

## The Effect of Antegrade Femoral Nailing on Femoral Head Perfusion: A Quantitative MRI and Cadaveric Dissection Study Comparing Piriformis and Trochanteric Entry Points

*Patrick C. Schottel, MD; Richard M. Hinds, MD; Lionel E. Lazaro, MD; Craig E. Klinger; Amelia Ni; David L. Helfet, MD; Dean G. Lorich, MD; Hospital for Special Surgery, New York, New York, USA*

**Background/Purpose:** Antegrade intramedullary femoral nailing (AIFN) is the technique of choice for the treatment of femoral diaphyseal fractures. However, clinically significant complications such as chronic hip pain, loss of hip abductor strength, heterotopic ossification, and femoral head (FH) osteonecrosis have been reported. To potentially mitigate these complications laterally based starting points, such as the tip of the greater trochanter (TGT), are becoming more commonplace than the historically popular piriformis fossa. Further, a recent cadaveric study by Dora et al tested different AIFN starting positions and found that the piriformis fossa start point places the deep branch of the medial femoral circumflex artery (MFCA) and its distal terminal branches at 100% risk for damage. However, no study has quantitatively assessed what effect different AIFN starting points and their potential MFCA damage has on femoral head perfusion.

**Methods:** 12 fresh-frozen human cadaveric specimens with an intact pelvis and bilateral femurs were dissected and the MFCA origin was cannulated. Specimens were then randomly allocated to either a piriformis or TGT starting point. All starting points were established percutaneously using a guidewire and biplanar fluoroscopy. A proximal femoral canal opening was then created using a 13-mm reamer and soft-tissue protector. The contralateral hip was left intact and therefore served as an internal matched control. All specimens underwent MRI consisting of high-resolution fat-suppressed gradient echo sequences both before and after infusion of gadolinium contrast through the MFCA cannula. Gross dissection of the operative hip was then performed to assess the integrity of the deep branch of the MFCA and its distance to the opening reamer path. The number of damaged terminal branches of the deep MFCA was also recorded.

**Results:** MRI quantification analysis revealed near-full FH perfusion with no significant difference between the piriformis and TGT starting points (95% vs. 97%,  $P=0.94$ ). Additionally, there was no observed damage to the deep branch of the MFCA in either group. However, the average distance from the reamer path to the deep branch of the MFCA in the TGT group was 18.5 mm (range, 12-31 mm) compared to only 3.2 mm (range, 1-7 mm) in the piriformis group ( $P=0.001$ ). There was also a significantly greater number of terminal branches of deep MFCA damaged per specimen in the piriformis group (0 vs. 1;  $P=0.007$ ). There were no cases of iatrogenic femoral neck fracture or other complications between the two groups.

**Conclusion:** The deep branch of the MFCA was in greater jeopardy using a piriformis starting point with only 1 mm separating the vessel from the reamer path in 40% of specimens. Additionally, a significantly greater number of terminal branches were damaged. However, no statistically significant difference in FH perfusion was found between the piriformis and TGT starting point specimens using gadolinium-enhanced MRI. Based on our findings we believe that using a piriformis fossa starting point for AIFN can be a safe technique assuming the achievement of an accurate starting point and meticulous soft-tissue protection.

See pages 99 - 147 for financial disclosure information.