] with appropriate implant positioning of the tibial and femoral [4,5] components have been shown to be major contributors to improving implant longevity. Malalignment of the lower limb after UKA is associated with increased polyethylene wear [4], progression of arthrosis within the other compartment [3,4,6–8]; as well as, implant loosening [9].

Total knee arthoplasty (TKA) navigation systems have been modified for use in UKA with the goal of achieving more precise implant positioning and restoration of normal lower limb alignment. Navigation-assisted UKA (nUKA) has been reported to provide superior limb and implant alignment compared to conventional UKA (cUKA) [10–12]. However, contradictory results have been published demonstrating no difference in knee alignment when cUKA was compared to nUKA [13]. This discrepancy calls into question the validity/accuracy and thus utility of intra-operative navigation alignment measurements.

Only one previous study by Cossey et al. [12] compared the results of intra-operative navigation measurements with post-operative two-leg stance whole-leg standing (WLS) films. Their study is important since intra-operative measurement of knee alignment cannot assess the physiological state of the limb during gait such as single-leg stance, which can be appreciated with WLS films [14].

The aim of this study was to compare the accuracy of mechanical axis restoration and implant positioning in two matched cohort groups: navigated UKA and conventional UKA.

Materials and Methods

Patients: Seventy-three patients with arthrosis isolated to the medial compartment underwent nUKA performed by the senior author between 2006 and 2008. Fifty-six patients (58 knees) on retrospective chart review were found to have complete charts including: pre-operative WLS films, comprehensive intra-operative navigation reports and post-operative WLS films. A control group of 67 patients (71 knees) who underwent cUKA was then matched to the nUKA group according to gender, age, Body Mass Index (BMI) and pre-operative limb alignment (MA). Exclusion criteria included: presence of osteoarthrosis in the lateral or patellofemoral compartments, anterior cruciate ligament injury/deficiency and previous procedures or injuries that potentially altered the limb alignment (e.g. high tibial osteotomy or tibial plateau fracture). Operating room time restraints and Praxim Navigation System availability were the main factors that led to the division between those who underwent nUKA

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2012.09.001

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0883-5403/2803-0015$36.00/0 – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.arth.2012.09.001

and those who underwent cUKA. This should not have created a selection bias.

This study underwent review and approval by the Institutional Review Board. A two sample T-Test Power Analysis showed n-values of 58 (nUKA) and 71 (cUKA) were needed to achieve a power of 80 with a confidence interval of 95% [15] .

The Praxim Navigation System is an imageless optical navigation system that uses infrared to monitor position sensors attached to the bone and surgical instruments to create a three dimensional digital model of the joint through vector analysis based off of the kinetic and morphological information input. This model then is used to provide real time visualization of limb and implant positioning [16].

All 123 patients (129 knees) underwent medial UKA with fixed bearing Miller–Galante metal-backed tibial components (Zimmer, Warsaw, Indiana). For the navigated group, there were 28 males and 28 females with a mean age at surgery of 65 years (range, 48 to 81 years) and the mean BMI was 30.08 (range, 20.5 to 49.4). For the conventional group there were 30 males and 36 females with a mean age at surgery of 67.3 years (range, 49 to 81 years) and the mean BMI was 30.51 (range, 21.6 to 53.2).

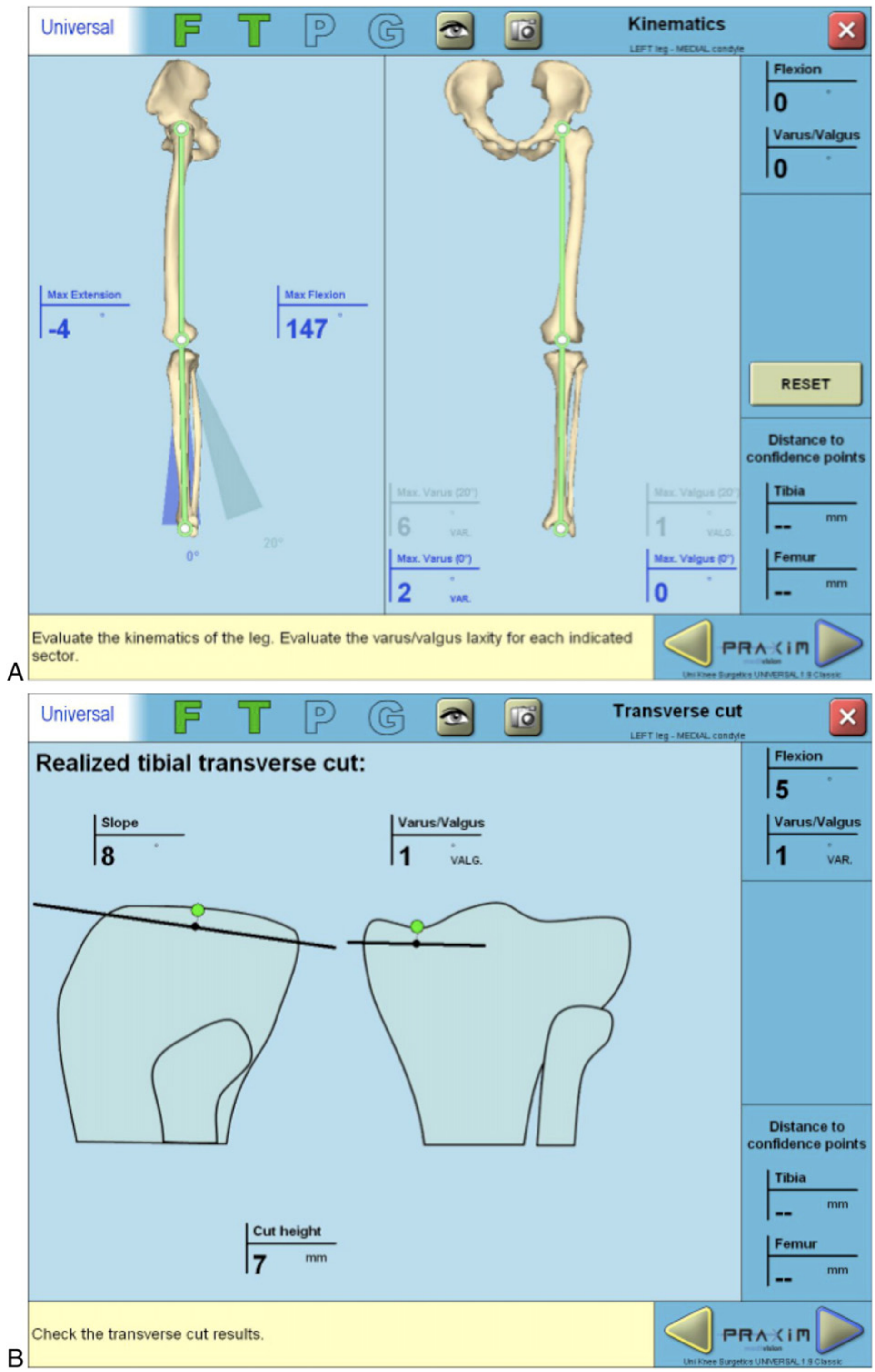

Fig. 1. Intra-operative data recorded from the Image-Free Praxim Navigation System (La Tronche, France); allows for real time intra-operative assessment of (1A) Hip–knee–ankle angle (HKA°), coronal and sagittal alignment of the tibial component and cut depth (1B).

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