Protrusio after Medial Acetabular Wall Breach in Total Hip Arthroplasty

Christopher Martin1, Anneliese D. Heiner, PhD2, Andrew James Pugely, MD2, Yubo Gao1, Thomas E. Baer, PhD2, Nicolas Noiseux, MD1.
1University of Iowa Hospitals and Clinics, Iowa City, IA, USA, 2University of Iowa, Iowa City, IA, USA.

Disclosures:
C. Martin: None. A.D. Heiner: None. A.J. Pugely: None. Y. Gao: None. T.E. Baer: None. N. Noiseux: 3B; Wright Medical. 5; Wright Medical.

Introduction: Medial acetabular prosthesis migration is a rare complication of total hip arthroplasty, usually resulting from a transverse acetabular fracture and subsequent pelvic discontinuity.1,2 The complication results in pain necessitating revision surgery, and can lead to disruption of the intra-pelvic structures and sepsis if left untreated (Figure 1).3-4 Over-reaming the medial acetabular wall resulting in loss of supportive bone stock has been proposed to be a significant risk factor, but few studies have investigated either the biomechanical effect of over-reaming, or treatment methods to prevent medial acetabular migration once over-reaming has occurred.5-8

Methods: Our study had two aims. First, we investigated the effect on load-to-failure strength of up to a 2 cm defect in the medial acetabular wall caused by over-reaming in a cadaveric model. Nine human fresh-frozen hemipelvises were over-reamed to create the defect, implanted with acetabular cups, and then loaded to failure. The nine contralateral hemipelvises were reamed line-to-line and served as a control. Second, we investigated the ability of acetabular screws to restore strength to the construct. Nine over-reamed hemipelvises were augmented with two acetabular screws each, and then loaded to failure. The contralateral side again served as the control. Load-to-failure, stiffness, and energy were recorded for each specimen (Figure 2). Specimens were compared against their control with paired sample wilcoxon signed ranked test.

Results: Over-reaming decreased the load to failure strength by a mean of 23% (4816 v. 3675 N, p=0.0024). The addition of two acetabular screws did not successfully restore the strength of the construct (mean 27% decrease, 4082 v. 2985 N, p=0.0018). No difference in stiffness or energy between specimens was detected with and without a medial wall defect, for either control versus experimental group. The majority of specimens failed in a supra-physiologic range of force. However, bone density correlated with failure loads, and osteoporotic specimens were more likely to fail in a physiologic range.

Discussion: Over-reaming the medial acetabular wall during total hip arthroplasty significantly decreases the load-to-failure strength, and patients with low bone density combined with a medial wall defect may be the group most susceptible to fracture (Figure 3) during the activities of daily living. Acetabular screws alone were not sufficient to restore the integrity of the construct.

Significance: In order to minimize the risk of post-operative fracture and subsequent medial cup protrusio, patients with this complication should have protected weight bearing on the operative side until cup ingrowth is achieved.

Acknowledgments: We would like to thank Tom Baer and M. James Rudert for the assistance in study design, and the Orthopaedic Research and Education foundation for their generous financial support. In addition, we would like to thank Lori Dolan for her assistance with the statistical analysis.


Figure 1: Right sided protrusio that developed two weeks after a primary total hip arthroplasty.