

The Effect of Femoral Component Sizing and Rotation on Anterior Femoral Notching

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Introduction

Several studies have demonstrated an association between anterior femoral notching and periprosthetic fracture. However, multiple studies have shown that notches less than 3mm do not decrease the integrity of the distal femur or predispose to periprosthetic fractures. Accurate femoral component rotation and sizing is critical to avoid anterior femoral notching or overstuffing. The location of sizer stylus placement can affect the sizing of the femoral component, and femoral component rotation can affect femoral sizing. Since both factors are surgeon dependent, surgeon choice can lead to various levels of femoral notching or oversizing when using a posterior referencing technique. The purpose of our study is twofold:
1.To investigate surgeon differences in femoral component sizing using posterior referencing technique and to determine how it is affected by femoral component rotation
2.To determine how femoral component size selection and rotation affects degree of anterior femoral notching

Methods

Five surgeons with varying level of experience used an Attune® posterior-up femoral component sizer (Attune Knee System, Depuy-Synthes, Warsaw, IN 46582) to record the AP size of 15 saw bone femurs. Surgeons obtained measurements to the nearest 1/10 size at 0°, 3° and 5° of external rotation relative to the posterior condylar line for each femur. They were then asked to select the size of their femoral component. Next, they mounted a 4 in 1 cutting block of the size selected at 0°, 3° and 5° of external rotation and made an anterior cut. Surgeons then were asked to make anterior cuts one and two sizes down from their size of choice using a posterior referencing technique. Computer processing of fluoroscopic images were used to determine notch depth after each cut. Student's t test was used for comparisons, a p-value of 0.05 was used as a cutoff for significance.

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Results

Surgeon of all levels tended to oversize their femoral components, especially less experienced surgeons, averaging a size 7 compared to their senior counterpart size average of 5 (p=0.03) Table1. Sizing increased with greater degrees of external rotation of the femoral component, averaging a size 6.53 at 0° and a 7.02 at 5° (p<0.001) Table 2. Less experienced surgeons tended to elect to oversize the femoral component to avoid notching. 100% of the time, junior level attendings elected to select the higher of two sizes of femoral component when in between sizes and only 25% of the time was this the case for senior attendings Table 3. The incidence and degree of notching increased with increasing femoral component external rotation (p=0.04) (Table 4). When surgeons were asked to drop down an entire size from the size they thought to be best fit, the average notch depth was 2.06 mm, still below the critical notch thickness Table 5. If surgeons were between two sizes, dropping down a size never lead to a significant notch. Also of note, 75% of the time when the posterior up sizer was set to 5° of external rotation, surgeons had to down size their cutting block 2 or more times to achieve an adequate level of resection and 100% of the time in junior level attendings.

Training Level	Seniors	Juniors
Average by training	5.3	6.67
STDEV	0.70	1.12

Table 1 Difference in initial size chosen by senior Vs junior surgeons was significant. P=0.03

Degree of rotation	0 Degree	3 Degree	5 Degree
Average By Rotation	6.53	6.76	7.02
STDEV	1.46	1.422	1.64

Table 2: Effect of Rotation on the initial size chosen was significant. P<0.001

Training Level	Seniors	Juniors
Number of Cuts Average	1.22	1.89
STDEV	0.92	0.44

Table 3: Comparing the number of cuts made initially by senior and junior surgeons before deeming the cut satisfactory. P=0.049

Discussion

We found that surgeons tended to oversize their femoral components, especially surgeons with less experience. Surgeons with less experience were also more indecisive with their initial anterior cut and required on average more cuts until they achieved what they believed was an adequate resection level as compared to more senior surgeons. When placing the 4 in 1 cutting block in 5 degrees of external rotation surgeons tended to create deeper notches. However, a notch greater than the critical depth of 3 cm was never created. Only in 1 of 18 case when a surgeon was asked to drop down an entire size from their size of choice was a significant notch created. The greatest risk of notching occurred when the 4 in 1 cutting block was set in 5 degrees of external rotation. Surgeons should be cognizant of the tendency to oversize their femoral component, especially early on in their careers. They should also be aware of situations where 5 degrees or more of external rotation of the femoral component is desired or occurs, as this situation has the greatest risk of creating a significant notch. When using the Attune posterior-up femoral sizer and others of similar design, surgeons should be aware that increased external rotation setting leads to a larger reading on the sizer

Degree of rotation	0 Degree	3 Degree	5 Degree	0 VS 5 P value
Initial Cut Notch Average	0.4	0.6	2.03	0.04
STDEV	0.54	0.89	1.07	

Table 4 Average notch depth in millimeters in 0, 3 and 5 degree rotation

Significance

Surgeons should be aware of the relationship between component rotation, sizing and notching to help guide intraoperative decision making.

Sawbone	Surgeon A	Surgeon B	Surgeon C	Surgeon D	Surgeon E	Surgeon F
0 degree	0	1	1	2	2	0
3 degree	1	2.4	2	2	0	0
5 degree	2.5	5	2.7	3	0	2
Averages	1.167	2.8	1.9	2.333	0.667	0.667

Table 5: When surgeons were asked to drop down an entire size from the size they thought to be best fit, the total average notch depth was 2.06 mm.