Biomechanical Evaluation of the Depth of Resection During Femoral Neck Osteoplasty for Anterior Impingement Following Slipped Capital Femoral Epiphysis

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**OBJECTIVES**

Femoroacetabular impingement (FAI) as a result of slipped capital femoral epiphysis (SCFE) has been traditionally treated with a proximal femoral osteotomy, but open and arthroscopic femoral osteoplasty is becoming increasingly popular. Cam lesions result from excess bone primarily at the anterolateral femoral head-neck junction. SCFEs result from posterior and inferior slippage of the femoral epiphysis, causing the metaphysis to move anteriorly (Figure 1).

The safe amount, zone, and depth of resection when treating cam lesions associated with FAI have been reported. There are no studies on the safe depth of resection in SCFEs.

The purpose of our study was to compare 4th generation Sawbones (Pacific Research Laboratories, Vashon, WA) standard femurs and SCFE femurs to determine if bone resection from the anterior metaphysis results in similar biomechanical properties.

**METHODS**

A custom 4th generation composite SCFE Sawbone was created with a 30-degree slip angle. Our control group consisted of 4th generation composite standard non-deformed medium femurs.

The femoral neck at the head-neck junction was divided into 4 quadrants and all resections were done in the anterolateral quadrant (Figure 2A).

There were 20 standard Sawbones (Figure 2B) and 20 SCFE Sawbones (Figure 2C) divided into 4 subgroups based on resection depths of 0%, 10%, 30%, and 50% of the metaphysis at the head-neck junction (Figure 2D).

After resection, all proximal femurs were loaded to failure in an Instron testing machine (ITW, Norwood, MA) to determine the ultimate load to failure, stiffness, and energy-to-failure (Figure 2E).

**RESULTS**

SCFE femurs demonstrate a significant reduction in strength and energy-to-failure after osteoplasty compared to non-deformed femurs. Strength and energy-to-failure are inversely proportional to the depth of bone resection. Aggressive femoral neck osteoplasty for treatment of a SCFE deformity may lead to increased risk of fracture. Further studies are necessary to determine the safe depth of resection in a clinical setting.

**CONCLUSIONS**

SCFE femurs demonstrate a significant reduction in strength and energy-to-failure after osteoplasty compared to non-deformed femurs. Strength and energy-to-failure are inversely proportional to the depth of bone resection. Aggressive femoral neck osteoplasty for treatment of a SCFE deformity may lead to increased risk of fracture. Further studies are necessary to determine the safe depth of resection in a clinical setting.

**DISCUSSION**

Femoral head-neck osteochondroplasty for cam-type FAI and FAI that results from SCFE has shown good results, but there is the risk of postoperative fracture from too large of a resection.

Femoral neck fracture after arthroscopic osteochondroplasty for cam-type FAI has been reported. We are unaware of any reports of fracture after osteoplasty for FAI associated with a SCFE.

Femoral neck osteoplasty for FAI that results from SCFE can be more technically challenging than head-neck osteochondroplasty for idiopathic cam-type FAI. There is concern that the different morphology of FAI that results from a SCFE may require a more extensive bony resection to achieve a successful result.

In our study, there was a steady, significant decrease in strength in the standard femurs and the SCFE femurs as the resection amount increased. The SCFE femurs were consistently weaker than the standard femurs both intact and at each amount of resection.

**REFERENCES**