



A comparison of alignment using patient specific guides, computer navigation and conventional instrumentation in total knee arthroplasty



Samuel J. MacDessi^{a,*}, Bob Jang^a, Ian A. Harris^b, Emma Wheatley^c, Carl Bryant^c, Darren B. Chen^a

^a Sydney Knee Specialists, St George Private Hospital, Sydney, NSW, Australia

^b South Western Sydney Clinical School, University of New South Wales, Australia

^c Bryant Radiology, St George Private Hospital, Sydney, NSW, Australia

ARTICLE INFO

Article history:

Received 25 July 2013

Received in revised form 23 September 2013

Accepted 6 November 2013

Keywords:

Patient specific guides

Alignment

Conventional

ABSTRACT

Background: Patient specific guides (PSG) have been introduced as a tool in total knee arthroplasty (TKA) in an attempt to improve limb alignment and reduce operative time compared to other established surgical techniques. The purpose of this study was to compare the post-operative radiographic alignment and operative time in patients who underwent TKA surgery with PSG, conventional instrumentation or computer-assisted navigation surgery using fully cemented components.

Methods: A cohort of 260 patients who underwent TKA surgery using PSG (PSG group, $n = 115$) was compared to patients who underwent TKA using either conventional instrumentation (CON group, $n = 92$) or computer-assisted navigation (CAS group, $n = 53$). Post-operative CT imaging using the Perth CT protocol was used to compare alignment between the three groups.

Results: In the PSG and CAS groups, the post-operative hip–knee angle (HKA) was within 3° of neutral alignment in 91.3% and 90.7% of patients, respectively. This compared to 80.4% of patients in the CON group ($p = 0.02$). There were no significant differences with respect to alignment when comparing individual component positioning between the PSG and CAS groups apart from tibial slope (Table 3). Total operative time was found to be significantly reduced in the PSG group (80.2 min) compared to both the CON group (86 min, $p = 0.002$) and the CAS group (110.2 min, $p < 0.0001$).

Conclusions: The use of PSG resulted in similar alignment accuracy to CAS and superior alignment to CON with significantly shorter operative times.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

Patient-specific guides (PSG) derived from pre-operative imaging have been recently introduced as a new strategy for improving component positioning in total knee arthroplasty (TKA). The other cited benefits of these instruments when compared to computer navigation are reduced operative times and inventory in the operating room; both of which may result in cost savings [1–3].

Most major orthopaedic implant manufacturers have introduced different versions of patient-specific guides. These guides rely on either magnetic resonance imaging (MRI), computed tomography (CT) scans with or without long alignment radiographs to produce moulds that conform to the patient's anatomy during surgery, using pre-defined radiographic parameters to restore a neutral mechanical alignment to the lower limb.

Despite these guides being available for several years, there is a paucity of data on their accuracy. The few studies available have only looked

at plain radiographic outcomes of coronal alignment, with mixed results [4–7]. This is in contrast to the literature evaluating the accuracy of computer-assisted navigation (CAS) surgery, with significant evidence validating CAS as being more accurate than conventional instrumented (CON) techniques by reducing the number of alignment outliers [8–11].

Like other studies on this topic, only coronal plane alignment had been assessed. In addition, no published data exists on comparing the accuracy of patient-specific guides against both conventional instrumentation and computer-assisted navigation surgery.

The aim of this paper is to compare the differences in alignment accuracy in patients who have undergone TKA using patient specific guides, conventional instrumentation, or computer-assisted navigation to see which method provides the best alignment accuracy. This is to be determined by examining the post-operative coronal, sagittal and axial alignment and comparing the alignment outliers between the groups.

2. Materials and methods

A cohort of patients who underwent TKA surgery using PSG (PSG group) was compared to patients who underwent TKA using either conventional instrumentation (CON group) or computer-assisted

* Corresponding author at: Sydney Knee Specialists, Suite 8, 19 Kensington St, Kogarah NSW 2217, Australia. Tel.: +61 2 8307 0333; fax: +61 2 8307 0334.

E-mail address: samuelmacdessi@sydneyknee.com.au (S.J. MacDessi).

navigation (CAS group). Pre-operative hip–knee angle (HKA) was measured using 4-foot long standing radiographs for all patients. The HKA is the angle formed by the intersection of a line connecting the centres of the hip and knee joint and another line connecting the centres of the knee and ankle joint. Post-operative CT imaging using the Perth CT protocol [12] was used to compare alignment between the three groups.

2.1. Study group

The PSG group comprised of 115 patients who underwent TKA surgery during a consecutive time period from April 2010 to February 2012. Patients who were not suitable to have a PSG TKA underwent surgery using conventional instrumentation during the same period as those patients who underwent a PSG TKA. There were 92 patients in this group who had a CON TKA. Reasons for exclusion from undergoing a PSG TKA included inability to undergo an MR scan because of cardiac and cerebral metal implants and patient factors such as cost and short time to surgery. This group also included patients who failed to have a PSG manufactured because of decreased image quality of their MR scan due to motion artefact. The commonest reason for this was claustrophobia as a cause of movement. There were no cases where knee deformity or pathology resulted in failure to produce a PSG. The final cohort comprised 53 patients who had CAS TKA using the Orthosoft Navigation System in 2009 prior to commencement of use of PSI guides. These patients voluntarily agreed to undergo CT radiographic assessment to act as a comparison group and represented a subgroup of 98 patients who had a CAS TKA in the same year.

2.2. Surgical technique

All operations were performed using an identical surgical technique by two orthopaedic knee surgeons. A medial parapatellar approach was used and a thigh tourniquet was inflated for the initial surgical exposure only. The one prosthesis was used in all cases, the Zimmer NexGen LPS Flex (Zimmer, Warsaw, IN) using fully cemented implants. The patella was resurfaced in all knees.

All operations were performed in an identical manner using a measured resection technique. All three techniques aimed for restoration of a neutral hip–knee angle, femoral component angle and tibial component angle in the coronal plane, a neutral femoral component flexion relative to the sagittal mechanical axis, seven degrees of posterior tibial slope and femoral component rotation parallel to the surgical femoral epicondylar axis.

For those patients who underwent a PSG TKA, a proprietary internet-based software planner was used to review, adjust and approve the surgical plan. Once registered, the approved plan was forwarded to Materialise (Leuven, Belgium) who used rapid-prototyping technology to create the customised patient specific guides. The patient specific guides used in this study rely on data acquisition from a pre-operative MRI scan to create a custom mould of the knee that conforms to the patient's knee anatomy at the time of surgery.

The distal femoral resection was performed first in all cases, followed by the proximal tibial resection. An extra-medullary tibial guide attached to a 10 mm spacer block was used to ensure creation of an adequate extension gap as well as a tibial resection perpendicular to the tibial mechanical axis. The remainder of the femoral preparation was then carried out. In the conventional instrumentation group, intra-medullary femoral and tibial alignment guides were used to restore coronal and sagittal knee alignment.

2.3. Radiographic analysis

All patients in this series underwent a radiographic analysis using the Perth CT Protocol [12]. The Perth CT Protocol is a technique whereby patients are CT scanned non weight bearing to allow a direct measurement of the alignment of the femoral and tibial components in the

coronal, sagittal and axial planes as well as comparing implant rotation. All scans were analysed by the chief CT radiographer at our institution. A second research assistant reviewed a subset of 20 scans. The mean absolute difference in angle measurements (pooling all angles measured) was 1.1° (SD = 1.1). The difference between the observers was 2° or less in 91.0% of cases. In the literature it has been noted that intra-observer error averages 2° on any given TKA radiograph [13].

2.4. Outcome measures

The post-operative parameters that were analysed were hip–knee angle, individual component alignment in the coronal and sagittal plane, and axial rotation of the femoral component. The proportion of patients within 3° of the neutral mechanical alignment for each measurement was recorded. Operative times were recorded in minutes and defined as the time from the initial skin incision until final wound closure.

2.5. Statistical analysis

Means, ranges, and standard deviations were recorded for all radiographic parameters. Student's *t*-tests and ANOVA were used to compare differences in means between continuous variables. ANOVA was used to statistically assess pre-operative demographic factors. The two-sample *t*-test was used to assess for differences in operative time between groups. Fisher's exact test was used to test for significance in difference of alignment (proportions) between the groups. Statistical significance was set at $p < 0.05$.

3. Results

There were no significant differences with regards to age, BMI, and pre-operative HKA between groups (Table 1).

3.1. Hip–knee coronal angle

When assessing HKA, 91.3% and 90.7% of patients in both the PSG and CAS groups, respectively, were within 3° of a neutral mechanical alignment. This compared to 80.4% of patients in CON group, which was statistically significant ($p = 0.039$, PSG vs CON). See Table 2 for a summary of results.

3.2. Individual component alignment

97.4% and 96.3% of patients in the PSG and CAS group, respectively, had a femoral coronal alignment within 3° of a neutral mechanical axis. This compared to 89.1% of patients in the CON group and this difference was statistically significant ($p = 0.02$).

In the PSG group, 94.8% were within 3° of neutral femoral sagittal alignment. This compared to 98.2% and 90.2% of cases in the CAS and CON groups respectively. The differences between the CAS and CON groups compared to the PSG group were not found to be significant ($p = 0.178$ and $p = 0.282$, respectively).

Tibial coronal alignment was within 3° of the neutral mechanical axis in 97.4% of patients in the PSG group and to 100.0% in the CAS group ($p = 0.552$). In the CON group, 88.0% were within an acceptable range and this was statistically significant when compared to PSG ($p = 0.011$).

Mean posterior tibial slope was found to be significantly decreased in the CAS group (Mean = 4.9°, SD = 1.7) compared to the CON (Mean = 6.9°, SD = 2.0) and PSG group (Mean = 7.0°, SD = 1.9, $p = 0.009$). The reduced tibial slope in the CAS group

Table 1
Group demographics.

	PSG ^a (n = 115)	CON ^b (n = 92)	CAS ^c (n = 53)	P-value
Age	67	66	67	0.7058
BMI	30.3	31.5	31.2	0.1718
Pre-op HKA	−3.3°	−4.3°	−3.3°	0.4646
Range HKA	−15° to +14°	−12° to +12°	−20° to +10°	N/A

^a Patient Specific Instrumentation.

^b Conventional Instrumentation.

^c Computer navigated surgery.

Download English Version:

<https://daneshyari.com/en/article/4077498>

Download Persian Version:

<https://daneshyari.com/article/4077498>

[Daneshyari.com](https://daneshyari.com)