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Indian Journal of ARTHROPLASTY

Official Publication of The Indian Arthroplasty Association

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Indian Journal of Arthroplasty

1. Aims and Scope

Indian Journal of Arthroplasty (IJOA) is the official publication of the Indian Arthroplasty Association. The Journal publishes four issues in a year, i.e., January–March, April–June, July–September and October–December. It is a peer-reviewed, open-access Journal and aims to publish original research articles, controlled trials, review articles, case series and case reports and surgical techniques pertaining to joint replacement surgery only.

The publications should not have been published anywhere else either as an abstract or paper and should be the original work of the authors, free of any plagiarism. Original papers that may have an impact on the management outcomes after an intervention are welcome. Case series should be based upon the personal experience of the surgeon on a cohort of patients but should have originality and key learning message for the readers. Case reports should have a new or rare diagnosis or intervention that has been performed. Review articles should be on a topic that has clinical relevance and dictates the management guidelines.

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Editorial

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Dear Indian Arthroplasty Association members and readers, it is our pleasure to share that our IJOA has been alloted online eISSN number which is the precursor to indexation of the journal. This Apr–Jun 2025 issue has some interesting articles on primary and revision arthroplasty. Please read the journal and give suggestions and critique for the journal's improvement. Please contribute towards the journal by writing and reviewing articles so as to improve the overall standard of the journal. Looking forward to an academically rewarding IAA 25.

Sincerely

Anoop Jhurani
Editor-in-Chief, IJOA

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ORIGINAL ARTICLE

Hip Arthroplasty in Trochanteric Fractures: A Single-center Retrospective Study of Clinical and Radiological Outcomes

Lavindra Tomar[1], Gaurav Govil[2]

Received on: 06 May 2025; *Accepted on*: 20 June 2025; *Published on*: 06 October 2025

Abstract

Introduction: Proximal femoral trochanteric fractures account for 40–45% of all hip fractures. Unstable type III–V/ reverse trochanteric fractures account for 35–40% of such fractures. In elderly patients, fixation of fractures by sliding screw or intramedullary devices is considered the standard of care. However, the failure rate accounts for 5–17% of such fixations. Comminution, osteoporosis, and instability delay full weight bearing and increase morbidity. Primary hip arthroplasty (HA) is an alternative viable option in unstable proximal femur fractures.

Materials and methods: We report 26 elderly patients with unstable proximal femoral fractures treated with primary hip replacement from January 2016 to December 2021 at the institution, with data collected from medical records. The mean age of the hemireplacement patients was 78.9 years, and for those with total hip replacement, it was 73.5 years. The minimum follow-up (FU) period was 2 years. We studied postoperative complications, functional outcome using the Harris hip score, time to return to normal activities, and radiographic progression. Mobilization and weight-bearing were started immediately in the postoperative period.

Results: A total of 25 patients achieved excellent to good hip function. One case of dislocation occurred, which was managed by closed reduction. No loosening or infection of the implants was observed.

Conclusion: Primary HA as an alternative treatment option in carefully selected elderly patients with unstable proximal femoral fractures gives good clinical and functional outcomes. This procedure offers quick recovery, avoids the risks associated with internal fixation, and enables the patient to maintain a good level of function immediately after surgery with low complication rates.

Keywords: Complications, Fragility fracture, Geriatric fracture, Harris hip score, Hip arthroplasty, Hip fracture, Trochanter fracture, Unstable fracture.

Indian Journal of Arthroplasty (2025): 10.5005/ijoa-11025-0025

Introduction

Proximal femoral trochanteric fractures account for 40–45% of all hip fractures.[1] Unstable Type III–V/ reverse trochanteric fractures account for 35–40% of such fractures.[2] In elderly patients, fixation of fractures by sliding screw or intramedullary devices is considered the standard of care.[3,4] However, the failure rate accounts for 5–17% of such fixations.[1] The one-year mortality of a hip fracture has been reported to range from 21 to 30%.[4,5] The fracture comminution, osteoporosis, and instability delay full weight bearing after hip fracture fixation and increase the morbidity. Prolonged recumbency in the elderly has an adverse effect on patient outcomes.[5,6] An osteoporotic hip fracture following internal fixation has high failure rates due to screw backout, implant breakage, and screw cutout proximally to cause secondary hip arthritis.[2] Nowadays, the increased life expectancy leads to a more elderly population with associated medical comorbidities presenting with increased hip osteoporotic fractures for management.[7]

Hip arthroplasty (HA) has revolutionized the management of painful hips. The primary HA as a viable alternate option in the management of unstable proximal femur fractures (UPFF) has been advocated since the 1970s onwards, with varied outcomes.[3] The restoration of functional ability to bear weight in the immediate post-injury status gives positive responses. The arthroplasty may be either a hemi-replacement HA (HRA) or a total HA (THA). Arthroplasty provides immediate stability, reduces complications related to deep vein thrombosis, chest infections, and decubitus sores. Post-procedure, HA provides excellent pain relief with the advantage of weight bearing potential, enhancing early rehabilitation with a marked positive psychological impact.

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Consent for publication: The patient were informed that data from the case would be submitted for publication, and the patients gave written consent. The patients understand that his name and initials will not be published, and due efforts will be made to conceal their identity.

The primary HA in the management of acute hip fractures in the elderly, though, presents its own specific challenges. They include establishing the correct anteversion angle, restoring the correct leg length, achieving a stable fixation of comminuted fracture fragments, maintaining the soft tissue tension of the abductor muscles, and reconstruction of the disturbed greater trochanter–abductor mechanism.[8] Trochanteric wiring in HA was additionally required to assist in the biomechanical function of the hip joint.[9]

We conducted a single-center retrospective study through the review of the medical records. The primary objective was to assess the clinical and functional outcomes of the primary HA in elderly patients with a UPFF. Secondary objectives included analyzing postoperative complications and comparing outcomes between HRA and THA. The complications noted were minimal. We also reviewed the literature and analyzed the associated risk factors linked to a poor functional outcome following a surgical treatment in UPFF.

Materials and Methods

The retrospective single-center study for unstable trochanteric fractures was conducted between January 2016 and December 2021, at Max Super Speciality Hospital, Patparganj, Delhi. Ethical committee/Institutional Review Board (IRB) approval was not considered due to its retrospective nature. All patients of (a) age more than 65 years, (b) hip fracture with a Muller AO/OTA (AO: Arbeitsgemeinschaft für Osteosynthesefragen; German for "Association for the Study of Internal Fixation", and OTA: Orthopaedic Trauma Association classified unstable trochanteric fracture (31- A2.2, 31-A2.3), with (c) history of recent trauma of less than 2 days, and (d) with minimum follow-up (FU) of two years were included in the study. The patients with (a) late presenting fracture beyond 2 days, (b) an additional limb fracture, (c) earlier operated limb fracture, (d) bilateral hip injury, (e) age less than 65 years, (f) pathological fracture, (g) poor FU or lost to FU, and (h) mortality before two years of minimum FU period were excluded from the final patient list for evaluation.

The demographic data of 35 patients fulfilled the inclusion criteria from the medical records. Six patients were lost to FU before completion of two years of postoperative duration, and another three patients had expired in one year of hip fracture due to causes unrelated to the fracture. The remaining 26 patients were identified, and their data were compiled and included in the study design. The unstable fractures were treated by primary HA. We either did an HRA or a THA for the management, presenting us two distinct groups designated as group A and group B. Group A was those who underwent HRA, and group B had undergone THA. Preoperative and operative patients' demographics including age, sex, type of fracture, time of presentation from injury and time to surgery, medical comorbidities, American Society of Anesthesiologist (ASA) grading, type of hip prosthesis, duration of surgery, blood loss, time to walk post-surgery, time to discharge, FU duration, functional outcome scores, and post arthroplasty complications were gathered through a review of the medical record.

The standard preoperative protocol for HA was followed for both groups. This included evaluation and optimization of the associated medical co-morbidities in the next 24–48 hours after admission. A preanesthesia evaluation and categorization based on ASA grading was done. The management for the initial pain control by intravenous analgesics, transdermal pain-killer narcotic patches, and application of limb traction was utilized. The preoperative antibiotic prophylaxis with injection cefuroxime sodium was given in the dosage of 1.5 gm intravenously about half an hour before the start time. The preoperative thromboprophylaxis was initiated at the time of admission with subcutaneous injection of Enoxaparin along with mechanical compression devices. The time of surgery was within 24–48 hours of injury in all except for five cases, which required optimization and modulation of the ongoing antiplatelet medications.

The senior surgeon was the primary operating surgeon in all the cases. Informed consent was taken with due stratification of medical comorbidities and complications. Patients were placed in lateral position after the spinal or general anesthesia on a radiolucent table. A posterolateral approach to the hip was used in all the cases. The fracture was exposed after incising the fascia lata. The glutei are split and avoid stripping the middle fragment of the trochanteric region to avoid damage to the glutei attachment. The fracture geometry was assessed intra-operatively without disturbing the muscle attachments to plan the plane of dissection for further hip exposure. The identification of abductors, short external rotators, and posterior trochanteric ridge in the distorted anatomy was considered essential. The posteromedial trochanteric buttress, once identified, guides the version of the hip. The rotators were thereafter carefully tagged with an additional care taken to protect and avoid any iatrogenic inadvertent sciatic nerve injury. The plane at times was through the trochanteric fracture fragments. The neck was osteotomized at an appropriate length where necessary, as determined by preoperative planning, and the femoral head was removed. The trochanteric fragments are largely left untouched. The subsequent step assessed the acetabulum, and either the removal of ligament teres was carried out for HRA, or the acetabular preparation was done for a cemented acetabular cup placement for THA. The version of the cup was guided by the identification of the transverse acetabular ligament (TAL) of the hip. The femoral canal was exposed, and sequential reaming was done to open the medullary canal with utmost caution to avoid breaching the femoral cortex, especially within an osteoporotic bone. The trial femoral and neck component was placed to assess the limb length, range of hip movements, and joint stability with the shuck test and telescoping test to judge the soft tissue tension. The version of the femoral component was guided by the calcar placement with an intact lesser trochanter. Also, version can be guided by approximation of the lesser trochanter and the posteromedial fragment or by the lower limb positioning at 10–15 degrees of external rotation from the neutral position when the lesser trochanter was broken. Once stability was confirmed clinically on the table, trial components were replaced by the original components with a standard manual cementing technique. A cement restrictor was used. The hip was relocated. The trochanteric fragments were additionally stabilized with K-wires, tension band wiring (TBW), the use of Ethibond suture, cables, and encirclage wiring. However, the fixation was done without compromising the soft tissue attachments of fracture fragments and maintaining the balance of the soft tissue tension to allow for a stable fixed joint construct. The joint capsule was closed whenever possible, and the short external rotators were reattached. A negative suction drain was placed routinely in all the cases.

The implants used for HA were from the DePuy J & J hip system. In HRA, the modular bipolar cups with cemented Corail smooth tapered femoral stem were implanted. A hybrid uncemented Pinnacle cup with poly-liner or a cemented acetabulum cup, depending upon the preoperative assessment of bone quality, was used. A cemented Corail smooth tapered stem was the preferred THA implant. The K wire, encirclage wire, and cables were usually made of stainless steel.

The pre-emptive measures to reduce the blood loss during the procedure were followed in all the cases. In the immediate preoperative period of around half an hour before the start of surgery, a one-gram injection of tranexamic acid was given intravenously, in all the cases, except for five cardiac patients with poor cardiac health. A local instillation of a similar dose of one gram of injection tranexamic acid was given locally through the negative suction drain into the operated hip cavity in all the cases, irrespective of cardiac status. The drain output pipe was clamped initially for at least three hours post-surgery. The drain was left open thereafter, and the standard removal of the negative suction drain was done on the second postoperative day.

The protocol for postoperative management included a day of continued intensive care unit observation. The static quadriceps, active toe movements, and chest physiotherapy exercises were initiated in the immediate postoperative period. The postoperative assessment of hemoglobin and packed cell volume was done on the next day of surgery. Blood transfusion was given when required based on hemodynamic instability and, if needed, to replenish the reserves to build up for general strength. A pillow was advised underneath the operated limb, keeping the knee in 5–10 degrees of flexion. The bed edge sitting was advocated along with walker support, standing, and ambulation from the second day of surgery. The out-of-bed activities of sitting on a chair, use of a toilet commode chair, and prolonged sitting were gradually introduced further, as per tolerance and comfort. The hip precautions included avoidance of any self-turns in bed, avoiding any acute hip flexion of the operated limb beyond 90 degrees, and avoiding any walking without walker support. The discharge was considered in the next three to four days for the rehabilitated patient with adequate control of pain and mobility. The average time to discharge considered adequate from admission was normally six days. Further rehabilitation was done on a domiciliary basis. The walker support was continued for three to four weeks, and gait training with independent walking was allowed after four weeks of the postoperative period. Patients were thereafter followed for stitch removal at a minimum of 15 days from the day of surgery. The monthly check-up was followed at intervals of 1, 2, and 3 months of operation. Thereafter, a 6-monthly and a yearly assessment were advised. The clinical and radiological assessment was done at each hospital visit. The FU continued a yearly basis for the next 5 years.

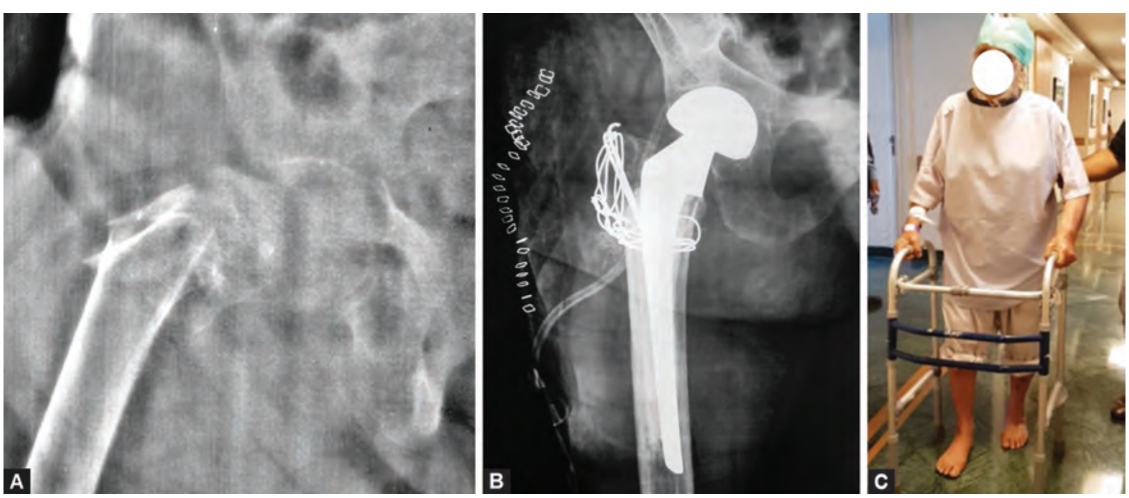
The clinical assessment was done by the Harris hip score (HHS), visual analog score (VAS) for pain evaluation, use of ambulatory aid (Ambulation Capacity by Clawson's Classification), and return to pre-injury levels. An HHS grading was considered poor for a score of <70, fair for 70–79, good for 80–89, and excellent for 90–100. HHS score has shown satisfactory responsiveness and has been validated in studies on the Indian population.[10] Harris hip score was calculated and compared to the preoperative status at 2 years and the final FU visit. The VAS score has been validated for assessment of pain intensity into mild category from 1 to 4, moderate from 5 to 6, and severe from 7 to 10 when measured on a scale of 0–10 rating.[11] The use of ambulatory aid and return to preinjury levels were assessed by clinical history and examination of walking ability. The radiological assessment included standard fracture healing, acetabular cup displacement, subsidence of the femoral prosthesis, osteolysis or lytic areas around the femoral stem, and disruption of the bone cement interface. The trochanteric wire breakage, nonunion, or proximal migration of the trochanter fragment was determined.

The data was entered in an MS Excel spreadsheet, and statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA). Statistical analysis was carried out using descriptive statistics, by calculating frequencies and percentages for qualitative data; mean with standard deviation (SD) and median for quantitative data of each parameter in the study. Differences in proportions or frequencies between the two groups were analyzed by the Chi-square test. Differences in mean between both groups were analyzed by an Independent *t*-test. The level of significance was adjusted at a *p*-value less than 0.05.

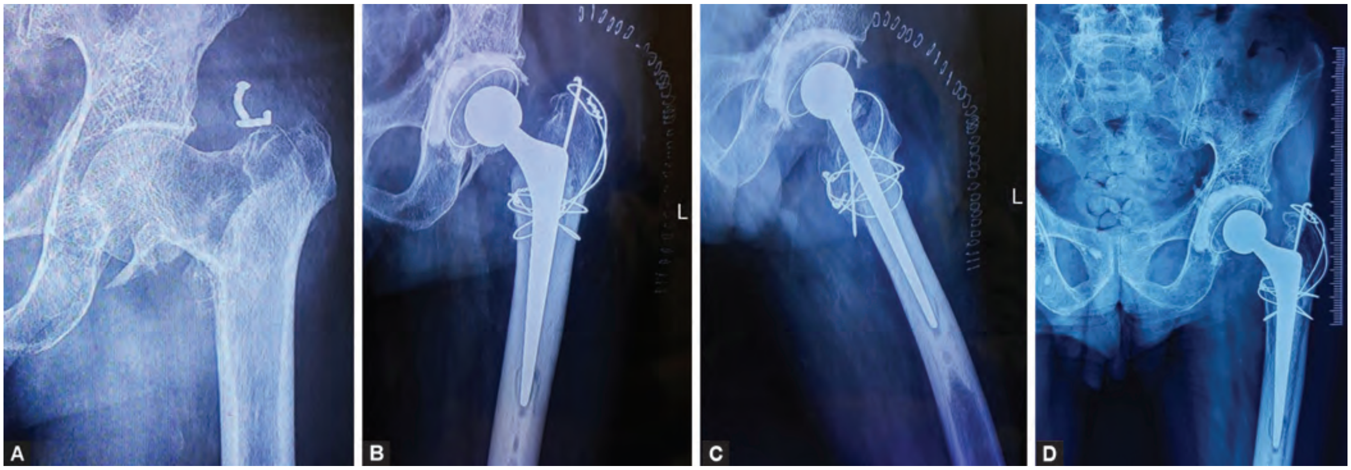
Results

The 26 patients underwent cemented HRA in 14 cases (group A) and cemented THA in 12 cases (group B) (Figs 1 and 2). The FU period ranged from a minimum of two years to five years. The demographic details are presented in Table 1.

Out of 14 cases treated with HRA, maximum 42.8% cases were aged 76–85 years of age with mean age being 78.9 years and out of 12 cases managed with THA, maximum 66.7% were aged between 65 and 75 years of age with mean age being 73.5 years, showing an insignificant difference (p-value > 0.05) between both the groups statistically (Fig. 3). In HRA group, 64.3% were females, whereas in THA group 58.3% were males, showing a significant difference (p-value < 0.05) statistically. In both groups, maximum cases showed left side involvement, showing an insignificant difference (p-value > 0.05) between the groups statistically. The cases with medical



Figs 1A to C: A case from group A in a 90-year-old male with (A) Right hip fracture on AP pelvis radiograph; (B) Underwent HRA with trochanteric TBW and encirclage wiring; (C) Was ambulated on the second day of surgery



Figs 2A to D: A case from group B in a 78-year-old male with poor cardiac status, with (A) Left hip fracture on AP pelvis radiograph; (B) Underwent THA with trochanteric TBW and encirclage wiring with AP; (C) Lateral view radiographs; (D) At 3 months FU showed sound union

Table 1: Demographic details and characteristics of the study group

	Group A (HRA) (n = 14)		*Group B (THA) (n = 12)*		
Variables	*Frequency (n)*	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	*p-value*
Age-groups					
65–75	5	35.714	8	66.667	0.083†
76–85	6.0	42.857	4	33.333	
>85	3.0	21.428	0	0	
Mean age	78.929	7.119	73.500	5.4188	
Gender					
Female	9	64.3	5	41.7	0.039*‡
Male	5	35.7	7	58.3	
Site					
Left	9	64.3	7	58.3	0.051‡
Right	5	35.7	5	41.7	
Comorbidity					
COPD	1	7.143	1	8.3	0.035*‡
DM	5	35.714	7	58.3	
HTN	6	42.857	4	33.3	
OB	4	28.571	1	8.3	
CAD	5	35.714	2	16.7	
Hypothyroidism	3	21.428	4	33.3	
Parkinsonism	2	14.285	1	8.3	
AO type					
A2.2	7	50.0	3	25.0	0.011*‡
A2.3	7	50.0	9	75.0	
Trochanteric wiring					
Yes	9	64.3	6	50.0	0.022*‡
Nonunion	3	21.4	2	16.7	
Mean duration of surgery (min)	69.357	10.931	84.083	9.452	0.002*†
Mean blood loss (mL)	325.00	37.977	337.500	37.689	0.166†
Blood transfusion					
No	8	57.1	5	41.7	0.042*‡
1 unit	5	35.7	7	58.3	
2 unit	1	7.1	0	0	
Mean duration of stay	6.857	2.381	7.167	1.528	0.754†

*p-value < 0.05 is significant; †t-test statistical analysis; ‡Chi-square statistical analysis

comorbidities associated were diabetes mellitus (12), hypertension (10), coronary artery disease (7), hypothyroidism (7), chronic renal impairment (6), obesity (5), chronic obstructive sleep apnea (4), Parkinsonism (3), and chronic obstructive pulmonary disease (2). Most of the study subjects, approximately 42.8% in group A, were hypertensive, and 58.3% suffered from diabetes in group B, showing a significant difference (p-value < 0.05) statistically. In group A, 50% each had A2.2 and A2.3 fractures, and in group B, a maximum of 75% cases had A2.3 fractures, showing a significant difference (p-value < 0.05) statistically. More number of cases required management with trochanteric wiring in group A (64.3%) than group B (50%), showing a significant difference (p-value < 0.05) statistically. The mean duration of surgery was significantly (p-value < 0.05) more in group B (84 min) than in group A (69.4 min). Mean blood loss was more in group B (337.5 mL) than in group A (325 ml), showing an insignificant (p-value > 0.05) difference. There were 13 cases that required postoperative blood transfusion. One unit of blood transfusion was more in the THA group (58.3%) than in the HRA group. Mean duration of stay was more in the THA group (7.17) than in the HRA group (6.86), showing an insignificant (p-value > 0.05) difference.

Mean HHS score increased from 3 weeks to the last FU in both groups (Table 2). Improvement in HHS score was greater in cases treated with HRA than THA (Fig. 4). Statistically difference between the groups in relation to HHS score was insignificant (p-value > 0.05) at 3 weeks, 2 years, and the last FU. Mean HHS score increased from 3 weeks to the last FU (LFU) in both groups in both fracture types (Table 3). Improvement in HHS score was greater in cases treated with THA than HRA in A2.2 fracture type. Improvement in HHS score was greater in cases treated with HRA than THA in A2.3 fracture type (Fig. 5). Statistically significant difference between the groups concerning HHS score was insignificant (p-value > 0.05) at 3 weeks, 2 years, and the last FU in both fracture types.

FU was longer in the THA group (39.1 months) than in the HRA (39 months). In group B, one case showed dislocation, whereas those cases managed with HRA showed no dislocation. Statistically, a significant (p-value < 0.05) difference is observed between the groups in relation to complications. The limb length discrepancy of 0.5–1 cm was noted in 10 cases. Mean limb length discrepancy (LLD) was comparable but more in cases managed with HRA (0.733) than THA (0.629). Ambulation status was more in group B (3.58) than in group A (3.43). The time to walking in

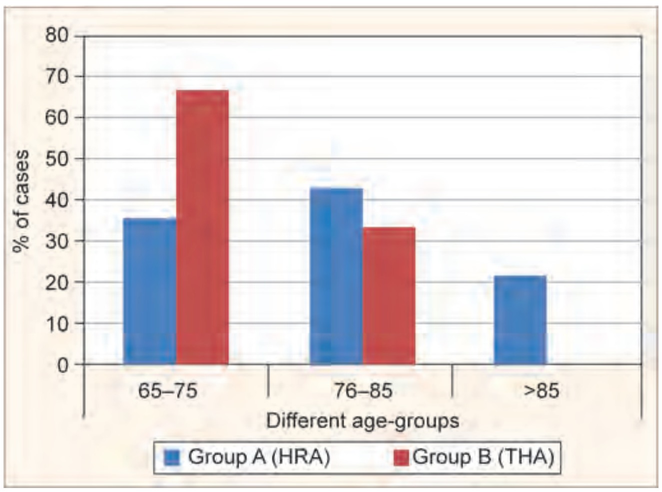


Fig. 3: Bar chart with the x-axis denoting the age-group and the y-axis denoting the % of cases in the two groups

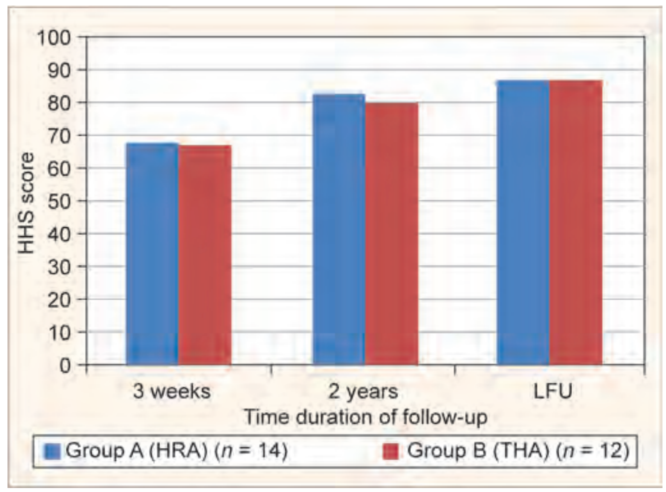


Fig. 4: Plotted graph with the x-axis denoting the time period of follow-up and the y-axis denoting the HHS in the two groups

Table 2: Harris hip score (HHS)

	Group A (HRA) (n = 14)		*Group B (THA) (n = 12)*		
HHS score	*Frequency (n)*	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	*p-value*†*
3 weeks					
<70 Poor	10	71.428	9	75	0.593
70–79 Fair	4	28.571	3	25	
80–89 Good	0	0	0	0	
90–100 Excellent	0	0	0	0	
Mean ± SD	67.7857	3.96482	66.667	5.03322	
2 years					
<70 Poor	0	0	1	8.333	0.841
70–79 Fair	5	35.714	5	41.667	
80–89 Good	6	42.857	5	41.667	
90–100 Excellent	3	21.426	1	8.333	
Mean ± SD	82.6429	5.63788	80.417	6.0527	
Last FU					
<70 Poor	0	0	0	0	0.455
70–79 Fair	0	0	0	0	
80–89 Good	9	64.286	9	75	
90–100 Excellent	5	35.714	3	25	
Mean ± SD	87.4286	4.36268	87.083	4.231	

FU, follow-up; *p-value > 0.05 is insignificant; †t-test statistical analysis

Table 3: Harris hip score with A2.2 and A2.3 fracture types

Fracture types	Time interval	Group A (HRA) (n = 14)		Group B (THA) (n = 12)		
		Mean	SD	Mean	SD	p-value†*
A2.2	3 weeks	65.6667	2.51661	68.6667	1.15470	0.095
	2 years	81.6667	5.68624	83.3333	5.50757	0.603
	FU	91.0000	2.64575	92.0000	3.46410	0.580
A2.3	3 weeks	69.4286	4.68534	65.7143	6.31702	0.332
	2 years	85.1429	6.38823	79.5714	7.13809	0.092
	FU	88.1429	4.48808	85.7143	3.49830	0.162

FU, follow-up; *p-value > 0.05 is insignificant; †t-test statistical analysis

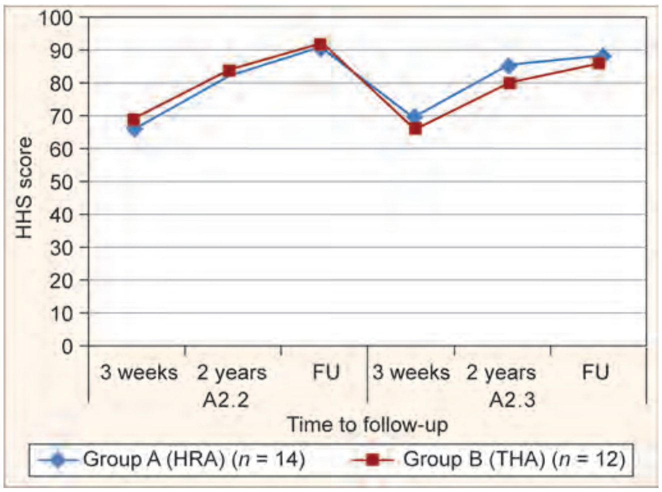


Fig. 5: Plotted graph with the x-axis denoting the time period of follow-up and the y-axis denoting the HHS in different classes of fractures in the two groups

Table 4: Limb length discrepancy, ambulation status, and time to walking in two groups

Follow-up status of	Group A (HRA) (n = 14)		Group B (THA) (n = 12)		
	Mean	SD	Mean	SD	p-value†*
LLD	0.733	0.252	0.629	0.198	0.648
FU (month)	39.000	9.064	39.417	9.596	0.901
Ambulation status	3.428	0.513	3.583	0.669	0.504
Time to walk (days)	1.429	0.646	1.417	0.669	0.674

FU, follow-up; *p-value > 0.05 is insignificant; †t-test statistical analysis

the postoperative period was within 36–48 hours. Time to walk was comparable but lesser in group B (1.42 days) than in group A (1.429 days). Statistically, an insignificant (p-value > 0.05) difference was observed between the groups in relation to LLD, ambulation status, and time to walk (Table 4). The mean VAS score was significantly reduced from 8.4 preoperatively to 0.70 at the final FU. The ambulatory ability was determined as class IV in 50%, class III in 46%, class II in 4%, and class I in none as per Clawson's classification. A total of 25 patients achieved excellent to good hip function within 3 months of surgery. The FU was done for a mean duration of 4.7 years with a minimum FU period of 2 years.

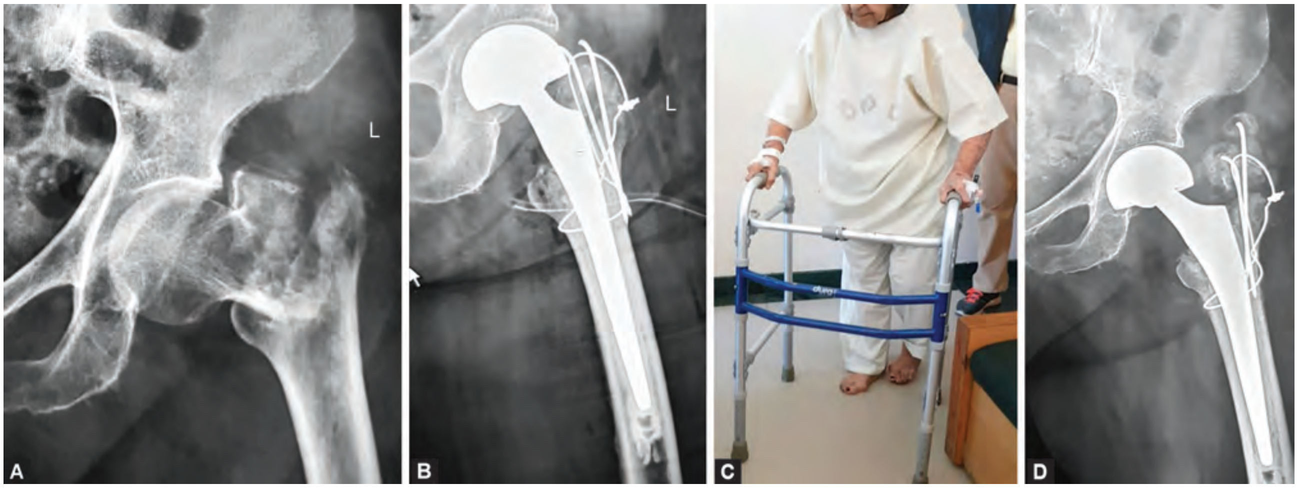
The fixation of the trochanter with wires had non-union in 5 cases out of 15 cases. No loosening or infection of the implants was observed. There was no radiological evidence of aseptic loosening or osteolysis of the femoral component. There were three cases with breakage of trochanteric wiring with non-union of fracture fragment and reduced ambulatory class from IV to class III (Fig. 6). No case had pulmonary embolism, deep vein thrombosis, or acute cardiac event in the immediate and early postoperative period.

One case of THA presented with dislocation in the subacute postoperative period at around the eleventh day following an unsupervised squatting. She was a 76-year-old, thin-built female of short stature. She was from a rural background with a known history of diabetes and anemia, having presented with an A2.3 fracture. A cemented THA with trochanteric wiring was done. The immediate postoperative period was uneventful, and she was discharged with relevant hip precautions in the next five days of postoperative care. At home, there was a history of deep squat position done for toileting activity on an Indian toilet seat against advice. The femoral head size was of small diameter of 28 mm. The hip was clinically and radiologically confirmed to be dislocated, and readmission was required. The dislocation was managed by closed reduction initially, and it progressed satisfactorily with HHS graded fair on last FU (Fig. 7). There was no significant difference between HRA and THA groups in terms of immediate mortality, associated postoperative complications, and functional outcomes.

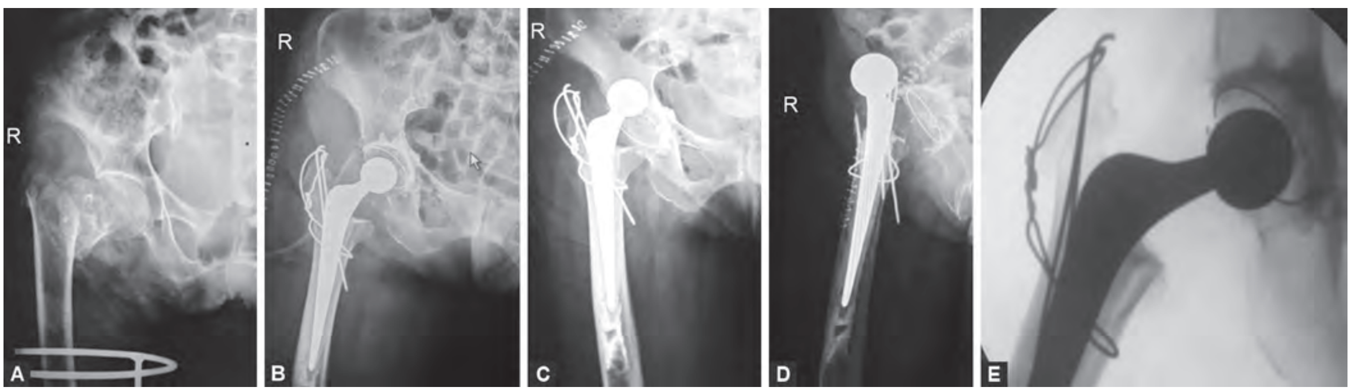
Discussion

The indications for primary HA in UPFF management are still not clearly defined.[7] The geriatric fracture management presents myriad challenges with its medical and surgical aspects. They need a multi-disciplinary team approach. The salvage HA for a failed fracture fixation, malunion, or non-union of fracture, or in post-traumatic arthritis, improved hip function substantially. However, HA may play a critical role in carefully selected trochanteric fractures as an alternative treatment, especially in the elderly.[4] A severely comminuted or unstable osteoporotic fracture considered unlikely to progress satisfactorily with internal fixation may be a candidate for consideration of HRA or THA. A coexisting hip arthritis or joint damage may be another clear indication for HA in a case of UPFF.[3]

There are many advantages of fracture fixation, namely less blood loss, less blood transfusion, and less time of surgery than an HA in an UPFF.[12,13] However, as the literature review suggests, there has been a high incidence of complications for an unstable trochanteric fracture fixation done either with an extra-medullary or an intramedullary fixation device.[1,4] The malunion, non-union, and avascular necrosis femoral head were concerning issues post-fixation.[14] The guiding factor for surgical considerations for a UPFF includes patient pre-injury level of activity, fracture geometry, comminution, and osteoporosis.[4] The mental state and functional demand also guide regarding decision making for HRA or THA for a fracture.[14] The pre-existing osteoporosis may compound the decision-making for the consideration of fixation in UPFF. The higher mean age at the time of fracture presentation and the associated medical comorbidities are other important factors for increased probability of complications in the operative management.[9] The comorbidity burden quantification using Elixhauser coding algorithms or Charlson Comorbidity index has been in use for clinical practice.[15] They are predictors of mortality



Figs 6A to D: A case from group A in an 82-year-old female with hypothyroidism, osteoporosis with (A) Left hip fracture on AP radiograph; (B) Underwent HRA with trochanteric TBW and encirclage wiring; and (C) Was ambulated on the second day of surgery in (D) AP radiograph follow-up showed non-union of the trochanter



Figs 7A to E: A case from group A in a 76-year-old female with diabetes mellitus, anemia, osteoporosis, with (A) Right hip fracture on AP radiograph; (B) Underwent HRA with trochanteric TBW and encirclage wiring; (C) Had dislocation on 11th day of surgery AP pelvis and (D) Lateral view radiograph; and (E) Was closed-reduced

in orthopedic procedures.[7] An associated ipsilateral knee arthritis of grade III/IV may be a relative indication to consider for HA, as it may allow better weight-bearing potential in an elderly person with UPFF. The arthritis of the knees has not been considered as a risk factor for a failed internal fixation of hip fractures, though in our opinion, the decision for HA allowed the immediate weight bearing potential in seven such cases in our study to eventually regain the pre-injury walking ability. A randomized controlled study should give evidence to identify knee arthritis as an independent risk factor. This will guide the decision making in an UPFF for consideration of HA over internal fixation in cases with coexistent arthritis of the knee.

The decision to do a HRA or THA for a trochanteric fracture was best "tailored to individual" patient with emphasis on patient age, activity level, bone quality, or pre-existing hip pathology.[3] An early surgery for a UPFF has potential advantages of reducing mortality and complications.[16,17] The advantages of HRA over THA are shorter operative time, reducing the perioperative risks, especially in frail elderly, less invasive as the acetabulum is not resurfaced, fewer dislocations, and with effective pain relief. The disadvantage of HRA remains that the risk of acetabulum erosions may cause a painful implant necessitating a secondary revision surgery.[17] On the other hand, the THA provides a durable solution and better joint mechanics. Total HA has been discredited as it has a longer surgical and anesthesia time with a higher risk of dislocation. There is no "one-plan-fits-all" solution, but HRA has been generally favored in older, less active patients with good acetabular health, while THA is preferred for fractures with pre-existing joint disease in high-demand patients.[4,18] An individualized decision should be taken based on patient-centered health status and functional expectations. Total HA may reduce the subsequent risk of revision surgery and improve the quality of life.

The primary aim of surgical intervention had been to allow for an early weight-bearing potential without the risk of failure. The HA procedure offers quick recovery, avoids the risks associated with internal fixation, and enables the patient to maintain a good level of function immediately after surgery with low complication rates.[19] In a meta-analysis done to compare the intramedullary fixation and HA for an UPFF, the authors advocated a "cautious approach" to use HA in carefully selected patients.[17] They recommend the use of HA in fractures with poor bone stock and associated hip arthritis.[13] The extensive retrospective survey for operated cases of UPFF between the period from 1990 to 2007 showed that the THA was found to have more peri-operative complications with HA than fracture fixation in the management of the UPFF.[7] The THA has decreased utility in the elderly with an advanced age associated with medical comorbidities.

In another retrospective study, the 1-year mortality risk post THA in an UPFF was not higher or significantly higher than an osteosynthesis-treated patient. The associated co-morbid conditions, if more than four, increased the mortality risk by more than 50%.[20]

The surgical challenges in HA in a case of trochanteric fracture are establishing ante-version angle correctly, restoring correct leg length, difficult to achieve initial fixation in comminution, maintaining soft tissue tension of the abductor muscles, and trochanteric wiring in arthroplasty to reconstruct the disturbed greater trochanter-abductor mechanism by either use of sutures, K wires, cables, and/or encirclage wire. The malrotation of the femoral stem in view of fractured fragments needs to be carefully avoided by perioperative correct orientation and assessment of limb position.[5] The careful preoperative evaluation for the center of rotation of the femoral head and its relationship to the position of the greater trochanter may avoid the abductor limp in an otherwise satisfactory HA.[5] The stability of the hip overrides the limb length discrepancy in unstable fractures, as due to poor muscle strength, the per-operative hip stability matters more.

Trochanteric wiring restores the biomechanical function of the hip. They aid in providing a stable fixation of fracture fragments.[9] The configuration can be variable; however, the soft tissue disruption of the glutei should be minimized. The wires with a minimum diameter of at least 1.5 mm and at least two to three wire configurations are recommended for a stable fixation.[9] A stable trochanteric wire fixation may assist in avoiding a postoperative Trendelenburg gait and abductor weakness leading to loss of ambulatory status from the pre-injury levels.

The hip dislocation rates were high with hip replacement for an UPFF. The reported rates may vary widely from 0 to approximately 45%. The HRA has lower rates of dislocation than a THA. Hemi-replacement HA has been considered a preferred option for an unstable fracture in the elderly.[2,12] There are significant concerns of more pulmonary complications and episodes of bed sores following a dislocation. The optimal orientation of the acetabular component, use of the acetabular component with a long posterior wall, and repair of the capsule are considered good practices to avoid dislocation. The numerous new prosthesis designs, such as a large femoral head size, constrained liner cups, and elevated-rim acetabular liner, have all been developed to overcome the risk of dislocation. Dual mobility cups are another alternative option used to reduce the risk of postoperative hip dislocation.[21]

With the advent of modified fixation devices such as triflanged femoral anti-de-rotation nail (TFNA) and improvement of implant design to incorporate cement instillation through proximal screw holes and correction of design with allowance for compression and static fixation, the failure rates with internal fixation may decrease. A stable fixation will give the ability of the reduced fracture to support physiological loading. However, a long-term study and a randomized controlled study will give conclusive evidence.

The limitations of our study include the retrospective design. The single-center study design brings more limitations. The study group was small. There was a lack of a control group of osteosynthesis for comparison. The study also lacked clearly defined guidelines to determine and quantify the pre-injury level of activity and extent of osteoporosis in a fracture scenario. The assessment of the pre-injury level of activity was history-based. The level of osteoporosis was adjudged by radiographic evaluation along with a history of treatment for any prevailing osteoporosis. A randomized prospective study design will further help to validate the clinical and functional outcomes observed in this study.

The individualized approach to an UPFF in the elderly is possibly the recommended approach. This should take substantial consideration of patient factors like age, walking ability, medical comorbidities, fracture geometry, and osteoporosis. The surgeon-related factors in consideration should include experience, technical expertise, workplace facilities, and a multidisciplinary team approach to overcome the challenges with the HA in an unstable hip fracture in the elderly. The decision to either do an HRA or THA in an UPFF as an index surgery can be challenging. It should be best considered based on the combined characteristics of the individual fracture and the surgeon's assessment.

Conclusion

Primary HA is an alternative treatment option in carefully selected elderly patients with an unstable proximal femoral fracture. This procedure offers quick recovery, avoids the risks associated with internal fixation, and enables the patient to maintain a good level of function immediately after surgery with low complication rates. The plan needs to be individualized with consideration for HRA in older, less active patients with good acetabular health, while THA can be preferred in high-demand elderly patients with pre-existing joint disease.

Clinical Significance

The HA for the management of an unstable trochanter fracture needs careful assessment of medical comorbidities, biological age, associated osteoporosis, and pre-injury level of activity for an effective treatment with a favorable outcome.

Author's Contribution and Declaration

LT and GG contributed to the study conception, design, investigation, and methodology.

LT performed the surgery, and GG was associated with the surgery.

GG performed data collection and interpretation.

GG performed the literature search and prepared the original draft of the manuscript, and reviewed the subsequent version with editing of the manuscript.

LT did review the analysis.

All authors commented on the previous versions of the manuscript.

All authors read and approved the final version of the manuscript.

Data Availability Statement

The datasets generated during and analyzed during the current study are available from the corresponding author on reasonable request.

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References

1. Sidhu AS, Singh AP, Singh AP, et al. Total hip replacement as primary treatment of unstable intertrochanteric fractures in elderly patients. Int Orthop 2010;34(6):789–792. DOI: 10.1007/s00264-009-0826-x.

2. Hassankhani EG, Omidi-Kashani F, Hajitaghi H, et al. How to treat the complex unstable intertrochanteric fractures in elderly patients? DHS or Arthroplasty. Arch Bone Jt Surg 2014;2(3):174–179. PMID: 25386578.
3. Martinho T, Stoffel K. Treatment of intertrochanteric femur fractures with hip arthroplasty in older patients: A narrative review of indications and outcomes. Medicina (Kaunas) 2021;57(8):763. DOI: 10.3390/medicina57080763.
4. Singh J, Kumar D, Kumar S, et al. Functional outcome of hemiarthroplasty of the hip for unstable intertrochanteric fractures of the femur in elderly patients: A prospective study. Cureus 2022;14(12): e32526. DOI: 10.7759/cureus.32526.
5. Waddell JP, Morton J, Schemitsch EH. The role of total hip replacement in intertrochanteric fractures of the femur. Clin Orthop Relat Res 2004;429:49–53. DOI: 10.1097/01.blo.0000150113.11866.48.
6. Koudouna S, Evangelopoulos DS, Sarantis M, et al. Rehabilitation prognostic factors following hip fractures associated with patient's pre-fracture mobility and functional ability: A prospective observation study. Life (Basel) 2023;13(8):1748. DOI: 10.3390/life13081748.
7. Grau L, Summers S, Massel DH, et al. Operative trends in the treatment of hip fractures and the role of arthroplasty. Geriatr Orthop Surg Rehabil 2018;9:2151459318760634. DOI: 10.1177/2151459318760634.
8. Liu XZ, Yang W, Yang SH, et al. Total hip arthroplasty for treatment of elderly patients with comminuted intertrochanteric fracture accompanied by femoral head necrosis. Chin J Traumatol 2008;11(6):359–363. DOI: 10.1016/s1008-1275(08)60072-3.
9. Lee JM, Cho Y, Kim J, et al. Wiring techniques for the fixation of trochanteric fragments during bipolar hemiarthroplasty for femoral intertrochanteric fracture: Clinical study and technical note. Hip Pelvis 2017;29(1):44–53. DOI: 10.5371/hp.2017.29.1.44.
10. Vishwanathan K, Akbari K, Patel AJ. Is the modified Harris hip score valid and responsive instrument for outcome assessment in the Indian population with pertrochanteric fractures? J Orthop 2018;15(1):40–46. DOI: 10.1016/j.jor.2017.12.001.
11. Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: A reanalysis of two clinical trials of postoperative pain. J Pain 2003;4(7):407–414. DOI: 10.1016/s1526-5900(03)00716-8.
12. Mittal R, Banerjee S. Proximal femoral fractures: Principles of management and review of literature. J Clin Orthop Trauma 2012;3(1):15–23. DOI: 10.1016/j.jcot.2012.04.001.
13. Nie B, Wu D, Yang Z, et al. Comparison of intramedullary fixation and arthroplasty for the treatment of intertrochanteric hip fractures in the elderly: A meta-analysis. Medicine (Baltimore) 2017;96(27):e7446. DOI: 10.1097/MD.0000000000007446.
14. Cho SH, Cho HL, Cho H. Primary cementless hip arthroplasty in unstable intertrochanteric femur fracture in elderlys: Short-term results. Hip Pelvis 2014;26(3):157–165. DOI: 10.5371/hp.2014.26.3.157.
15. Menendez ME, Neuhaus V, van Dijk CN, et al. The Elixhauser comorbidity method outperforms the Charlson index in predicting inpatient death after orthopaedic surgery. Clin Orthop Relat Res 2014;472(9):2878–2886. DOI: 10.1007/s11999-014-3686-7.
16. Klestil T, Röder C, Stotter C, et al. Impact of timing of surgery in elderly hip fracture patients: A systematic review and meta-analysis. Sci Rep 2018;8(1):13933. DOI: 10.1038/s41598-018-32098-7.
17. Chen J, Yue C, He P, et al. Comparison of clinical outcomes with hip replacement versus PFNA in the treatment of intertrochanteric fractures in the elderly: A systematic review and meta-analysis (PRISMA). Medicine (Baltimore) 2021;100(9):e24166. DOI: 10.1097/MD.0000000000024166.
18. Rozell JC, Hasenauer M, Donegan DJ, et al. Recent advances in the treatment of hip fractures in the elderly. F1000Res 2016 Aug 11;5:F1000 Faculty Rev-1953. DOI: 10.12688/f1000research.8172.1.
19. Ridha M, Al-Jabri T, Stelzhammer T, et al. Osteosynthesis, hemiarthroplasty, total hip arthroplasty in hip fractures: All I need to know. Injury 2024;55(3):111377. DOI: 10.1016/j.injury.2024.111377.
20. Geiger F, Zimmermann-Stenzel M, Heisel C, et al. Trochanteric fractures in the elderly: The influence of primary hip arthroplasty on 1-year mortality. Arch Orthop Trauma Surg 2007;127(10):959–966. DOI: 10.1007/s00402-007-0423-7.
21. Favreau H, Ehlinger M, Adam P, et al. Total hip arthroplasty with exclusive use of dual-mobility cup after failure of internal fixation in trochanteric fracture. Orthop Traumatol Surg Res 2020;106(4):645–649. DOI: 10.1016/j.otsr.2020.02.011.

ORIGINAL ARTICLE

Flexion Instability Post-cruciate Retaining Total Knee Arthroplasty—Is Polyethylene Insert Exchange Enough?

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Abstract

Aim: Flexion instability is a complication of cruciate retaining total knee arthroplasty (CR TKA), primarily due to an increased posterior tibial slope and secondarily due to implant design, surgical technique or delayed insufficiency of the posterior cruciate ligament (PCL). We hypothesize that flexion instability post-TKA with the Vanguard® knee system, is more commonly associated with "CR" polyethylene insert as compared to the "CR lipped" insert due to the inbuilt extra 3-degree posterior slope design of the CR insert and its thinner poly posteriorly.

Materials and methods: This is a retrospective study of 653 CR TKAs. Total knee arthroplasties were divided into two groups, with 442 TKAs using the CR insert (3-degree inbuilt slope) included in group A and 221 using the CR lipped insert (no inbuilt slope) in group B and revision rates were calculated. All TKAs that were revised underwent only polyethylene insert exchange from the CR insert to the anterior stabilized (AS) insert and were then followed up clinically and radiologically for recurrent instability.

Results: There were four TKAs that failed, needing revision for flexion instability in group A (4/442) and no failures in group B (0/221), with odds ratio (OR) of 4.341 (95% CI: 0.2326–81, $p = 0.3106$). Of the four that were revised with a poly exchange all remained stable with good functional outcomes at a mean follow-up of 12 months postoperatively.

Conclusion: The risk of flexion instability after primary CR TKA with the Vanguard knee system is clinically higher with the "CR" insert than the "CR lipped" insert but this was not statistically significant. Revision with a poly insert exchange to the AS insert, which corrects the slope and increases the constraint, is an effective, reliable, and low morbidity alternative for the treatment of this complication.

Keywords: Cruciate retaining, Flexion instability, Revision total knee arthroplasty, Total knee arthroplasty.

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Introduction

Total knee arthroplasty (TKA) is one of the most commonly performed orthopedic procedures worldwide and is considered to be the gold standard for the treatment of advanced osteoarthritis (OA) of the knee.[1] Its overall survival at 25 years is approximately 82%.[2] Post-TKA instability remains one of the important causes of failure, accounting for 17.4% of the single-stage revisions.[3] Al-Jabri et al.[4] broadly classified post-TKA instability into five different types: 1. Extension, 2. Genu recurvatum, 3. Flexion, 4. Mid-flexion, and 5. Global multi-planar. Each type can be further classified into early/acute and late.

Flexion instability of the knee is defined as anteroposterior instability at 90 degrees of knee flexion.[5] The usual clinical presentation of this condition is subjective feeling of pain and instability, difficulty in rising from the chair or climbing down the stairs, and recurrent knee effusion.[4] On examination, patients have positive anterior-to-posterior drawer test and tenderness at the insertion of hamstrings and pes anserinus.[5] While there is a big list of causative factors, it can be roughly categorized into patient-specific, technique-specific, or implant design-specific.[4] Increased posterior tibial slope is one of the important reasons, and it can be related to the surgical technique, implant design, or both.[4,5]

The Vanguard® knee system (Zimmer Biomet) is a widely used TKA implant system. The cementless cruciate-retaining (CR) design offers a polyethylene tibial insert that can come either in a lipped (CR Lip) or flat (CR) variety.[6] The "CR" insert (Fig. 1A) has an inbuilt posterior slope of three degrees, thereby increasing the effective total posterior slope of the tibial implant. On the other hand, the "CR Lip" (Fig. 1A) insert does not have this inbuilt slope in the poly but has an elevated posterior margin (the Lip). Both of these factors collectively result in an additional 5 mm polyethylene in the posterior dimension of the insert without changing the anterior dimension in the "CR Lip" design as compared to the "CR" (Zimmer Biomet product information).[6] To the best of our knowledge, there is no literature available on the association between the flat "CR" insert design and flexion instability.

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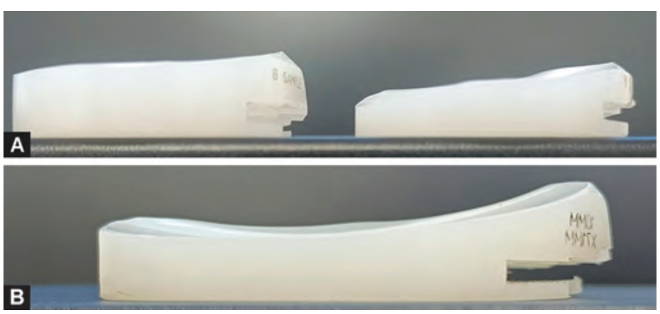
While post-TKA flexion instability can be addressed non-operatively, this mode of treatment has high failure rates in CR designs, with the presence of subjective knee instability and effusion.[7] In terms of surgical treatment, polyethylene insert exchange is associated with high failure rate; however, the literature evidence is strikingly limited.[8] Therefore, a complete revision of TKA with higher constraint remains the gold standard treatment. In this retrospective study, we hypothesize that flexion instability post-TKA with Vanguard® knee system is more commonly associated with “CR” insert as compared to the “CR lipped”, due to the inbuilt posterior slope design and thinner polyethylene thickness posteriorly. Therefore, polyethylene exchange exclusively could be an equally effective, reliable, and less morbid alternative to a complete revision TKA.

Materials and Methods

This study is a retrospective case–control study of 653 primary CR TKAs operated by a single surgeon from year 2011 to 2019. The data were retrieved from the medical records from the consultation rooms of the senior author, which are regularly maintained in the physical format as part of his standard practice.

All the TKAs included in the study were performed using the medial parapatellar approach and Patient-Specific Instrumentation (PSI) with Vanguard® cementless CR knee system. The decision on choosing between the two types of inserts was taken intraoperatively by the operating surgeon. The “CR Lip” (Fig. 1A) was the first choice during trial reduction for all patients due to its better congruence with the femoral component. The patients who had balanced flexion gap and good flexion range during the trial reduction were implanted with the final “CR Lip” insert. However, for knees that had tight flexion gap and needed optimization of the flexion range, a repeat trial reduction was performed with the “CR” insert. Due to its inbuilt slope and lack of the lip, this design is 5 mm thinner in the posterior dimension as compared to the “CR Lip”. This reduces the flexion tightness, thereby optimizing the flexion range in these patients.[6] After confirming the stability, these patients were implanted with the final flat “CR” insert.



Figs 1A and B: (A) “Cruciate retaining (CR) Lip” (left; no inbuilt slope, raised posterior margin) vs “CR” (right; 3 degrees inbuilt slope) polyethylene insert; (B) Anterior stabilized polyethylene inserts with raised anterior and posterior margins (increased constraint) and no inbuilt slope

Postoperatively, all patients were mobilized full weight bearing and full range of motion exercises, along with quadriceps strengthening from day one. All patients were followed up at 6 and 24 weeks and five-yearly thereafter with fresh radiographs for clinical and radiological analysis. After their first follow-up, all patients had a CT scan of their operated lower limb as per the “Perth protocol” to analyze the final position of the implants. This is our standard follow-up protocol for all cases of TKR.

The TKAs included in the study were divided into two groups based on the design of polyethylene insert used. Group “A” constituted for 442 TKAs where “CR flat” insert was used, whereas group “B” constituted for 221 TKAs with “CR Lipped” insert.

The indication for revision was patients representing with symptoms of late flexion instability for each case, which was confirmed clinically as well as radiologically. Each patient presented with a set of similar symptoms described in the patient summaries below after a long period of normal and pain-free function from their TKA. Prosthetic joint infection was ruled out on clinical examinations and blood tests [complete blood count, serum erythrocyte sedimentation rate (ESR), and C reactive protein (CRP)] before the surgery. All four cases required surgery for instability and were operated on using the same approach, and only the polyethylene tibial insert was exchanged from CR to an anterior stabilized (AS) insert (Fig. 1B). The femoral and tibial components, being stable and well ingrown, were left *in situ*. Inventory backup was ensured for the revision of all three components if needed before going ahead with the revision procedure. Intraoperative stability was confirmed throughout the range of motion with the trial poly insert before going ahead with the final implant. Demographic and implant details for the primary as well as the revision surgery are illustrated in Table 1. The surgical planning by the PSI vs the final position of the components as shown by the postoperative CT scan after the primary TKR is illustrated in Table 2.

Statistical Analysis

Univariate descriptive statistics were performed as required; continuous variables were recorded as a mean and range, and categorical variables as a percentage. The comparison of the rate of revision surgery was done specifically for flexion instability to compare between the two groups using the Fisher’s test and odds ratio (OR) was calculated. For all analyses, p-values of < 0.05 were considered statistically significant.

Results

The revision rates for flexion instability for groups “A” (CR Flat) and “B” (CR Lipped) were 4/442 and 0/221, respectively (OR = 4.341;

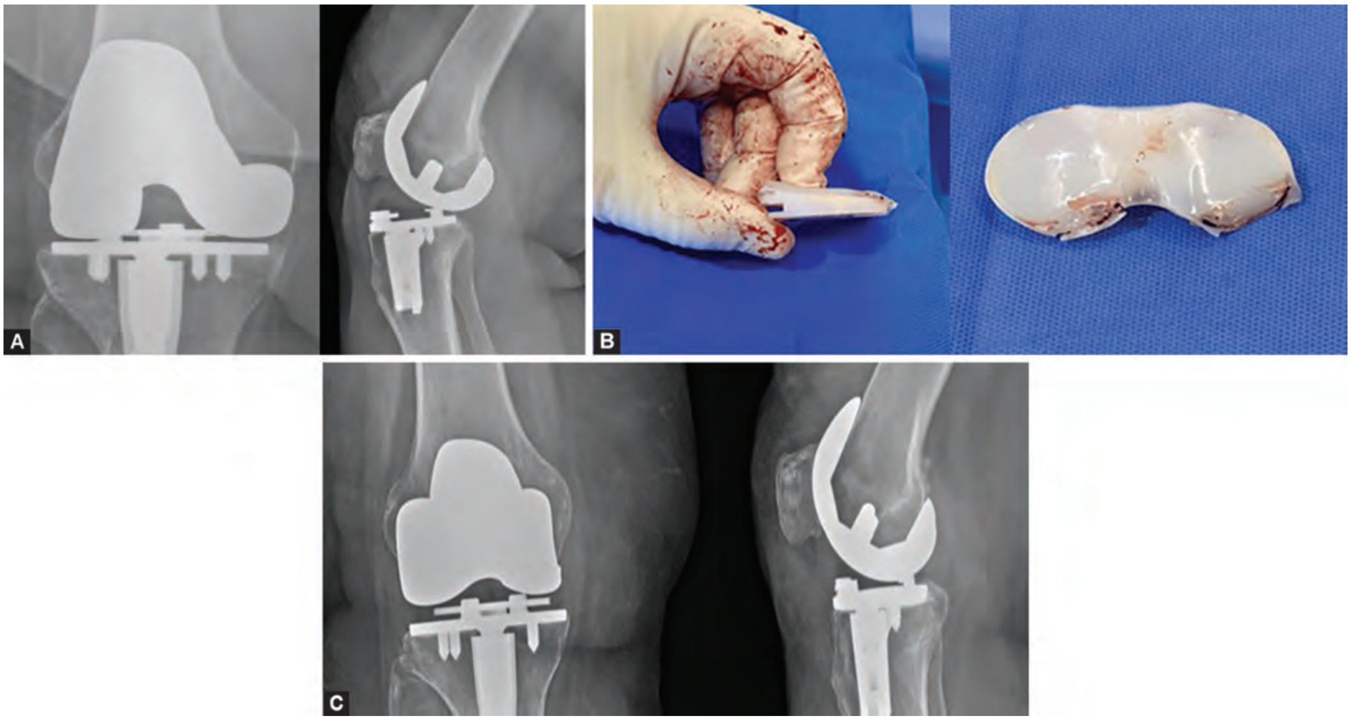
Table 1: Patient demographics and implant details

	Case 1	*Case 2*	*Case 3*	*Case 4*
Age	78	88	70	80
Sex	F	F	F	M
Symptomatic side	Right	Left	Left	Right
Polyethylene insert	10 mm CR	12 mm CR	12 mm CR	10 mm CR
Patellar component	Not resurfaced	Not resurfaced	34 mm cemented	Not resurfaced
Revised polyethylene insert	10 mm AS	16 mm AS	14 mm AS	10 mm AS

Table 2: The surgical planning by the PSI vs the final position of the components as shown by the postoperative CT scan after the primary TKR

	Preoperative plan with PSI (mean degrees)	*Final position as per the postoperative CT (mean degrees)*
HKA axis	0	−3
Femoral mechanical alignment	0	−1
Femoral component rotation (wrt TEA)	0	0
Tibial mechanical alignment	0	−1
Tibial component posterior slope	4.5	8

Values in mean degrees. Negative sign indicates valgus alignment. HKA, hip knee ankle axis; TEA, trans epicondylar axis



Figs 2A to C: (A) Case 1 preoperative X-rays showing anterior subluxation of the tibia; (B) Case 1 polyethylene insert found worn out on posterior aspect due to flexion instability; (C) Case 1 postoperative X-rays with re-established stability

95% CI: 0.2326–81; $p = 0.3106$). The mean duration between the primary and revision surgery was 9.75 years.

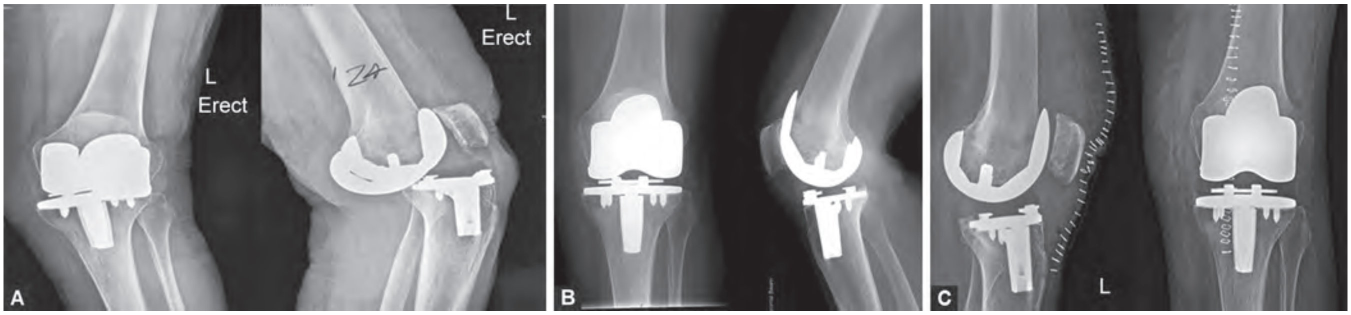
The study found that none of the revised four cases from group A had clinical or radiological signs of persistent or recurrent instability at mean follow-up of 12 months. All four patients returned to the same level of activity and comfort which they had before developing the symptoms of flexion instability. The revised cases are illustrated below.

Case 1—78F TKA 6 Years

Presented with a 3-month history of pain, swelling, and a sensation of giving way in the right knee, especially on climbing downstairs. She had a history of right TKA 6 years back, for valgus OA. On clinical examination, she had mild effusion, mild tenderness in the pes anserinus insertion, and grade II flexion instability. She had a good range of motion. There was no history of fever, and her local temperature was normal. Her preoperative X-rays showed anterior subluxation of the tibia on a lateral view (Fig. 2A). There were no radiographic signs suggesting loosening. Her complete blood count, serum ESR, and CRP were within normal limits. During the revision surgery, moderate metallosis was evident after arthrotomy. Extension gaps were satisfactory and balanced. Flexion gaps showed grade II instability along with attenuated posterior cruciate ligament (PCL) (although its continuity was intact). The polyethylene insert (10 mm CR) was then removed and was found to be worn posteriorly (Fig. 2B). The tibial and femoral components were found to be well-fixed. A 10 mm AS trial insert was then used, and the joint demonstrated good stability and balance throughout the range of motion. The final 10 mm AS insert was implanted, retaining the tibial and femoral components. Postoperative X-rays (Fig. 2C) showed well-aligned and balanced joint with corrected tibiofemoral subluxation on the lateral view as compared to the preoperative X-rays. At 6 weeks follow-up, the patient is walking and climbing down the stairs comfortably without any support. Her wound is well-healed, and the signs and symptoms are resolved.

Case 2—88F TKA 8 Years

History of staged bilateral CR Vanguard TKA (right side—"CR lipped" insert, 12 years back; left side—"CR flat" insert, 8 years back) for bilateral valgus OA. She came to the emergency department with an anterior subluxation of the left knee joint (Fig. 3A). As per the history given, the patient had sudden give way and pain in the knee while climbing down the stairs. Before this event, she had ongoing



Figs 3A to C: (A) Case 2 preoperative anterior subluxation of the left knee joint; (B) Case 2 close reduction with protective bracing; (C) Case 2 postoperative X-rays after revision TKR with insert exchange to AS

symptoms similar to the case 1 for 6 months. The knee was then locked in flexion, and the patient could not walk. The patient was treated with closed reduction (Fig. 3B) and protective bracing. Revision surgery was planned since the patient had persistent left knee laxity in flexion. Clinical and radiological evaluation of the right knee was normal. Clinical examinations, X-ray findings, and intraoperative evaluation of the left knee were like case 1. The left TKR was revised in a similar fashion with the exchange of the polyethylene insert from 12 mm CR to 16 mm AS. The patient's postoperative X-rays (Fig. 3C) and function at 6-week, 6-month, and 1-year follow-up were excellent without any signs of persistence or recurrence of instability.

Case 3—70F TKA 14 Years

The patient was a 70-year-old lady who had a history of staged bilateral TKA (right side—"CR lipped" insert, 8 years back; left side—"CR flat" insert, 14 years back) for bilateral varus OA with similar complaints, but only in the left knee. Clinical and radiological evaluation of the right knee was normal. Clinical examinations, X-ray findings, and intraoperative evaluation of the left knee were also similar to case 1. The left TKR was revised in a similar fashion with the exchange of the polyethylene insert from 12 mm CR to 14 mm AS. Her postoperative X-rays and function were satisfactory and similar to the first case.

Case 4—80M TKA 10 Years

Right TKA 10 years for varus OA. The patient's presenting complaints, clinical examination, X-ray findings, and intraoperative evaluation were like case 1 and were revised in a similar fashion with the exchange of the polyethylene insert from 10 mm CR to 12 mm AS. Postoperative X-rays and function were satisfactory and like the first case.

Discussion

Late flexion instability is not an uncommon complication after a primary CR TKA.[3] To the best of our knowledge, this is the first study to evaluate its association with the design of polyethylene insert. This study did not demonstrate any significant difference in the flexion instability rate between the two groups ($p = 0.3106$). However, the "CR flat" group showed a higher tendency towards this complication (OR = 4.341) as compared to the "CR lipped". The possible explanation for it could be an inbuilt posterior slope of 3 degrees and lack of the posterior lip. This reduces the posterior thickness of the insert by 5 mm and increases the functional slope of the tibia, which is one of the important causative factors for the development of flexion instability post-TKA.[4–6] The thinner posterior part of the insert tends to wear out, as seen in the four revised cases in group A (Fig. 2B), and creates laxity of the flexion gap, which, in turn, increases the wear and so on. This vicious cycle becomes even more evident if the PCL is attenuated, as there is no mechanism left to provide stability to the flexed knee. It is important to note the revision Cases 2 and 3 in our study. Both patients had bilateral Vanguard CR TKAs with "CR lipped" insert on the right and "CR flat" on the left. The fact that both patients developed flexion laxity only on the left side supports our concern.

All four cases that were revised had symptomatic flexion instability with recurrent knee effusion and CR knee design. Plain radiographs of the knee and clinical examination confirmed the diagnosis. Considering the clinical scenario and after ruling out infection, surgical treatment with revision was the best choice of treatment in all four cases.[7] Intraoperatively, the PCL was found to be attenuated. The polyethylene insert was found to be worn on both posteromedial and posterolateral aspects. It is, however, difficult to comment whether the ligament dysfunction gave rise to the instability or vice versa.

The first step of the operative correction of post-TKA flexion instability is evaluation and correction of the tibial slope.[5] If the instability persists, the next steps to be followed in sequence are the correction of component malalignment, recreation of adequate posterior condylar offset, and elevation of the joint line.[5] Additionally, an appropriate increase in the level of constraint is crucial to prevent recurrence of instability.[9] This decision depends upon the intraoperative analysis of associated laxity in coronal planes and the degree of mismatch of the flexion and extension spaces. The presence of either of these factors advocates the use of a condylar hinge prosthesis.[9]

As the "CR flat" insert has an inbuilt posterior slope of three degrees, it effectively contributes to the posterior tibial slope. Therefore, changing this insert to the AS insert, which has no inbuilt slope, is equivalent to correction of the posterior tibial slope by three degrees. Additionally, the AS design has an elevated posterior margin. Hence, similar to the "CR Lip" design, it has 5 mm thicker polyethylene in the posterior part of the insert (Zimmer Biomet product information).[6] When a "CR" design is revised to "AS", this feature helps to fill the flexion space more than the extension space, thereby, taking care of the laxity in the former without causing a tight extension space or flexion contracture. Using an AS design also augments for an attenuated or absent PCL. Since the trial reduction with an appropriate size AS insert was found to be stable in all cases, further intervention was not required and the implants were retained. Moreover, intraoperatively, none of the cases demonstrated either coronal plane instability or flexion-extension mismatch. Hence, increasing the constraint by one level is well within the documented guidelines.[9] Anterior stabilized and posterior stabilized (PS) designs are the next level of constraint and are equivalent in terms of dynamic stability.[10] However, the AS design has an advantage that it is compatible with the CR femoral component. Therefore, the AS design was chosen over the PS to avoid revision of the well-fixed femoral component, thereby reducing the morbidity of the procedure while following the documented principles. The second revision case illustrated above is a classic example of how effective and reliable this option could be, even in a scenario of significant subluxation.

A 10-year survival rate of 87% has been reported for the revisions done for post-TKA flexion instability.[7] However, some studies suggest that the improvement in KSS score after revision TKA done for flexion instability is poorer as compared to that done for infection or aseptic loosening.[9] While the KSS remains inversely proportional to the level of constraint, it has no association with the degree of radiological correction. Moreover, most of the patients requiring this procedure are elderly and often have significant medical comorbidities. Considering this, the exchange of polyethylene insert, a procedure that is equally effective, avoids the unnecessary addition of a higher constraint design and significantly reduces the morbidity by avoiding the revision of well-fixed components, which holds tremendous value. Although Pagnano et al.[8] demonstrated higher failure rates with insert exchange as compared to full revision, the sample size was very small. Additionally, in the present study, by changing the insert from flat CR to AS, the posterior slope was corrected as well as the constraint was incremented, making it non-comparable to that by Pagnano et al.

Limitations

Retrospective design, selection bias for the type of insert, and short-term follow-up of the four revision TKAs are the drawbacks of this study. We understand that a well-designed randomized controlled trial (RCT) with long-term follow-up is required to further evaluate the association of flexion instability with the insert design and to establish the superiority of insert exchange over conventional complete revision TKA in this special situation. But the number of presenting cases is insufficient to make this a viable option.

Conclusion

The chances of developing flexion instability after a CR TKA are not significantly different with the use of the Vanguard "CR" and "CR Lip" polyethylene insert designs. However, in case of the former, it can be effectively and reliably treated merely by exchanging the insert to an "AS" design.

Clinical Significance

Although there was an increased tendency of developing flexion instability with "CR" vs the "CR Lip" design, the difference observed in our study was not statistically significant. Hence, we do not recommend against the use of the "CR" design of the vanguard knee system. However, we expect the surgeon to be aware of this trend. Also, if this complication occurs with "CR" design, then we recommend changing the tibial polyethylene insert to an AS design alone, as a reasonable and less invasive alternative to an all-component revision TKA.

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References

1. Price AJ, Alvand A, Troelsen A, et al. Knee replacement. Lancet 2018;392(10158):1672–1682. DOI: 10.1016/S0140-6736(18)32344-4.
2. Evans JT, Walker RW, Evans JP, et al. How long does a knee replacement last? A systematic review and meta-analysis of case series and national registry reports with more than 15 years of follow-up. Lancet 2019;393(10172):655–663. DOI: 10.1016/S0140-6736(18)32531-5.
3. 17th Annual report of the UK NJR. Available from: https://reports.njrcentre.org.uk/Portals/0/PDFdownloads/NJR%2017th%20Annual%20Report%202020.pdf.
4. Al-Jabri T, Brivio A, Maffulli N, et al. Management of instability after primary total knee arthroplasty: An evidence-based review. J Orthop Surg Res 2021;16(1):729. DOI: 10.1186/s13018-021-02878-5.
5. Abdel MP, Pulido L, Severson EP, et al. Stepwise surgical correction of instability in flexion after total knee replacement. Bone Joint J 2014;96-B(12):1644–1648. DOI: 10.1302/0301-620X.96B12.34821.
6. Emerson RH Jr, Barrington JW, Olugbode SA, et al. A comparison of 2 tibial inserts of different constraint for cruciate-retaining primary total knee arthroplasty: An additional tool for balancing the posterior cruciate ligament. J Arthroplasty 2016;31(2):425–428. DOI: 10.1016/j.arth.2015.09.032.
7. Hannon CP, Kruckeberg BM, Lewallen DG, et al. Treatment of flexion instability after primary total knee arthroplasty: Operative and nonoperative management of 218 cases. J Arthroplasty 2022;37(6S):S333–S341. DOI: 10.1016/j.arth.2022.02.069.
8. Pagnano MW, Hanssen AD, Lewallen DG, et al. Flexion instability after primary posterior cruciate retaining total knee arthroplasty. Clin Orthop Relat Res 1998(356):39–46. DOI: 10.1097/00003086-199811000-00008.
9. Stambough JB, Edwards PK, Mannen EM, et al. Flexion instability after total knee arthroplasty. J Am Acad Orthop Surg 2019;27(17):642–651. DOI: 10.5435/JAAOS-D-18-00347.
10. Jang SW, Kim MS, Koh IJ, et al. Comparison of anterior-stabilized and posterior-stabilized total knee arthroplasty in the same patients: A prospective randomized study. J Arthroplasty 2019;34(8):1682–1689. DOI: 10.1016/j.arth.2019.03.062.

ORIGINAL ARTICLE

Arthroplasty Surgical Checklist: Simple Protocols Leading to Perfection!

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Abstract

Introduction: Despite the widespread adoption of the World Health Organization (WHO) surgical safety checklist (SSC), preventable intraoperative errors and adverse events remain a concern in arthroplasty procedures. This study introduces and evaluates the effectiveness of a novel, three-phase, arthroplasty-specific surgical checklist aimed at improving patient safety.

Materials and methods: A novel 37-point checklist covering preoperative, intraoperative, and postoperative phases was developed and implemented across two tertiary centers. A prospective cohort of 520 patients undergoing primary or revision hip and knee arthroplasty (2022–2023) using the new checklist was compared to a retrospective control group of 418 patients (2019–2021) managed with the standard WHO checklist. Adverse events and near-miss errors were analyzed using descriptive statistics and appropriate significance testing.

Results: The overall incidence of preventable adverse events decreased significantly from 6.9% in the control group to 1.7% in the study group ($p < 0.01$). Notable reductions were observed in retained drain plugs (3.1 to 0%, $p < 0.001$), retained gauze pieces (1.4 to 0.2%, $p < 0.001$), and mismatched implants (0.9 to 0%, $p < 0.001$). The checklist demonstrated high reproducibility and interobserver reliability, with near-perfect agreement between surgeons and circulating nurses ($\kappa = 0.98$).

Conclusion: This study demonstrates that a comprehensive, subspecialty-specific arthroplasty checklist significantly reduces preventable surgical errors and enhances patient safety. It offers a practical and reproducible tool adaptable to diverse clinical settings, with potential for broader surgical and institutional implementation.

Keywords: Arthroplasty, Patient safety, Preventable errors, Quality improvement, Surgical accuracy, Surgical checklist.

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Introduction

Total joint replacement is one of the most frequently performed and successful surgical procedures of the past century. It has consistently demonstrated effectiveness in alleviating pain, restoring function, and improving patients' quality of life. Despite its high overall success rate, a notable proportion of patients—up to 28% in some reports—remain dissatisfied with the surgical outcome.[1,2]

A significant contributor to postoperative dissatisfaction is the occurrence of complications, many of which are potentially preventable if identified and addressed in a timely manner. These errors are often rooted in systemic issues such as the absence of standardized protocols, insufficient clinical experience, surgeon fatigue, occupational stress, high patient volumes, and poor interprofessional communication.[3,4] A majority of these complications can be attributed to breakdowns in teamwork, decision-making, communication, and situational awareness.[5]

Checklists have emerged as effective tools to minimize human error in high-stakes environments by identifying procedural gaps and ensuring that critical steps are not overlooked.[6] The World Health Organization (WHO) recognized this need and introduced the 19-item surgical safety checklist (SSC), which was designed to improve intraoperative communication and establish a minimum global standard of care. Its implementation has been shown to significantly reduce avoidable complications in surgical patients worldwide.[7]

However, the WHO checklist is intentionally broad and non-specialty-specific. Growing evidence suggests that for optimal outcomes, surgical subspecialties should adopt tailored protocols that reflect the unique complexities of their procedures.[8,9] In our practice, we observed several preventable errors that contributed to postoperative dissatisfaction among joint replacement patients. This prompted the development of a specialized arthroplasty surgical checklist to address these issues directly.

To our knowledge, only a limited number of studies have explored the implementation of procedure-specific checklists in arthroplasty. We, therefore, propose a novel, subspecialty-focused checklist specifically designed for joint replacement surgery. This checklist aims to bridge gaps arising from human error, strengthen team communication, and standardize perioperative practices, ultimately enhancing patient safety and outcomes in arthroplasty procedures.

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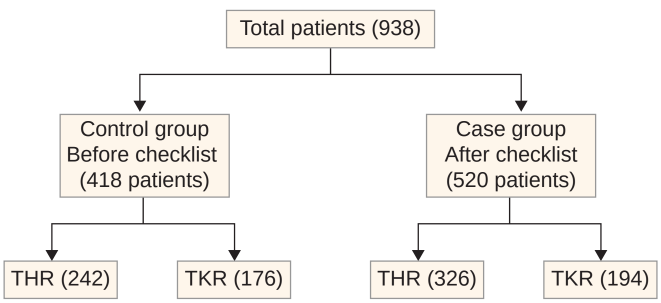
Aims and Objectives

To propose an arthroplasty surgery-specific checklist in order to recognize the risk factors/reduce human errors, and to evaluate the efficacy of this novel checklist.

Materials and Methods

This is a retroprospective cohort study, performed at multicentric tertiary care hospitals in order to evaluate the efficacy of the proposed novel arthroplasty surgery checklist. The novel checklist was implemented from November 2021 onward after obtaining approval from the Government Medical College, Nagpur to Bombay Hospital Institute of Medical Science, Mumbai. A total of 520 patients scheduled to undergo hip/knee joint replacement surgery were scanned using the checklist during the 2-year period from November 2021 to 2023. The study group patients were compared with the controls (418 patients) in whom the checklist was not used in the previous year (June 2019–Oct 2021). The perioperative demographic and clinical data were recorded and compared between the study and control groups.

The proposed novel arthroplasty surgery checklist comprised the following three parts:



1. Preoperative Checklist

Preoperative checklist consists of patient identification, diagnosis, clinical and radiological findings, patient's comorbidities status, blood investigations, side marking, surgical site inspection, templating, surgical plan, anticipated difficulties, bail-out plan, and procedural requirements. The checklist was completed in the wards by the training fellow/Senior resident under the guidance of the operating surgeon after discussion.

2. Intraoperative Checklist

This checklist involves the steps that need to be followed from the point of positioning of the patient to identify the correct operative side and other vital steps to be taken care of throughout the procedure. This was in addition to and independent of the routinely performed "time-out system" employed by the nursing staff, which is a standard practice followed in the operation theater. Prophylactic antibiotic, padding of the bony prominences, any biopsy/culture to be collected and sent, and surgical time are added in the intraoperative component.

3. Postoperative Checklist

A novel feature of the proposed checklist is the inclusion of postoperative monitoring elements, which, to our knowledge, have not been incorporated into any existing surgical checklists. This component covers postoperative vital signs and neurological assessments, inpatient management protocols, dressing guidelines, physiotherapy and mobilization schedules, dietary advice, follow-up instructions, and, importantly, a clear explanation of red flag symptoms to be communicated at the time of discharge.

This structured protocol ensured continuous communication between the operating surgeon and the trainee fellows or residents at every stage of perioperative care. The primary surgeon actively supervised the process, conducted counterchecks, and resolved any inconsistencies to uphold standardized care and patient safety.

To evaluate the effectiveness of the checklist, all recorded errors were meticulously documented and analyzed by a fellowship-trained arthroplasty surgeon. Each error was assessed based on its frequency, severity, and potential clinical consequence. A multidisciplinary team—comprising the senior surgeon, orthopedic fellow, and operating room (OR) head nurse—performed stratification and classification of these events.

Checklist utility was measured by assessing its availability during surgeries, the frequency of its usage, and its correlation with perioperative outcomes such as wound-related complications and unplanned readmissions. These metrics were linked to various checklist domains as outlined in Table 1.

Statistical analysis was conducted to evaluate the significance of outcomes. Categorical variables were tested using Pearson's Chi-square test. Normally distributed numerical variables (e.g., age) were analyzed using the independent samples *t*-test, whereas non-normally distributed data (e.g., duration of hospital stay, timing of complication onset, and average complication rates) were assessed using the Mann–Whitney *U* test. A p-value of < 0.05 was considered statistically significant. All statistical evaluations were performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

The arthroplasty surgery checklist was developed by the authors and introduced at two academic institutions—Bombay Hospital Institute of Medical Sciences, Mumbai, and Government Medical College Hospital, Nagpur. Before implementation, formal orientation and foundational training sessions were conducted for fellows, residents, ward nurses, and OR staff. These sessions were supervised by senior arthroplasty surgeons to ensure proper understanding and uniform application of the checklist.

The pilot study involved a total of 520 patients who underwent joint replacement surgeries between November 2021 and 2023, following the implementation of the checklist. A retrospective control group, comprising 418 patients operated between June 2019 and October 2021—before the checklist was introduced—was used for comparative analysis. As shown in Table 2, there were no statistically significant differences in baseline demographics, surgical divisions, or operative indications between the two groups.

In the prechecklist cohort, several preventable errors were identified, which primarily stemmed from lapses in preoperative, intraoperative, and postoperative protocols (as outlined in Table 3 and Figs 1 to 3). These oversights were more frequently observed during periods of high clinical workload or when there was rotation in resident staff, leading to inconsistencies in plan execution.

Following the adoption of the checklist, the incidence of preventable adverse events dropped significantly—from 6.9% in the control group to 1.7% in the checklist group (Table 4).

Table 1: Arthroplasty surgical checklist

(A) Preoperative

01. Patient identification
    - Name: ____
    - Age/sex: _________________________
02. Essential imaging
    - X-ray:
    - Any other:
03. Essential findings on imaging: _____________________________
04. Template size:
05. Essential deformity and LLD findings: _________________________
06. Diagnosis: ____________________________
07. Comorbidities: __________________
    - Blood thinner status: __________
08. Blood investigation: Hb:___; TLC:___; Creat:___; HHH:_____
09. Consent for surgery/anesthesia ☐
10. BGCM ☐ Yes ☐ No ; Number of packed cell volume reserved: ☐
11. Intensive care unit
    - Required ☐ Yes ☐ No
    - If Yes, Booked ☐
12. Anesthesia
    - General ☐
    - Spinal ☐
    - Epidural ☐
13. Surgical plan
    - Side: ☐ Right ☐ Left
    - Side marking: ☐ Yes ☐ No
    - Surgical site inspection: ☐ Yes ☐ No
    - Tenotomy required ☐ Yes ☐ No
14. Surgical difficulties anticipated/Bail-out plan: ______________________________
15. Implants
    - Company: ___________
    - Sizes available: ______________
    - Cement: ☐ Yes ☐ No
    - Any other
16. Bone graft: ☐ Yes ☐ No

(B) Intraoperative

01. Time out: ☐ Yes ☐ No
02. Prophylactic antibiotics
    - Golden hour (30 minutes before surgery) ☐
    - Repeat (blood loss >1500 mL/duration > 4 hours) ☐
03. Catheter ☐ Yes ☐ No
04. Patient positioning
    - Position: ________________________
    - Padding of bony prominences ☐ Yes ☐ No
05. Blood loss: _________
06. Gauze/Gamjee count checked: ☐ Yes ☐ No
07. Any biopsy/culture sample to be collected ☐
08. Drain ☐ Yes ☐ No
09. Surgical time: ___________
10. Gloves change (If surgical time exceeds >3 hrs): ☐ Yes ☐ No

(Contd...)

Table 1: *(Contd...)*

(C) Postoperative
01. Vitals check ☐ Yes ☐ No
02. Neurology check ☐
03. Urine catheter side: ☐ Over the wound ☐ Opposite side
04. Postoperative treatment plan mentioned ☐ Yes ☐ No
05. DVT prophylaxis ☐ Yes ☐ No
06. Physiotherapy plan mentioned ☐ Yes ☐ No
07. Collected sample properly dispatched ☐ Yes ☐ No
08. Physician review ☐ Yes ☐ No
09. Red flag signs explained ☐ Yes ☐ No
10. Catheter removal (Urine/Epidural) ☐ Yes ☐ No
11. Discharging advices (mentioned and explained) ☐ Yes ☐ No

DVT, deep venous thrombosis, LLD, leg length discrepancy

Signature of unit head:

Signature of training fellow:

Signature of ward in-charge nurse:

Signature of OR in-charge nurse:

Table 2: Demographic data

Patient demographic and perioperative data			
Characteristics	*Before checklist*	*After checklist*	*p-value*
No. of patients	418	520	0.186
Mean age (Hip/Knee)	32/66	34/64	0.285
Sex (Male:Female)	1.1:1	1.1:1	–
Type of surgery			
Hip arthroplasty	242	326	0.231
Knee arthroplasty	176	194	0.206
Pathology (surgical indications)			
OA	4/166	6/181	0.22
AVN	206/0	273/0	0.098
RA	4/8	6/12	0.66
Ankylosing spondylitis	4/0	7/0	0.36
Sickle cell	6/0	9/0	0.42
NOF fracture	16/0	21/0	0.46
TB	2/2	3/1	0.32
Mean hospital stay	3.72 ± 1.3	3.91 ± 1.1	0.152
Mean follow-up	7.1 weeks	6.2 weeks	–

AVN, avascular necrosis; NOF, neck of femur; OA, osteoarthritis; RA, rheumatoid arthritis; TB, tuberculosis

This marked reduction highlights the effectiveness of the checklist in enhancing procedural compliance and minimizing human error across the surgical workflow.

Discussion

Various potential complications may occur during arthroplasty surgery; few of these are preventable, whereas most are non-preventable.[10] The institution of a "checklist" is one of the key critical strategies deployed to reduce preventable human errors.

Numerous studies have highlighted the benefits of incorporating structured checklists in surgical practice, demonstrating significant reductions in complication rates and even mortality.[11–14] For instance, the introduction of the WHO SSC has been linked to a decline in mortality from 1.5 to 0.8%, and a drop in overall complication rates from 15.4 to 10.6%.[8,11] However, while the WHO checklist serves as a foundational tool, it is intentionally broad in design. Surgical subspecialties often demand more focused and detailed protocols tailored to the specific risks and complexities inherent in their procedures.[9]

Joint replacement surgery, in particular, carries unique challenges that general checklists may not fully address. Certain high-risk events—such as performing surgery on the incorrect site—can be prevented through established protocols like site marking, yet critical steps like surgical site inspection are still sometimes overlooked during intraoperative procedures. These gaps can contribute to avoidable adverse outcomes.

Table 3: Errors record in the perioperative period

Phase of checklist	*Errors recorded*	*Point of realization*	*Steps taken*
Preoperative	Blood products were not reserved preoperatively for a patient posted for a total knee replacement surgery in a patient with Hb 9.1	Just before the induction	The blood sample was sent immediately from the OR to our blood bank for grouping and cross-matching, thus preventing any possible harm, as sufficient blood of the same group was made available
	A florid fungal infection/bed sore was not observed due to a failure to check the surgical site preoperatively (Fig. 1)	After induction, while positioning the patient	Postponement of the surgery
Intraoperative	Cemented implants were not kept handy (Fig. 2)	The uncemented cup failed to obtain a good hold during trial. Failure to do preoperative templating and anticipate such a forthcoming	Arrangements were made intraoperatively with prolonged surgical timing. Spinal anesthesia was converted to general anesthesia in the floppy lateral position
	Antiplatelet medications were not stopped preoperatively	Profuse blood loss intraoperative	Multiple blood transfusions with a prolonged unplanned ICU stay
Postoperative	Improper discharge advice and the red flag signs were not explained to the patients	Dislocation of the hip due to squatting (Fig. 3)	Readmission and relocation
	Improper discharge card, which did not mention the rehabilitation protocol/suture removal	At 1 month patient followed up with minimal mobilization, and sutures were still present	Delayed rehabilitation/delayed suture removal

OR, operating room

Fig. 1: Florid fungal infection/bed sore at the surgical site

Fig. 2: Shows an anteroposterior (AP) X-ray hip for which a cemented cup was inserted

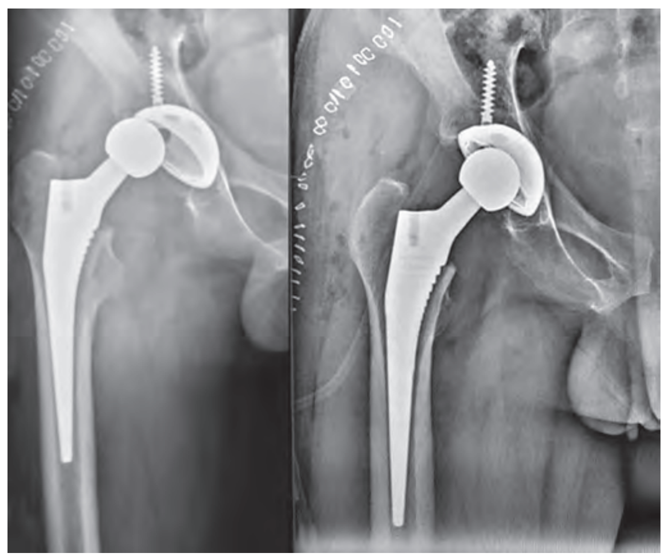


Fig. 3: Shows the dislocation of the total hip replacement (THR) due to squatting, which was relocated

Recognizing this need, the present study introduces a detailed 37-point checklist specifically developed for use in joint arthroplasty. The aim was to embed safety checks throughout the perioperative process—encompassing preoperative, intraoperative, and postoperative stages. Following its implementation, the frequency of avoidable complications significantly decreased from 6.9 to 1.7%. Notably, reductions were observed in infection rates, extended hospitalizations, and unplanned readmissions—particularly among those considered preventable.

This checklist functions not merely as a reminder tool but as a mechanism to encourage proactive clinical planning. For example,

Table 4: Number of cases that happened before the checklist and after the checklist introduction

Preventable adverse events	*Before checklist*	*After checklist*
Preoperative		
Wrong side surgery	0	0
Postponement of the surgery	4	0
Intraoperative		
Complications due to implant-related issues	6	0
Unplanned ICU stay	8	1
Postoperative		
Dislocation	1	0
Stiffness	3	0
Rehabilitation delay	13	0
DVT	3	2
Delayed suture removal	9	0
Readmission rate	3	1

DVT, deep venous thrombosis

it helps the team anticipate intraoperative needs such as bone graft substitutes or bail-out strategies. It also reinforces critical time-sensitive practices like administering intravenous antibiotics within the optimal preincision window—commonly referred to as the "golden hour"—to help minimize infection risk.

While this checklist may appear more detailed than the WHO's version, such thoroughness is justified given the technical demands and narrow margin for error in arthroplasty. In contrast to many general surgical procedures, joint replacement requires precise execution and coordinated care that continues well into the postoperative period. For this reason, the checklist also includes postoperative checkpoints that prompt discussion of warning signs and ensure proper discharge education and planning.

In our early experience, implementing the surgical checklist proved to be time-intensive, especially during the postoperative phase. The most frequent challenge arose when completing the final sections of the checklist before patient discharge. To address this, the nursing staff was firmly instructed not to discharge any patient until the checklist was thoroughly reviewed and all essential postoperative instructions were communicated. Although adopting such checklists poses practical difficulties, their use is critical in enhancing patient safety.[15]

Designing a comprehensive and subspecialty-specific checklist is a complex endeavor with wide-reaching implications across various components of the healthcare system.[16–18] The checklist introduced in this study incorporates a unique two-step verification process that differentiates it from previously available tools. Its effectiveness, however, is contingent upon collaborative efforts among surgeons, trainees, nursing teams, and allied health professionals. What sets this model apart is the deep level of coordination it fosters among all stakeholders involved in joint replacement procedures.

Numerous studies have shown that surgical checklists are a practical, low-cost, and effective strategy for improving intra-team communication and reducing complications in surgical patients.[19–22] This initiative draws on a substantial dataset collected from two tertiary care centers and demonstrates a measurable reduction in preventable errors during joint arthroplasty. Additionally, the structure of this checklist provides a versatile framework that can be adapted by arthroplasty surgeons to fit specific institutional workflows.

To the best of our knowledge, this is the first checklist to comprehensively address the full spectrum of perioperative care in joint replacement surgery. While the current design is based on clinical insights and experience, its broader application in arthroplasty would benefit from validation through large-scale, multicenter, randomized studies.

Conclusion

The newly developed arthroplasty surgery checklist offers a practical, reliable, and cost-effective solution that contributes to reducing preventable adverse events while fostering a stronger culture of perioperative safety in joint replacement procedures. By streamlining critical safety steps, it enhances the surgical team's confidence and operational efficiency. Given the rising number of medico-legal cases in surgical practice, there is a pressing need for comprehensive, subspecialty-specific tools that specifically target human error mitigation. This checklist incorporates a two-level verification process that reinforces safety at multiple stages and promotes seamless communication and collaboration among the lead surgeon, surgical trainees, and OR personnel.

Declaration of Conflicting Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval and Informed Consent

Ethical Approval was taken from the Bombay Hospital Institute of Medical Science, Mumbai.

Data Availability

Yes, it can be reproduced whenever required.

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References

1. Bhutta MA, Arshad MS, Hassan S, et al. Trends in joint arthroplasty litigation over five years: The British experience. Ann R Coll Surg Engl 2011;93(6):460–464. DOI: 10.1308/003588411X587226.
2. Attarian DE, Vail TP. Medicolegal aspects of hip and knee arthroplasty. Clin Orthop Relat Res 2005;433:72–76. DOI: 10.1097/01.blo.0000159765.42036.56.
3. Tully MP, Ashcroft DM, Dornan T, et al. The causes of and factors associated with prescribing errors in hospital inpatients: A systematic review. Drug Saf 2009;32:819–836. DOI: 10.2165/11316560-000000000-00000.
4. Manojlovich M, Kerr M, Davies B, et al. Achieving a climate for patient safety by focusing on relationships. Int J Qual Health Care 2014;26:579–584. DOI: 10.1093/intqhc/mzu068.
5. Sewell M, Adebibe M, Jayakumar P, et al. Use of the WHO surgical safety checklist in trauma and orthopaedic patients. Int Orthop 2011;35(6):897–901. DOI: 10.1007/s00264-010-1112-7.
6. Kulkarni AG, Patel JY, Asati S, et al. "Spine surgery checklist": A step towards perfection through protocols. Asian Spine J 2022;16(1):38–46. DOI: 10.31616/asj.2020.0432.
7. WHO (2008). The Surgical Safety Checklist. World Health Organisation, Geneva. http://Www.Who.Int/Patientsafety/Safe Surgery/Tools_Resources/SSSL_Checklist_Finaljun08.Pdf. Accessed: 5 August 2010.

8. Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009;360:491–499. DOI: 10.1056/NEJMsa0810119.
9. Sleiman B, Sayeed Z, Padela MT, et al. Review article: Current literature on surgical checklists and handoff tools and application for orthopaedic surgery. J Orthop 2018;16(1):86–90. DOI: 10.1016/j.jor.2018.12.006.
10. Kim FJ, Da Silva RD, Gustafson D, et al. Current issues in patient safety in surgery: A review. Patient Saf Surg 2015;9:26. DOI: 10.1186/s13037-015-0067-4.
11. Gautreau S, Gould ON, Allanach WW, et al. Total knee arthroplasty communication checklist increases patient satisfaction. J Arthroplasty 2018;S0883–5403(18):31160–31164. DOI: 10.1016/J.Arth.2018.11.032.
12. Maziero EC, de Camargo Silva AE, de Fátima Mantovani M, et al. Adherence to the use of the surgical checklist for patient safety. Rev Gaucha Enferm 2015;36(4):14–20. DOI: 10.1590/1983-1447.2015.04.53716.
13. Treadwell JR, Lucas S, Tsou AY. Surgical checklists: A systematic review of impacts and implementation. BMJ Qual Saf 2014;23(4):299–318. DOI: 10.1136/bmjqs-2012-001797.
14. Papaconstantinou HT, Smythe WR, Reznik SI, et al. Surgical safety checklist and operating room efficiency: Results from a large multispecialty tertiary care hospital. Am J Surg 2013;206(6):853–859; discussion 859–860. DOI: 10.1016/j.amjsurg.2013.08.016.
15. Thomasson BG, Fuller D, Mansour J, et al. Efficacy of surgical safety checklist: Assessing orthopaedic surgical implant readiness. Healthc (Amst) 2016;4(4):307–311. DOI: 10.1016/j.hjdsi.2016.01.005.
16. van Klei WA, Hoff RG, van Aarnhem EE, et al. Effects of the introduction of the WHO “Surgical Safety Checklist” on in-hospital mortality: A cohort study. Ann Surg 2012;255(1):44–49. DOI: 10.1097/SLA.0b013e31823779ae.
17. National Patient Safety Agency. Patient Safety First 2008 To 2010: The Campaign Review. London: National Patient Safety Agency; 2011.
18. Vats A, Vincent CA, Nagpal K, et al. Practical challenges of introducing WHO surgical checklist: UK pilot experience. BMJ 2010;340:b5433. DOI: 10.1136/bmj.b5433.
19. Conley DM, Singer SJ, Edmondson L, et al. Effective surgical safety checklist implementation. J Am Coll Surg 2011;212:873–879. DOI: 10.1016/j.jamcollsurg.2011.01.052.
20. Haynes AB, Weiser TG, Berry WR, et al. Changes in safety attitude and relationship to decreased postoperative morbidity and mortality following implementation of a checklist-based surgical safety intervention. BMJ Qual Saf 2011;20:102–107. DOI: 10.1136/bmjqs.2009.040022.
21. Lepanluoma M, Takala R, Kotkansalo A, et al. Surgical safety checklist is associated with improved operating room safety culture, reduced wound complications, and unplanned readmissions in a pilot study in neurosurgery. Scand J Surg 2014;103:66–72. DOI: 10.1177/1457496913482255.
22. Weiser TG, Haynes AB, Dziekan G, et al. Effect of a 19-item surgical safety checklist during urgent operations in a global patient population. Ann Surg 2010;251:976–980. DOI: 10.1097/SLA.0b013e3181d970e3.

CASE SERIES

Total Knee Arthroplasty in Ankylosed Knee with Severe Flexion and Valgus Deformity: Challenges and Outcomes—Case Series

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Abstract

Background: Total knee arthroplasty (TKA) in patients with ankylosed knees in flexion and valgus deformity presents significant challenges, including risks of postoperative neurovascular injury. Acute correction of flexion and valgus deformities often stretches neurovascular structures, leading to complications like common peroneal nerve palsy and foot drop.

Methods: This study evaluated three cases of ankylosed knees with flexion and valgus deformity undergoing TKA. One male (hemophilic) with unilateral involvement and one female (rheumatoid) with bilateral involvement were treated using supracondylar femoral shortening osteotomy and tibial tubercle osteotomy. All the two cases had ankylosed knees in more than 50° of flexion and valgus of more than 12°. The procedures included posterior capsule and soft tissue release, constrained hinged knee arthroplasty, and incremental supracondylar femoral shortening to achieve full extension intraoperatively while avoiding neurovascular traction injury. Femoral stability was achieved by docking the segments under vision, and alignment was secured with an uncemented femoral implant stem.

Results: All patients achieved 0° extension and functional alignment intraoperatively without postoperative neurovascular complications. Supracondylar femoral shortening osteotomy minimized limb lengthening from deformity correction, circumventing the limitations of distal femoral resection. Although some patients exhibited extensor lag due to quadriceps laxity because of femoral shortening and patella baja, these were mitigated postoperatively with physiotherapy and extension splints.

Conclusion: Supracondylar femoral shortening osteotomy is a viable alternative for managing flexion and valgus deformities in ankylosed knees undergoing TKA, balancing the risks of neurovascular traction injuries and postoperative quadriceps laxity.

Keywords: Ankylosed knees, Case series, Flexion deformity, Supracondylar femoral shortening osteotomy, Total knee arthroplasty, Valgus deformity.

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Introduction

The surgical complexity of stiff or ankylosed knees in severe valgus and flexion deformities compounds the risk of complications such as neurovascular injury, patellar tendon rupture, collateral ligament injuries, and component malpositioning.[1] These challenges highlight the need for advanced exposure techniques and tailored approaches to minimize complications. An ankylosed knee in flexion presents unique challenges in surgical management, particularly in total knee arthroplasty (TKA).[2–4] Ankylosis can develop in flexion due to posterior soft-tissue contractures, mechanical bone blocks, or adhesions, and in extension due to quadriceps contracture, heterotopic ossification, or patella baja, which diminishes quadriceps efficiency. Correcting such deformities is particularly complex when compounded by severe valgus alignment, which increases the risk of common peroneal nerve (PN) palsy—a known complication of TKA. Insufficient surgical exposure during TKA in stiff knees can exacerbate complications, including improper gap balancing, extensor mechanism injuries, or ligament avulsions. Acute correction of flexion deformity during TKR can stretch neurovascular structures, increasing the risk of complications such as common PN palsy and foot drop. Hamstring muscles, posterior soft tissue structures, and capsules are contracted in such patients. Currently, there are no proper guidelines regarding how much acute correction of flexion deformity intraoperatively is tolerable without causing neurovascular injury.

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Total knee arthroplasty in patients with ankylosed knee in severe flexion and valgus deformities presents significant challenges, including the risk of neurovascular complications such as PN palsy.[5–7] Peroneal nerve palsy, which often arises from neurapraxia due to acute nerve lengthening during deformity correction, is particularly prevalent in cases involving valgus alignment exceeding 12°, flexion contractures >30°, or pre-existing spinal pathologies. The risk of PN palsy following TKA ranges from

0.3 to 7%. The nerve's anatomical location in the concavity of the valgus and flexion deformity further predisposes it to injury during surgery.

While surgical decompression of the PN is well established for treating post-TKA palsy, the role of prophylactic peroneal nerve decompression (PPND) in high-risk patients remains underexplored.[8] Traditionally, PPND has been considered a preventative strategy for high-risk patients, particularly in limb lengthening and deformity correction surgeries. To address the risk of neurovascular injury during TKA in cases with severe deformities, this study adopts a novel approach using supracondylar femoral shortening osteotomy (SFSO). By reducing tension on the neurovascular structures and facilitating deformity correction and improving extension, this technique provides an alternative to PPND while mitigating complications, such as PN palsy, patellar tendon rupture, and collateral ligament injuries.

The SFSO effectively reduces femoral length intraoperatively, counterbalancing the length gained from acute flexion correction and minimizing neurovascular traction risks.

This report presents two cases where SFSO was performed during TKA in patients with complex valgus and flexion deformities in ankylosed knees. The study evaluates the outcomes and effectiveness of this approach in preventing neurovascular injury and ensuring successful surgical correction.

Surgical Technique

All surgeries were performed by a single experienced orthopedic surgeon. Medial parapatellar approach was used for exposure of the knee joint. In all cases, SFSO was performed to address the severe valgus and flexion deformities. The osteotomy was planned to minimize tension on the neurovascular structures, particularly the common PN, while facilitating extension and proper alignment of the knee joint for TKA.

Case 1

A 47-year-old female, a known case of rheumatoid arthritis (RA), presented with bilateral knee ankylosis in flexion and valgus (Fig. 1). She was nonambulatory since past 4 years due to severe bilateral knees arthritis. Rheumatoid arthritis had affected multiple bilateral joints in her body, including bilateral hip, ankle, and small joints of both hands and foot. She had multiple bilateral hand and foot deformities, classical of RA. She underwent bilateral total hip arthroplasty 2 years back. Her knees were painful and affected her movements. Knee exam revealed bilateral ankylosis of knee in flexion of around 70°. Her hips had good painless range of motion (ROM) post total hip arthroplasty. Pulses were intact at the end of surgery. The patient gave her consent for this information to be published.

Anteroposterior and lateral X-rays of bilateral knees revealed severe arthritis of both knees leading to bony ankylosis of both the knee joints in severe flexion and valgus deformity (Fig. 2).

In order to provide her with a good, functional, and painless knee motion to help her ambulate, the surgical team decided to offer her total knee replacement. Total knee replacement would provide access to the joint, correct the deformity, and improve ROM. Bilateral knee replacements were planned. Both the knees were replaced within 2 weeks interval, right followed by left. Because of severe deformity (Fig. 1) and anticipated significant bone resection, a hinged knee prosthesis was selected for stability.

Fig. 1: Preoperative photograph of a 47-year-old rheumatoid lady with bilateral severe flexion deformity

Fig. 2: Preoperative radiographs of a 47-year-old rheumatoid lady showing bilateral ankylosed knee with severe flexion and valgus deformity

A midline central incision was made, and a medial parapatellar approach was used. Thick cutaneofascial flaps were raised, and Hoffa's pad of fat was excised. A hinged knee prosthesis was planned, and both the collaterals were released for balancing the knee. The tibial tubercle osteotomy (TTO) was done of around 8 cm from joint line using saw. Patellofemoral ankylosis was present. Patella was osteotomized and freed from the trochlear groove. Tibial tubercle with patella and patellar tendon was retracted laterally, which provided excellent exposure of the knee. There was absolutely no cartilage throughout the joint and completely bony ankylosis of both compartments of tibiofemoral joint. Tibio femoral ankylosis was broken with osteotome, and tibial joint line and femoral joint line were freed. Knee was flexed throughout the

Fig. 3: Postoperative 6 weeks photographs of 47-year old, rheumatoid lady showing near complete extension of both knees with normal alignment

procedure to avoid traction on neurovascular structures. Posterior structures were released, and the posterior aspect of femur and tibia were freed of soft tissue. However, after posterior soft tissue release, extension was correctable to 40–50°. The decision was made to proceed with the hinge knee arthroplasty. Next, trial femoral and tibial components were placed, resulting in good medial and lateral stability in flexion. The femoral and tibial stems were uncemented, long stem and press fit. In order to achieve extension, SFSO was done with saw in increments of 1 cm till complete extension was achieved intraoperatively while avoiding traction on neurovascular structures. Around 3 cm of bone was removed, and extension up to near 0° was achievable on table (Fig. 3). The osteotomy was stabilized by slowly extending the knee and docking of proximal and distal fragments over the intramedullary femoral stem maintaining alignment and reduction. This made the osteotomy inherently stable. Full extension of knees without traction of the neurovascular bundle was achieved. Tibial tubercle osteotomy was fixed with two anteroposterior 6.5 cortico-cancellous screws. Osteotomized bone was used as a bone graft. Pulses were intact.

Case 2

The patient was a 22-year-old male, who was a case of severe bilateral knee arthritis (Fig. 4) because of hemophilic arthropathy. Patient had left-sided ankylosed knee in flexion and valgus (Figs 5 and 6). Bilateral knees were painful and affected his movements. He was ambulatory only with support. Knee exam revealed left-side ankylosis of knee in flexion of around 50° with severe valgus (femorotibial angle of 30°). Distal neurovascular status was normal. The patient's clotting profile was optimized preoperatively in consultation with the hematology team, and perioperative factor replacement therapy was administered. The patient gave his consent for this information to be published.

Same surgical technique was used as in previous case. A TTO was performed followed by retraction of tibial tubercle, patella, and patellar tendon to the lateral side, providing good exposure of the joint. Collateral ligaments were released and the posterior soft tissues were released to balance knee mediolaterally. Extension was limited to 30° after all soft tissue releases. It was decided to use uncemented hinged knee arthroplasty for proper balancing and stabilization. In this case, 2 cm of SSFO was required to achieve complete extension up to 0° while avoiding neurovascular traction. Supracondylar shortening femoral osteotomy was stabilized by slowly extending the knee and docking of proximal and distal shaft over the uncemented intramedullary femoral stem. Tibial tubercle osteotomy was fixed with 6.5 mm cortico-cancellous screws (Fig. 7). Distal pulses were intact.

Fig. 4: Preoperative radiographs of a 22-year-old man with hemophilic arthritis showing left side ankylosed knee with severe valgus and flexion deformity

Fig. 5: Preoperative clinical standing photograph of a 22-year-old man with hemophilic arthritis showing left side severe valgus and flexion deformities

Postoperative Care

Postoperatively, all patients were closely monitored for signs of neurovascular compromise. Early mobilization was encouraged as tolerated, and rehabilitation was initiated to improve ROM and strength. The patients were followed up regularly at 4 weeks, 2 months, and 6 months after surgery to assess functional outcomes, complications, and recovery.

Fig. 6: Preoperative photograph of a 22-year-old man with hemophilic arthritis showing left side severe valgus and flexion deformities

Fig. 7: Postoperative radiographs of a 22-year-old man with hemophilic arthritis showing left-sided correction of severe valgus and flexion deformity with hinged TKA and SFSO with TTO

Outcome Measures

The primary outcome measures included:

- Incidence of PN palsy or other neurovascular complications.
- Knee function, assessed using the knee society score (KSS) and knee ROM.
- Postoperative radiographic alignment and implant positioning (Figs 8 to 13).
- Complications, including extensor mechanism injuries, ligament avulsions, and any need for additional surgical interventions.

Results/Complications

Immediately postoperatively, both the patients had dorsiflexion of toes and normal sensations. Distal pulses were intact. Capillary refill time was less than 3 seconds. Both patients were gradually able to ambulate with the help of a walker, and ROM improved in bilateral knees. The mean ROM improved from 6.7° (0–30°) to 100° (15–115°) at the final follow-up of 12 months. Initially there was extensor lag of around 20–30° in all the three cases, due to extensor laxity and patella baja because of femoral shortening, which gradually improved up to 10–15° over 6 weeks' time with physiotherapy and splints. The mean KSS knee score improved from –23.4 (–20 to –10) to 70.6 (55–80) points, and the mean KSS function score improved from 6.7 (0–20) to 73.4 (50–90) points. Table 1 summarizes the results. A scanogram was obtained at 2 weeks during discharge after suture removal to accurately determine alignment and leg lengths. There was residual extensor lag of around 10–15° on follow-up after 6–12 months due to patella baja and laxity of quadriceps mechanism due to supracondylar shortening.

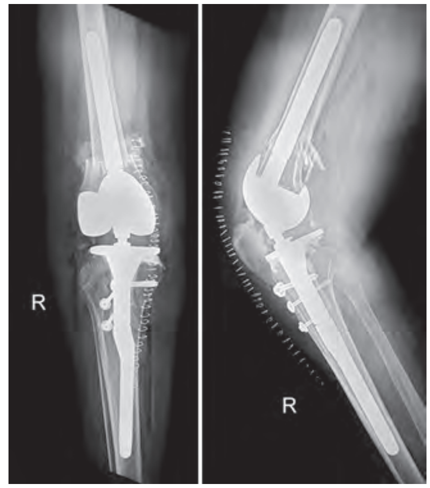

Fig. 8: Postoperative radiograph of right side with hinged TKA and SFSO

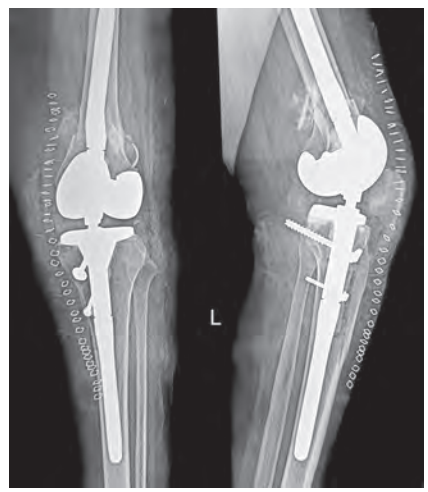

Fig. 9: Postoperative radiograph of left side with hinged TKA and SFSO

Fig. 10: Follow-up X-ray of right knee: AP view of case 1

Fig. 11: Follow-up X-ray of right knee: Lateral view of case 1

Fig. 12: Follow-up X-ray of left knee: AP view of case 1

Fig. 13: Follow-up X-ray of left knee: Lateral view of case 1

Table 1: Results of hinged total knee arthroplasty in patients with ankylosis of the knee in flexion and valgus after final follow-up

Patients	*Patellar resurface (yes/no)*	*Follow-up period (months)*	*ROM (preop)*	*ROM (postop)*	*KSS knee score (preop)*	*KSS knee score (postop)*	*KSS functional score (preop)*	*KSS functional score (postop)*	*Complications*
1	No	12 months	0	100	–20	68	0	70	Residual extensor lag of 10–15°, anterior thigh pain
2	No	12 months	0	90	–20	74	0	70	Residual extensor lag of 10–15°
3	No	12 months	20	110	–30	70	20	80	Residual extensor lag of 10–15°

Discussion

In this study, there were good clinical and radiological results after TKA for patients with ankylosed knees in severe flexion and valgus deformity with SFSO to avoid neurovascular traction injury, tibial tuberosity osteotomy for adequate exposure, and hinged knee prosthesis. Total knee arthroplasty is a dependable procedure for alleviating pain, enhancing joint mobility, preserving stability, and improving gait function in individuals with stiff or ankylosed knees.[9–11] Severe flexion contractures in the knee present significant surgical challenges due to anatomical limitations, including risks to the neurovascular bundle and collateral ligaments. Kitchen et al. highlight the successful use of a shortening femoral osteotomy during TKA to address a 120° flexion contracture, achieving improved function, extension, and ROM, while preserving bone stock and avoiding mechanical complications associated with hinged implants.[12]

Common PN palsy is a significant complication of TKA, often linked to valgus deformities.[13] Christ et al. found that valgus alignment increased the risk (odds ratio 4.19), with an even greater risk in patients with spinal pathology (odds ratio 17.1).[13] Nerve stretching during deformity correction is the most common cause, though factors like prolonged tourniquet use and lateral release also contribute.

Management typically involves knee flexion, loosening dressings, physical therapy, and ankle-foot orthoses. Electromyography is recommended if symptoms persist beyond 6–12 weeks.[14] Surgical decompression, whether delayed or immediate, has shown excellent outcomes.[6,7,15] Prophylactic peroneal nerve decompression during TKA is particularly effective in patients with severe valgus deformities, enabling full functional recovery.[8]

In patients with underlying conditions, such as RA and hemophilic arthritis, the bone quality may be compromised, and soft tissues weakened. These factors can affect the mechanism of quadriceps and collateral ligaments, increasing the risk of avulsion during attempts at knee flexion. Achieving adequate surgical exposure in such cases is crucial to prevent complications. Essential methods, such as proximally extending the quadriceps incision, conducting lateral retinacular release, and externally rotating the tibia, often facilitate better medial subperiosteal dissection and exposure. However, if standard techniques like patellar eversion and these adjunctive measures do not provide sufficient exposure, more extensive methods may be required. Surgeons may need to consider advanced exposure techniques, including quadriceps snip, V-Y quadricepsplasty, femoral peel, TTO, or transepicondylar osteotomy with skeletonization. These methods allow for improved visualization and safe manipulation of the knee joint, ensuring proper deformity correction and minimizing the risk of neurovascular damage during surgery. In patients with ankylosed knees, TKA can yield favorable outcomes in terms of motion and function, even without performing a tibial tuberosity osteotomy, provided the thigh's soft tissue quality is adequate.[16]

One approach to improving distal knee exposure during surgery is the TTO. First described by Dolin and subsequently refined by Whiteside and Ohl, this technique involves creating an elongated and robust tibial tubercle fragment that remains attached laterally through the periosteum and anterior compartment musculature.[17,18] By elevating the distal attachment of the extensor mechanism, TTO facilitates effective surgical exposure while maintaining the integrity of critical soft-tissue structures.

Supracondylar femoral shortening osteotomy is a surgical technique used to shorten the femur above the knee joint in order to correct severe deformities, such as fixed flexion contractures and angular malalignments—commonly encountered in patients with ankylosed knees. The primary objective of SFSO is to restore limb alignment, relieve neurovascular tension, and facilitate functional joint positioning while avoiding complications related to excessive soft tissue stretching.

The procedure begins through the standard midline TKA approach, which is extended proximally to access the distal femur. Intramedullary canal reaming and preparation for the hinged femoral prosthesis stem are carried out prior to the osteotomy. With a press-fit femoral trial stem inserted *in situ*, a transverse supracondylar femoral osteotomy is performed at the metaphyseo-diaphyseal junction, typically 5–10 cm above the knee joint. The femoral shortening is carried out incrementally, usually in 1-cm steps, with adjustments based on intraoperative correction of the deformity and the amount of extension achieved. The presence of the press-fit intramedullary stem inherently provides stability across the osteotomy site, acting like an internal nail, eliminating the need for additional fixation hardware. Once the desired alignment and correction are achieved, the final femoral stem is implanted and stability is reassessed. Proper reduction and mechanical axis alignment are confirmed using a C-arm under fluoroscopic guidance. In cases with valgus deformity, the osteotomy contributes to both coronal and sagittal plane correction, restoring appropriate biomechanical alignment. Autologous bone graft harvested from uncapped tibial and femoral bone cuts is placed around the osteotomy site to promote healing. As the construct is stable, patients are allowed immediate full weight-bearing postoperatively, which aids bone healing through controlled axial compression during ambulation. Our case study demonstrates an innovative approach to preventing neurovascular injury during TKA in patients with significant limb deformity. In such patients, PN palsy is a recognized complication, particularly in cases requiring extensive correction of angular deformities or lengthening. Traditionally, PPND has been employed to mitigate this risk. However, this method carries its own risks, including delayed recovery, additional surgical morbidity, and variable efficacy. In our case, an SFSO was performed as an alternative to PPND. This approach offers several advantages like reduction of neurovascular tension by addressing limb-length discrepancy or deformity through femoral shortening; the osteotomy directly reduces the stretch and tension placed on the PN and surrounding neurovascular structures. Unlike PPND, which is preventive but does not alter the underlying biomechanical tension, this technique proactively eliminates the cause of potential nerve injury. Enhanced limb alignment and stability is achieved—supratrochanteric osteotomy enables simultaneous correction of both length and alignment in cases of severe deformity. This can improve overall limb biomechanics, facilitate proper implant positioning, and reduce compensatory stresses on the knee and hip joints. Controlled bone healing and load sharing is seen—the osteotomy creates a controlled site for bone healing, which can be managed with stable internal fixation. This reduces the risk of intraoperative complications, such as implant instability or fixation failure, often encountered in challenging TKA cases. Secondary procedures are avoided—unlike PPND, which is an adjunctive procedure with no guarantee of efficacy, femoral shortening osteotomy resolves multiple issues in a single surgical session. By addressing both deformity and neurovascular concerns simultaneously, it reduces the need for subsequent interventions.

The SFSO effectively reduces femoral length intraoperatively, counterbalancing the length gained from acute flexion correction and minimizing neurovascular traction risks. Alternatives to this method mentioned in the literature are distal femur resection and prophylactic common PN exploration. However, there is a limit of distal femoral resection as medial epicondyle in 3 cm proximal to medial joint line and lateral epicondyle is 2.5 cm proximal to lateral joint line. It is not possible to resect more than that, as the stability and implantation of knee prosthesis is compromised. Due to supracondylar femoral shortening, there is a risk of patella baja and patellar maltracking, and these can be managed by proximalizing and lateralizing the attachment site of TTO. However, this might lead to some degree of quadriceps laxity and extensor lag postoperatively, which we tried to overcome using extension splints and physiotherapy/quads exercises. Thus, there are pros and cons of SFSO in ankylosed knee in flexion and valgus to avoid neurovascular traction injury intraoperatively vs quadriceps laxity and extensor lag postoperatively.

Despite these advantages, there are some challenges and considerations associated with supracondylar femoral osteotomy. Proper preoperative planning, including advanced imaging and templating, is essential to determine the appropriate site and degree of osteotomy. Additionally, the procedure demands technical expertise to achieve accurate alignment, stable fixation, and controlled healing. Postoperative monitoring is crucial to ensure union at the osteotomy site and to assess for potential complications, such as delayed union or malalignment.

In this case, the successful use of supracondylar femoral osteotomy highlights its potential as a superior alternative to PPND, particularly in patients with severe deformities where neurovascular compromise is a significant concern. More research is needed to review the outcomes of these two approaches systematically and to establish clear indications for their use. Nonetheless, this case emphasizes the importance of innovation and adaptability in achieving optimal outcomes for complex TKA scenarios.

Conclusion

Supracondylar femoral shortening osteotomy during TKA is a viable option to reduce the risk of PN palsy in high-risk patients. It is an innovative approach and should be considered for patients undergoing TKA in ankylosed knees with valgus and flexion deformities.

References

1. Kelly MA, Clarke HD. Stiffness and ankylosis in primary total knee arthroplasty. Clin Orthop Relat Res 2003;416:68–73. DOI: 10.1097/01.blo.0000092989.90435.64.
2. Aglietti P, Windsor RE, Buzzi R, et al. Arthroplasty for the stiff or ankylosed knee. J Arthroplasty 1989;4(1):1–5. DOI: 10.1016/s0883-5403(89)80046-4.
3. Montgomery WH 3rd, Insall JN, Haas SB, et al. Primary total knee arthroplasty in stiff and ankylosed knees. Am J Knee Surg 1998;11(1):20–23. PMID: 9533049.
4. Bradley GW, Freeman MA, Albrektsson BE. Total prosthetic replacement of ankylosed knees. J Arthroplasty 1987;2(3):179–183. DOI: 10.1016/s0883-5403(87)80035-9.
5. Schinsky MF, Macaulay W, Parks ML, et al. Nerve injury after primary total knee arthroplasty. J Arthroplasty 2001;16(8):1048–1054. DOI: 10.1054/arth.2001.26591.
6. Krackow KA, Maar DC, Mont MA, et al. Surgical decompression for peroneal nerve palsy after total knee arthroplasty. Clin Orthop Relat Res 1993;292:223–228. PMID: 8390926.
7. Erickson BJ, Brown N, Fernandez J, et al. Acute decompression for peroneal nerve palsy following primary total knee arthroplasty: A report of two cases. JBJS Case Connect 2015;5(1):e16–e24. DOI: 10.2106/JBJS.CC.N.00134.
8. Makhdom A, Hamilton AA, Rozbruch SR. The role of prophylactic peroneal nerve decompression in patients with severe valgus deformity at the time of primary total knee arthroplasty. Strategies Trauma Limb Reconstr 2022;17(1):38–43. DOI: 10.5005/jp-journals-10080-1545.
9. Rajgopal A, Ahuja N, Dolai B. Total knee arthroplasty in stiff and ankylosed knees. J Arthroplasty 2005;20(5):585–590. DOI: 10.1016/j.arth.2005.04.002.
10. Kim Y, Kim J. Total knee replacement for patients with ankylosed knees. J Bone Joint Surg Br 2008;90(10):1311–1316. DOI: 10.1302/0301-620X.90B10.20857.
11. Schurman 2nd JR, Wilde AH. Total knee replacement after spontaneous osseous ankylosis. A report of three cases. J Bone Joint Surg Am 1990;72(3):455–459. PMID: 2312547.
12. Kitchen B, Sanchez HB, Wagner RA. Shortening femoral osteotomy with stemmed resurfacing total knee arthroplasty for severe flexion contracture in juvenile rheumatoid arthritis. J Orthop 2014;12(2):118–121. DOI: 10.1016/j.jor.2014.05.002.
13. Christ AB, Chiu YF, Joseph A, et al. Incidence and risk factors for peripheral nerve injury after 383,000 total knee arthroplasties using a New York state database (SPARCS). Arthroplasty 2019;34(10):2473–2478. DOI: 10.1016/j.arth.2019.05.008.
14. Idusuyi OB, Morrey BF. Peroneal nerve palsy after total knee arthroplasty. Assessment of predisposing and prognostic factors. J Bone Joint Surg Am 1996;78(2):177–184. DOI: 10.2106/00004623 199602000-00003.
15. Mont MA, Dellon AL, Chen F, et al. The operative treatment of peroneal nerve palsy. J Bone Joint Surg Am 1996;78(6):863–869. PMID: 8666604.
16. Kim HJ, Mun JU, Kim KH, et al. Total knee arthroplasty conversion for patients with ankylosed knees. J Orthop Surg (Hong Kong) 2017;25(1):2309499016684095. DOI: 10.1177/2309499016684095.
17. Dolin MG. Osteotomy of the tibial tubercle in total knee replacement. A technical note. J Bone Joint Surg Am 1983;65(5):704–706. PMID: 6853581.
18. Whiteside LA, Ohl MD. Tibial tubercle osteotomy for exposure of the difficult total knee arthroplasty. Clin Orthop Relat Res 1990;260:6–9. PMID: 2225644.

CASE SERIES

Results of Medial Epicondylar Osteotomy without Fixation for Severe Varus Deformity in CAS TKA: A Case Series

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Abstract

Introduction: Severe varus deformity of >15° and lateral joint line opening greater than 4.7 mm need additional maneuvers apart from standard soft tissue release to achieve coronal and sagittal alignment. Epicondylar osteotomies have been described to correct such deformities with or without fixation. In this study, we describe a surgical technique of medial epicondylar osteotomy without fixation in computer-assisted surgery total knee arthroplasty (CAS TKA) with a minimum follow-up of 3 years.

Materials and methods: This is a retrospective study from a prospective database that records patients' demographic data, preoperative deformity, CAS or robotic kinematic data, post-op correction, soft tissue releases, outcome scores, and complications. There were 23 knees (6 B/L and 11U/L) which required medial epicondyle osteotomy (MEO).

Results: The average preoperative varus was 21.1 ± 4.5 (15–30). Thirteen patients had associated fixed flexion deformity (FFD) and four patients had varus with recurvatum. After MEO, knee deformity got corrected to residual varus of 1.9 ± 2 (0.5–10) and FFD of 3.9 ± 1.6 (1–7). Additional stem fixation was done in seven patients (30%). Seventeen patients had a definitive bony union (74%) and six had a fibrous union of the osteotomy (26%). There was substantial improvement in functional score and no patient had instability and any other complication at the end of 3 years follow-up.

Conclusion: Medial epicondylar osteotomy without fixation for severe deformities in CAS TKA can give good functional outcomes, without complications and a high bony union rate.

Level of evidence: IV.

Keywords: Case report, Computer-assisted surgery, Medial epicondylar osteotomy, Severe varus, Total knee arthroplasty.

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Introduction

Severe varus deformity is defined as axial deformity greater than 15° and lateral joint line opening greater than 4.7 mm.[1,2] It may need additional maneuvers apart from standard soft tissue release to achieve coronal and sagittal alignment along with optimal soft tissue balance (Fig. 1).[3]

Epicondylar osteotomies have been described to correct recalcitrant deformities that are present along with severe bone loss, subluxation, and ligament laxity on the convex side of the deformity.[4]

In the past, fixation of medial epicondyle osteotomy (MEO) has been described with cancellous screw or suture anchors to achieve stability with the help of computer navigation.[5,6] The fixation of osteotomy may not always be possible because of the small size of the fragment available for purchase, osteoporosis, or the chance of recurrence of deformity after fixation.[7]

We found a lacuna in the literature, as there was no study for medial epicondylar fixation with the help of computer navigation without fixation. In this study, we describe a surgical technique of medial epicondylar osteotomy without fixation in computer-assisted surgery total knee arthroplasty (CAS TKA) to assess its efficacy in deformity correction and union at the final follow-up of 3 years.

Materials and Methods

This is a retrospective study from a prospective database that records patients' demographic data, preoperative deformity, CAS or robotic kinematic data, post-op correction, soft tissue releases, outcome scores, and complications (Fig. 2).

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Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

Our institutional database was searched for MEO in varus deformity from 2020 onwards. All cases were operated using a brain lab navigation system (15 knees) or Cori handheld navigation system (8 knees) with a cemented posterior stabilized system (Freedom®, Meril, USA) or (Anthem®, Smith & Nephew, USA). Initial deformity and kinematics were recorded and documented in all cases. Around 8–9 mm of the distal femur was cut from the less affected condyle at 0° mechanical axis. A deviation of ±1° was accepted in the coronal plane. Sizing was done of

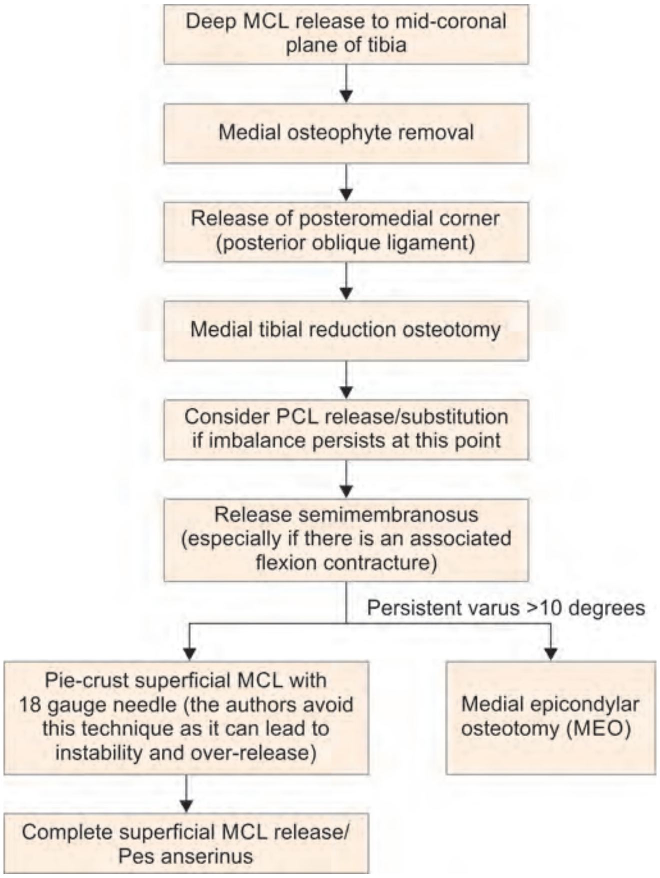

Fig. 1: Standard soft tissue release for varus knee

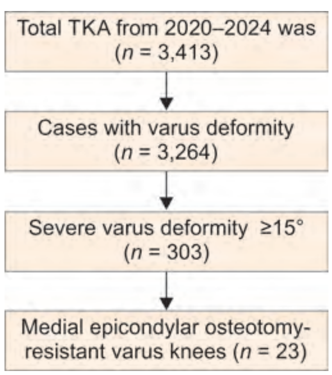

Fig. 2: Identification of epicondylar osteotomy without fixation in severe varus deformity

the femur with anterior referencing. The size was chosen such that it cuts 8–9 mm of posterior condyle and does not overhang mediolaterally. The flexion plane of the distal femur cut was 1–3° based on the resection depth of posterior condyles. After the anteroposterior cut was completed, posterior osteophytes were removed meticulously. The tibia cut was taken 8–9 mm from the less affected condyle at 0° varus/valgus and accepted within ±0.5° of the coronal axis with a slope of between 3 and 5°. After osteophytes were removed, a trial with PS insert was taken and assessed for correction of deformity. If deformity was less than 5°, then steps of varus correction were followed sequentially to create an adequate medial gap before trial (Fig. 1). Deformity with the first trial was recorded.

Surgical Technique for Medial Epicondylar Osteotomy

In severe deformities that did not correct beyond 5° with severe mediolateral laxity after removal of osteophytes and downsizing of the tibia, it was preferable to do a medial epicondylar osteotomy as an aggressive release or pie crusting of MCL could cause instability in flexion or extension.

The authors prefer to do an MEO to correct severe uncorrectable components of the deformity if it persists after downsizing of the tibia, reduction osteotomy, and release of the posterior medial capsule.

A sharp 20 mm osteotome was used for osteotomies of the medial epicondyle just medial to femur trial. A proximal part of the synovium was left intact so that the osteotomy fragment was stable without fixation. The knee was moved from extension to flexion 2–3 times and deformity was recorded on CAS screen. Once the deformity correction was achieved within ±3° along with medial and lateral soft tissue balance, osteotomy was not disturbed beyond it and was left to find a suitable fixation with the help of an adjacent synovium and soft tissue sleeve. Usually, the osteotomy displaces distally and posteriorly. The osteotomy fragment available for fixation after displacement is small and can fragment by drilling and screw insertion. More often, the fragment is osteoporotic because of long-standing arthritis and disuse. The osteotomy fragment finds a stable position with the correction of deformity and optimal ligament balance that is achieved in the mediolateral plane (Figs 3 to 8). Residual correction was noted on CAS with trial implants.

Postoperative Protocol

The patient was kept in a short knee brace for three weeks. Patients were made weight-bearing and started walking from next day of surgery. After 3 weeks, a hinged knee brace was used and patients were allowed to gradually increase their range of motion till osteotomy achieved fibrous or bony union.

Results

Out of the total of 3,413 patients operated in between 2020 and 2024; 3,264 patients had varus deformity including 303 patients having severe varus deformity of ≥15°. Of these, 17 patients (23 knees) required MEO for correction of severe resistant deformity. The average age was 64.2 ± 8 (50–77) and the body mass index of 28.5 ± 2.7 (22.7–33.3) (Table 1).

The average varus was 21.1 ± 4.5 (15–30). Thirteen patients had associated fixed flexion deformity (FFD) and four patients had varus with recurvatum (Table 2).

The average computer navigation value for preosteotomy deformity after initial osteophytes removal and soft tissue releases with the trial implant was varus 8.6 ± 2.6 (7–11) and FFD of 7.7 ± 3.3 (3–15) (Table 3). After MEO, knee deformity got corrected to residual varus of 1.9 ± 2 (0.5–10) and FFD of 3.9 ± 1.6 (1–7) (Table 4).

The average distal femur cut was 8 ± 2.7 mm (2.5–13) and the tibial cut was 8.2 ± 1.2 mm (6–11). The average insert size was 10.7 ± 1.6 mm (9–14) in all 23 cases. Additional stem fixation was done in 7 knees (30%) to provide stability with a constrained insert. There were six cases in which bilateral MEO was done, rest were unilateral cases.

The average preoperative functional score is given in Table 5 and their improvement 3 years postoperative is mentioned in Table 6. There was substantial improvement in functional score and no patient had instability and any other complication at the end of 3 years follow-up. Soft tissue releases done for corrections

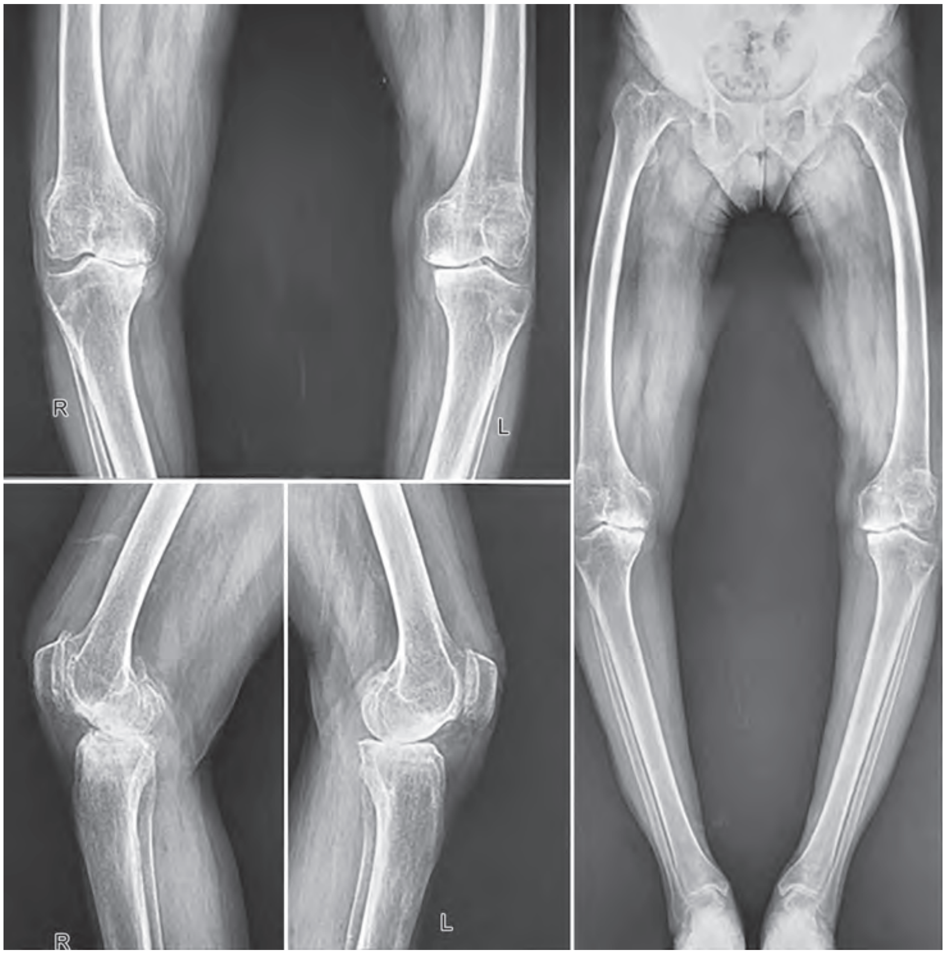

Fig. 3: Preoperative radiograph showing osteoarthritis with severe varus deformity

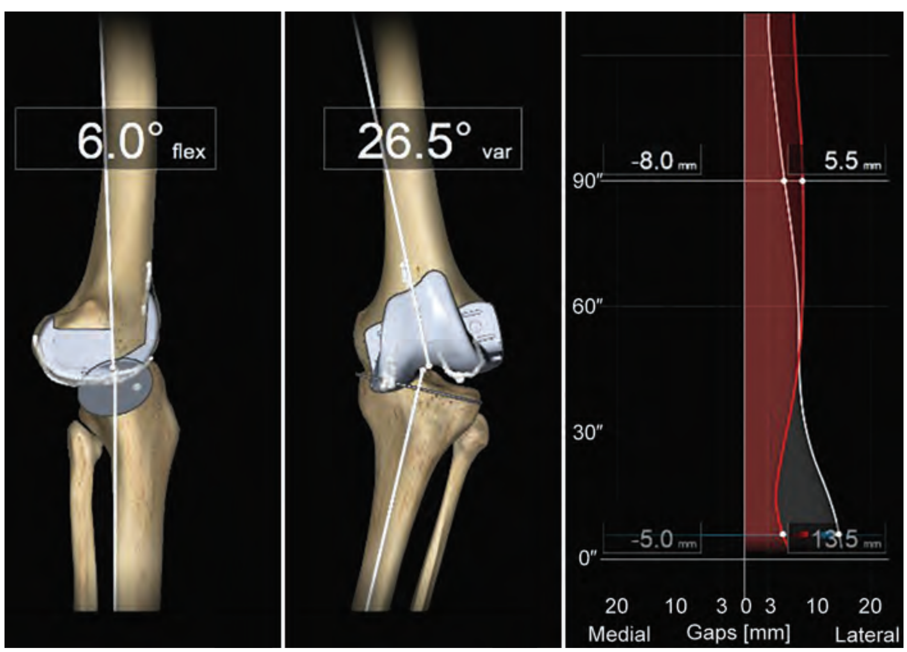

Fig. 4: Preoperative deformity

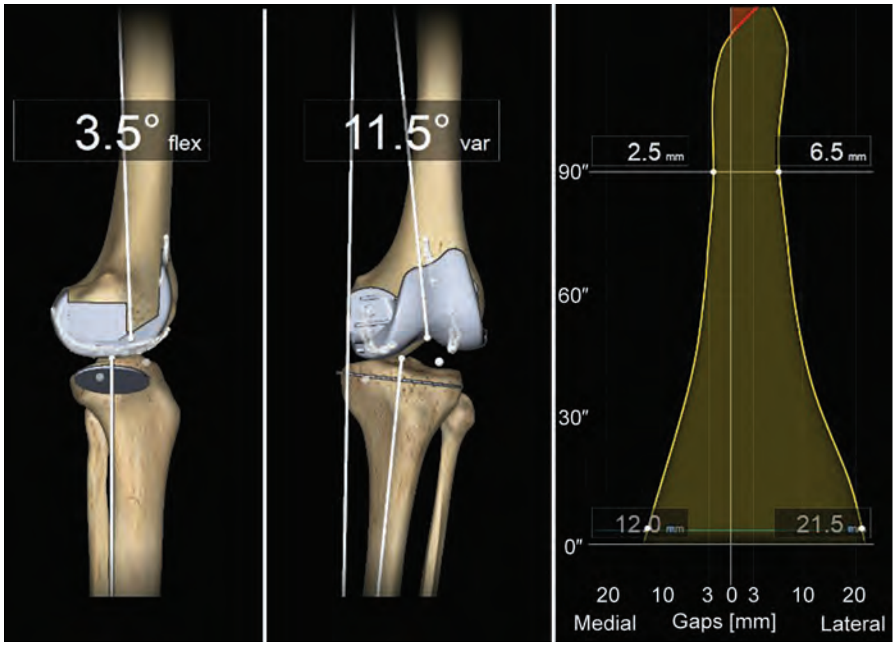

Fig. 5: Preosteotomy deformity

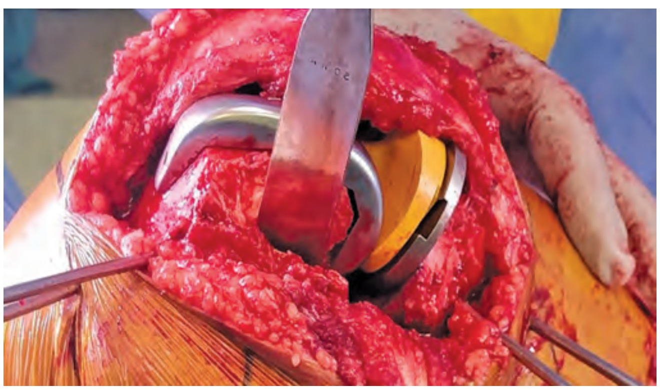

Fig. 6: Intraoperative image showing osteotomy

are given in Table 7. All radiographs were carefully evaluated for the bony union of osteotomy. Seventeen knees had a definitive bony union (74%) and six had a fibrous union of the osteotomy (26%). No patient had progressive mediolateral instability at the end of 3 years of follow-up.

Discussion

The main finding of this study is that MEO can be left with intact synovium and without fixation to find a stable position and sound bony union can be achieved in most patients.

The osteotomy fragment usually moves distally and posteriorly after deformity correction, and the remnant bony piece available for fixation is usually small to accommodate a 3.5/4.5 mm cancellous

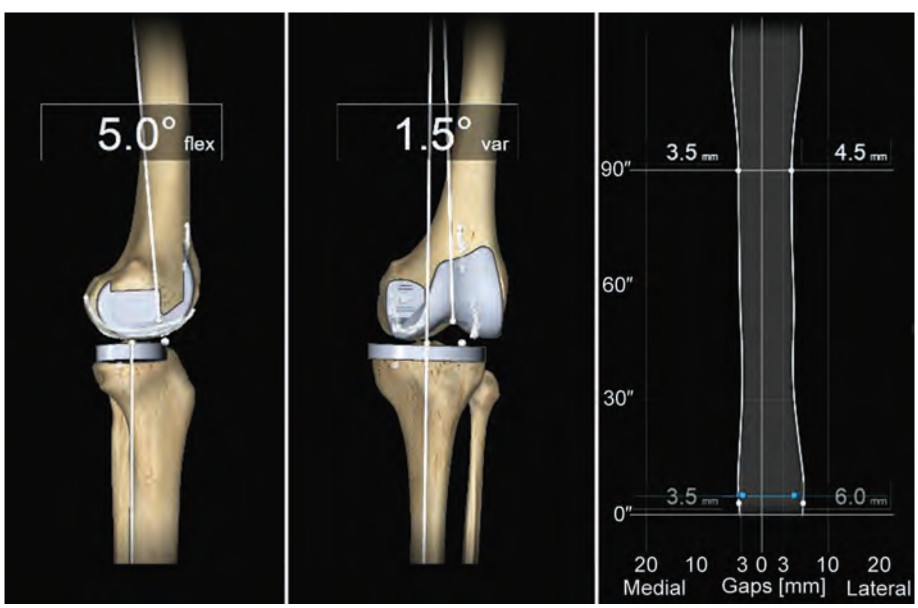

Fig. 7: Postosteotomy final correction

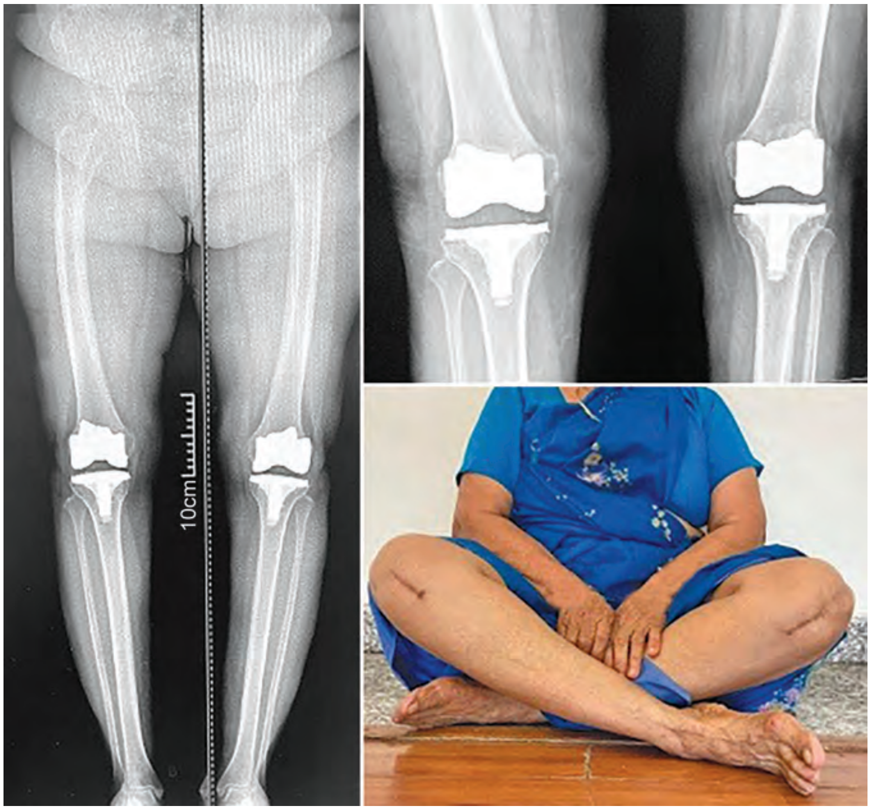

Fig. 8: Postoperative radiographs and clinical result

Table 1: Demographic data of patients

N	*23*
Sex	
Male *N* (%)	7 (30%)
Female *N* (%)	16 (70%)
Age (years)	64.2 ± 8 (50–77)
Height (cm)	161.6 ± 10.4 (155–170)
Weight (kg)	74 ± 9.1 (58–90)
BMI (kg/m^2)	28.5 ± 2.7 (22.7–33.3)
CCI scores	2 ± 0.2 (1–2)

Table 2: Preoperative deformity

Pre-op deformity	*Epicondylar osteotomy without fixation (N = 23)*
Varus (degree)	21.1 ± 4.5 (15–30)
FFD (degree)	9.8 ± 8.7 (1–30)
Recurvatum (degree)	–6.4 ± 5.5 [(–16)–(–2)]
ROM (degree)	109.6 ± 20.3 (60–130)

screw.[8,9] It also risks fragmentation and fracture on drilling for screw insertion. Other methods of fixation, like anchor suture, can overtighten the fragment leading to the recurrence of deformity or compromised correction.[7]

Twenty-three cases were described in this series, united either through bony/fibrous union with no cases of late instability or failure proving that osteotomy without fixation hinging on synovium and inherent ligament balance, can unite without risk of failure.

Table 3: Preosteotomy residual deformity

Preosteotomy deformity	*Epicondylar osteotomy without fixation (N = 23)*
Varus (degree)	8.6 ± 2.6 (7–11)
FFD (degree)	7.7 ± 3.3 (3–15)
Recurvatum (degree)	None

Table 4: Immediate postoperative corrected deformity

Post-op corrected deformity	*Epicondylar osteotomy without fixation (N = 23)*
Varus (degree)	1.9 ± 2 (0.5–10)
FFD (degree)	3.9 ± 1.6 (1–7)
Hyper (degree)	NA

Table 5: Preoperative orthopedic scores

Preoperative scores	*Epicondylar osteotomy without fixation (N = 23)*
KSS	32.6 ± 6.2 (15–40)
KSFS	8.8 ± 4.6 (0–15)
WOMAC	23.2 ± 7.1 (12–33)
KOOS	18.4 ± 6.7 (10–29)
HFKS	14.2 ± 5.4 (10–14)
VAS	8.7 ± 0.6 (8–10)

Though fixation of MEO has been described by many authors, we found that the osteotomy fragment was often thin and friable for fixation and had the risk of fracture or fragmentation on drilling

Table 6: Postoperative orthopedic scores

Postoperative scores	*Epicondylar osteotomy without fixation (N = 23)*
KSS	87 ± 5.7 (84–93)
KSFS	72.5 ± 11 (50–80)
WOMAC	81.2 ± 8.4 (72–89)
KOOS	83.6 ± 5.1 (75–90)
HFKS	38.6 ± 5.8 (35–42)
VAS	2.6 ± 1.7 (2–4)

Table 7: Soft tissue releases

Surgical procedure	*Epicondylar osteotomy without fixation (N = 23)*
Removal of medial osteophyte	23 (100%)
Downsizing tibia	18 (78.2%)
Semimembranous release	10 (21.7%)
Popliteus release	1 (4.3%)

or screw insertion. Hence, we chose to leave it with intact soft tissue attachments so that it could unite in its new position after deformity correction.

We did not find any use of late instability or failure at the end of a minimum of 3 years of follow-up, further strengthening our conviction of leaving the MEO without adjuvant fixation.

The use of CAS helped in optimizing the control of MEO as it was left undisturbed once coronal and sagittal alignment of ±3° was achieved.

There are many studies that recommend medial epicondylar osteotomy for severe varus deformity but with either a screw or suture fixation method.[6,10] There could be a risk for recurrence of deformity post-fixation or fragments of osteotomized fragments.

Some studies recommend MEO for severe varus deformity without fixation.[11,12] Engh et al. demonstrated that MEO has a high success rate, with 95% of patients reporting improved functional scores, less postoperative pain, and knee stability throughout ROM. But in contrast to our study, it had only 54% bony union of osteotomy.[8]

Stan did a comparative study between varus deformity correction with either MEO or soft tissue releases. Medial epicondyle osteotomy was not fixed in the study. There was significant improvement in patient outcomes, but in this study, only fibrous union was achieved; no osteotomy achieved bony union.[9]

Some studies have pointed to the complications that may arise with MEO. Mihalko et al. compared MEO with soft tissue releases for varus correction and found that there was significantly higher laxity in coronal and transverse plane laxity at 60 and 90° in cases done with MEO.[13]

Kim et al. described that while MEO can be done to correct coronal deformity, it may compromise MCL or damage neurovascular structures. It may lead to non-union or delayed healing at the osteotomy site.[14]

Computer navigation helped in the titration of the soft tissue releases and extension of MEO. This helped in intact soft tissue sleeve postosteotomy and higher bony union.

There are a few limitations of this study. All cases were done with principles of mechanical alignment. It is possible that the need for epicondylar osteotomy could be reduced by following a kinematic alignment philosophy that does not chase a neutral HKA axis.[15,16] This study was also limited by its retrospective nature, single surgeon experience, and lack of a control group.

However, we found no other study that described MEO without fixation under the guidance of navigation control. A high union rate achieved without fixation of MEO and no revision is the main strength of this study.

Conclusion

Medial epicondylar osteotomy without fixation in CAS TKA can give good functional outcomes, deformity correction without complications, and a high bony union rate.

References

1. Kwak IH, Lee SS, Lee J, et al. Effects of severe varus deformity on soft tissue balancing in total knee arthroplasty. J Clin Med 2022;12(1):263. DOI: 10.3390/jcm12010263.
2. Colyn W, Cleymans A, Bruckers L, et al. The lateral joint line opening: A radiographic indicative parameter for high grade varus knees. J Exp Orthop 2022;9(1):51. DOI: 10.1186/s40634-022-00489-5.
3. Meloni MC, Hoedemaeker RW, Violante B, et al. Soft tissue balancing in total knee arthroplasty. Joints 2014;2(1):37–40. PMID: 25606540.
4. Mirzatolooei F, Tabrizi A, Taleb H, et al. Primary results of medial epicondylar osteotomy in patients with severe bilateral varus knee candidate for total knee replacement. J Knee Surg 2021;34(2):142–146. DOI: 10.1055/s-0039-1694047.
5. Gupta S, Service BC, Service J, et al. Novel fixation of medial epicondyle fractures in a throwing athlete using suture bridge technique. JSES Int 2020;5(1):13–17. DOI: 10.1016/j.jseint.2020.10.004.
6. Mullaji AB, Shetty GM. Surgical technique: Computer-assisted sliding medial condylar osteotomy to achieve gap balance in varus knees during TKA. Clin Orthop Relat Res 2013;471(5):1484–1491. DOI: 10.1007/s11999-012-2773-x.
7. Koyonos L, Slenker N, Cohen S. Complications in brief: Osteotomy for lower extremity malalignment. Clin Orthop Relat Res 2012;470(12):3630–3636. DOI: 10.1007/s11999-012-2392-6.
8. Engh GA. Medial epicondylar osteotomy: A technique used with primary and revision total knee arthroplasty to improve surgical exposure and correct varus deformity. Instr Course Lect 1999;48:153–156. PMID: 10098039.
9. Stan G. Medial epicondyle osteotomy for balancing severe varus knee. IntechOpen; 2020. DOI: 10.5772/intechopen.89740.
10. Horia O, Gabriel S, Dragusanu M, et al. Medial epicondyle osteotomy: A method of choice in severe varus knee arthroplasty. Eur J Orthopaedic Surg Traumatol 2011;22(7):577–583. DOI: 10.1007/s00590-011-0895-6.
11. Pathak C, Chattaraj A, Hazra S, et al. A simple surgical technique for correction of varus deformity in advanced osteoarthritis of knees by medial femoral condylar sliding osteotomy-description of procedure and short term outcome-a prospective study. Indian J Orthop 2024;58(8):1079–1091. DOI: 10.1007/s43465-024-01158-8.
12. Sim JA, Na YG, Go JY, et al. Clinical and radiologic evaluation of medial epicondylar osteotomy for varus total knee arthroplasty. Knee 2018;25(1):177–184. DOI: 10.1016/j.knee.2017.11.004.
13. Mihalko WM, Saeki K, Whiteside LA. Effect of medial epicondylar osteotomy on soft tissue balancing in total knee arthroplasty. Orthopedics 2013;36(11):e1353–e1357. DOI: 10.3928/01477447-20131021-14.
14. Kim MW, Koh IJ, Kim JH, et al. Efficacy and safety of a novel three-step medial release technique in varus total knee arthroplasty. J Arthroplasty 2015;30(9):1542–1547. DOI: 10.1016/j.arth.2015.03.037.
15. Nisar S, Palan J, Rivière C, et al. Kinematic alignment in total knee arthroplasty. EFORT Open Rev 2020;5(7):380–390. DOI: 10.1302/2058-5241.5.200010.
16. Lee S-S, Jung J, Kim H, et al. The effect of severe varus deformity on clinical and radiographic outcomes in mechanical aligned total knee arthroplasty with medial stabilizing technique. J Clin Med 2024;13(6):1595. DOI: 10.3390/jcm13061595.

CASE REPORT

Robotic-assisted Simultaneous Bilateral Total Knee Arthroplasty in a Treated Case of Deep Vein Thrombosis

Prasanna Deshpande[1], Kingshuk Ganguly[2], Gaurav Yadav[3], Sanjeev Jain[4]

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Abstract

Background: Severe osteoarthritis of both knees is a common condition among the elderly, often resulting in restricted mobility and painful knee joints. Total knee arthroplasty (TKA) is the treatment of choice in end-stage knee arthritis, providing dramatic and significant improvement in function and mobility. However, deep vein thrombosis (DVT) and pulmonary thromboembolism (PTE) following TKA remain dreaded complications, posing a challenge for planning TKA; nevertheless, with thorough assessment of risk factors, conducting appropriate investigations, and adopting a multidisciplinary approach, the risk of DVT and PTE can be significantly reduced even in patients with a history of DVT who need to undergo simultaneous bilateral TKA.

Case description: We present the case of a 71-year-old housewife with severe osteoarthritis of bilateral knees, with a previously diagnosed and medically managed case of DVT of the left lower limb. Robotic-assisted simultaneous bilateral TKA was performed with anticoagulant coverage. Postoperatively, there was no evidence of recurrence or propagation of DVT and/or PTE, and the patient recovered uneventfully till the 6-month follow-up.

Conclusion: Prevention of recurrence of DVT or fatal thromboembolism is of utmost importance after TKA, especially in patients with a prior history of DVT, as its recurrence rate in such patients is significantly high. This can be achieved by the placement of inferior vena cava (IVC) filters or through pharmacological prophylaxis. With detailed imaging, meticulous planning, and prophylactic treatment, robotic-assisted simultaneous bilateral TKA can be beneficial for such patients instead of the conventional simultaneous bilateral TKA.

Keywords: Case report, Deep vein thrombosis, Robotic total knee arthroplasty, Simultaneous bilateral TKA.

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Introduction

Deep vein thrombosis (DVT) is a known complication in patients undergoing total knee arthroplasty (TKA). It can lead to prolonged hospital stay and increased costs, delay the rehabilitation, and can further lead to pulmonary thromboembolism (PTE).[1] The incidence of DVT after joint replacement has been extensively studied in different populations. In the Western population, around 69% of patients who undergo TKA without prophylaxis against DVT develop asymptomatic DVT.[2] Studies of the Asian population show the rate of asymptomatic DVT to be 26.6–60.8% after TKA without DVT prophylaxis and the rate of symptomatic DVT to be 1.9%. While recent studies show that DVT and PTE are seen less commonly in Asian populations as compared to Western populations, previous studies have reported that the incidence is comparable in both populations.[3–5] Deep vein thrombosis, as described by Virchow, is associated with alterations in the vessel walls, flow of blood, and coagulability.[1] The rate of recurrence of DVT in patients with a previous history of DVT is approximately 30% over 10 years.[6] The clinical features of DVT are rest pain in the calf with passive stretch pain, pitting edema, and increased temperature of the limb.[7] Pulmonary thromboembolism may be seen in patients without any signs of DVT, hence, investigations to diagnose DVT are necessary.[8] Venous Doppler, being non-invasive, is the easiest and the most readily available investigation modality with a sensitivity of 89% and a specificity of 100%.[9] We present a case report of a patient who underwent robotic-assisted simultaneous bilateral TKA for severe advanced osteoarthritis of both knees with a prior history of DVT of the left lower limb. Robotic-assisted knee arthroplasty has gained popularity in recent times, with studies reporting a lower incidence of systemic complications like DVT in robotic-assisted knee arthroplasty as compared to non-robotic, conventional knee arthroplasty.[10] The patient had a history of DVT of her left lower limb 10 years ago, which was treated with oral direct factor 10 inhibitors (Rivaroxaban) for 6 months, following which she was asymptomatic. Analysis of patient-related risk factors and surgery-related complications, like DVT, was done. This case report is unique as robotic-assisted simultaneous bilateral TKA in a patient with a history of DVT has not been reported in the literature, to the best of our knowledge.

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Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

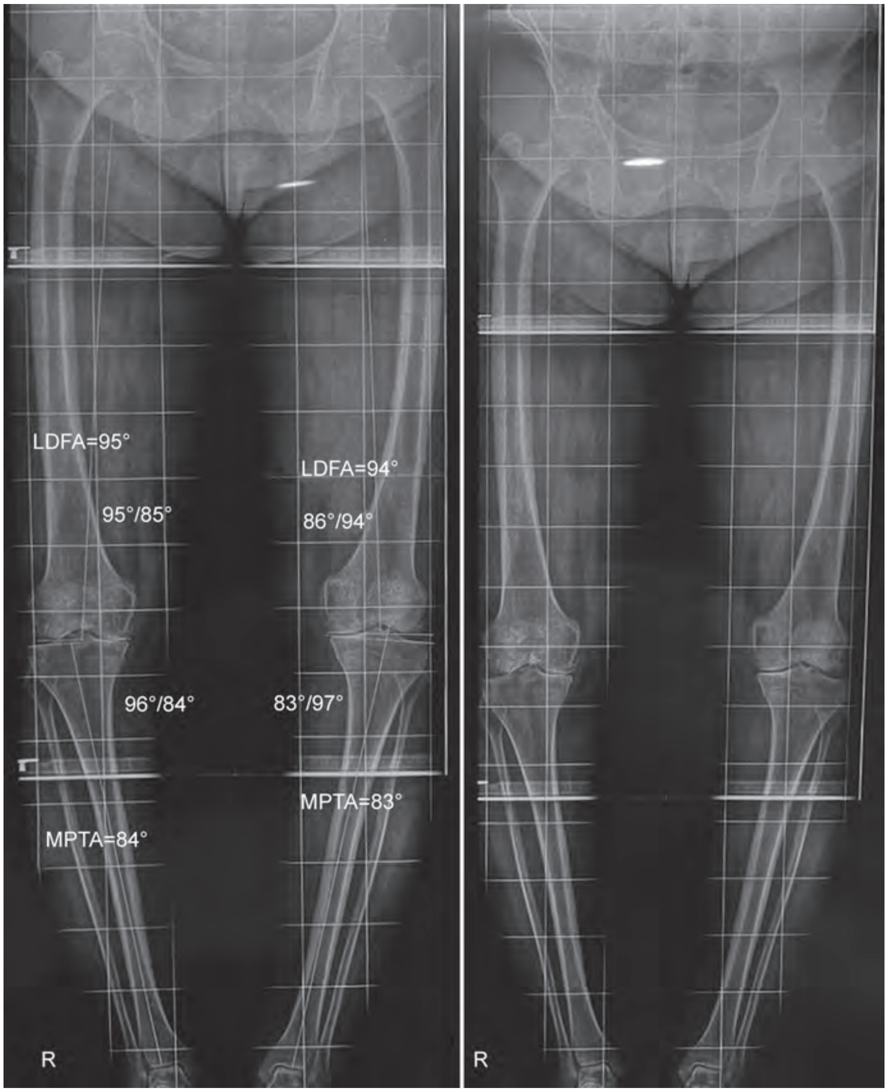

Fig. 1: Preoperative scanogram of both knees

Case Description

A 71-year-old housewife came to us with complaints of pain in both knees for the past 5 years, which was insidious in onset, gradually progressive, and had aggravated in the last 6 months, affecting her activities of daily living and severely restricting her mobility. The patient was a known case of hypertension being treated with oral antihypertensives and had a history of DVT in her left leg 10 years ago, which was treated with anticoagulants (oral direct factor 10 inhibitors) for 6 months. The anticoagulants were discontinued, and the patient showed no signs and/or symptoms of DVT upon presentation. Clinically, she had severe varus deformity of 20° with fixed flexion deformity of both knees, medial joint line tenderness, and painful knee flexion. Distal pulses of both legs were palpable, and Homan's sign was negative. X-rays of both knees showed grade 4 osteoarthritis of both knees with multiple osteophytes and varus deformity (Figs 1 and 2). Doppler ultrasound of both lower limbs was done and was suggestive of chronic, partially recanalized thrombus in the left external iliac vein. The patient was evaluated by a vascular surgeon, interventional radiologist, and cardiologist, following which she underwent computed tomography (CT) angiography of left lower limb vessels which revealed that the lumen of the left external iliac vein was completely obliterated with formation of large collaterals running from left CFV to right (Fig. 3). Hence, as per the opinion of the interventional radiologist, the findings were suggestive of total obliteration of left external iliac vein and there was no risk of PTE from the previous thrombus and the patient could undergo the surgery with just anticoagulant coverage as prophylaxis for recurrence without inferior vena cava (IVC) filter placement. The patient also underwent dobutamine stress echo as part of routine pre-operative cardiac evaluation, which was negative for inducible ischemia. The patient had severe pain while walking, and her functions were grossly restricted, hence, she insisted on scheduling the surgery at the earliest. Upon literature search, we found that a similar case was not reported in the written literature. Surgical procedures are commonly done in patients with DVT after placement of an IVC filter to prevent intraoperative and postoperative thromboembolism.[6–8] The purpose of the IVC filter is to block the embolus, if dislodged from the leg veins, from reaching the pulmonary vasculature.

Simultaneous bilateral robotic-assisted TKA was done with cruciate retaining rotating platform prosthesis under combined

Fig. 2: Preoperative standing anteroposterior, lateral, and skyline view X-rays of both knees

Fig. 3: Computed tomography venography of the left lower limb. Axial section showing left leg venous thrombus and rich collaterals

spinal and epidural anesthesia by the same surgeon after stopping anticoagulants for 7 days before the day of surgery (Figs 4 to 6). Tourniquet was inflated for the right knee, but it was not used for the left knee in view of the history of DVT of left leg veins. The wound was closed in layers without any drain. Postoperatively, the patient was started on oral rivaroxaban (10 mg once a day), and continued

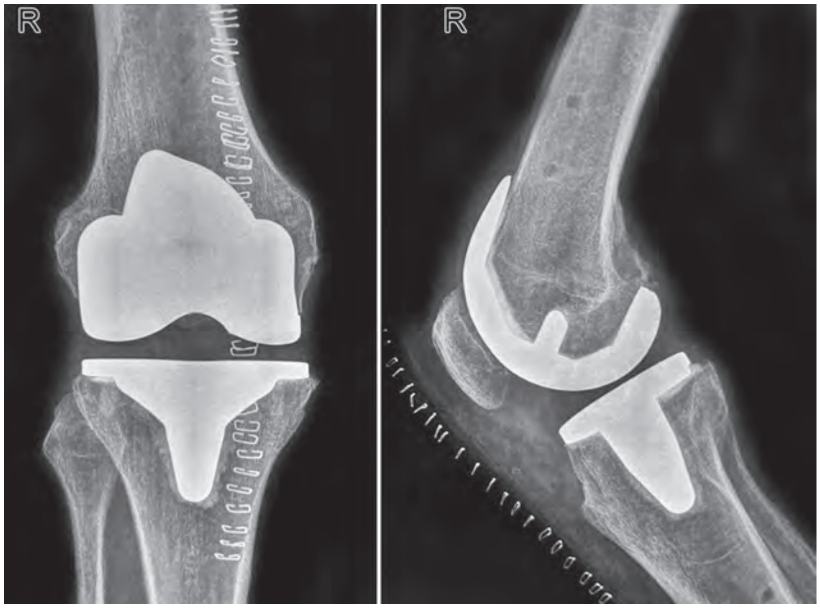

Fig. 4: Postoperative anteroposterior and lateral X-ray of right knee

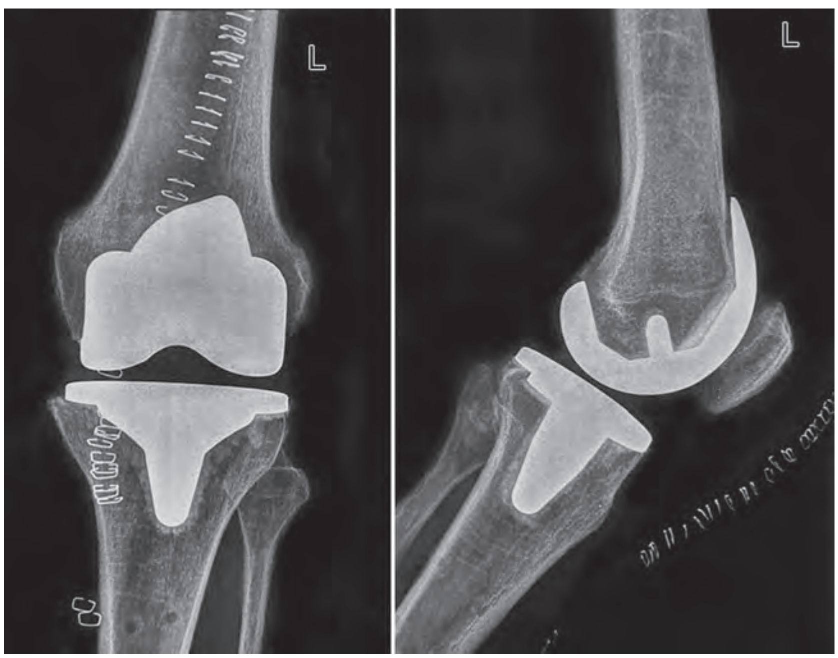

Fig. 5: Postoperative anteroposterior and lateral X-ray of left knee

for 4 weeks. No mechanical prophylaxis for DVT was used as the patient was mobilized with a walker on the day of surgery. Static quadriceps exercises with knee range of motion exercises were started in the evening once motor function had recovered from regional anesthesia. Surgical wound check was done 48 hours after the surgery, and was found to be healthy. The patient was discharged satisfactorily with oral anticoagulant coverage and daily home physiotherapy. The wound healed uneventfully, and stitches were removed after 2 weeks. Pain had subsided completely over 3 months. Doppler ultrasound of both lower limbs was done at third-month follow-up, which showed no evidence of new DVT or propagation of existing thrombus in the veins of the bilateral lower limbs. At 6 months follow-up, the patient is now doing well, mobilizing pain-free with a good range of motion without any evidence of DVT or PE.

Discussion

Severe osteoarthritis of both knee joints leads to severely compromised mobility in the patient. Total knee arthroplasty (TKA), being the best treatment option for such patients, needs to be planned meticulously, as DVT is a known complication post-TKA. Prior history of VTE is the leading risk factor for an increased rate of VTE postoperatively.[11] The rate of symptomatic DVT in the

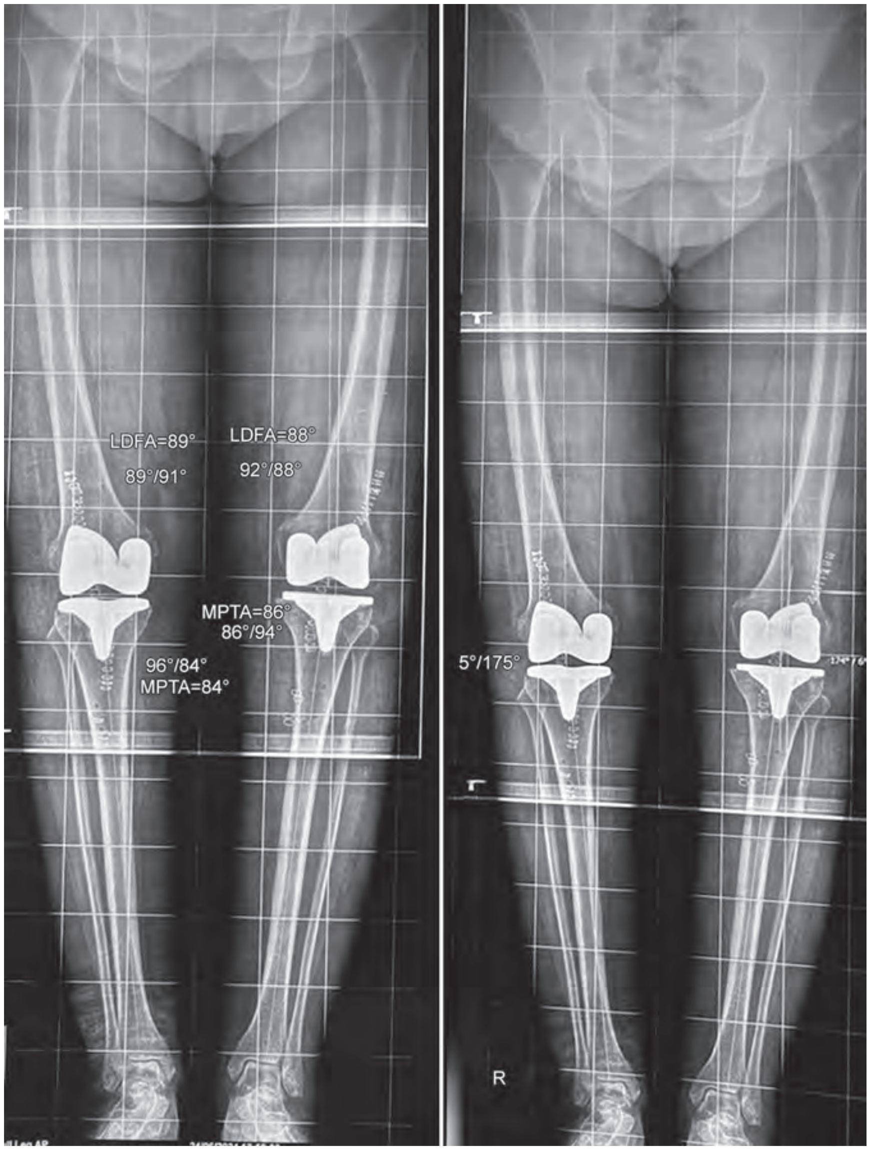

Fig. 6: Postoperative scanogram of both knees

Asian population undergoing TKA was found to be approximately 1.9%.[3] Contrary to the previous belief that patients undergoing simultaneous bilateral TKA had a higher incidence of complications like mortality, blood transfusion, and PE, which was demonstrated by Fu et al., recent studies have found that simultaneous bilateral TKA was not associated with increased risk of these complications.[12,13] Although the incidence of DVT in patients undergoing TKA is significant, the incidence of fatal PE is low, as has been reported in studies by Stulberg et al.[14] (0%), Stringer et al.[15] (0%), Khaw et al.[16] (0.2%), and Ansari et al.[17,18] (0.4%). Weeks 3 and 4 post-surgery have the major risk for a fatal pulmonary embolism. Factors like prolonged inactivity or bed rest, high body mass index, chronic smoking, and disorders like vasculitis and varicose veins increase the chances of DVT.[19]

Our patient had a history of DVT in her left external iliac vein 10 years ago, which was managed with direct oral factor 10 inhibitor (Rivaroxaban). Recently, she had marked restriction of activities of daily living owing to the severe osteoarthritis of both knees. To prevent the recurrence of DVT after TKA, the patient had to be mobilized early. Also, preventing the dislodgement of the thrombus, leading to fatal PTE, was critical. In a case of DVT, according to the literature, 6% of uninvolved contralateral extremities may show thrombus formation, whereas thrombosis of new segments occurs in 30% of involved limbs and rethrombosis of a partially occluded or recanalized segment in 31% of extremities. The thrombus may propagate in the ipsilateral limb in less than 40 days after the development of DVT, whereas rethrombosis and extension of the thrombus to the opposite limb usually tend to occur late.[8] Luminal obliteration and formation of rich collaterals in the superficial veins can be seen in 30% of patients with chronic DVT.[20] In consultation with a vascular surgeon and interventional radiologist, since the external iliac vessel on the left side was completely obliterated and rich collaterals were formed between the right and left common femoral vein, we decided to go ahead with robotically-assisted simultaneous bilateral TKA with just anticoagulant coverage and without placement of IVC filter. Deep vein thrombosis prophylaxis, post TKA, broadly includes two strategies of pharmacological prophylaxis and mechanical prophylaxis. Pharmacological prophylaxis can be done with low molecular weight heparin, antithrombotic agents, or direct factor 10 inhibitors. Mechanical prophylaxis includes early mobilization and intermittent compression devices.[21] Recent literature on pharmacological DVT prophylaxis shows that aspirin is being used more commonly for DVT prophylaxis post TKA as compared to enoxaparin and rivaroxaban.[22–24] However, we used oral rivaroxaban (10 mg once daily) for prophylaxis of DVT as rivaroxaban is reported to be better than Aspirin to prevent recurrence of DVT.[25]

There is a scarcity of literature about undertaking robotic-assisted simultaneous bilateral TKA in a diagnosed and treated case of DVT, and we could not find reporting of any similar case, to the best of our knowledge. In a study by Ofa et al.,[10] which analyzed the incidence of postoperative complications following robotic-assisted and conventional knee arthroplasty noted that complications like DVT and PE were significantly less in the robotic-assisted cohort.[10] Hence, we decided to offer this patient a robotic-assisted knee arthroplasty after explaining the benefits. Robotic-assisted TKA is less invasive to soft tissues,[26] which may be advantageous for early discharge and resumption of activities of daily living.[10] Furthermore, robotic-assisted TKA does not require insertion of an intramedullary guiding rod for preparation of femoral bone, which may reduce the invasiveness in terms of the venous circulation.[10] Agarwal et al.[27] reported a case of unilateral TKA in a diagnosed case of DVT in which they implanted a retractable IVC filter before surgery to prevent thromboembolism. A study by Muratani et al.[28] reported the use of an IVC filter in a case of ankle fracture for the prevention of thromboembolism intraoperatively.[28] Similarly, Rosenthal et al.[29] reported the use of a temporary IVC filter before treating patients of polytrauma surgically. They could not use anticoagulants due to the increased risk of bleeding from fracture sites, which could be fatal for polytrauma patients. Seto et al.[30] also reported the implantation of an IVC filter intraoperatively in patients with past DVT undergoing hysterectomy for uterine leiomyoma to prevent PE. Our study has a limitation as the duration of follow-up is 6 months only.

Conclusion

We conclude that robotic assisted simultaneous bilateral TKA can be beneficial as compared to conventional TKA in a patient with a history of DVT of leg veins, after adequate planning and adopting a multidisciplinary approach to effectively prevent recurrence or propagation of DVT or PTE post the surgery giving the patient a better quality of life without any delay.

Clinical Significance

Patients with a prior history of unprovoked DVT have a high risk of recurrence. Concomitant bilateral knee osteoarthritis warrants TKA of both knee joints to improve the quality of life of the patient, which inherently is associated with the risk of DVT. With advanced techniques like Robotic-assisted TKA, early mobilization post-surgery, and pharmacological prophylaxis of DVT, simultaneous bilateral TKA can be done successfully in such patients.

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References

1. Bagot CN, Arya R. Virchow and his triad: A question of attribution. Br J Haematol 2008;143(2):180–190. DOI: 10.1111/j.1365-2141.2008.07323.x.
2. Chang MJ, Song MK, Kyung MG, et al. Incidence of deep vein thrombosis before and after total knee arthroplasty without pharmacologic prophylaxis: A 128-row multidetector CT indirect venography study. BMC Musculoskelet Disord 2018;19:1–6. DOI: 10.1186/s12891-018-2166-8.
3. Lee WS, Kim KI, Lee HJ, et al. The incidence of pulmonary embolism and deep vein thrombosis after knee arthroplasty in Asians remains low: A meta-analysis. Clin Orthop Relat Res 2013;471:1523–1532. DOI: 10.1007/s11999-012-2758-9.
4. Dhillon KS. Postoperative deep-vein thrombosis in Asian patients is not a rarity. J Bone Joint Surg B 1996;78:427–430. PMID: 8636180.
5. Kim YH, Kim JS. Incidence and natural history of deep-vein thrombosis after total knee arthroplasty: A prospective, randomised study. J Bone Joint Surg Br 2002;84(4):566–570. DOI: 10.1302/0301-620x.84b4.12330.
6. Kyrle PA, Kammer M, Eischer L, et al. The long-term recurrence risk of patients with unprovoked venous thromboembolism: An observational cohort study. J Thromb Haemost 2016;14(12):2402–2409. DOI: 10.1111/jth.13524.
7. Tapson VF, Carroll BA, Davidson BL, et al. The diagnostic approach to acute venous thromboembolism. Clinical practice guideline. American Thoracic Society. Am J Respir Crit Care Med 1999;160(3):1043–1066. DOI: 10.1164/ajrccm.160.3.16030.
8. Lambie JM, Mahaffy RG, Barber DC, et al. Diagnostic accuracy in venous thrombosis. Br Med J 1970;2(5702):142–143. DOI: 10.1136/bmj.2.5702.142.
9. Markel A, Weich Y, Gaitini D. Doppler ultrasound in the diagnosis of venous thrombosis. Angiology 1995;46(1):65–73. DOI: 10.1177/000331979504600109.
10. Ofa SA, Ross BJ, Flick TR, et al. Robotic total knee arthroplasty vs conventional total knee arthroplasty: A nationwide database study. Arthroplasty Today 2020;6(4):1001–1008. DOI: 10.1016/j.artd.2020.09.014.
11. Simon SJ, Patell R, Zwicker JI, et al. Venous thromboembolism in total hip and total knee arthroplasty. JAMA Netw Open 2023;6(12):e2345883. DOI: 10.1001/jamanetworkopen.2023.45883.
12. Dong F, Li G, Kai C, et al. Comparison of clinical outcome between simultaneous-bilateral and staged-bilateral total knee arthroplasty: A systematic review of retrospective studies. J Arthroplasty 2013;28:1141–1147. DOI: 10.1016/j.arth.2012.09.023.
13. Richardson SS, Kahlenberg CA, Blevins JL, et al. Complications associated with staged versus simultaneous bilateral total knee arthroplasty: An analysis of 7747 patients. Knee 2019;26(5):1096–1101. DOI: 10.1016/j.knee.2019.06.008.
14. Stulberg BN, Insall JN, Williams GW, et al. Deep-vein thrombosis following total knee replacement: An analysis of six hundred and thirty-eight arthroplasties. J Bone Joint Surg Am 1984;66:194. PMID: 6693445.
15. Stringer MD, Steadman CA, Hedges AR, et al. Deep vein thrombosis after elective knee surgery: An incidence study in 312 patients. J Bone Joint Surg Br 1989;71:492. DOI: 10.1302/0301-620X.71B3.2785998.
16. Khaw FM, Moran CG, Pinder IM, et al. The incidence of fatal pulmonary embolism after knee replacement with no prophylactic anticoagulation. J Bone Joint Surg Br 1993;75:940. DOI: 10.1302/0301-620X.75B6.8245087.
17. Ansari S, Warwick D, Ackroyd CE, et al. Incidence of fatal pulmonary embolism after 1,390 knee arthroplasties without routine prophylactic anticoagulation, except in high-risk cases. J Arthroplasty 1997;12:599. DOI: 10.1016/s0883-5403(97)90131-5.
18. Giachino A. Relationship between deep-vein thrombosis in the calf and fatal pulmonary embolism. Can J Surg 1988;31(2):129–130. PMID: 3349377.
19. Coiteux I, Mazzolai L. Deep vein thrombosis: Epidemiology, risk factors and natural history. Praxis (Bern 1994) 2006;95(12):455–459. DOI: 10.1024/0369-8394.95.12.455.
20. Park EA, Lee W, Lee MW, et al. Chronic-stage deep vein thrombosis of the lower extremities: Indirect CT venographic findings.

J Comput Assist Tomogr 2007;31(4):649–656. DOI: 10.1097/RCT.0b013e31803151d9.

21. Mont MA, Jacobs JJ. AAOS clinical practice guideline: Preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty. Am Acad Orthop Surg 2011;19(12):777–778. DOI: 10.5435/00124635-201112000-00008.
22. Dubin JA, Bains SS, Hameed D, et al. Trends in deep vein thrombosis prophylaxis after total knee arthroplasty: 2016 to 2021. J Arthroplasty 2024;39(8S1):S328–S332. DOI: 10.1016/j.arth.2024.01.050.
23. Sidhu VS, Kelly TL, Pratt N, et al. Effect of aspirin vs enoxaparin on symptomatic venous thromboembolism in patients undergoing hip or knee arthroplasty: The CRISTAL randomized trial. JAMA 2022;328(8):719–727. DOI: 10.1001/jama.2022.13416.
24. Lavu MS, Porto JR, Hecht CJ, et al. Low-dose aspirin is the safest prophylaxis for prevention of venous thromboembolism after total knee arthroplasty across all patient risk profiles. JBJS 2021:10:2106. DOI: 10.2106/JBJS.23.01158.
25. Weitz JI, Lensing AW, Prins MH, et al. Rivaroxaban or aspirin for extended treatment of venous thromboembolism. N Engl J Med 2017;376(13):1211–1222. DOI: 10.1056/NEJMoa1700518.
26. Hampp EL, Sodhi N, Scholl L, et al. Less iatrogenic soft-tissue damage utilizing robotic-assisted total knee arthroplasty when compared with a manual approach: A blinded assessment. Bone Joint Res 2019;8(10):495–501. DOI: 10.1302/2046-3758.810.BJR-2019-0129.R1.
27. Agarwal S, Rana A, Gupta G, et al. Total knee arthroplasty in a diagnosed case of deep vein thrombosis: Our experience and review of literature. J Orthop Case Rep 2017;7(1):16–19. DOI: 10.13107/jocr.2250-0685.668.
28. Muratani T, Tsunemi K, Yazu M, et al. Case of trimalleolar ankle fracture managed by placement of a temporary inferior vena cava filter by an anesthesiologist. Masui 2014;63(8):682–685. PMID: 24979865.
29. Rosenthal D, Wellons ED, Levitt AB, et al. Role of prophylactic temporary inferior vena cava filters placed at the ICU bedside under intravascular ultrasound guidance in patients with multiple trauma. J Vasc Surg 2004;40(5):958–964. DOI: 10.1016/j.jvs.2004.07.048.
30. Seto A, Fukuyama H, Niijima K, et al. Anesthetic management of a patient with deep venous thrombosis using a temporary inferior vena cava filter. Masui 2000;49(3):302–304. PMID: 10752327.

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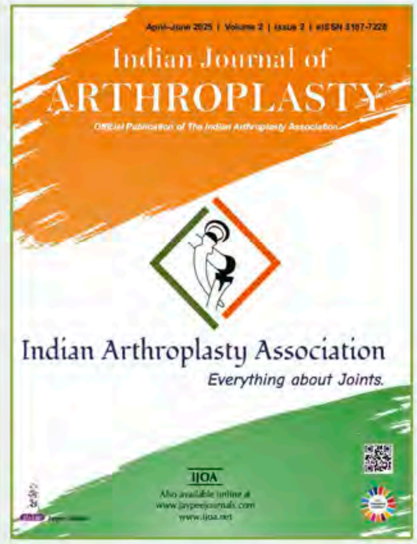

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