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Range of motion and function are not affected by increased post constraint in patients undergoing posterior stabilized total knee arthroplasty

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ABSTRACT

Background: Constrained primary total knee arthroplasty (TKA) can provide stability in the face of incompetent collateral structures or irreconcilable flexion–extension imbalances. However, little is known about its effect on overall knee range of motion (ROM). This study determines whether TKA with increased constraint affects postoperative ROM.
Methods: Patients undergoing primary TKA using either posterior stabilized (PS) or constrained condylar knee (CCK) inserts were match-paired based on body mass index, preoperative ROM, and direction and severity of the coronal deformity, yielding 68 pairs. ROM and Knee Society Score (KSS) were obtained preoperatively and at 6 weeks, 4 months, and 1 year.
Results: When the 68 matched pairs were considered, all outcome variables related to ROM between the PS and CCK groups at each of the postoperative intervals were similar. Additionally, both the individual items and combined scores of the KSS were similar between groups at all time points.
Conclusions: We demonstrate that the use of increased constraint does not affect ROM, relief of pain, or function after TKA.
Level of evidence: Level III (retrospective case-controlled study, based on prospectively collected data).

1. Introduction

Unhinged varus–valgus constraint, such as in constrained condylar knee (CCK) implants, is frequently used in stemmed, revision total knee arthroplasty (TKA). The oversized post (Fig. 1) provides additional stability in the face of incompetent collateral structures or irreconcilable flexion–extension imbalances [1–6].

The use of constrained inserts has expanded to primary TKA [5]. Some modern TKA designs allow for the use of a constrained insert on primary, non-stemmed tibial and femoral components [4]. Despite the obvious contribution to added stability, increased constraint has a number of theoretical disadvantages: it may increase polyethylene wear, impart higher stresses to the modular and fixation interfaces, and reduce post-operative range of motion (ROM) [4,6–9]. Most studies reporting on the results of constrained primary TKA are case series that focus on implant survivorship, wear, and clinical outcomes, often within a single cohort [1–5]. To our knowledge, only one of these studies analyzes non-stemmed components [4]. We are unaware of any studies that provide a direct comparative analysis between constrained and non-constrained posterior stabilized, non-stemmed, primary TKAs in terms of post-operative ROM, pain, and function.

In this retrospective case-controlled study, we determine whether increased constraint has an effect on postoperative ROM in patients undergoing primary, non-stemmed TKA. In addition, we assess the potential effect of increased constraint on postoperative pain relief and function.

2. Methods

2.1. Study design

This study received institutional review board approval prior to commencement. We conducted a retrospective review of the senior author's (AGDV) prospective primary TKA database for patients who underwent elective surgery for osteoarthritis between January 2006 and December 2010.

We identified 400 consecutive patients (430 knees) who underwent primary TKA. All but 10 patients (10 knees), received the same prosthetic design [Genesis II Total Knee System, Smith and Nephew, Memphis, TN]. The remaining 10 patients presented with extreme preoperative valgus deformity (with and without associated bone loss) and required a stemmed implant; they were thus not included in our analysis.

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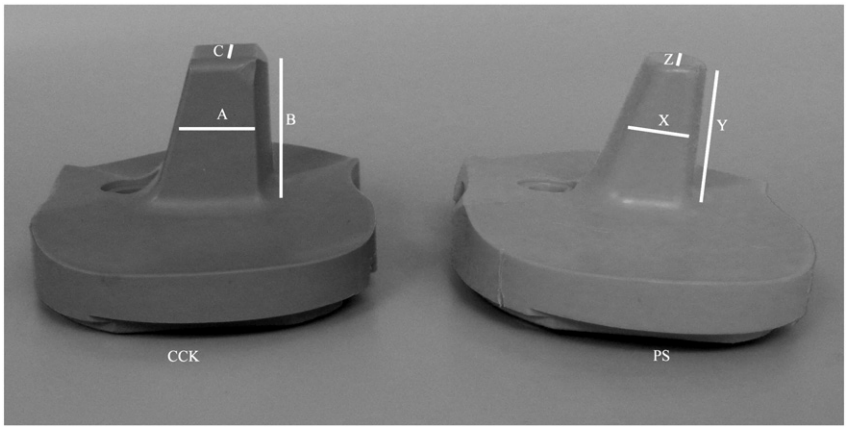

Fig. 1. The CCK insert (left) has an oversized post, which fully engages into the femoral box, providing stability in the frontal plane. The CCK post is thicker (A > X), taller (B > Y), and wider (C > Z) than the corresponding PS post (right). This allows greater constraint of the articulation to within 2–3° of varus/valgus motion when the knee is in full extension.

Of the remaining 390 patients (420 knees), 86 patients (91 knees) were excluded: 32 patients (32 knees) were pleased with the surgical outcome and declined to return for follow-up; two patients (two knees) were unhappy with the surgical outcome and declined to return for follow-up; 47 patients (50 knees) did not respond to our request of returning for follow-up at one year; three patients (four knees) underwent re-operation within the first year (one for aseptic loosening of the tibial component, one for aseptic loosening of the patella, and one for stiffness); and two patients (three knees) died before the first year. The remaining 304 patients (329 knees) were considered for the study. Because our study focused on endpoints pertinent to TKA (namely ROM), the knee itself and not the patient was considered the unit of study.

2.2. Clinical protocol

All patients followed a standardized preoperative, intraoperative, and postoperative protocol. All surgeries were performed using a combined spinal/epidural anesthetic, supplemented by a femoral nerve block. Under tourniquet control that ranged between 200 and 300 mm Hg, a standard midline incision and a standard medial parapatellar arthrotomy without patellar eversion were used in all patients. The tibial cut was made using an extramedullary guide referencing off the most normal side. The femur was prepared with an intramedullary guide set at 5° of valgus and using anterior referencing jigs. Rotation was determined by the posterior femoral condyles, and by using the epicondylar axis and Whiteside's line [10] in patients with anatomical abnormalities. Flexion and extension soft tissue gap balancing was done with the use of spacer blocks attempting at obtaining equally symmetric gaps. Resurfacing of the patella was performed in all cases. All implants were cemented. The Genesis II TKA prosthesis includes a femoral component with symmetrical posterior condyles and an asymmetric tibial tray. The implants accept a standard non-constrained posterior stabilized (PS) or a constrained (CCK) insert that can be selected during trial reduction based on the perceived stability of the joint (Fig. 1). After implanting the trial components, the senior surgeon (AGDV) evaluated the stability of each knee, using varus and valgus stress at full extension, mid-flexion, and 90° of flexion. When lift-off of either the medial or lateral compartment was greater than or equal to 3 mm, consideration was given to use of the CCK liner. The Genesis II design facilitates easy intraoperative conversion of a standard PS knee to a CCK, thus we believe this prosthetic design is ideal for a comparative study of these two insert options.

Postoperative pain control was obtained with an epidural patient-controlled analgesic of a local anesthetic and fentanyl for the first 24 h postoperatively, progressing to oral analgesics as tolerated. Drains were used in all cases and removed on the first postoperative day. Rehabilitation was initiated on the day of surgery with a continuous passive motion machine initiated at 0 to 60° and patients were allowed weight bearing as tolerated. All patients received antibiotic prophylaxis and multimodal thromboprophylaxis, limiting the use of potent anticoagulants [11]. Patients were discharged to home or inpatient rehabilitation units within 3 to 4 days after surgery, and were seen in the surgeon's office at 6 weeks, 4 months, and 1 year after surgery. Range of motion data and Knee Society Score (KSS) [12] (Knee score and Function score) were obtained by the operating surgeon (AGDV) during each visit.

2.3. Match-pairing and data analysis

Of the 329 TKAs included in our study, 259 received a PS insert, and 70 a CCK insert. A matching process was undertaken to compare

Table 1
Matching variables for PS and CCK knees, with data shown after matching was performed. Data ranges are provided where appropriate.

After matching	PS *n = 68*		CCK *n = 68*		
		Min, max		Min, max	*p*-Value
BMI, mean ± std	32.1 ± 5.2	24.6, 50.7	32.1 ± 5.5	22.5, 54.1	0.9969*
Pre-op arc of motion (°), mean ± std	110.1 ± 13.6	65, 135	109.9 ± 13.9	65, 135	0.9059*
Direction of deformity, n (%)					0.9999**
No deformity	8 (11.8%)	–	8 (11.8%)	–	–
Varus	45 (66.2%)	–	45 (66.2%)	–	–
Valgus	15 (22.1%)	–	15 (22.1%)	–	–
Severity of deformity (°), mean ± std	−4.1 ± 2.3	−8, 0	−4.3 ± 2.6	−8,0	0.5339*

° = degrees.
* *p*-Values were obtained using two sample *t*-test.
** *p*-Values were obtained using chi-square test.