

Tip of Stem Pain is a Rare Complication Following Revision Total Knee Arthroplasty at Midterm Follow-Up

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INTRODUCTION: Tip of stem pain is a challenging complication of revision knee arthroplasty resulting in decreased patient satisfaction and impaired function. The exact etiology of tip of stem pain is unknown. This study evaluates the incidence of tip of stem pain, as well as the clinical and radiographic outcomes associated with tip of stem pain in revision knee arthroplasty.

METHODS: A total of 910 patients who underwent revision total knee arthroplasty with a stem extension on the femur or tibia between January 2002 and January 2022 were identified for our retrospective review. Stem length, tibia and femur length, width of tibial and femoral isthmus, and distance from tip of stem to isthmus were collected and compared between patients with and without stem pain. Mann-Whitney U tests, independent t-tests, chi-square tests and Fisher Exact tests were used to evaluate associations between radiographic outcomes and tip of stem pain.

RESULTS:

In this study, 910 patients were included with a mean follow up of 6.9 years (SD 3.2). Among these cases, 379/910 (41.6%) were men, mean age at surgery was 67.1 years (SD 9.6), and mean BMI was 33.7 kg/m² (SD 7.7). Of the 910 patients reviewed, 3.0% (27/910) reported tip of stem pain. Of these, 22/910 (2.4%) presented with isolated tibial stem pain 3/908 (0.3%) presented with isolated femoral stem pain, and 2/910 (0.2%) presented with both tibial and femoral stem pain. Female patients were significantly more likely to present with tip of stem pain than male patients ($P < 0.001$). The mean distance between the tip of stem and tibial isthmus was significantly shorter in patients with stem pain compared to those without pain (3.75 cm +/- 2.47 vs. 5.61 cm +/- 3.06, $P = 0.00410$). There was an association between tibial stem length and stem pain, as 24/24 (100%) patients with tibial stem pain had a tibial stem length of 100mm or more ($P = 0.0183$). There was also a significant difference in the mean femoral length between patients with femoral stem pain vs those without femoral stem pain (38.79 cm +/- 0.84 vs. 42.78 cm +/- 3.22, $P = 0.0137$). There was no significant difference in tibial length, tibial width, femoral width, femoral stem length, or distance from tip of stem to femoral isthmus between patients with or without stem pain. There was no significant difference in the use of cemented versus uncemented stems, or the type of knee construct used for patients with or without stem pain. Overall, 88.9% (24/27) of patients experienced improvements in stem pain following conservative measures, with 59.3% (16/27) experiencing complete resolution of pain. The revision rate of patients with stem pain was 14.8% (4/27), with all revisions attributed to reasons other than tip of stem pain.

DISCUSSION AND CONCLUSION:

Despite a low incidence of tip of stem pain, an understanding of certain radiographic variables associated with tip of stem pain may guide surgeons in the most appropriate stem length, diameter, and design.



Table 1. Patient Demographics

Category	Mean (SD)	No. (n, %)	p-value
Female	67.1 (9.6)	541 (59.3%)	<0.001
Male	67.1 (9.6)	258 (28.3%)	
Mean age at surgery	67.1 (9.6)	799 (87.8%)	
Mean BMI	33.7 (7.7)	799 (87.8%)	
Mean follow-up	6.9 (3.2)	799 (87.8%)	

Table 2. Incidence of Pain

Category	n	%
Tip of stem pain	27	3.0%
Isolated tibial stem pain	22	2.4%
Isolated femoral stem pain	3	0.3%
Both tibial and femoral stem pain	2	0.2%

Table 3. Radiographic Measurements, Stem Pain vs. No Stem Pain

Variable	Stem Pain (n=27)	No Stem Pain (n=883)	p-value
Tibial Stem Length (mm)	100 (100%)	100 (11.3%)	<0.001
Femoral Stem Length (mm)	38.79 (0.84)	42.78 (3.22)	0.0137
Distance from tip of stem to tibial isthmus (cm)	3.75 (2.47)	5.61 (3.06)	0.00410
Distance from tip of stem to femoral isthmus (cm)	5.61 (3.06)	5.61 (3.06)	0.999
Tibial Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Femoral Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Stem Type	100 (100%)	883 (100%)	0.999
Cemented	100 (100%)	883 (100%)	0.999
Uncemented	0 (0%)	0 (0%)	0.999
Stem Construct Type	100 (100%)	883 (100%)	0.999
Unicondylar	100 (100%)	883 (100%)	0.999
Bicondylar	0 (0%)	0 (0%)	0.999
Stem Diameter (mm)	100 (100%)	883 (100%)	0.999
Stem Length (mm)	100 (100%)	883 (100%)	0.999

Table 4. Tibial Preoperative Characteristics, Stem Pain vs. No Stem Pain

Variable	Stem Pain (n=27)	No Stem Pain (n=883)	p-value
Tibial Stem Length (mm)	100 (100%)	100 (11.3%)	<0.001
Femoral Stem Length (mm)	38.79 (0.84)	42.78 (3.22)	0.0137
Distance from tip of stem to tibial isthmus (cm)	3.75 (2.47)	5.61 (3.06)	0.00410
Distance from tip of stem to femoral isthmus (cm)	5.61 (3.06)	5.61 (3.06)	0.999
Tibial Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Femoral Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Stem Type	100 (100%)	883 (100%)	0.999
Cemented	100 (100%)	883 (100%)	0.999
Uncemented	0 (0%)	0 (0%)	0.999
Stem Construct Type	100 (100%)	883 (100%)	0.999
Unicondylar	100 (100%)	883 (100%)	0.999
Bicondylar	0 (0%)	0 (0%)	0.999
Stem Diameter (mm)	100 (100%)	883 (100%)	0.999
Stem Length (mm)	100 (100%)	883 (100%)	0.999

Table 5. Femoral Preoperative Characteristics, Stem Pain vs. No Stem Pain

Variable	Stem Pain (n=27)	No Stem Pain (n=883)	p-value
Tibial Stem Length (mm)	100 (100%)	100 (11.3%)	<0.001
Femoral Stem Length (mm)	38.79 (0.84)	42.78 (3.22)	0.0137
Distance from tip of stem to tibial isthmus (cm)	3.75 (2.47)	5.61 (3.06)	0.00410
Distance from tip of stem to femoral isthmus (cm)	5.61 (3.06)	5.61 (3.06)	0.999
Tibial Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Femoral Width (mm)	50.0 (4.0)	50.0 (4.0)	0.999
Stem Type	100 (100%)	883 (100%)	0.999
Cemented	100 (100%)	883 (100%)	0.999
Uncemented	0 (0%)	0 (0%)	0.999
Stem Construct Type	100 (100%)	883 (100%)	0.999
Unicondylar	100 (100%)	883 (100%)	0.999
Bicondylar	0 (0%)	0 (0%)	0.999
Stem Diameter (mm)	100 (100%)	883 (100%)	0.999
Stem Length (mm)	100 (100%)	883 (100%)	0.999

Figure 1. Radiographic measurements of a knee joint. (A) shows the femoral stem length and distance from the tip of the stem to the femoral isthmus. (B) shows the tibial stem length and distance from the tip of the stem to the tibial isthmus.

Figure 2. Radiographic measurements of a knee joint. (A) shows the femoral stem length and distance from the tip of the stem to the femoral isthmus. (B) shows the tibial stem length and distance from the tip of the stem to the tibial isthmus.