

## INTRODUCTION

- Automated broaching has recently been introduced for total hip arthroplasty, with the goal of improving operating room efficiency and reducing surgeon workload.
- Multiple authors have now reported clinical results with automated broaching and have additionally suggested that this technique may improve femoral sizing and alignment.
- However, little has been published regarding the safety of this device, particularly with regard to calcar fractures.

## SPECIFIC AIMS

- The purpose of the present study was to evaluate the risk of calcar fracture during automated broaching, and to determine if this risk can be mitigated by the surgeon's technique.

## METHODS

- We queried our prospective institutional database and identified 1,530 unilateral THAs performed by the senior author at a specialty orthopaedic hospital using automated impaction between January 2019 and November 2023.
- We then reviewed the database to identify the incidence of calcar fracture with automated impaction, and whether the fracture occurred during broaching or with stem insertion.
- We determined the incidence of calcar fracture within two consecutive sub-groups of patients using two different stem insertion techniques:
  - Automated broaching with automated stem insertion for all patients.
  - Automated broaching and automated stem impaction ONLY if cushion of cancellous bone separated the broach from the calcar, otherwise the stem was placed manually.

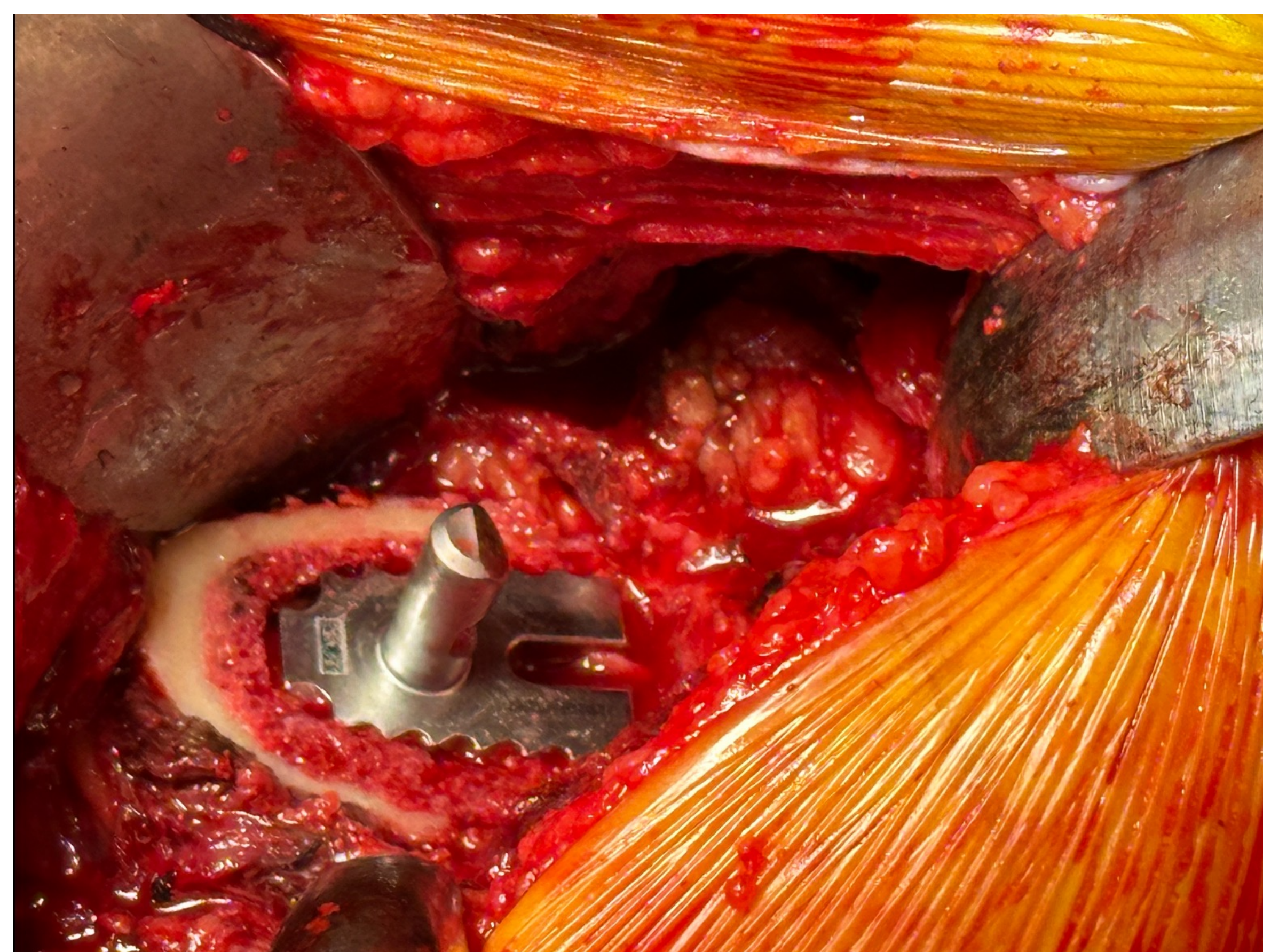


Fig 1. Intraoperative photo demonstrating the presence of a cancellous bone cushion between the implanted stem and medial femoral calcar.

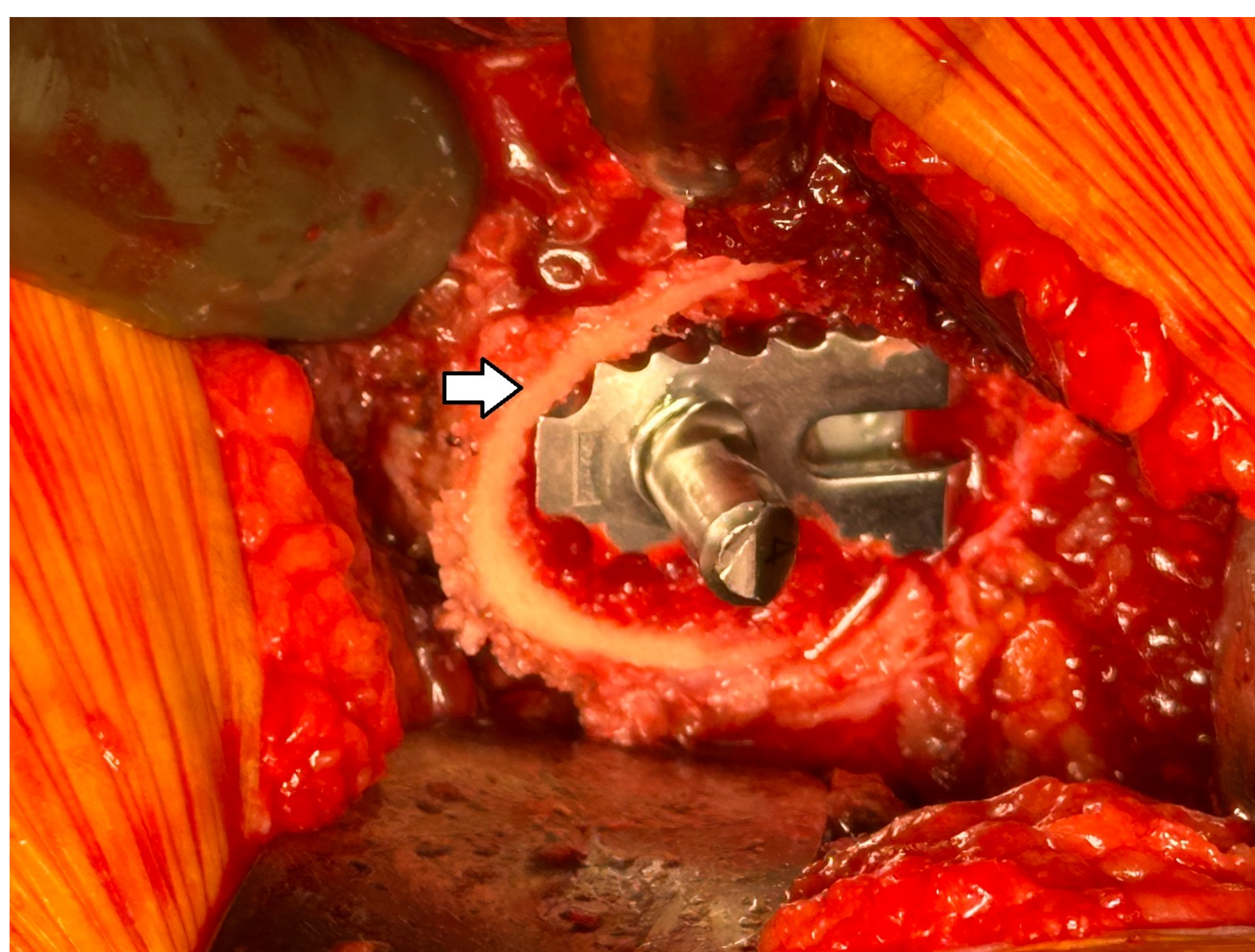


Fig 2. Intraoperative photo demonstrating the absence of a cancellous bone cushion (indicated by arrow). The stem directly abuts the medial femoral calcar.

Calcar Fracture Risk by Surgical Step and Technique Variation Subgroup					
	n	Fractures	%	RR	95% CI
Overall	1596	17	1.1		
During broaching		2	0.1	Ref.	
During final stem impaction		15	0.9	7.5	1.7 to 32.7
Technique Variation Subgroups					
Subgroup 1	285	4	1.4	Ref.	
Subgroup 2	363	2	0.6	0.39	0.07 to 2.13

## RESULTS

- A total of seventeen calcar fractures occurred intra-operatively (17/1,530; 1.1%).
- No difference in cup anteversion (25.5 deg vs 25.1 deg), (p=0.65).
- Only two calcar fractures occurred during automated broaching (2/1,530; 0.1%).
- Fifteen calcar fractures occurred during impaction of the final stem (15/1,530; 1.0%) (p = 0.0023).
- Four calcar fractures (4/349; 1.1%) occurred in sub-Group 1 (all final stems inserted with automation), compared to two calcar fractures in sub-Group 2 (2/319; 0.6%) (final stem inserted with automation only if a cushion of cancellous bone separated the broach from the calcar) (p = 0.69).

## CONCLUSIONS

- Calcar fracture is the most common type of intraoperative periprosthetic femoral fracture in primary THA.
- Recent analysis from the UK National Joint Registry demonstrated a calcar fracture rate of 0.4%, with an overall fracture rate of 0.6%<sup>1</sup>.
- Recent meta-analysis of the arthroplasty literature reports a calcar fracture rate of 1.7% in primary THA<sup>2</sup>. In the present study, we report a calcar fracture rate of 1.1% using automated impaction, consistent with the historical fracture rates presented in the arthroplasty literature.
- We also find that when using automated impaction, calcar fractures, while rare, are more likely to occur during stem insertion than during femoral broaching.
- The authors recommend that if any part of the final broach is in direct contact with the calcar (rather than cancellous bone), the final stem should be impacted manually to minimize the risk of calcar fractures.

## REFERENCES

- Lamb JN, Matharu GS, Redmond A, Judge A, West RM, Pandit HG. Risk Factors for Intraoperative Periprosthetic Femoral Fractures During Primary Total Hip Arthroplasty. An Analysis From the National Joint Registry for England and Wales and the Isle of Man. J Arthroplasty 34(12): 3065, 2019
- Awad ME, Farley BJ, Mostafa G, Darwiche HF, Saleh KJ. The risk of hospital readmission, revision, and intra- and postoperative complications between direct anterior versus posterior approaches in primary total hip arthroplasty: a stratified meta-analysis and a probability based cost projection. HIP International 2023 33:3, 442-462