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Complex Hip Arthroplasty Following Failed Proximal Femur Osteosynthesis

Shahzaib Riaz Baloch [1,2], *Mohammad Sohail Rafi* [2], *Imtiaz Ahmed Hashmi* [3], *Syed Ata Ur Rahman* [2], *Eamaan Abid* [2], *Faryal Karim* [4]

[1]Department of Orthopaedics & Traumatology, School of Clinical Medicine, The University of Hong Kong, Hong Kong, [2]Department of Orthopaedic Surgery, Ziauddin University, Karachi, [3]Department of Orthopaedic Surgery, Kings College Hospital Dubai, UAE, [4]Department of Orthopaedic Surgery, Sheikh Kalifa Bin Zayed Al-Nahyan, Medical Complex, Quetta, Pakistan.

ABSTRACT

Background: Hip fractures are common, especially in the elderly population, and orthopaedic surgeons frequently face many technical difficulties in their surgical management. It is commonly known that proximal femur fractures can result in failed osteosynthesis, which can be characterized by non-union, loss of reduction, or implant loosening. If osteosynthesis is unsuccessful for any reason, the next step in management is likely a complex hip replacement procedure. We hope to advance the current knowledge base and assist in the management of this difficult patient population.

Methods: This retrospective study included 64 patients who underwent complex hip arthroplasty after failed osteosynthesis for proximal femur fractures initially treated with Open Reduction and Internal Fixation (ORIF) from January 2017 to December 2021 using the non-probability Convenience Sampling technique .Data from Dr. Ziauddin Hospital's electronic records were analyzed for functional and radiographic outcomes up to one-year post-surgery. The Fisher exact test was used for contingency tables, and data was calculated via SPSS version 23, $P < 0.05$ was considered significant.

Results: Of the 64 patients, 24 were male (37.5%) and 40 females (62.5%). Initial fractures included 26 subtrochanteric (40.6%) and 38 intertrochanteric (59.4%), treated with Proximal Femoral Nail (37.5%), Recon Nail (12.5%), or Dynamic Hip Screw (50%). Failure reasons were cut-outs (59.3%) and non-unions (40.6%). Pre-operatively, most patients had poor or fair Harris Hip Scores (HHS). Post-revision, 62 patients (96.8%) underwent cementless THA, and 2 (3.2%) cemented THA, with significant HHS improvement: 78% scored good, 18.8% excellent, and 3.2% fair.

Conclusion: This study confirmed the efficacy of complex hip arthroplasty for failed osteosynthesis with good radio-clinical outcomes.

Keywords: Hip Fractures, Total Hip Arthroplasty, Fracture Fixation, Surgical Revision.

Corresponding Author:
Dr. Shahzaib Riaz Baloch,
School of Clinical Medicine,
The University of Hong Kong, Hong Kong,
Ziauddin University, Karachi, Pakistan.
Email:drshahzaibriazbaloch@gmail.com
ORCID: https://orcid.org/0009-0003-1741-228X
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INTRODUCTION

Hip fractures are common, especially in the elderly population, and Orthopaedic surgeons face many difficulties in treating them. Particularly, proximal femur fractures can cause serious morbidity and functional impairment. The main objectives of surgical therapy for these fractures are pain alleviation and hip function restoration. But even with improvements in surgery and implants, problems like non-union and implant failure can still arise and provide less-than-ideal results[1].

Proximal femoral fractures are commonly known to result in failed osteosynthesis and are characterized by non-union, implant loosening or loss of reduction. If conservative therapy does not have the desired effect and patients will still have symptoms, a revision surgery, i.e. a hip replacement, is necessary. After unsuccessful osteosynthesis, hip replacement surgery offers the opportunity to improve quality of life and restore joint function[2].

If for any reason the osteosynthesis fails, a replacement of the hip joint may become necessary. Reasons of failure could be inadequate reduction, unstable fracture, implant problems (technical), low bone quality and late presentation remains the commonest causes of failed osteosynthesis. To select the specific surgery to treat these injuries, a detailed assessment of the nature of the fracture, characteristics of the patient and general health status, must be taken into consideration[3].

Total hip arthroplasty (THA) is the recommended surgical procedure for replacement of failed osteosynthesis of the hip. This means removing the failed implants, cleaning up the fracture site and reconstructing the hip with a hip prosthesis while maintaining adequate limb length along with restoring the biomechanics. The advantages of THA are better mobility, Immediate pain reduction, and restoration of joint function. However, it has its own share of challenges - there is a risk of infection in addition to prosthesis dislocation and loosening[4,5].

Studies on hip replacements following failed osteosynthesis have produced varied results. Some authors have reported beneficial effects with a significantly larger reduction in pain and functional results. Outspoken Critiques and others have pointed out that there is a downside to undergoing revision surgery: the operation takes longer to recover from, the risk of developing complications is greater, and further operations may be needed. The appropriate prosthesis, the type of bearing surface, the surgical approach also play a role but to a lesser extent when considering treatment results[2].

The purpose of this study was to describe our experience with hip replacement following failure of osteosynthesis for a proximal femur fracture. We aimed to evaluate the impact of surgical interventions on clinical outcomes, complications and functional improvement. The patient's data were retrospectively reviewed patient, focusing on cases between January 2017 and December 2021.

In this study, we assessed functional outcomes, comorbidities and patient satisfaction following hip replacement after failed osteosynthesis. All aspects of the hip function, pain severity, radiological, and patient-reported outcomes were covered. We also evaluated the impact of other variables such as age, type of fracture, time to revision and implant choice on the outcome of the procedure. By circulating our results, we hope to further the existing knowledge base and help with the management of this challenging patient population. This could possibly guide orthopaedic surgeons in selecting patients better and customizing their surgical techniques for this challenging patient group.

METHODS

This retrospective study evaluated the functional status of all those patients who had undergone hip replacement surgery for an unsuccessful osteosynthesis for a proximal femoral fracture. The study was conducted at Dr. Ziauddin Hospital, Clifton campus. The hospital's data was retrospectively analysed and approval was taken from the institute's review board (ERC# 8021123SRORT), to conduct this study in congruity with ethical standards.

A total of 112 patients were screened and only 64 patients were included who had a failed Osteosynthesis (DHS, PFN, I/M Nail) for a proximal femoral fracture and had been revised with a hip arthroplasty surgery from January 2017 to December 2021. The non-probability Convenience Sampling technique was used. In the analysis, patients who had at least a 12-month follow-up time were included. Excluded patients were those with insufficient medical data, those who lost to follow-up, those with cognitive impairments, and those who had revision surgery performed for non-osteosynthesis-related causes.

Patients' age, gender, and comorbidities were gathered from their medical records. Pre-operative radiographs were evaluated for the fracture pattern and bone quality. Surgical records were reviewed for the time of revision from the index surgery, surgical technique, type of failed osteosynthesis, choice of implant, and if any additional procedures were performed during the revision procedure.
A visual analogue scale was used to assess both pre-and post-operative pain. A number of criteria were used to assess clinical outcomes. To assess the

hip function Harris Hip Score (HHS) was used and radiographs were assessed by qualified radiologists, the parameters that were looked into were as follows; infection, prosthesis loosening, union, and implant position. Postoperative complications that were assessed were infection, DVT, dislocations, intra-op and periprosthetic fractures, and prosthetic loosening. Any additional surgical procedures or adjustments that were necessary throughout the follow-up period were also included in the documents. Patient-reported outcome measures, such as the satisfaction scale, were used to gauge patient satisfaction with the surgery and its results overall.

A summary of the clinical and demographic data was produced using descriptive statistics. Continuous variables were displayed as means with standard deviations or as medians with interquartile ranges, depending on how they were distributed. The categorical variables were reported using percentages and frequencies. P-values of less than 0.05 were considered statistically significant, and the appropriate software was used to conduct the statistical analyses. The data was analysed using IBM SPSS version 24.

Ethics guidelines were followed in the conduct of this investigation with approval taken from the centre's review board. The privacy and confidentiality of patients were rigorously upheld during the investigation.

RESULTS

Table 1: Patient Characteristic

Demographics			
Gender Distribution (n=64)	**Mean±SD/Frequency (%)**		
Age	67.37±6.67		
Male	24 (37.5%)		
Female	40 (62.5%).		
Primary Diagnosis & Gender Distribution			
Gender	**Primary Diagnosis at The Time of Index Surgery**		
	Subtrochanteric Fracture n (%)	**Intertrochanteric Fracture n (%)**	**Total**
Female	14 (21.87)	26 (40.63)	40
Male	12 (18.75)	12 (18.75)	24
Total	26 (40.62)	38 (59.38)	64

A total of 146 patients were operated on with a Total Hip Arthroplasty (THA) following a failed osteosynthesis for a hip fracture from January 2017 to December 2021 at Dr. Ziauddin Hospital Clifton campus, Karachi by 3 Orthopedic surgeons. Only 64 patients were included in the study after fulfilling the inclusion criteria. The mean age of the patients was 67.37 (+/-6.6), with the majority of the patients being females 62.5%. **(Table 1).**

Thirteen patients had a primary diagnosis of sub-trochanteric fractures, the majority of our proximal femoral fractures comprised of intertrochanteric fractures which comprised 59.38% of all patients **(Table 1).**

Table 2: Reason for Failure of Osteosynthesis & Previous- Implants Used at The Time of Index Surgery

Previous Implant	Non-Union	Cutouts	Total	Primary Diagnosis	Subtrochanteric Fracture	Intertrochanteric Fracture	Total
*PFN	8(12.5%)	16(25%)	24(37.5%)	*PFN	18(28.1%)	6(9.4%)	24(37.5%)
Recon Nail	6(9.4%)	2(3.1%)	8(12.5%)	Recon Nail	8(12.5%)	0	8(12.5%)
*DHS	12(18.8%)	20(31.3%)	32(50%)	*DHS	0	32(50%)	32(50%)
Total	26(40.6%)	38(59.4%)	64(100%)	Total	26(40.6%)	38(59.4%)	64(100%)

***** PFN = Proximal Femoral Nail, DHS = Dynamic Hip Screw.

Twenty-four patients were treated with PFNs, 8 of them had undergone a recon nail, and 32 were treated with dynamic hip screws to stabilize the initial fractures. Among the reasons for the failure were the 38 cut-outs (59.3%) as opposed to the 26 non-unions (40.6%) in our patient population **(Table 2).**

All 26 sub-trochanteric fractures were treated with intra-medullary devices and out of 38 Intertrochanteric fractures 32 (84.2%) were fixed with DHS **(Table 2)** and out of those 20 (62.5%) had failed with cut-outs liable to the poor quality of bone similarly seen in those who were treated with PFN 16 (66.67%) **(Table 2).** After an index operation, the patients had undergone revision surgery on average 14.64 ± 2.01 months later.

Table 3: Comparisons Between Pre-Op and One Year Post-Op Harris Hip Scores

Harris Hip Score	Pre-Op HHS Prior Revision Surgery			1-Year Postoperative HHS After Revision Surgery		
Reason of Failure	Non-Union	Cutouts	Total	Non-Union	Cutouts	Total
Poor	18(28.1%)	22(34.4%)	40(62.5%)	0	0	0
Fair	8(12.5%)	16(25%)	24(37.5%)	2(3.1%)	0	2(3.1%)
Good	0	0	0	22(34.4%)	28(43.8%)	50(78.1%)
Excellent	0	0	0	2(3.1%)	10(15.6%)	12(18.8%)
Total	26(40.6%)	38(59.3%)	64(100%)	26(40.6%)	38(59.3%)	64(100%)

*****HHS = Harris Hip Score

When assessing the functional status of our patients' pre-operative (revision surgery) Harris Hip scores **(Table 3)**, 24 patients had a fair HHS, no patient scored well, whereas 40 of them had a poor HHS at the time of presentation (when the decision to re-operate was made). When comparing the one-year post-operative period to the pre-operative status (the decision to operate at the time of presentation), a significant improvement in HHS was observed. Fifty patients received good scores (78%), only two received a fair score (3.2%), and twelve received excellent scores (18.8%) as seen in **Table 3**.

Table 4: Functional Outcome of Implant

Harris Hip Score 1-Year Postoperative After Revision Surgery	Femoral Stems					
	Cemented	Single Wedge Tapered	Modular	Anatomic	Total	p-value
Fair	2(3.1%)	0	2(3.1%)	0	4(6.3%)	0.006
Good	0	20(31.3%)	28(43.8%)	2(3.1%)	50(78.1%)	
Excellent	0	2(3.1%)	6(9.4%)	2(3.1%)	10(15.6%)	
Total	2(3.1%)	22(34.4)	36(56.3%)	4(6.3%)	64(100%)	

In 62 patients (96.8%) a cementless THA was used, whereas cemented THA was used in 2 (3.2%) of the cases. Acute (superficial) surgical site infection occurred one-week following total hip arthroplasty (THA); this complication was effectively managed with oral antibiotics and dressings. According to Gruen criteria, none of the cases had radiological evidence of implant loosening at the one-year follow-up **(Table 4)**. By one year after surgery, there had been no deaths. The difference between the HHS scores before and one year after surgery has been shown in tabular form.

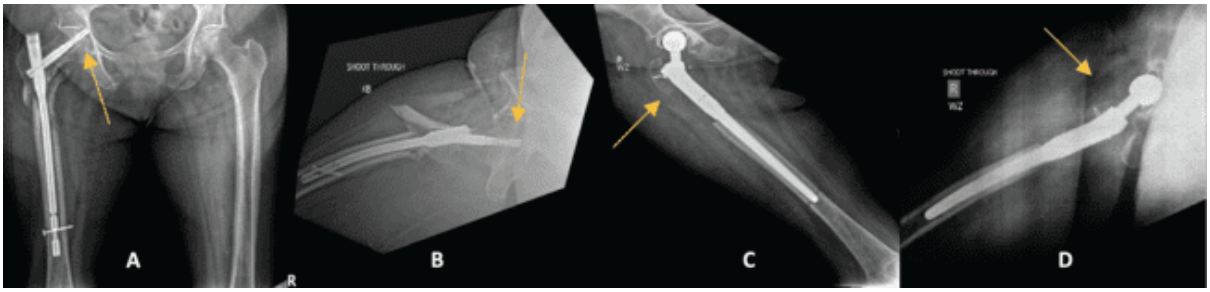

Fig 1: PFN head cut-out showing Implant failure A: AP View of pelvis with screw cut-out and penetrating the head, B: Lateral view, C: Proximal Femoral Replacement, 1-year post-surgery Ap view and D: Lateral view

Figure 1: depicts a case of proximal femoral nail (PFN) helical blade cut-out, a mechanical failure leading to joint penetration, followed by successful revision with a proximal femoral replacement (PFR), with Image-A reveals the catastrophic failure of the PFN implant, with the helical blade cutting out of the femoral head and protruding into the acetabulum, suggesting loss of fixation and possible instability. Image-B confirms the posterior migration of the blade, perforating the femoral head, likely due to osteoporotic bone collapse or improper implant positioning. Image-C and Image-D at 1-Year Post-Op demonstrate the reconstructed hip using a proximal femoral replacement, with well-fixed components and restored joint alignment, implant stability, showing no signs of loosening or dislocation, indicating a successful long-term outcome.

Fig 2: Showing Non-union of the right femoral Neck A: AP view of pelvis, B: AP-view pelvis 1-year post-surgery of the above patient which was revised with Wagner Implant and C: Lateral view of femur.

Figure 2 series illustrates a case of non-union of the right femoral neck following initial fixation with a dynamic hip screw (DHS), later revised with a proximal femoral replacement (PFR) using a Wagner implant. Image-A demonstrates failed fixation with a DHS, showing persistent non-union of the femoral neck fracture, characterized by a visible fracture gap, lack of bony bridging, and possible implant loosening or varus collapse. Image-B at 1-year post-revision, revealing successful reconstruction using a Wagner PFR implant with Bipolar cup, a stable fixation, restored femoral alignment, and no signs of loosening or subsidence at one-year follow-up. This sequence highlights the challenges of femoral neck non-union after DHS fixation and the effectiveness of prosthetic replacement (Wagner PFR) as a salvage solution, providing durable function and pain relief. The follow-up images demonstrate excellent implant integration and mechanical stability at one year post-revision.

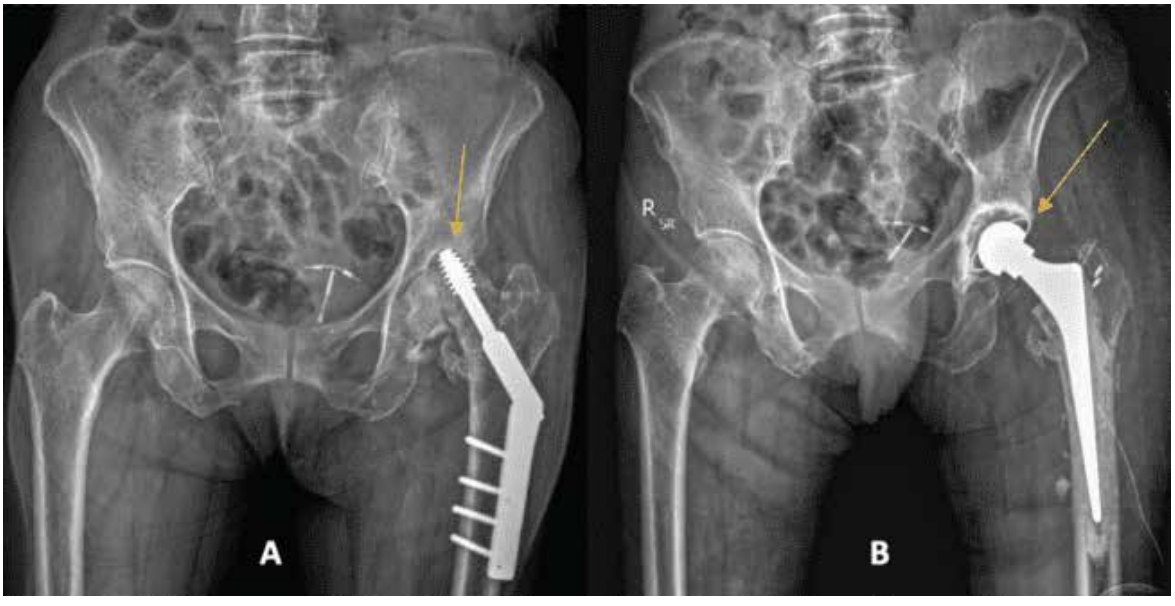

Fig 3: A: Implant Failure with screw cut-out post-DHS revised with a cemented Total Hip Arthroplasty B: 11-months post revision surgery

Image-A demonstrates a failed dynamic hip screw (DHS) fixation, complicated by screw cut-out from the femoral head. The superior migration of the lag screw has resulted in significant acetabular erosion and joint destruction, indicative of advanced mechanical failure. The femoral head appears collapsed, with evidence of osteolysis and possible avascular necrosis, necessitating revision surgery. And in Image-B, 11-month follow-up image revealing a successfully revised cemented total hip replacement, with well-fixed components and restored hip biomechanics. The acetabular component shows stable positioning with adequate bone-cement interface, while the femoral stem demonstrates proper alignment and cement mantle integrity. There are no signs of loosening, subsidence, or periprosthetic fractures, suggesting favorable osseointegration and functional recovery at 11 months postoperatively (Fig 3).This figure highlights a common complication of DHS fixation (cut-out) leading to joint destruction, and its definitive management with cemented THA, resulting in stable reconstruction and improved patient outcomes. The long-term follow-up confirms the durability of the revision arthroplasty in restoring hip function.

DISCUSSION

The study highlighted the efficacy of Total Hip Arthroplasty (THA) as a revision surgery following failed osteosynthesis for proximal femur fractures, demonstrating significant improvements in functional outcomes and pain relief. Among the 64 patients included in the study, the majority were female (62.5%), with a mean age of 67.37 (±6.6) years, reflecting the demographic most susceptible to such fractures. The primary reasons for osteosynthesis failure were cut-outs (59.3%) and non-unions (40.6%), with intertrochanteric fractures being the most common (59.38%). Notably, THA resulted in a marked improvement in Harris Hip Scores (HHS), with 78% of patients achieving good scores and 18.8% achieving excellent scores at one-year post-operation, compared to the pre-operative status where 62.5% had poor HHS. These findings underscore the potential of THA to restore hip function and alleviate pain in patients with failed osteosynthesis.

Hip replacement surgery is a sophisticated procedure intended to relieve pain and restore hip

function in patients who have undergone unsuccessful initial fracture fixation due to failed osteosynthesis of proximal femur fractures[6,7,8,9]. In this paper, we describe our experience with this surgical strategy and go over the results and consequences of hip replacement in these situations.

In case of failure to osteosynthesis, our observations lead us to think that hip replacement may present better clinical results. The participants aging in our study was averaged 67(+/-6.6) years old, which was matched with the population at high risk for proximal femur fractures in a similar region[10], and was only a little older than the average aging (69.2 years) in the European region that had been documented in the system review[11]. This highlights the importance of providing effective treatment options to this population as these fractures can impair mobility and reduce the quality of life.

With regard to the gender of patients, we found that the majority of studied subjects were female in a similar way to the corresponding research in the same region (62.5%)[12]. This was consistent with other studies correlating the higher rates of trauma and falls with women, thereby increasing the risk for proximal femur fractures. More research is required however to assess how sex affects the results of hip replacement surgery after failed osteosynthesis.

To determine the efficacy of hip replacement surgery following a failed osteosynthesis procedure, clinical assessment is essential. Hip function was evaluated using the Harris Hip Score (HHS) both preoperatively and postoperatively[13]. The HHS measures mobility, function, and pain. The HHS mean values both postoperatively improved significantly, which denoted better hip function and less pain, as our results suggested. The results of our population-based study demonstrated that hip arthroplasty can substantially improve the range of motion and reduce pain in cases of failed osteosynthesis.

The pain visual analogue scale (VAS) is a well-recognized method for assessing pain and allows us to understand better the subjective experience of the patients[14]. A significant decrease in pain levels following surgery was apparent by the results showing lower VAS scores in our study. This is additional proof of practice in favour of hip replacement surgery after osteosynthesis failure as improved pain management.

Complications of Hip Replacement Surgery is an important aspect that needs to be taken into consideration while assessing its success[15]. We consider that an occurrence of a complication (infection, dislocation, DVT, periprosthetic fracture, and prosthetic loosening) was almost negligible as demonstrated by our results but that could be because of our small size but it is an essential factor that needs to be considered and documented throughout patient follow-ups[16,17]. A single patient was found to have a superficial skin infection, and that too as a result of non-compliance and poor hygiene; nevertheless, the infection was effectively treated with a brief course of antibiotics and wound care. We did not experience any of the other complications. Higher complication rates and poorer survival rates were noted in THA following acetabular osteosynthesis compared to osteosynthesis of proximal femur fractures, which is similar to our findings, concerning complications noted in THA following osteosynthesis for a proximal femoral fracture[18,19]. The infection rate was documented in the literature as between 22 to 26% which is fairly high, and liable to comorbidities, which was not seen in our case[20,21,22]. Long-term monitoring is also necessary to spot any potential delayed complications [23,24].

When assessing the effectiveness of hip replacement surgery, patient satisfaction is an essential outcome measure[25]. Overall patient satisfaction, which includes pain relief, improved function, and quality of life, is a subjective assessment that was not quantitatively measured in our study[26]. To evaluate satisfaction more objectively, validated patient-reported outcome measures should be included in future research.

The study's limitations should be taken into account when interpreting the findings. First of all, the retrospective design restricts the control over confounding factors and introduces inherent biases. Furthermore, the research was carried out at a solitary establishment, potentially limiting the applicability of the results. Furthermore, the short follow-up period might miss long-term consequences and outcomes. Thus, to confirm our results and offer more thorough evidence, prospective multi-centre studies with long-term follow-up are required.

LIST OF ABBREVIATIONS

THA Total Hip Arthroplasty
HHS Harris Hip Score
RECON Nail Reconstruction Nail
I/M Nail Intra-Medullary Nail
IRB Institutional Review Board
VAS visual analogue scale
DVT Deep Vein Thrombosis
PFN Proximal Femoral Nail
DHS Dynamic Hip Screw
AP view Anteroposterior View

CONFLICT OF INTEREST

None.

FUNDING
None.

PATIENT CONSENT
All participants gave written informed consent before their inclusion in the study.

ETHICAL APPROVAL
The ethical approval for the current study was taken from the Ethical Review Committee at the Ziauddin University, Karachi under reference number (8071123SRORT).

AUTHORS' CONTRIBUTIONS
SRB: contributed substantially to the work's concept and design, analyzed and interpreted the data, performed a final review and approved the final version, and agreed to be accountable for all aspects of the work. **MSR** was involved in the design, data interpretation, and final review of the work. **IAH:** Design and did a final review of the article, **SAR:** design, data interpretation and did a final review and editing, **EA:** was involved in the design and did a final review and editing, **FK :**was involved in data analysis and statistical work along with the final editing.

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