

# **Clinical outcomes of computer-assisted total knee arthroplasty using pinless navigation**

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## **INTRODUCTION**

The current literature comparing pinless navigated TKA with computer-assisted surgery (CAS) with conventional TKA revealed improved lower limb alignment and placement of components<sup>1</sup> without significant difference in early post-operative function and range of movement<sup>2</sup>, although a longer duration of surgery was required<sup>3</sup>. Although systemic reviews of TKA with CAS assisted by tracker pins have revealed no difference in clinical outcomes when compared to conventional TKA, there is a paucity of data describing the clinical outcomes in patients who underwent TKA with CAS using pinless navigation.

This study aims to evaluate the clinical outcomes of patients who underwent TKA with CAS using a pinless navigation system (BrainLAB® VectorVision® Knee 2.5 Navigation System) with a follow-up period of two years.

## **MATERIALS AND METHODS**

An analysis of prospectively collected clinical data of patients who underwent TKA with CAS by a single senior surgeon was conducted for consistency of surgical technique and post-operative care. The study included 100 consecutive patients who

received TKA with CAS using pinless navigation between November 2008 and October 2012, compared with 100 patients who underwent tracker pin-guided standard CAS. Patients with pre-operative varus or valgus deformity of more than 15° were excluded from the study. Patients who had undergone previous knee joint surgery or who could not be treated with an unconstrained total knee arthroplasty with a short stem were also excluded.

The software used for the tracker pin-guided standard CAS was Ci Mi TKR Version 2.0 by BrainLab/ Depuy Orthopaedic Inc (Johnson and Johnson, Leeds, UK. In the pinless navigation group the BrainLAB® VectorVision® Knee 2.5 Navigation System (BrainLAB®, Munich, Germany) was employed for navigation. All surgeries were performed using the standard medial parapatellar quadriceps splitting approach with patella eversion under tourniquet control at 300 mmHg with prostheses from DePuy Synthes Sigma® Fixed Bearing Knee system (Warsaw, IN, USA) and closure of wounds was performed in a standard manner.

Clinical outcomes were evaluated with the Knee Society Score<sup>4</sup>, SF-36 questionnaire<sup>5</sup> and the Oxford Knee score<sup>6</sup> at six-month and two-year intervals in addition to preoperative demographic data including BMI, age and gender. The study was approved by our Institutional Review Board.

## **RESULTS**

There was no difference in age, BMI, gender or site of surgery between the pinless and tracker-pin guided navigation group (Table 1). However, the duration of surgery

was shorter in the pinless group at  $72 \pm 13$  min compared to  $83 \pm 11$  min in the tracker-pin guided navigation group ( $p < 0.001$ ).

<b>Table 1. Patients' Demographics</b>			
	Pinless	Traditional	p-value
<b>Age (years)</b>	$67 \pm 8$	$68 \pm 8$	0.353
<b>BMI (kg/m<sup>2</sup>)</b>	$27.7 \pm 4.2$	$27.9 \pm 3.9$	0.744
<b>Gender (male:female)</b>	31:69	26:74	0.434
<b>Side of surgery (left:right)</b>	50:50	46:54	0.571
<b>Duration of Surgery (minutes)</b>	$72 \pm 13$	$83 \pm 11$	$<0.001$

There was a significant improvement in both the function and knee subcomponent scores of the KSS in the pinless navigation group from  $55 \pm 19$  to  $77 \pm 18$  ( $p < 0.001$ ) and  $39 \pm 16$  to  $87 \pm 10$  ( $p < 0.001$ ) respectively. This improvement was similarly reflected in both the Physical Component Score (PCS) of the SF-36 questionnaire and the OKS from  $33 \pm 10$  to  $49 \pm 8$  ( $p < 0.001$ ) and  $34 \pm 8$  to  $18 \pm 5$  ( $p < 0.001$ ) respectively. However, there was no statistically significant difference between the improvement in clinical outcome scores between the pinless and tracker-pin guided navigation group. The patients in the tracker-pin guided navigation group experienced similar statistically significant improvement in clinical outcomes as detailed in Table 2. There was no occurrence of pin-tract related complications in the tracker-pin guided standard CAS group.

<b>Table 2. Functional Outcome Scores</b>			
	Pinless	Traditional	p-value
<b>KSFS</b>			
<b>Preoperative</b>	$55 \pm 19$	$55 \pm 18$	0.954
<b>2 years</b>	$77 \pm 18$	$78 \pm 19$	0.701

<b>KSKS</b>			
<b>Preoperative</b>	39 ± 16	39 ± 18	0.884
<b>2 years</b>	87 ± 10	88 ± 12	0.587
<b>OKS</b>			
<b>Preoperative</b>	34 ± 8	34 ± 9	0.538
<b>2 years</b>	18 ± 5	18 ± 5	0.770
<b>PCS</b>			
<b>Preoperative</b>	33 ± 10	33 ± 10	0.922
<b>2 years</b>	49 ± 8	48 ± 9	0.574
<b>MCS</b>			
<b>Preoperative</b>	52 ± 11	53 ± 10	0.295
<b>2 years</b>	55 ± 10	58 ± 10	0.056

## **DISCUSSION**

The study revealed a shorter duration of surgery in TKA with CAS using pinless navigation versus standard CAS which corresponds to an earlier study by Chen et al<sup>6</sup>. CAS TKA conventionally led to a longer mean duration of surgery of 23%<sup>5</sup> when compared to conventional TKA largely due to time expenditure in placement of additional reference landmarks including the tibial and femoral tracker pins. Pinless navigation circumvents the surgical time spent on the drilling and removal of tracker pins, reducing the duration by 11 minutes using the navigation system described in this study.

Previous studies have demonstrated that pinless navigation achieves satisfactory post-operative mechanical leg axis alignment and no significant difference in coronal alignment in both tibial and femoral component placement when compared with

conventional TKA<sup>7</sup>. In addition, Chen et al have found that pinless navigation is an effective tool for reducing the proportion of outliers of normal alignment<sup>8</sup>. However, whether the satisfactory alignment or decreased proportion of outliers translated to any detectable differences in clinical outcomes was not previously described.

Previous studies have demonstrated that good placement of the implants within three degrees of the mechanical axis of the lower limb reduces the wear of the implants and prevents implant failure<sup>9 10</sup>. This study has demonstrated that pinless navigation results in significant improvement in clinical outcomes at two-year follow up which is comparable to the improvement in patients who underwent standard tracker-pin.

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<sup>1</sup> Chen JY, Chin PL, Li Z, Yew AK, Tay DK, Chia SL, Lo NN, Yeo SJ. Radiological outcomes of pinless navigation in total knee arthroplasty: a randomized controlled trial. *Knee Surg Sports Traumatol Arthrosc.* 2014 Aug 14.

<sup>2</sup> Keyes BJ, Markel DC, Meneghini RM. Evaluation of limb alignment, component positioning, and function in primary total knee arthroplasty using a pinless navigation technique compared with conventional methods. *J Knee Surg.* 2013 Apr;26(2):127-32.

<sup>3</sup> Maderbacher G, Schaumburger J, Keshmiri A, Barthel M, Springorum HR, Craiovan B, Grifka J, Baier C. Pinless navigation in total knee arthroplasty: Navigation reduced by the maximum? *Int Orthop.* 2014 Sep 23.

<sup>4</sup> Insall JN, Dorr LD, Scott RD et al. Rationale of The Knee Society Clinical Rating System *Clin Orthop* 1989;248:13-14.

<sup>5</sup> Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection *Med Care* 1992; 30(6):473-483

<sup>6</sup> Dawson J, Fitzpatrick R, Murray D et al. Questionnaire on the perceptions of patients about total knee replacement *J Bone Joint Surg Br* 1998; 80(1):63-69.

<sup>7</sup> Baier C, Maderbacher G, Springorum HR, Zeman F, Fitz W, Schaumburger J, Grifka J, Beckmann J. No difference in accuracy between pinless and conventional computer-assisted surgery in total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2014 Aug;22(8):1819-26. doi: 10.1007/s00167-013-2430-2.

<sup>8</sup> Chen JY, Chin PL, Tay DK, Chia SL, Lo NN, Yeo SJ. Less outliers in pinless navigation compared with conventional surgery in total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2014 Aug;22(8):1827-32. doi: 10.1007/s00167-013-2456-5.

<sup>9</sup> Ritter MA, Faris PM, Keating EM, Meding JB (1994) Postoperative alignment of total knee replacement. Its effect on survival. *Clin Orthop Relat Res* 299:153–156

<sup>10</sup> Wasielewski RC, Galante JO, Leighty RM, Natarajan RN, Rosenberg AG (1994) Wear patterns on retrieved polyethylene tibial inserts and their relationship to technical considerations during total knee arthroplasty. *Clin Orthop Relat Res* 299:31–43