The Journal of Arthroplasty xxx (2017) 1–5

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Cementless Total Knee Arthroplasty in Knee Osteonecrosis Demonstrated Excellent Survivorship and Outcomes at Three-Year Minimum Follow-Up

Assem A. Sultan, MD [a], Anton Khlopas, MD [a], Nipun Sodhi, BA [a], Mark L. Denzine, DO [a], Prem N. Ramkumar, MD, MBA [a], Steven F. Harwin, MD [b], Michael A. Mont, MD [a, *]

[a] Department of Orthopaedic Surgery, Cleveland Clinic, Cleveland, Ohio
[b] Department of Orthopaedic Surgery, Mount Sinai West Hospital, New York, New York

ARTICLE INFO

Article history:
Received 9 August 2017
Received in revised form
6 October 2017
Accepted 9 October 2017
Available online xxx

Keywords:
cementless
TKA
osteonecrosis
survivorship
outcomes
arthroplasty

ABSTRACT

Background: Lack of consensus exists on the use of cementless total knee arthroplasty (TKA) in patients with knee osteonecrosis. Therefore, this study was conducted to evaluate (1) implant survivorship; (2) clinical outcomes and complications; and (3) radiographic outcomes of primary cementless TKA in knee osteonecrosis.

Methods: This study included 46 patients (49 knees) who had knee osteonecrosis and underwent primary cementless TKA and had a mean follow-up of 44 months (range 36-96). Kaplan-Meier analysis was used to evaluate implant survivorship. Follow-up was performed post-operatively at 6 weeks, 3 months, and annually thereafter. Clinical outcomes including the Knee Society Scores (KSS) for pain and function, changes in range-of-motion, complications, and radiographic outcomes were analyzed.

Results: Aseptic implant survivorship was 97.9% (95% confidence interval 1.01-0.93) and all-cause implant survivorship was 95.9% (95% confidence interval 1.01-0.9), with 1 septic and 1 aseptic failures. The mean KSS for pain was 93 points (range 85-100) and the mean KSS for function was 84 points (range 70-90). Additionally, 1 patient had superficial wound necrosis and was treated with local wound care with no further sequela. Otherwise, no evidence of loosening, subsidence, or progressive radiolucencies were noted on radiological evaluation.

Conclusion: Excellent implant survivorship, clinical, and radiographic outcomes of primary cementless TKA in the setting of knee osteonecrosis was demonstrated. Although further long-term study is needed to validate survivorship, new generation cementless TKA implants provide promising results in this subset of patients.

The knee is the second most commonly affected joint by osteonecrosis following the hip [1]. Etiologically, 2 distinct forms of knee osteonecrosis have been described: spontaneous and secondary osteonecrosis. Spontaneous osteonecrosis primarily affects elderly population without specific identifiable risk factors with limited monoarticular involvement of the articular surface of the knee [2–7]. In secondary osteonecrosis, patients younger than 55 years of age are more typically affected and have one or more risk factors that have been linked to the disease occurrence including corticosteroid use, alcoholism, and smoking [1,8–10]. Despite nonoperative management and joint preservation procedures, many of these patients continue to progress to end-stage joint destruction and arthrosis [1]. Therefore, total knee arthroplasty (TKA) particularly in the younger patients of secondary osteonecrosis can be the only option to address their pain and disability [1,11].

In osteonecrosis, the presence of dead bone in sometimes multiple subchondral areas may be a relative contraindication to the use of cementless fixation when TKA is indicated. Osteointegration to the porous metallic surface of cementless implants requires live bone and regenerative capacity [12,13], and hence implant survivorship and stability may not be achieved. Therefore, cemented implants may be a better option for fixation of often

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to https://doi.org/10.1016/j.arth.2017.10.018.

* Reprint requests: Michael A. Mont, MD, Department of Orthopaedics, Cleveland Clinic, Cleveland, OH.

https://doi.org/10.1016/j.arth.2017.10.018
0883-5403/

Table 1
Risk Factors, Locations, and Sizes of the Lesions (Percentage of Affected Condyle) in MRI Images in the Affected Knees.

Risk Factors	Knees, n (%)	Location of Lesions (n)				Lateralization, n (%)
		Medial Femoral Condyle	Lateral Femoral Condyle	Tibial	Femoral and Tibial	
SONK	38 (60.8)	30	4	4	–	38 unilateral (100)
Secondary osteonecrosis						
Corticosteroids	6 (30.4)	–	–	–	6	9 bilateral vs 2 unilateral
Alcohol use	3 (8.6)	–	–	–	3	(82 vs 18)
Multiple including others (chemotherapy, trauma, smoking, and post-arthroscopic)	2 (6.5)	–	–	–	2	

devitalized osseous bone interface. However, this theory has not been clinically verified with few studies of this patient population [1,14,15]. In addition, conflicting data from previous studies on survivorship and outcomes of TKA in osteonecrosis did not serve to well-characterize the use of cemented vs cementless prosthesis [11,15,16]. Fortunately, newly introduced cementless implants with potentially improved bioengineering designs have increasingly demonstrated comparable clinical outcomes to cemented prosthesis including patients with altered bone quality [17–28]. A few studies on this "new" cementless fixation that included patients with osteonecrosis demonstrated good clinical outcomes [20,23]. Potential benefit proposed by cementless TKA in patients with osteonecrosis is the more durable fixation in this largely younger patient population [1,20,21,23,29].

Due to the paucity of evidence, we conducted this study with the purpose of evaluating (1) implant survivorship; (2) clinical outcomes and complications; and (3) radiographic outcomes of primary cementless TKA in patients with knee osteonecrosis.

Methods

Patient Selection

Institutional review board approval was obtained prior to the study. Between June 1, 2008 and May 31, 2014, 1025 primary cementless posterior-stabilized TKAs were performed on 952 patients at a single high-volume institution. Of this cohort, 49 knees in 46 patients (4.8%) including 3 patients with bilateral osteonecrosis who had minimal follow-up of 2 years were identified. There were 12 men and 34 women, who had a mean BMI of 33 kg/m^2 (range 22-47) and a mean age of 65 years (range 42-78). Mean follow-up was 44 months (range 36-96). For every patient, the diagnosis of osteonecrosis was made by radiographic demonstration of characteristic lesions on screening plain radiographs (anteroposterior, lateral, and oblique views) and confirmed by magnetic resonance imaging (MRI) images. Patients were categorized into having either spontaneous osteonecrosis of the knee (SONK) or secondary osteonecrosis. Nearly 78% of patients had SONK with no identifiable risk factors and unilateral solitary lesions demonstrated on radiographic evaluation. Patients with secondary osteonecrosis accounted for 22% of the cases, had at least 1 identifiable risk factor, and all had bilateral or multi-focal involvement of femoral condyles and tibial plateaus (see Table 1). On plain radiographs, the Koshino Classification System [30] was utilized to stage patients with SONK (stage I: no X-ray abnormality; stage II: radiolucent oval shadow and mild sclerosis; stage II: sclerotic halo; stage IV: degenerative changes on both sides of the joint), while a modification of the Ficat Classification System by Mont and Hungerford [31] was applied to each femoral and tibial condyle with secondary osteonecrosis (stage I: normal plain X-rays, diagnosis from MRI scan; stage II: cystic and sclerotic changes; stage III: subchondral collapse, crescent sign; stage IV: degenerative changes present on both sides of the joint). All the patients had stage III and IV lesions of at least one condyle (see Table 2). MRIs were used to confirm the diagnosis of osteonecrosis for the visualized lesions on plain radiographs. These confirmatory findings were the demonstration of a discrete low-signal intensity lesion in T1-weighted images, corresponding to an area of low-signal intensity surrounded by high-intensity marrow signal in T2-weighted images. All radiographs were read by an experienced radiologist as well as the operating surgeon to confirm the aforementioned findings. Further details about the locations and sizes of the lesions [5] and identified risk factors are summarized in Tables 1 and 3. Figure 1A and B shows MRI images for a patient with knee osteonecrosis secondary to corticosteroid use.

Cementless implants were utilized in all patients (Triathlon Total Knee System and Triathlon Tritanium; Stryker Orthopaedics, Mahwah, NJ) and all were posterior-stabilized prostheses. All implant components including patellar component were cementless. All patients followed a standard post-operative protocol with early mobilization on the same day of the surgery as tolerated. Protected weight bearing was instituted for the first post-operative week and gradually advanced over the second week. Occasional patients used wheeled walker for assistance for the first 2 weeks. Additionally, range-of-motion (ROM) exercises along with physical therapy was carried out from the day of surgery and advanced as tolerated by the patient without specific restrictions. Patients were evaluated clinically at 4-6 weeks, 3 months, 1 year, and then yearly intervals thereafter. All surgeries were performed by a single experienced board-certified and fellowship trained orthopedic surgeon.

Study Endpoints

Patients were evaluated clinically at 4-6 weeks, 3 months, 1 year, and then yearly intervals thereafter. Pre-operatively and at each

Table 2
X-Ray Grading of the Affected Knees According to Koshino Classification for SONK, and the Modified Ficat Classification System by Mont and Hungerford for Secondary Osteonecrosis in the Affected Knees.

Grade	Knees, n (%)	SONK/Secondary
I	–	–
II	–	–
III	31 (63)	26/5
IV	18 (37)	12/6

Table 3
Characterization of Lesions by Size According to Ahlback Classification System.

Size of the Lesion (Greatest Width in AP and Lateral Radiographs)	Knees, n (%)
More than 10 mm (Large)	42 (86)
Less than 10 mm (Small)	7 (14)

AP, anteroposterior.