Use of Slide Presentation Software as a Tool to Measure Hip Arthroplasty Wear

Ho Hyun Yun, MD,* Nirmal K. Jajodia, MS, DNB,* Jae Sung Myung, MD,†
Jong Keon Oh, MD, PhD,* Sang Won Park, MD, PhD,* and
Won Yong Shon, MD, PhD*

Abstract: The authors propose a manual measurement method for wear in total hip arthroplasty (PowerPoint method) based on the well-known Microsoft PowerPoint software (Microsoft Corporation, Redmond, Wash). In addition, the accuracy and reproducibility of the devised method were quantified and compared with two methods previously described by Livermore and Dorr, and accuracies were determined at different degrees of wear. The 57 hips recruited were allocated to: class 1 (retrieval series), class 2 (clinical series), and class 3 (a repeat film analysis series). The PowerPoint method was found to have good reproducibility and to better detect wear differences between classes. The devised method can be easily used for recording wear at follow-up visits and could be used as a supplementary method when computerized methods cannot be employed.
Keywords: total hip arthroplasty, wear measurement, PowerPoint method.

Total hip arthroplasty (THA) wear may trigger aseptic osteolysis due to chronic inflammatory response to implant-derived wear particles [1,2]. Accordingly, component wear substantially determines implant longevity [3,4]. Several efforts have been made to reduce the impact of particulate debris produced by wear [5-8], and modern materials used to produce articulating components are more resistant to wear [9,10].

Wear measurement methods were essentially divided into three types: (i) manual [11-13], (ii) computer-assisted [14,15], and (iii) radiostereometry analysis (RSA) [5,6]. Manual methods have been used successfully to measure high levels of wear in cemented all polyethylene acetabular components [11-13]. However, the advents of low-wear bearing surfaces and the increased use of metal backings in acetabular components have revealed shortcomings in manual measurement methods. In particular, the accuracies of manual methods are limited in low-wear subjects, as has been determined by retrieval studies [16,17]. Computer-assisted methods [14,15] and stand-alone computer software packages increase the accuracy and precision of hip arthroplasty wear measurements. However, they are costly and not readily available and, furthermore, require high quality digitalized radiographs and technical expertise. On the other hand, RSA provides an accurate means of analyzing conventional radiographs for migration and wear in THA [5,6]. However, RSA requires a prospective study design and higher expense, and is thus, is of limited value to practicing orthopedists.

In the present study, we proposed to develop a new method of manual wear measurement (PowerPoint method [PP method]), which uses Microsoft PowerPoint (Microsoft Corporation, Redmond, Wash).

The purposes of the study were (1) to quantify the accuracy and reproducibility of the PP method on clinical radiographs and to compare it with that of the previously described methods (Livermore's [13] and Dorr's [12]), and (2) to determine the usefulness of the PP method for wear measurement.

Materials and Methods

The following exclusion criteria were applied: (i) the nonavailability of postoperative (6 weeks) or latest prerevision radiographs; (ii) evidence of femoral or acetabular loosening or migration according to Callaghan's guidelines [18]; (iii) paired films having significant different rotation on the *y* axis using the profile of the screws, shape of the tear drop and profiles of the cup, and (iv) poor-quality radiographs.

*From the *Department of Orthopaedic Surgery, Korea University School of Medicine, Seoul, South Korea; and †Department of Radiology, Korea University School of Medicine, Seoul, South Korea.*
Submitted January 15, 2009; accepted June 6, 2009.
No benefits or funds were received in support of this study.
Level of evidence: Diagnostic study, level–II.
Reprint requests: Won Yong Shon, MD, PhD, Department of Orthopaedic Surgery, Guro Hospital, Korea University School of Medicine, 80, Guro-Dong, Guro-Gu, Seoul 152703, South Korea.

0883-5403/09/2408-0014$36.00/0
doi:10.1016/j.arth.2009.06.012

Between July 1999 and November 2004, 48 patients underwent liner exchange at our institution for high wear, osteolysis, and infection and/or during femoral revision. Of these 48 patients, 13 underwent liner exchange for high wear and met the study inclusion criteria and were allotted to the C1 group (retrieval series; high wear), representing a high wear situation. Between January 2001 and March 2004, 202 patients were implanted. Applying the exclusion criteria, 24 patients were randomly chosen for the C2 group (clinical series; low wear), representing low wear. In addition, 20 patients selected at random from the C1 (10 patients) and C2 groups (10 patients) were radiographed twice and were also assigned to the C3 group (repeat film analysis series; zero wear). This repeat imaging was performed to mimic the zero wear at follow-up situation and, specifically, to check the accuracy of our method in terms of its ability to recognize zero wear. Thus, 37 patients (57 hips) were enrolled in this study.

Femoral heads were of cobalt-chrome alloy of diameter 28 mm in all cases. Femoral stems used were; Versys cemented (27), Centrealign Precoat stems (15), and Zimmer Versys beaded midcoat stems (15). Acetabular shells were Trilogy clustered hole (30), Harris Galante cups (16), and Trilogy multiholed (11) of mean diameter 50 mm (range, 46-56 mm). Harris-Galante liners (16) were sterilized with γ-irradiation in air, nonlongevity trilogy liners (5) were sterilized with γ-radiation either in air or in an inert gas environment, and longevity trilogy liners (36) were manufactured by 10 Mrad γ-irradiation and sterilized using a gas plasma [19].

Wear Measurements

Paired radiographs (6 weeks and latest follow-up) were analyzed using the Livermore and Dorr methods, and the PP method. For the Livermore [13] and Dorr [12] methods, radiographs were magnified to 200%, printed, and readings taken with digital calipers with an accuracy of 0.01 mm (digimatic calipers, Mitutoyo Corporation, Kawasaki, Kanagawa, Japan).

The algorithm used in PP method is described below.

1. Acquire the digitalized images of the 6 weeks and latest follow-up radiographs using the PACS system (Infinite, Seoul, Korea) and record the size of the head used from operative records.
2. Rotate the images for correction of the x-axis using Microsoft office picture manager software with the aid of a screen ruler (MB-Ruler, MB-Software Solutions, Hameln, Lower Saxony, Germany).
3. Crop the area of interest after correction for rotation.
4. Design the PP templates (head centering circle and acetabular circles) for the study on Microsoft PowerPoint and use this slide as a template for all paired radiographs (Fig. 1).

How to design the PP templates:

a. Head centering template: open a blank presentation in PowerPoint and click on auto shapes/circle in Picture tool of Insert in upper tool bar to insert a circle with two diameter crossing at 90° to each other (x and y axis). Adjust the height and width of the circle to 1 in. each side (or real size from 22–32 mm) to make a perfect circle.
b. Acetabular template: the acetabular templates were designed by inserting several circles at incremental diameters of 0.1 in. (or 2 mm) with different color codes for better visual contrast and then bringing the different circles to exactly overlap the center of each so that they are absolutely concentric to each other. We used the minimum size as 0.1 in. because after various permutations and combinations with different sizes, we found that it was most convenient to select the base size as 0.1 in.

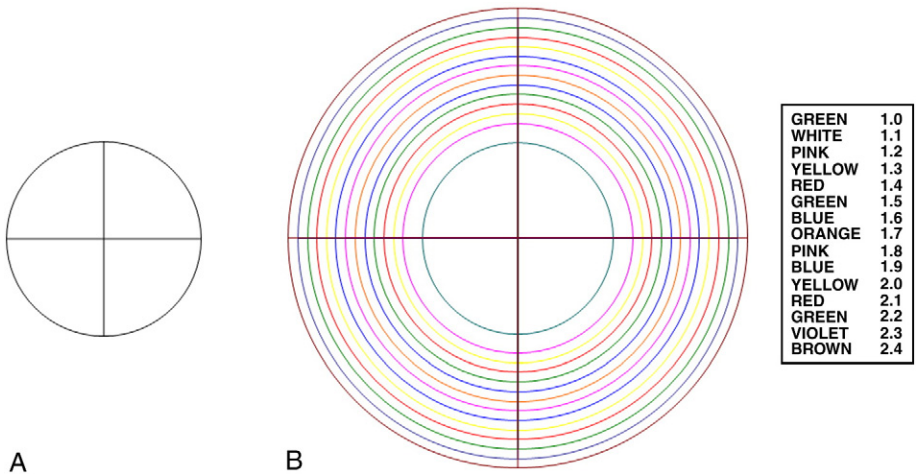

Fig. 1. The PP templates. A, Head centering plate to correct for magnification. B, Acetabular template to measure the amount of wear.