

# Unrestricted Weight-Bearing Following Femoral Component Revision Total Hip Arthroplasty Does Not Impact Subsidence in Modern Revision Stem Designs *Findings from a Retrospective Multicenter Radiographic Analysis Study*

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## INTRODUCTION:

Tapered, fluted stems are commonly utilized in revision total hip arthroplasty (THA). While reported subsidence and subsequent failure of these stems are low, patients are often restricted to touch-down weight-bearing (TDWB) status due to concerns about stem subsidence. However, restricted weight-bearing may impede postoperative recovery. If more patients can be safely transitioned to weight-bearing as tolerated (WBAT) without increasing rates of subsidence, early postoperative functional rehabilitation may be improved. The purpose of this study is to measure and compare femoral stem subsidence in a contemporary multi-institutional cohort of femoral revision THA patients treated with modern revision stem designs, stratified by TDWB and WBAT status.

## METHODS:

This was a multicenter retrospective analysis. Data was sourced from two longitudinally maintained institutional arthroplasty registries at high-volume revision centers, in separate U.S. states. At Institution 1, consecutive series of TDWB and WBAT femoral component revision THAs from 2016-2022 were reviewed. At Institution 2, a randomized selection of 5 TDWB and 5 WBAT cases from 2017-2019 were reviewed. Patients were categorized according to postoperative weight-bearing status (WBAT vs. TDWB). Non-weight bearing and partial weight bearing patients were excluded due to low sample size.

The following variables were collected at the time of surgery: age, sex, body mass index, American Society of Anesthesiologists score (ASA), revision indication, and whether an extended trochanteric osteotomy (ETO) was performed. Femoral stem subsidence was measured on calibrated radiographs using established methods at the following postoperative time-points: 3-months, 1-year, 2-year.

An *a priori* power analysis based on literature-derived anticipated rates of subsidence revealed that a sample size of 82 (41 TDWB vs 41 WBAT) would be sufficient to detect a difference in subsidence of 0.63 mm between groups (power = 80%; alpha = 0.05). The final cohort consisted of 41 TDWB and 41 WBAT patients.

Full demographics are listed in **Table 1**. Baseline characteristics were similar between cohorts, with the exception of ASA score, as TDWB had a higher proportion of patients with ASA  $\geq 3$  (51% vs. 17%;  $p = 0.001$ ).

Stem subsidence at all postoperative time points and all-cause re-revision within 3 years were compared. In addition, to account for heterogeneity in patient cohorts, we performed a forward conditional multivariable linear regression of stem subsidence at 2-year follow-up. Only variables statistically significantly improving model fit were included. This enabled us to isolate the independent association of weight-bearing status with subsidence. All collected variables were considered for model inclusion.

## RESULTS:

Femoral stem subsidence did not differ between TDWB and WBAT cohorts at 3-months ( $4.0 \pm 3.4$  mm vs.  $2.6 \pm 2.7$  mm;  $p = 0.09$ ), 1-year ( $6.2 \pm 4.7$  mm vs.  $5.1 \pm 4.0$  mm;  $p = 0.35$ ), and 2-years ( $7.6 \pm 4.5$  vs.  $7.0 \pm 4.5$  mm;  $p = 0.70$ ) (**Table 2**). **Figure 1** depicts postoperative patterns in stem subsidence, stratified by procedure type. In the forward conditional multivariable linear regression, the only variables independently statistically significant associated with increased stem subsidence were ETO (Adjusted Mean Difference: +6.8 mm;  $p = 0.012$ ) and older age (Adjusted Mean Difference per 1-year increase: +0.1 mm;  $p = 0.03$ ) (**Table 3**). Weight-bearing status was not independently associated with variation in stem subsidence ( $p = 0.24$ ). All-cause re-revision at 3-years also did not differ between cohorts ( $p = 0.64$ ).

## DISCUSSION AND CONCLUSION:

Following femoral component revision of THA with modern revision stem designs, there is no significant difference in femoral stem subsidence measurements regardless of weight-bearing status postoperatively. To our best knowledge, the present analysis is the first investigation of this topic in a contemporary cohort. Although many patients are placed on restricted weight-bearing protocols after femoral component revision, this practice may be unnecessarily limiting for select patients. In the present study, WBAT patients were found to have similar rates of femoral stem subsidence to TDWB patients. There were no statistically significant nor clinically relevant differences in stem subsidence at 3 months, 1 year, or 2 year, nor were there differences in re-revision rates. By allowing patients to be weight-bearing as tolerated, patients can benefit from improved early mobility. Thus, the present study supports allowing additional select patients to weight bear as tolerated following femoral component revision arthroplasty, as this may allow for improved functionality without meaningfully increasing risk for stem subsidence.

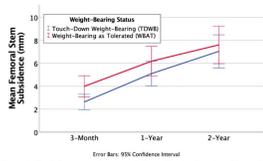


Figure 1. Trends in postoperative stem subsidence following femoral revision total hip arthroplasty, stratified by weight bearing status. Weight-bearing as tolerated patients (WBAT) did not exhibit statistically significantly higher degree of stem subsidence at any measured postoperative timepoint, as compared to touch-down weight bearing (TDWB) patients ( $p > 0.05$ ).

Table 1. Baseline characteristics of Femoral Component Revision Total Hip Arthroplasty patients, stratified by weight-bearing status.

Variable, n (%) or mean ± standard deviation	Touch-Down Weight Bearing Patients (N=41)	Weight Bearing as Tolerated Patients (N=41)	P Value
Institution	36 (88%)	36 (88%)	N/A
Institution 1	7 (17%)	5 (12%)	
Institution 2	63 ± 8.8	62.6 ± 11.0	0.71
Age			
Male	20 (49%)	14 (34%)	0.51
Female	21 (51%)	27 (66%)	
Body Mass Index	31.9 ± 6.5	28.4 ± 5.7	0.12
American Society of Anesthesiologists score			0.881
1 or 2	20 (49%)	14 (34%)	
3 or 4	21 (51%)	27 (66%)	0.34
Indication for Revision			
Periprosthetic Fracture	12 (29%)	7 (17%)	
Other Mechanical Indication (e.g. instability, Acrylic Loosening, Polywear, etc.)	19 (46%)	21 (51%)	
Periprosthetic Joint Infection	10 (24%)	9 (22%)	
Extended Tachycardic Obsessivity Performed During Revision	2 (5%)	3 (7%)	0.64

Table 2. Stem subsidence and all-cause re-revision within 3 years of Femoral Revision Total Hip Arthroplasty patients, stratified by weight-bearing status.

Variable, n (%) or mean ± standard deviation	Touch-Down Weight Bearing Patients (N=39)	Weight Bearing as Tolerated Patients (N=31)	P Value
3-Month Subsidence (mm)	2.4 ± 2.7	4.0 ± 3.4	0.09
1-Year Subsidence (mm)	5.1 ± 4.0	6.2 ± 4.7	0.35
2-Year Subsidence (mm)	7.8 ± 4.5	7.6 ± 4.5	0.70
All-Cause Re-Revision within 3 Years	3 (7%)	2 (5%)	0.64

Table 3. Results of the forward conditional multivariable linear regression model. Which factors are independently statistically significantly associated with higher rates of subsidence?

Variable*	Adjusted Mean Difference (95% CI)	95% Confidence Interval Lower	95% Confidence Interval Upper	P Value
Extended Tachycardic Obsessivity (ETO)	-16.8	-2.8	-9.8	0.012
Age (per 1-year increase)	-0.1	-0.1	-0.2	<0.001

Variables were entered in a forward conditional manner, where only variables independently statistically significantly improving model fit were included. All collected variables were considered for model inclusion: age, sex, body mass index, American Society of Anesthesiologists score (1-5 vs. ≤2), weight-bearing status, indication. All variables not listed did not independently statistically significantly improve model fit ( $p > 0.05$ ).