Weight of Polyethylene Wear Particles is Similar in TKAs with Oxidized Zirconium and Cobalt-chrome Prostheses

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Abstract

Background The greater lubricity and resistance to scratching of oxidized zirconium femoral components are expected to result in less polyethylene wear than cobalt-chrome femoral components.

Questions/purposes We examined polyethylene wear particles in synovial fluid and compared the weight, size (equivalent circle diameter), and shape (aspect ratio) of polyethylene wear particles in knees with an oxidized zirconium femoral component with those in knees with a cobalt-chrome femoral component.

Patients and Methods One hundred patients received an oxidized zirconium femoral component in one knee and a cobalt-chrome femoral component in the other. There were 73 women and 27 men with a mean age of 55.6 years (range, 44–60 years). The minimum followup was 5 years (mean, 5.5 years; range, 5–6 years). Polyethylene wear

particles were analyzed using thermogravimetric methods and scanning electron microscopy.

Results The weight of polyethylene wear particles produced at the bearing surface was 0.0223 ± 0.0054 g in 1 g synovial fluid in patients with an oxidized zirconium femoral component and 0.0228 ± 0.0062 g in patients with a cobalt-chrome femoral component. Size and shape of polyethylene wear particles were 0.59 ± 0.05 μ m and 1.21 ± 0.24 , respectively, in the patients with an oxidized zirconium femoral component and 0.52 ± 0.03 μ m and 1.27 ± 0.31 , respectively, in the patients with a cobalt-chrome femoral component. Knee Society knee and function scores, radiographic results, and complication rate were similar between the knees with an oxidized zirconium and cobalt-chrome femoral component.

Conclusions The weight, size, and shape of polyethylene wear particles were similar in the knees with an oxidized zirconium and a cobalt-chrome femoral component. We found the theoretical advantages of this surface did not provide the actual advantage.

Level of Evidence Level I, therapeutic study. See the guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at The Joint Replacement Center of Korea, Ewha Womans University School of Medicine.

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Introduction

Although TKA reliably provides durable pain relief, polyethylene wear remains a major limitation of the long-term success of TKA [4, 8, 14, 20, 24–29, 32]. Lowering the rate of polyethylene wear should reduce the prevalence of osteolysis and would be expected to increase the survivorship of implants used in TKA. One potential method of lowering polyethylene wear in TKA is to use ceramic bearing surfaces. Zirconium is a metal that, when oxidized,

becomes zirconium oxide, a ceramic, also referred to as zirconia. The resulting material (oxidized zirconium or OxZr) of total knee prostheses maintains the strength of the metal zirconium core yet provides the benefit of a ceramic articulating surface. Preliminary studies of this material using wear machines have reported reduction in polyethylene wear rates of 42% to 89% compared with cobalt-chrome (Co-Cr) [9, 11, 30]. It also has been reported there was a more rapid return of flexion and regaining functional milestones in the group of patients with OxZr femoral knee components [18, 19].

Although one can indirectly infer wear from osteolysis [25], it is difficult to determine *in vivo* polyethylene wear using postoperative radiographs in TKA [25]. Although methods for measuring wear continue to be improved and validated [4, 8, 19], the use of plain standing radiographs to identify joint space narrowing remains the technique most commonly used [5]. Simple asymmetry of the joint space on radiographs obtained after TKA, however, does not necessarily confirm polyethylene wear is present because ligamentous laxity on one side of the knee may appear as joint space narrowing in the opposite component. Therefore, polyethylene wear particle analysis from synovial fluid aspiration has been proposed as a surrogate for assessing wear [2, 3, 17, 21, 22, 34]. Presumably the generation of larger numbers of polyethylene wear particles will be reflected by greater numbers of polyethylene wear particles in the synovial fluid, leading to osteolysis [10, 15].

We examined two hypotheses in this prospective and randomized study: (1) the weight, size, and shape of polyethylene wear particles would differ between knees with OxZr and Co-Cr femoral components; and (2) Knee Society knee and function scores [7], radiographic results, and complication rates would be similar between knees with OxZr and Co-Cr femoral components.

Patients and Methods

From January 2003 to May 2004, we prospectively enrolled 105 patients (210 knees) who had bilateral osteoarthritis of the knee severe enough to warrant simultaneous bilateral sequential TKAs, who were younger than 60 years, and who agreed to participate in the study. During this same time, we operated on 289 patients (527 knees) older than 60 years and seven patients (14 knees) with rheumatoid arthritis, all of whom were excluded from enrollment. We excluded the patients who were elderly and had rheumatoid arthritis because we assumed their activity level would be too low to detect polyethylene wear particles in the synovial fluid in the short-term followup. A sample size estimation according to the weight of

polyethylene wear particles in 1 g synovial fluid would require 100 knees in each group to show a difference between the two groups of at least 0.0086 g from a mean of 0.0859 g in the OxZr group and 0.0945 g in the Co-Cr group with an alpha level of 0.05 and a power level of 80%. We interpreted, when the total number of polyethylene particles in synovial fluid, according to Minoda et al. [22], in the posterior stabilized TKA is 12.9 times more than that in the medial pivot TKA, it would have a significant ($p = 0.004$) influence on the long-term clinical survival owing to wear or osteolysis. The mean difference of 0.0086 g between the two groups in the current series would not make a difference in the long-term clinical survival owing to wear or osteolysis, but it requires long-term followup to prove it. Five patients were lost to followup before 1 year, leaving 100 of the 105 patients (95%) available with a minimum followup of 5 years (mean, 5.5 years; range, 5–6 years) (Fig. 1). There were 73 female and 27 male patients with a mean age of 55.6 years (range, 44–60 years) at the time of the operation (Table 1). All knees had a varus deformity between 7° and 20°. Eleven patients with an OxZr femoral knee component and 13 patients with a Co-Cr femoral component had previous arthroscopic débridements and the remaining patients in both groups had no previous surgery. We obtained prior approval of our institutional review board. A detailed informed consent form was signed by each patient, and all information was kept confidential.

Fig. 1 A CONSORT flow diagram shows enrollment, allocation, followup, and analysis.

Table 1. Details of the 100 patients

Parameter	Oxidized zirconium	Cobalt-chrome	p Value
Gender (male/female)	27/73		
Age (years)*	55.6 ± 4.21 (44–60)		
Height (cm)*	153.8 ± 6.56 (140–178)		
Weight (kg)*	64.0 ± 8.88 (42–94)		
Body mass index (kg/m ²)*	27.0 ± 3.40 (21–36)		
Diagnosis (number of patients)			
Osteoarthritis	100 (100%)		
Anesthesia (number of patients)			
Epidural	84		
General	16		
Operating time (minutes)*	46.8 ± 4.22 (60–75)	47.9 ± 5.1 (58–70)	0.696
Tourniquet time (minutes)*	31.7 ± 5.63 (40–65)	32.9 ± 5.81 (39–67)	0.509
Intraoperative blood loss (mL)*	495 ± 170.6 (50–1570)	511 ± 192.47 (100–1690)	0.685
Hemovac® drainage (mL)*	760 ± 488.11 (20–1915)	730.9 ± 399.7 (110–1660)	0.678
Amount of transfusion (mL)*	569.3 ± 323.6 (100–1500)		
Followup (years)*	5.5 (5–6)		

* Values are expressed as mean ± SD, with range in parentheses.

Randomization of the Genesis II® total knee prosthesis (Smith and Nephew, Memphis, TN) to an OxZr femoral knee component or a Co-Cr femoral knee component was accomplished using a sealed study number envelope, which was opened in the operating room before the skin incision had been made. After opening the randomization envelope, the first knee received the prosthesis indicated by the envelope and the contralateral (second TKA) knee received the other prosthesis. The tibial components were modular with a ram-extruded, ethylene oxide-sterilized polyethylene insert. All the patellae were resurfaced with an all-polyethylene (ram-extruded, ethylene oxide-sterilized polyethylene) biconvex insert implant.

Epidural anesthesia was used in 84 patients and general anesthesia was used in 16 patients. A bloodless field was obtained by using a pneumatic tourniquet at a pressure of 250 mmHg after exsanguinations with an Esmarch bandage. An anterior midline skin incision (10–12 cm in length) was used with a medial parapatellar capsular incision of the joint in all patients. In both groups, femoral preparation was performed first followed by tibial preparation. All implants were of a posterior cruciate-retaining design. All implants were cemented using Simplex® P cement (Howmedica, Rutherford, NJ) after pulsed lavage, drying, and pressurization of cement.

We performed clinical and radiographic evaluations at 3 months and 1 year after the operation and yearly thereafter. All clinical data at the time of each followup were recorded and compiled by a clinical fellow (YWC) who was not part of the operative team and who had no knowledge of the radiographic findings. The observer was

blinded as to which knee had the OxZr versus Co-Cr femoral component. The level of activity of the patients after the TKA was assessed with the activity score of Tegner and Lysholm [31].

All 100 patients had complete radiographic followup a minimum of 5 years after surgery. Radiographs were analyzed and findings were recorded by one observer (SML) who had no knowledge of the names of the patients to determine consistency in radiographic assessment (component position, radiolucent lines, joint lines, and osteolysis). Radiographs obtained before and after surgery, which included AP radiographs obtained with the patient standing (including hip and ankle) and supine, a lateral radiograph, and a skyline patellar radiograph, were assessed for alignment of the limb, position of the component, and the presence and location of all radiolucent lines at the bone-cement or cement-implant interface according to the recommendation of the Knee Society [12]. All radiographs were taken under the control of fluoroscopic radiographic examinations at each followup to determine the interfaces critically. The joint lines were determined on AP radiographs obtained before and after surgery with the patient supine by measuring the distance between the tip of the fibular head and the distal margin of the lateral femoral condyle preoperatively and between the tip of the fibular head and the distal margin of the lateral femoral component postoperatively. The skyline patellar radiographs were examined for patellar tilt, subluxation, or dislocation. Any osteolysis around three components was recorded.

We isolated polyethylene wear particles from aspirated synovial fluid in all patients (200 knees) at a mean of

5.5 years (range, 5–6 years) after surgery. Before aspiration of the knee was performed to collect synovial fluid, patients were asked to do active and passive ROM exercises of both knees for 5 minutes to have polyethylene wear particles distributed evenly in the synovial fluid as much as possible. We were able to obtain a mean weight of 4.07 g (range, 0.65–10.08 g) synovial fluid from each knee. Aspirated synovial fluid from each knee was plated on a Petri dish and the real amount of polyethylene wear particles in the sample was measured by thermogravimetric analysis (TGA) using a TGA instrument (Model TGA/SDTA 851e; Mettler Toledo Co, Greifensee, Switzerland) [6]. Briefly, the weight of the sample solution was measured before and after removing the organic content by heating the sample solution. The sample solution was plated on Petri dishes. The Petri dish was covered and kept in a dry oven at 60°C for 2 days. While the sample solution was kept in a dry oven for 2 days, a small hole was made on the cover of the Petri dish to allow water to evaporate slowly for 2 days. After this procedure, the cover of the Petri dish was removed and the TGA sample was dried at 60°C for another 2 days. For TGA analysis, the sample was heated from room temperature to 1000°C with a heating rate of 5°C per minute. During the TGA experiment, dry nitrogen gas was introduced in the test furnace at a rate of 50 mL per minute as a test environment. When the temperature reaches the point of decomposition of polyethylene wear particles, weight loss of the sample occurs. By calculating the weight of the TGA sample at the time of decomposition of the polyethylene particles, the real amount of polyethylene wear particle is measured.

The size and shape of polyethylene wear particles were examined using scanning electron microscopy (Model

JSH-6360A; Jeol Co, Tokyo, Japan). The samples were coated using a platinum sputtering machine for 20 seconds. Three to five samples from each patient were examined. At least 100 particles were counted in the scanning electron microscopic photographs for each sample. One observer (JSK) examined the samples and intraobserver agreement was 0.69 to 0.87. Particle size was expressed using equivalent circle diameter, which is the diameter of a circle having the same area as the particle. Particle shape was determined by the aspect ratio (length/breadth) and roundness ($\text{perimeter}^2/4\pi \times \text{area}$) [10].

Differences in polyethylene particles between the types of prostheses were analyzed using the paired t test and chi square test. Weight of polyethylene particles in synovial fluid was the primary variable and its difference between the two groups was determined using the paired t test. We determined differences in the Knee Society score between the two groups using two-way repeated-measures ANOVA. The ROMs of the knee also were compared between the two groups using two-way repeated-measures ANOVA. Complication rates and radiographic data were compared between the groups with chi square tests. All statistical analyses were performed with SPSS® Version 14.0 (SPSS Inc, Chicago, IL) with two-tailed tests.

Results

The mean weight of the polyethylene wear particles was similar ($p = 0.6366$) in the two groups: 0.0223 g (SD, 0.0054 g) in the OxZr group and 0.0228 g (SD, 0.0062 g) in the Co-Cr group (Table 2). The size, aspect ratio, and roundness of the polyethylene wear particles were similar ($p = 0.438$, $p = 0.379$, and $p = 0.837$, respectively) between the two groups (Table 3; Fig. 2). The particle size expressed using equivalent circle diameter was 0.59 μm (SD, 0.05 μm) in the OxZr femoral component group and 0.52 μm (SD, 0.03 μm) in the Co-Cr femoral component group. The particle shape determined by the aspect ratio was 1.21 (SD, 0.24) in the OxZr group and 1.27 (SD, 0.31) in the Co-Cr group. The particle shape determined by the roundness was 1.78 (SD, 2.83) in the OxZr group and 1.62 (SD 2.62) in the Co-Cr group (Table 3).

Table 2. Weight of polyethylene in 1 g synovial fluid

Group	Weight of polyethylene (g)	
	Average	SD
Oxidized zirconium	0.0223	0.0054
Cobalt-chrome	0.0228	0.0062
p Value (paired t test)	0.6366	

Table 3. Comparison of particle characteristics

Group	ECD (μm)	Aspect ratio	Roundness
Oxidized zirconium	0.59 $\pm$ 0.05 (0.43)	1.21 $\pm$ 0.24 (1.13)	1.78 $\pm$ 2.83 (0.98)
Cobalt-chrome	0.52 $\pm$ 0.03 (0.48)	1.27 $\pm$ 0.31 (1.17)	1.62 $\pm$ 2.62 (1.07)
p Value (paired t test)	0.438	0.379	0.837

Values are expressed as mean $\pm$ SD, with median in parentheses; ECD = equivalent circle diameter = $(4 \times \text{area}/\pi)^{1/2}$; aspect ratio = length/breadth; roundness = $\text{perimeter}^2/4\pi \times \text{area}$.

Fig. 2A–B Scanning electron microscope images show polyethylene wear particles from a Genesis II® total knee prosthesis with (A) an OxZr femoral component (magnification, $\times 17000$) and (B) a Co-Cr femoral component (magnification, $\times 27,000$). Polyethylene particles in both groups are flaked and irregularly shaped (particles that cannot be described as round or spherical).

The mean Knee Society score and mean ROM were similar in patients with an OxZr femoral knee component and a Co-Cr femoral knee component (Table 4). All but five patients had an activity score of 5 or 6 points after the TKA, indicating participation in strenuous farm work (a score of 5 points) or playing tennis (a score of 6 points). We found no radiographic difference between the two groups in the following parameters: alignment of the knee, position of the component, joint line, posterior condylar offset, and prevalence of radiolucent lines (Table 5; Fig. 3). Complication rates were similar in both groups (Table 6).

Discussion

Although it has been claimed TKAs with an OxZr femoral knee component produced less polyethylene wear [8, 9, 11]

than those with a Co-Cr femoral knee component, these findings have not been well demonstrated clinically. We examined polyethylene wear particles in synovial fluid and compared the weight, size, and shape of polyethylene particles in knees with an OxZr femoral component with those in knees with a Co-Cr femoral component. Also, the clinical and radiographic results were compared between the two groups.

There are some limitations of this study. First, it was difficult to make sure synovial fluid was aspirated completely from each knee. Also, it was impossible to measure the weight of all polyethylene wear particles completely in vivo. Second, we performed no interobserver variability studies on the radiolucent lines and radiographic loosening. One observer can systematically bias the observations leading to error (either underestimation or overestimation). However, we did determine intraobserver agreement of radiographic measurements. For the new, modified radiographic evaluation system, Bach et al. [1] found the mean kappa intraobserver reproducibility coefficient was 0.46 to 0.96. Intraobserver agreement in our series was 0.73 to 0.95. Third, it is difficult for a patient who has had bilateral TKAs to separate the function of each knee. Although this is a problem when assessing function after bilateral TKAs, we believe we were able to obtain fairly accurate information after careful assessment of the performance of each knee, including walking distance, transfer from a chair, and negotiating stairs. If patients have a limited walking distance and/or difficulty in negotiating stairs, they are asked to grade which knee is bothering them more in terms of these functional limitations. They usually tell the functional differences between the two knees. Finally, the followup is relatively short for wear analysis. We understand this precludes any conclusions regarding long-term differences in the weight, size, and shape of polyethylene wear particles in the TKAs with an OxZr femoral component and in those with a Co-Cr femoral component. Although polyethylene wear particles from failed knee prostheses yield important information, polyethylene wear particles in such failed TKA prostheses are generated in extreme conditions [2, 23] and might be affected by unstable interface and third bodies; thus we believe such data from patients who are functioning well yield complementary data.

Many authors reported reduction in polyethylene wear rates in a knee wear simulator of 42% to 89% in knees with an OxZr femoral component compared with knees with a Co-Cr femoral component [9, 29, 30, 34] (Table 7). Kobayashi et al. [16] observed there was no correlation between the presence or absence of osteolysis and the morphologic features of the particles present. However, they reported there was an association between the number of particles and the presence of osteolysis. In our study, the

Table 4. Preoperative and postoperative data for patients in both groups

Parameter	Knee Society score				p Value (Student's t test)	
	Oxidized zirconium		Cobalt-chrome		Preoperative	Postoperative
	Preoperative	Postoperative	Preoperative	Postoperative		
Total knee score (points)*	27.5 (4–50)	93 (88–100)	27.2 (4–44)	92 (90–100)	0.688	0.291
Function score (points)*	55.4 (–10–80)	78 (30–100)	55.4 (–10–80)	78 (30–100)	1.000	1.000
Pain score (points)*	0	47	0	47	0.612	0.614
Pain (number of patients)						
None		75 (75%)		73 (73%)		
Mild		25 (25%)		27 (27%)		
Moderate	5 (5%)		5 (5%)			
Severe	95 (95%)		95 (95%)			
Walking distance (number of patients)						
Cannot walk						
< 1 block	16 (16%)		16 (16%)			
1–5 blocks	26 (26%)	4 (4%)	26 (26%)	4 (4%)		
5–10 blocks	33 (33%)	7 (7%)	33 (33%)	7 (7%)		
Unlimited	25 (25%)	89 (89%)	25 (25%)	89 (89%)		
ROM (°)*	125 (60–150)	127 (80–145)	124 (70–151)	126 (90–145)	0.808	0.262
Walking support (number of patients)						
No support	73 (73%)	93 (93%)	73 (73%)	93 (93%)		
1 cane	22 (22%)	5 (5%)	22 (22%)	5 (5%)		
1 crutch	3 (3%)		3 (3%)			
2 crutches	2 (2%)	2 (2%)	2 (2%)	2 (2%)		
Stairs (number of patients)						
Normal		49 (49%)		49 (49%)		
With support	100 (100%)	51 (51%)	100 (100%)	51 (51%)		

* Values are expressed as mean, with range in parentheses.

weight of polyethylene wear particles generated in TKAs with the OxZr and Co-Cr femoral components was similar in vivo. This finding suggests the numbers of polyethylene wear particles generated in TKAs with the OxZr femoral component were not reduced in vivo in contrast to the findings in a knee simulator. The findings from polyethylene wear particle analysis in two studies [26, 30] suggested OxZr produces submicrometer particles equivalent in size to those produced by Co-Cr but fewer in number (Table 8). In our in vivo study, there were no differences in the mean size or the number of submicrometer particles between the OxZr femoral component and Co-Cr femoral component.

In one randomized prospective clinical study, the results of Genesis II® TKA with an OxZr femoral knee component and that with a Co-Cr femoral knee component were compared in 73 patients (73 knees) [13]. At a mean followup of 2 years, there were no differences in the knee scores and ROMs between the two groups, but there were more rapid return of flexion and regaining functional

milestones in the OxZr group. In our series, no differences in clinical outcomes and ROMs (127° versus 126°) were identified between the two groups. The postoperative total knee, function scores, and pain scores were not different between the two groups. In the one clinical series of TKAs with an OxZr femoral component, the femoral and tibial component orientations in coronal and sagittal planes were satisfactory [18]. Also, there was no evidence of gross loosening or osteolysis of any component in that series. We found no radiographic differences between the two groups in the following parameters: alignment of the knee, position of the components, joint line, posterior condylar offset, and prevalence of radiolucent lines. No knee in either group was revised. In one clinical series, no patient had a postoperative infection [18]. In our series, one knee in each group had a deep infection. Each knee had débridement and tibial polyethylene liner change followed by administration of intravenous antibiotics for 6 weeks. No knee had revision of the component because of deep infection.

Table 5. Radiographic results for patients in both groups

Parameter	Oxidized zirconium	Cobalt-chrome	p Value
Alignment (°)*			
Preoperative	6° varus (2°–16° varus)	5° varus (1°–95° varus)	0.765
Postoperative	6° valgus (1°–7° valgus)	6° valgus (0°–7° valgus)	0.935
Femoral component position (femoral angle) (°)*			
Coronal	97° (93°–102°)	97° (93°–103°)	0.965
Sagittal	0.2° (–9°–9°)	0.1° (–8°–8°)	0.605
Tibial component position (tibial angle) (°)*			
Coronal	89° (84°–93°)	89° (83°–93°)	0.779
Sagittal	83° (77°–88°)	83° (75°–99°)	0.893
Patellar component angle (°)*	7° (–8°–18°)	6° (–7°–19°)	0.499
Joint line (mm)*			
Preoperative	17 (8–28)	17 (3–26)	0.726
Postoperative	14 (5–28)	14 (7–26)	0.515
Posterior condylar offset (mm)*			
Preoperative	25 (19–32)	15 (19–33)	0.838
Postoperative	24 (18–32)	24 (9–32)	0.868
Radiolucent line (overall) (number of knees)			
Absence	93 (93%)	92 (92%)	0.388
Presence	7 (7%)	8 (8%)	
Radiolucent line (femoral side) (number of knees)			
Zone 1	2 (2%)	3 (3%)	
Radiolucent line (tibial side) (number of knees)			
Zone 1	5 (5%)	5 (5%)	

* Values are expressed as mean, with range in parentheses.

Fig. 3A–D AP radiographs of both knees of a 59-year-old woman with osteoarthritis taken 5 years after surgery show the (A) Genesis II® total knee prosthesis with an OxZr femoral component and the (B) Genesis II® total knee prosthesis with a Co-Cr femoral component to be solidly embedded in a satisfactory position. There are no radiolucent lines or other signs of osteolysis around the tibial

components. Lateral radiographs taken 5 years after surgery show the Genesis II® total knee prosthesis with an (C) OxZr femoral component and the Genesis II® total knee prosthesis with a (D) Co-Cr femoral component to be rigidly fixed in a satisfactory position. There are no radiolucent lines or other signs of osteolysis around the femoral, tibial, or patellar components.

Table 6. Complications for patients in both groups

Parameter	Oxidized zirconium	Cobalt-chrome
Infection (number of patients)	1 (1%)	1 (1%)
Insufficient ROM (< 120°) (number of patients)	5 (5%)	6 (6%)
Constant mild pain and stiffness (number of patients)	2 (2%)	3 (3%)

Table 7. Comparison of polyethylene wear rates

Study	Wear rate (mm ³ /Mcycle)		% Reduction in wear in oxidized zirconium
	Oxidized zirconium	Cobalt-chrome	
Spector et al. [30]	0.69 ± 0.52	4.68 ± 2.30	85%
Ries et al. [26]	5.27 ± 0.64	46.1 ± 4.73	89%
Ezzet et al. [9]	11.64 ± 1.26	19.99 ± 2.07	42%
White et al. [33]	104 ± 5.3	165.3 ± 19.3	63%

Table 8. Analyses of polyethylene wear particles

Study	Particle size (μm)		% Submicrometer polyethylene particles in oxidized zirconium
	Oxidized zirconium	Cobalt-chrome	
Spector et al. [30]	0.0–0.4	0.05–0.5	23% < Co-Cr (p = 0.28)
Ries et al. [26]	0.16 ± 0.11*	0.16 ± 0.11*	44% < Co-Cr (p = 0.02)
Current study	0.59 ± 0.05*	0.52 ± 0.03*	No difference (20% vs 25%)

* Values are expressed as mean ± SD.

Our in vivo data suggest the weight, size, and shape of polyethylene wear particles are similar in the TKAs with an OxZr femoral component and in those with a Co-Cr femoral knee component. Under the conditions and the duration of this study in this specific group of patients, TKAs with an OxZr or a Co-Cr femoral knee component had similar clinical and radiographic outcomes with no osteolysis.

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