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Early morbidity and mortality after one-stage bilateral THA: Anterior versus posterior approach

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ABSTRACT

Background: Advantages of performing bilateral total hip arthroplasty (THA) in one stage include a single hospital stay, a single exposure to anaesthesia risks, and expedited rehabilitation. Controversy persists however, regarding safety, notably morbidity and mortality rates. Importantly, few studies have compared the anterior to the posterior approach for single-stage bilateral THA (1B-THA). The objective of this retrospective study in a uniform patient population was to compare the anterior and posterior approaches for 1B-THA in terms of: 1) early mortality rates, 2) early complications, 3) and 90-day re-admission rates, hospital stay lengths, and blood loss.

Hypothesis: 1B-THA in patients younger than 80 years who have an ASA score of 1 or 2 is associated with no early mortality and with low early morbidity rates regardless of whether the anterior or posterior approach is used.

Material and methods: A single-centre retrospective comparative design was used to assess 90-day mortality and morbidity rates in consecutive patients who underwent 1B-THA between 2004 and 2018. The groups managed with the anterior approach (AA) without traction table and posterior approach (PA) were compared. The ASA score was ≤ 2 and age ≤ 80 years in all patients. The groups were comparable for age, sex distribution, ASA score, pre-operative haemoglobin level, and reason for THA.

Results: We included 55 patients managed via the AA and 82 managed via the PA. No patients died in either group. Early complications occurred in 3 patients in the AA group and 6 in the AP group ($p = 0.74$). No differences were noted between the two groups for each type of complication. In the AA group, 3 patients experienced major complications ($p = 0.06$) (2 cerebrovascular events and 1 peri-prosthetic fracture). In the PA group, 6 patients experienced minor complications (1 case each of dislocation, piriformis syndrome, sacral pressure sore, and deep vein thrombosis and 2 cases of ilio-psoas irritation; $p = 0.08$). Operative time was 144 minutes (range, 110-195 minutes) in the AA group and 171 minutes (range, 108–255 minutes) in the PA group ($p < 0.001$). Mean hospital stay length was 7.6 days (range, 3-13 days) overall, 6.7 days (range, 5–11 days) in the AA group, and 8.2 days (range, 3–13 days) in the PA group ($p < 0.001$). The early re-admission rate was 2.9% overall, with no difference between the AA group (3.6% [2/55]) and the PA group (2.4% [2/82]) A post-operative blood transfusion was required by 34/137 (24.8%) patients overall, 15/55 (27.3%) patients in the AA group and 19/82 (23.2%) patients in the PA group ($p = 0.58$).

Discussion: In selected patients (ASA score 1 or 2 and age ≤ 80 years), 1B-THA was not followed by any early deaths in the patients managed using the anterior or posterior approach. Total early morbidity rates were low. Neither the types of complications nor the early re-admission rates differed between the AA and PA groups. The shorter operative time in the AA group is ascribable to change in patient installation between the two arthroplasties when the PA is used.

Level of evidence: III, comparative study of consecutive patients.

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1. Introduction

Total hip arthroplasty (THA), described by *The Lancet* as the operation of the century [1], significantly improves quality of life [2]. Among patients who undergo THA on one side, 10% undergo THA on the other side during the second following year [3]. Among patients with severe bilateral hip disease, 97% have THA on both sides within an interval of only a few years [4]. The cost-effectiveness of THA has been convincingly established [5]. The 1971 paper about 50 patients by Sir John Charnley was the first report of single-stage bilateral THA (1B-THA) [6]. Advantages of 1B-THA include a single hospital stay, a single exposure to the risks of anaesthesia, and expedited rehabilitation. In addition, 1B-THA results in substantial cost savings [7]. In France, paradoxically, the amount reimbursed by the national health insurance system is smaller with 1B-THA than with two-stage bilateral THA (2B-THA), because the second implant is only partially reimbursed [8].

Despite the expected benefits, 1B-THA continues to raise safety concerns, as some studies found higher post-operative mortality and morbidity rates compared to 2B-THA. Berend et al. [8] reported a significant increase in the post-operative complication rate and greater blood loss with 1B-THA compared to 2B-THA. Early mortality was also higher with 1B-THA in a study by Swanson et al. [9]. In both these studies, the American Society of Anesthesiology (ASA) score and age were identified as predictive factors: ASA scores of 3 and 4 and age > 80 years were associated with significantly higher complication rates compared to ASA scores of 1 and 2 and age < 80 years. However, Aghayev et al. [10] found a lower complication rate after 1B-THA than after 2B-THA.

Importantly, no studies have assessed whether the surgical approach used for 1B-THA is associated with early mortality and morbidity rates, operative time, hospital stay length, re-admission rates, and/or blood loss. When studying these factors, careful patient selection based on an ASA score of 1 or 2 and age under 80 years is mandatory given the available data.

The objective of this retrospective study in a uniform patient population was to compare the anterior and posterior approaches for 1B-THA in terms of:

- early mortality rates;
- early complications;
- and 90-day re-admission rates, hospital stay lengths, and blood loss.

The working hypothesis was that 1B-THA in patients younger than 80 years who have an ASA score of 1 or 2 is associated with no early mortality and with low early morbidity rates regardless of whether the anterior or posterior approach is used.

2. Material and method

2.1. Patients

A single-centre retrospective comparative study of consecutive patients who underwent 1B-THA over the 15-year period between 2004 and 2018 was conducted. 1B-THA was offered to patients younger than 80 years who were seen at the outpatient clinic for incapacitating bilateral hip disease, defined as severe limitation of daily activities and/or severe restriction of walking distance and/or pain with an intensity of at least 5 on a 10-point scale. The ASA score was determined and the overall anaesthetic risk assessed during a pre-operative anaesthesiologist visit. Patients whose ASA score was 3 or 4 were considered ineligible for 1B-THA and were offered 2B-THA. Patients whose ASA score was 1 or 2 were eligible for the study. Those whose haemoglobin level was < 13 g/dL were given

iron supplementation and/or recombinant erythropoietin to minimise blood transfusion requirements. Patients requiring revision THA and those with a history of hip surgery were not included.

Of the 426 bilateral THA procedures performed during the study period, 278 were done in two stages and 148 in a single stage. Of the 148 patients with 1B-THA, 11 were excluded due to an ASA score of 3 or to resurfacing arthroplasty, leaving 137 patients for the study (Fig. 1). During the study period, the number of 1B-THA procedures increased steadily, by 133% between the first 3 years ($n = 12$) and the last 3 years ($n = 28$).

Of the 137 study patients, 55 were managed via the anterior approach (AA) and 82 via the posterior approach (PA). The two groups were not significantly different for mean age at inclusion, sex distribution, ASA score, body mass index, pre-operative haemoglobin level, or reason for THA (Table 1).

2.2. Operative technique

General anaesthesia was used. A single surgeon performed both hip replacements sequentially. One surgeon (RBD) used the Hueter AA with the patient supine and no traction table and another surgeon (CT) used the Moore PA with the patient lying on the side, requiring a change in patient installation between the two replacements. Starting in 2013, a tranexamic acid injection was given in the absence of contraindications, to minimise blood loss. No other substantial changes in management were introduced during the study period, notably starting in 2010, when the AA was included.

The implants were chosen by the surgeons. For the acetabulum, the Dynacup^{TM} (Corin-Tornier) ($n = 81$) or Trilogy^{TM} (Zimmer) ($n = 56$) implant was used. The Meije^{TM} (Tornier) uncemented self-locking stem was used in 133 cases and the cemented B2C^{TM} (Lépine) stem in 4 (4/137, 2.9%) cases. With the Dynacup^{TM} implant, the bearing couple was ceramic-ceramic with a 32- or 36-mm head depending on the diameter of the cup. With the Trilogy^{TM} cup, the bearing couple was metal-polyethylene or ceramic-polyethylene and head diameter was 28 mm.

Two suction drains were inserted at the end of the procedure and used to measure blood loss during the first 48 hours. In 8 patients, the drains were connected to a blood salvage system in the post-anaesthesia care unit, and the recovered blood was re-injected. Prophylactic antibiotic therapy was continued until discharge from the orthopaedics department. Prophylactic anticoagulation was given for 30 days.

Ambulation was started on the day of surgery as soon as allowed by the condition of the patient. All patients were offered admission to a rehabilitation centre once they recovered the ability to walk.

2.3. Assessment methods

The medical files of consecutive patients who underwent 1B-THA between January 2004 and December 2018 were reviewed. The clinical findings and results of investigations during the hospital admission, rehabilitation centre stay, and outpatient visits 6 weeks and 3 months after surgery were recorded. Further information was obtained from the TrakCare Clinicom software (InterSystems, Vilvoorde, Belgium) used to track all health events in each admitted patient. This method allowed the identification of all deaths and early complications.

Complications were classified as major or minor [11,12]. Table 2 lists the complications considered for the study. Data on the re-admission rate, hospital stay length, operative time, and blood-sparing strategy were obtained from the TrakCare Clinicom records and patient anaesthesiology files.
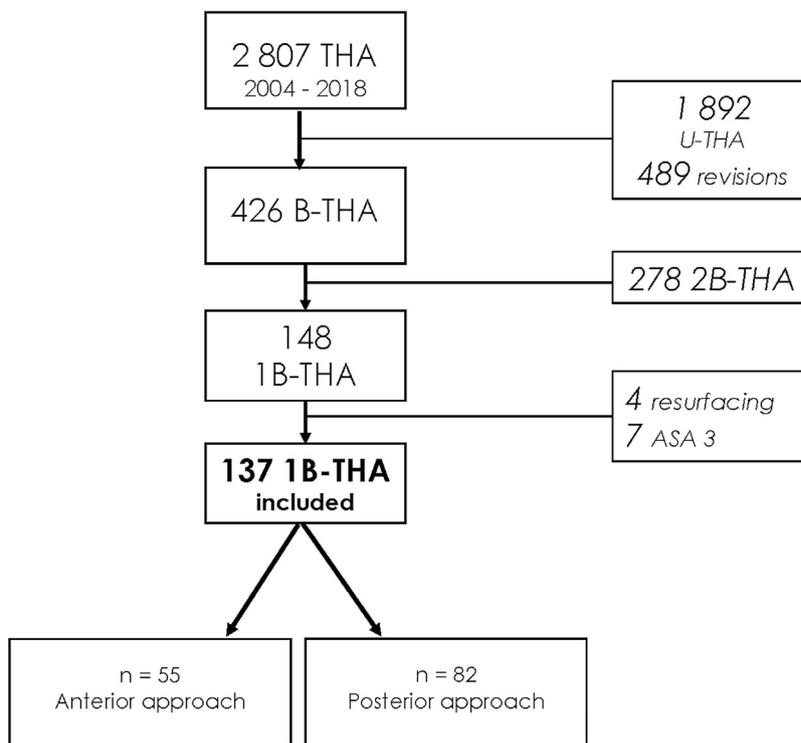
Fig. 1. Study flow chart. THA, total hip arthroplasty; U-THA, unilateral THA; B-THA, bilateral THA; 1B-THA, one-stage bilateral THA.

Table 1
Pre-operative features in the patients who underwent single-stage bilateral total hip arthroplasty via the anterior approach or posterior approach.

Groups	Anterior approach n = 55	Posterior approach n = 82	p value
Females/Males, n (%)	27 (49%)/28 (51%)	45 (55%)/37 (50%)	0.50 (NS)
Age at surgery, years, mean (range)	63 (24 - 80)	65 (20 - 80)	0.29 (NS)
ASA score	1, n = 17 2, n = 38	1, n = 38 2, n = 44	0.07 (NS)
Body mass index, mean (range)	24.9 (16–34)	26.3 (15–38)	0.10 (NS)
Hip disease	Primary or secondary OA, n = 27 (83.6%) AVN, n = 6 (10.9%) IJD, n = 2 (5.5%)	Primary or secondary OA, n = 64 (78.0%) AVN, n = 15 (18,3%) IJD, n = 3 (3.7%)	0.46 (NS)
Pre-operative haemoglobin level, mean (range)	14.42 g/dL (13.0–16.9 g/dL)	14.31 g/dL (13.0–17.5 g/dL)	0.55 (NS)

ASA: American Society of Anesthesiologists; OA: osteoarthritis; AVN: avascular necrosis of the femoral head; IJD: inflammatory joint disease.

2.4. Statistical methods

The pre-, intra-, and post-operative variables were analysed using EasyMedStat (Neuilly-Sur-Seine, France). Values of $p < 0.05$ were considered significant. Quantitative variables were compared by applying Student's t test or the non-parametric Mann–Whitney test and qualitative variables (early complications) using the chi-square test or Fisher's exact test.

3. Results

No early deaths were recorded in the AA or PA groups. Early complications occurred in 9/137 (6.6%) patients overall, 3 in the AA group and 6 in the PA group ($p = 0.74$). The complication rate was not affected by the date of surgery: 4 complications (4/39) occurred during the first half and 5 (5/98) during the second half of the study period ($p = 0.27$).

The rates of each type of complication were not significantly different between the AA and PA groups (Table 3). Major complications were more common in the AA group (3/55 vs. 0/82; $p = 0.06$) and minor complications in the PA group (0/55 vs. 6/82; $p = 0.08$). Of the 3 major complications in the AA group, 2 were cerebrovascular events ($p = 0.16$), including rupture of a cerebral aneurysm 10 days after surgery. The other major complication in the AA group was a peri-prosthetic fracture (1.8%) that required femoral implant revision. In the PA group, 1 patient (1.2%) experienced piriformis syndrome which was managed by release of the trochanteric tendons. Dislocation in another PA-group patient was managed by external reduction. The 2 patients in the PA group who developed ilio-psoas irritation underwent additional investigations to look for anterior prominence of the cup (Table 3). Finally, 1 patient in the PA group has a sacral pressure sore and another deep vein thrombosis.

Mean hospital stay length was 7.6 days (range, 3-13 days) overall, 6.7 days (range, 5–11 days) in the AA group, and 8.2 days (range, 3–13 days) in the PA group ($p < 0.001$). Mean operative time

Table 2
List of early post-operative complications recorded in the patients managed by one-stage bilateral total hip arthroplasty.

Major complications	Minor complications
Death	Deep vein thrombosis
Cardiac events (myocardial infarction, acute pulmonary oedema, severe cardiac arrhythmia, cardiac arrest)	Confusion
Pulmonary embolus	Surgical haematoma
Fat embolus	Pressure sore
Neurological events (Cerebrovascular events, transient ischaemic attack, uremic encephalopathy)	Ilio-psoas irritation
Acute kidney failure requiring dialysis	Piriformis syndrome
Acute respiratory failure	Sciatic nerve palsy
Intestinal obstruction	Dislocation
Lower respiratory tract infection	
Surgical site infection	

Table 3
Comparison of early complications (within 90 days after surgery) in the groups treated with one-stage bilateral total hip arthroplasty via the anterior approach or posterior approach.

Groups	Anterior approach	Posterior approach	p value
Total	3 (5.4%)	6 (7.3%)	0.74 (NS)
Major complications	3 (5.4%)	0 (0%)	0.06 (NS)
Infection	0 (0%)	0 (0%)	1.00 (NS)
Cerebrovascular event	2 (3.6%)	0 (0%)	0.16 (NS)
Peri-prosthetic fracture	1 (1.8%)	0 (0%)	0.40 (NS)
Minor complications	0 (0%)	6 (7.3%)	0.08 (NS)
Deep vein thrombosis	0 (0%)	1 (1.2%)	1.00 (NS)
Sacral pressure sore	0 (0%)	1 (1.2%)	1.00 (NS)
Dislocation	0 (0%)	1 (1.2%)	1.00 (NS)
Ilio-psoas irritation	0 (0%)	2 (2.4%)	0.51 (NS)
Piriformis syndrome	0 (0%)	1 (1.2%)	1.00 (NS)

was 160 minutes (range, 108–255 minutes) overall, 144 minutes (range, 110–195 minutes) in the AA group, and 171 minutes (range, 108–255 minutes) in the PA group ($p < 0.001$). The early re-admission rate was 2.9%, with no significant difference between the two groups: 2/55 (3.6%) AA patients and 2/82 (2.4%) PA patients required early readmission.

Iron supplementation was prescribed pre-operatively to 19% (26/137) of patients overall, 22% of AA-group patients, and 18% of PA-group patients. Erythropoietin was given to 16% (22/137) of patients overall, 15% of AA-group patients, and 18% of PA-group patients. These between-group differences were not statistically significant. On the first post-operative day, the mean haemoglobin level was 9.6 g/dL (range, 4.3-14.0 g/dL) overall, 9.8 g/dL (range, 7.4-14.0 g/dL) in the AA group, and 9.4 g/dL (range, 4.3-13 g/dL) in the PA group ($p = 0.22$). In the PA group, 1 patient developed acute anaemia after surgery, with a haemoglobin level of 4.3 g/dL, which was ascribed to a flare of Still's disease. Tranexamic acid (Exacyl®) was given intra-operatively to 43 (31.4%) patients overall, 27/55 (49%) in the AA group and 28/82 (34.1%) in the PA group ($p = 0.10$). Post-operatively, blood transfusion was required in 34 (24.8%) patients overall, with no difference between the groups 15 [27.3%] patients in the AA group vs. 19 [23.2%] in the PA group ($p = 0.58$). Erythropoietin was given post-operatively to 34 (24.8%) patients overall, 8/55 (14.5%) patients in the AA group and 26/82 (31.7%) patients in the PA group. The proportion of patients requiring blood transfusions was not significantly different between the groups with vs. without intra-operative tranexamic acid therapy (8/43 [18.6%] vs. 26/94 [28%], respectively; $p = 0.25$). Reinjection of salvaged autologous blood was performed in 3/55 (5.0%) AA-group patients and 5/82 (6.0%) PA-group patients ($p = 0.87$).

4. Discussion

This study is original, as it compared early mortality and morbidity between the AA and PA used for 1B-THA in selected patients. Several secondary criteria were also compared between these two groups. In keeping with data from the literature, only patients younger than 80 years of age who had an ASA score of 1 or 2 were included. In several studies, ASA score and age were the only two criteria used for selecting patients to 1B-THA [3,9,13]. The results of these studies indicated that 1B-THA should be offered only to patients younger than 80 years of age and having an ASA score of 1 or 2. However, in a study by Kim et al. [14] the early mortality and morbidity rates were the same in the groups defined by an ASA score of 1 or 2 versus 3 or 4. In our study of patients younger than 80 years who had an ASA score of 1 or 2, no early deaths were recorded. In addition, early morbidity rates were low and, under the conditions of the study, did not differ with the approach used. Other studies also found that no deaths occurred after 1B-THA [10,12–14] and mortality do not differ between simultaneous and staged bilateral THA [15]. For none of the types of complications were any significant differences found between the AA and PA groups. The overall complication rate was consistent with earlier reports [9,16]. In a meta-analysis by Shao et al. [17] of 63 909 patients who underwent bilateral THA, including 17 762 who had 1B-THA and 46 147 2B-THA, the rate of minor complications was not significantly different between the two groups and major complications were significantly more common in the 2B-THA group. Table 4 compares our data on complications after 1B-THA to those reported previously in.

The early re-admission rate was fairly low, consistent with previous data [24,25], and not significantly different between the AA and PA groups. The mean operative time was 27 minutes shorter in the AA than in the PA group. This difference is obviously ascribable to the need for a change in patient position between the two arthroplasties when the PA is used. Parvizi et al. [26] reported that the operative time was shorter by 10 minutes with the AA compared to the lateral Hardinge approach.

Blood transfusions were used more often in the AA than in the PA group, although the difference was not statistically significant. Erythropoietin was given more often in the PA group, but discontinuation of treatment with this agent in 2016 coincided with an increase in the use of the AA. The shorter operative time in the AA group was not associated with a difference in blood loss. The post-operative haemoglobin level was similar in the two groups. The proportion of patients who required post-operative blood transfusions was consistent with previous reports, although considerable variability exists, from 20% in a study by Parvizi et al. [21] to 66% in another, by Kim et al. [14]. Berend et al. [8] reported a higher blood transfusion rate in patients undergoing 1B-THA, but Poultsides et al. [16] did not replicate this finding, observing instead a higher blood transfusion rate with 2B-THA at an interval of 0-3 months. This last finding is probably ascribable to insufficient haematocrit recovery after the first procedure. In the meta-analysis by Shao et al. [17], blood transfusion rates were similar with 1B-THA and 2B-THA. The 9.6 g/dL mean haemoglobin level in our study is consistent with previous reports [21,27]. The administration of tranexamic acid did not seem to be associated with the blood transfusion rate [17]. As experience accumulated, we decided to give tranexamic acid to all patients who were free of contra-indications, but we rarely used autologous blood transfusions. Post-operative drainage via the AA or PA remains required after 1B-THA. A prospective study would be useful to better delineate the effects of tranexamic acid therapy in patients undergoing 1B-THA.

The main limitation of this study is the retrospective design. However, data were collected prospectively for all patients during the routine outpatient visits 6 weeks and 3 months after surgery.

Table 4
Early complications after one-stage bilateral total hip arthroplasty in published studies.

Author	Year	Study design	ASA score	n of patients	Major complications	Minor complications	Deep vein thrombosis	Pulmonary embolus	Cerebro-Vascular event	Infection	Dislocation	Death
Ritter and Randolph. [18]	1976	R; Sc	-	50	10%	58%	12%	6%	0%	0%	6%	2%
Salvati et al. [19]	1978	R; Sc	-	122	-	-	3.2%	2.4%	-	1.1%	0%	0.8%
Alfaro-Adrian et al. [3]	1999	R; Sc	1 to 4	95	-	-	0%	1%	-	1%	4%	1%
Bhan et al. [20]	2006	RCT; Sc	1 to 4	83	-	-	3.6%	1.2%	0%	3.6%	0%	0%
Parvizi et al. [21]	2006	R; Sc	1 to 3	98	8%	20%	0%	0%	0%	0%	-	0%
Swanson et al. [9]	2006	R; Sc	1 to 3	400	7.5%	68.5%	5.5%	1.2%	0.5%	0.5%	3.2%	0%
Kim et al. [14]	2009	R; Sc	1 to 4	978	2.2%	27%	6.1%	0.3	0.3	0.9%	3.4%	0.3%
Aghayev et al. [10]	2010	R; Mc	-	247	-	-	0%	0.4%	0%		0.4%	-
Haverkamp et al. [22]	2010	PM	1 to 4	878	10.9%	14.7%	-	-	-	-	-	-
Trojani et al. [12]	2012	R; M	1 to 3	112	7.9%	18%	7.5%	5.5%	0%	0.5%	0.5%	0%
Stavrakis et al. [23]	2015	R; M	-	2233	-	-	-	0.3%	-	0.2%	-	0.1%
Shao et al. [17]	2016	RM; PM	-	17 762	OR = 0.5 (0.4–0.8)	OR = 1.2 (0.6-2.5)	OR = 0.4 (0.2–0.8)	OR = 1.0 (0.5–2.5)	-	OR = 2.1 (1.3-3.7)	-	OR = 0.7 (0.4-1.5)
Poultsides et al. [16]	2017	R; Sc	-	1946	4.3%	10.1%	1.2%	0.8%	0.1%	0.2%	-	-
Our study	2019	R; Sc	1 to 2	137	2.2%	4.4%	0.7%	0%	1.4%	0%	0.7%	0%

R: retrospective; RCT: randomised controlled trial; RM: retrospective meta-analysis; PM: prospective meta-analysis; Sc: single-centre; Mc: multicentre; OR: odds ratio.

Another limitation is the absence of a multivariate analysis. Nevertheless, the similarity of the two groups regarding the pre-operative variables supports the absence of confusion bias. No comparison group of patients undergoing unilateral THA or 2B-THA was used. Such comparisons would be of interest in the future.

5. Conclusion

In a selected population of patients managed by 1B-THA via the AA or PA, no peri-operative deaths occurred. Under the conditions of the study, early overall morbidity was not significantly different between the AA and PA groups. Thus, 1B-THA is safe in patients younger than 80 years of age who have an ASA score of 1 or 2.

Disclosure of interest

The authors declare that they have no competing interest.

Potential conflicts of interest unrelated to this study are as follows: C. Trojani receives royalties from Corin; R. Bernard de Dompsure is a consultant for Corin; and P. Boileau receives royalties from Wright and is a consultant for Wright, Smith & Nephew, and Conmed. None of the other authors has any conflicts of interest unrelated to this work to declare.

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Authors' contributions

GM acquired, analysed, and interpreted the data, performed the statistical tests, and drafted the manuscript.

RBD conceived the study, interpreted the data, performed part of the surgical procedures, and revised the manuscript for important intellectual content.

LT revised the manuscript for important intellectual content.

MC revised the manuscript for important intellectual content.

PB interpreted the data and revised the manuscript for important intellectual content.

NB revised the manuscript for important intellectual content.

CT conceived the study, interpreted the data, performed part of the surgical procedures, drafted the manuscript, revised the manuscript for important intellectual content, and validated the final version of the manuscript.

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