PATELLAR DEFORMATION PATTERNS FROM A PRE-CLINICAL PATELLAR COMPONENT TEST

[1]Mariana Kersh, [1]Heidi-Lynn Ploeg
[1]University of Wisconsin – Madison, Department of Mechanical Engineering
E-mail: mekersh@wisc.edu, web: www.engr.wisc.edu/groups/BM

INTRODUCTION

More attention is being given to the role of patellar components in total knee arthroplasty (TKA) as it is continually cited as a primary cause for TKA revision [1]. Various studies have documented the failure of patellar components [2-4], and as advances in TKA devices are made, it is important to ensure that the history of patellar failure is understood. This information can be used to develop pre-clinical tests to aid the design of clinically successful components. The goal of this study was to compare the polyethylene (PE) deformation of patellar components tested according to a new test protocol [4] against clinical results as one method for test validation.

METHODS

Five metal-backed (Component A) and five all-polyethylene (Component B) patellae were tested using an AMTI knee simulator. All components were fixed with bone cement and tested in bovine serum. A deep knee flexion cycle from 60° to 120° was simulated using a saw tooth waveform developed in a previous study [5]. The femoral component was initially displaced 1.2mm medially with an initial load of 1177N and then translated a total of 6.4mm medially as the load increased to 4258N. Components were tested at 1Hz to 50,000 cycles (20 years of deep knee bending activities), photographed before and after testing, and visually examined.

PE deformation defined as burnishing, creep, and polyethylene transparency, was quantified according to a 4-level scale for each deformation trait: none (0), minimal (1), moderate (2), and extreme (3). This scale was used to evaluate each section of a sixteen-area grid (Figure 1). Each section was assigned a score based on the amount of deformation present. Creep was measured by evaluating circumferential area changes.

RESULTS AND DISCUSSION

The average scores for each area and each component type are found in Table 1. There was no significant difference in the scores for Areas 3 and 4 of Component A or B for any deformation trait and were omitted from overall scores.

Overall, burnishing was more evident in the metal-backed components (score = 2.0) compared to the PE components (1.7). In both components, burnishing scores were higher on the lateral aspect (Area 1) of the patella compared to the medial (Area 2). A more pronounced difference was found in

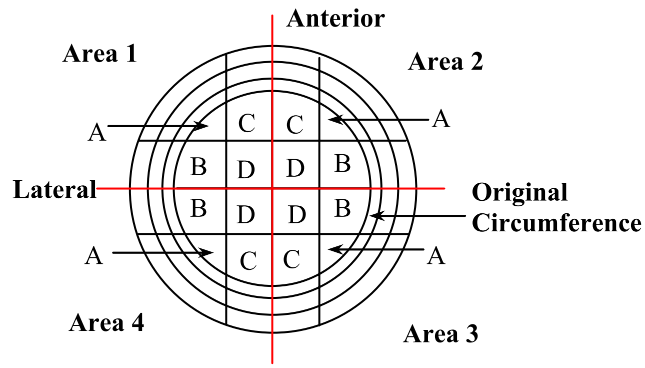

Figure 1. Segmentation of Patella For Evaluation

the evaluation of creep: Component A had an average score of 2.0 compared to 0.8 for Component B. PE transparency was only found in Component A.

In a review of TKA revisions, Baech [4] documented asymmetrical wear patterns in metal-backed components. Andersen also found the presence of lateral edge wear [2]. Stulberg noted similar patterns of failure between the metal-backed and all-polyethylene components noting that both groups deformed at the lateral aspect of the component [3].

Regarding test survival, Component A averaged 5200 cycles before excess deformation required the test to be stopped. In contrast, all of the PE components survived 50,000 cycles. Studies have reported an average time to revision range of 11-18 months [2, 4]. The deformation results presented, as well as time to failure results, are similar to those documented in clinical literature indicating potential for the new test protocol to be used as a clinically relevant design tool.

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Table 1: Overall Deformation Scores for Metal-Backed Component A and All-Polyethylene Component B

		Burnishing				Creep				PE Transparency			
Area	**Component**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
1	A	3.0	1.6	2.0	1.8	2.4	1.0	3.0	-	2.6	1.0	1.4	0
	B	3.0	2.2	1.4	1.6	1.0	0.6	1.0	-	0	0	0	0
2	A	3.0	2.0	2.0	0.4	2.4	0.8	3.0	-	3.0	1.8	1.0	0.4
	B	2.6	2.4	0.2	0	1.0	1.0	1.0	-	0	0	0	0