The Journal of Arthroplasty 29 (2014) 2091–2094

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Doctor, What Does my Knee Arthroplasty Weigh?

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ARTICLE INFO

Article history:
Received 2 June 2014
Accepted 12 July 2014

Keywords:
TKA components
cement
bone
soft tissues
weight

ABSTRACT

The aim of this study was to compare the weight of the total knee arthroplasty (TKA) implants and the weight of the natural knee. A prospective study was conducted with two different brands of cemented primary TKA. During the procedure, we collected the removed bone, soft tissues and the post-implantation cement and weighed them all separately at the end. In both groups, the implants plus cement were significantly heavier than the removed bone and soft tissues. The average weight gained was 266.7 ±35.1 g for group 1 and 279.1 ± 48.7 g for group 2. This significant local weight gained after TKA is a new parameter that should be taken into account for further studies and when creating new implants.

Introduction

Total joint arthroplasties (TJA) have revolutionized the treatment of hip and knee osteoarthritis. Orthopaedic surgeons, in close collaboration with bio-engineers have endeavored to design and create implants that are safer, more biocompatible and that can last longer. Studies focusing on long-term outcomes of total knee arthroplasty (TKA) have shown survivorship after 15 years ranging from 81.7% to 98.14% [1-3]. Those results are similar to what is reported for total hip arthroplasty (THA) with survivorship after 15 years ranging above 90% [4,5]. However many patients remain in pain after TKA. As shown by Nashi et al [6] 31.1% and 28.9% of patients experience a residual knee pain at 1 and 2 year respectively after TKA. When comparing TKA and THA, patients report more pain after TKA with a proportion up to 20% on long-term pain [7,8]. The function is also unequally restored with poorer functional outcome in TKA patients compared to THA as shown by Wylde et al [9]. Despite extensive literature and many parameters studied such as preoperative pain, gender, associated diseases, implant design, surgical approach and more, the reasons for a long recovery time after TKA remain sometimes unexplained. Thus, Nashi et al [6] have shown that female gender, ischemic heart disease and postero-stabilized implants are associated to poor outcomes. Wylde et al [7] outlined that major depression and the number of pain problems elsewhere were critical in developing persistent postoperative pain. Puolakka et al [10] concluded that the degree of early postoperative pain is a strong risk factor for persistent pain. The role of the implant design has been widely studied as well. Peters et al [11] have shown no difference between highly congruent anterior-stabilized and cruciate retaining design regarding functional scores, complication, revision and survivorship. Many other studies [12-14] focusing on the influence of the implant design on functional outcomes found no significant difference either. Therefore, the long time for recovery and the reason why so many knees are not "forgotten", as most of the hips are, remain unknown. Moreover, some patients often ask what does their knee prosthesis weigh or have the feeling that their knee is heavier than before the procedure. The weight of the implants might have an influence on the recovery, especially in an old patient with an amyotrophied quadriceps femoris muscle. To the best of our knowledge, there is no study related to the weight of the implants for any joint arthroplasy in general and for the knee in particular. Inasmuch this parameter has never been studied, we asked whether or not the weight of the knee prosthesis is a valuable criterion. The aim of the present study was to compare the weight of the removed bone and soft tissues to the weight of the implants and the cement. We hypothesized that the weight of a knee prosthesis is heavier than a natural knee. In this study, we test this hypothesis with two different brands of postero-stabilized prosthesis.

Patients and Methods

We prospectively included patients undergoing a unilateral primary total knee arthroplasy for osteoarthritis from February 2014 to April 2014. The experimental design was approved beforehand by our institutional review board. We recorded patient demographics, axis of the lower limb, surgical approach, type of synovectomy, and use of the computer-assisted navigation. We carefully weighed the removed bone and soft tissue as well as the cement with a digital scale with an accuracy of half a gram. We use two aluminum cups to gather

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.07.012.

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http://dx.doi.org/10.1016/j.arth.2014.07.012
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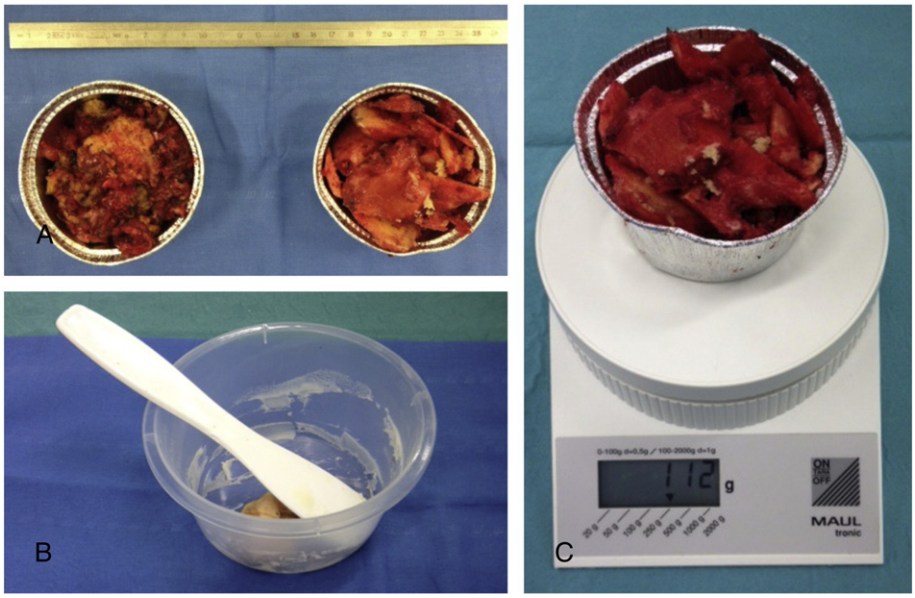

Fig. 1. (A) Picture of the removed soft tissues (left) and the removed bone (right) in their aluminum cup. (B) Picture of the cement left at the end of the procedure. (C) Removed bone weighed on the scale.

the bone and the soft tissues. The aluminum cups and the spatula and cup for the cement were all weighed with no contents at the beginning of the study. Then, we weighed one dose of polymerized cement. By subtracting the weight of the spatula and the cup we obtained the weight of the polymerized cement. The bone was collected from the resection of the osteophytes, the femoral, tibial and patellar cuts as well as the bone trapped within the thread of the drills. We gathered the cement that comes off the edges of the implants after implantation and we put it back into the cup. At the end of the procedure, we weighed the bone, the soft tissues and the cement in their cups and by subtracting the weight of each of the cups and the spatula we obtained the weight of the removed bone and soft tissues as well as the weight of the cement used (Fig. 1). The weight of the implants (femoral component, tibial base, tibial insert, patellar insert and extension stem) was provided by the manufacturers.

Operating Procedure

Six experienced lower limb reconstruction surgeons in a single institution carried out all procedures under general anesthesia. The surgical approach was used according to the surgeon's usual practice. The implants were all cemented and no tourniquet was used. Two different brands of postero-stabilized knee prosthesis were used: the Amplitude Anatomic® (Group 1) and the Tornier Kneetec® (Group 2) according to the surgeon's preference. Details are in Table 1.

Statistical Analysis

Data analysis was performed using the GraphPad Prism 4.0 software (GraphPad Software Inc., San Diego, CA, USA). For data tested positive for Gaussian distribution according to the Kolmogorov–Smirnov test we used a Student t test whereas for data tested negative for Gaussian distribution, we used a non parametric Mann–Whitney U test. Chi-square or Fisher's analysis were used to compare categorical data. In each group, we compared the weight of the removed bone and soft tissue versus the weight of the prosthesis. Moreover, we compared the weight of the removed bone and soft tissues between the two groups as well as the weight of the implants.

With regard to the power analysis [15]: the sample size was based on the precision of the main outcome we wanted to estimate, namely the difference in weight between the prosthetic knee and the tissues removed during surgery. Because we found no previous data for our computation,

Table 1
Patients' Characteristics and Surgical Data in Group 1 and Group 2.

Parameter	Group 1	Group 2	
	57 Patients	45 Patients	*P* Value
Components	Amplitude Anatomic®	Tornier Kneetec®	
Average age (years, mean ± SD)	74.3 ± 7.5	72.7 ± 10.2	0.35
Average BMI (mean ± SD)	28.6 ± 3.7	27.9 ± 4.4	0.06
Axis of the LL			
Varus/valgus/normal (number)	41/14/2	33/11/1	1.0/0.02/1.0
Angle degree (mean ± SD)	7.6 ± 3.7/7.1 ± 4.1/0	7.3 ± 3.8/8.4 ± 4.7/0	0.47/0.48
Surgical approach, number			
Subvastus	39	32	0.83
Midvastus	1	1	1.00
Transvastus	15	6	0.14
Keblish	2	6	0.13
CAS (yes/no)	50/7	45/0	0.01
Tibial extension stem (yes/no)	56/1	15/30	<0.001
Synovectomy (yes/no)	57/0	45/0	<0.001
Anterior	57	45	
Other	0	0	