Biomechanical Comparison of One Peg versus Three Peg Patellar Component on Fracture Resistance

The University of Texas
Health Science Center at Houston
Medical School

Volkan B Guzel, MD; Terry Clyburn, MD; Kamran Aurang, MD, Catherine Ambrose, Phd

Department of Orthopaedic Surgery

Introduction

The prevalence of fracture in resurfaced patellae ranges from 0.2 % to 21% in the literature. One peg patellar designs have been considered as an etiologic factor in patella fracture after total knee arthroplasty.

The purpose of this study was to analyze the effect of peg configuration on patella fracture after total knee arthroplasty in cadaver model.

Materials and Methods

Thirty-four matched pairs of fresh-frozen cadaveric patellae with intact patellar and quadriceps tendons were used in the study. DXA scans were performed to determine bone mineral density of each specimen. One patella from each matched pair was resurfaced with a 1-peg design, and the matching patella was resurfaced with the 3-peg design. Size 35, one and three peg, dome shaped, all-polyethylene Axiom patellar components by Wright Medical were used (figure 1). The components were identical other than the peg design. The un-resurfaced patellae were also tested to provide control values. The direct injury mechanism with a fall on a knee in flexion was simulated (fig 2). The extensor mechanism was secured with freeze clamps under constant reproducible tension (figure 3). A 2.27kg lead weight was released through the drop tube at different heights until fracture was noted using radiographic imaging. Cumulative total energy to failure was calculated as the total sum of the weight multiplied by the drop heights for all drops sustained until fracture of the patella. A paired t-test was used to analyze the data statistically.

Figure 1- One peg and three peg patellar components with identical conforming surface.

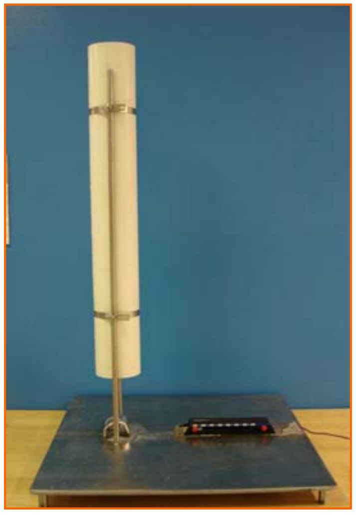

Figure 2- Drop tube apparatus to simulate injury mechanism.

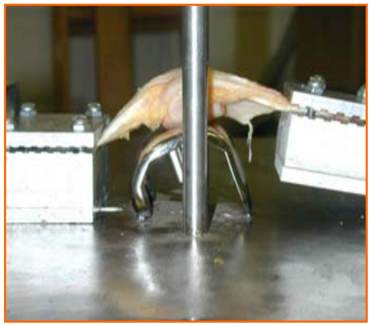

Figure 3 – Patellar component secured with freeze clamps underneath the drop tube apparatus

Results

The average energy to failure was 217.38 (s.d.-137.08) joules in un-resurfaced patella, 326.88 (s.d.-263.46) joules in one peg patella, 297.11 (s.d.-213.29) joules in three peg patella. The energy to failure values were not significantly different (p=0.54).

For further analysis, the patellae were then divided into low (BMD<0.7859 g/cm^2) and high (BMD>0.7859 g/cm^2) bone mineral density subgroups. Energy to failure for the one peg patellae in the high BMD subgroup was 480.35 J, whereas in the low BMD subgroup it was 183.61 J. The difference between the subgroups was significant (p=0.002). Energy to failure for three-peg patella in the high BMD subgroup was 360.31 J, and in the low BMD subgroup was 238.12 J. The difference between the subgroups was not statistically significant (p=0.13) (figure 4).

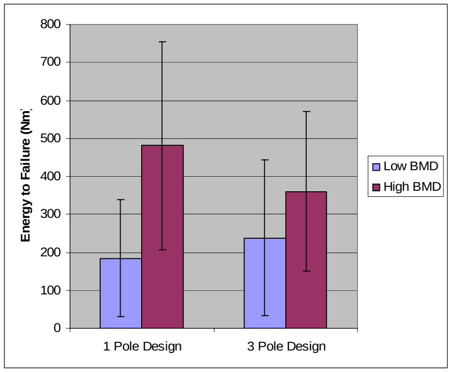

Figure 4- Chart showing energy to failure at high and low bone mineral density subgroups.

Conclusion

The results of this study suggested that the three peg patellar component is less sensitive to decreases in bone mineral density. In light of this finding, we would recommend the clinical use of three peg patellar components in patients with low bone mineral density. In patients with higher bone mineral density, one versus three peg component would make no statistically significant difference at the time of implantation but this finding might change if the patients' bone mineral density decreases with time.

Acknowledgement: Wright Medical, Inc, donated the bone cement and the patella components used in this study.