

Management of distal femoral periprosthetic fractures by distal femoral locking plate: A retrospective study.

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ABSTRACT

Background: Management of periprosthetic supracondylar femoral fractures is difficult. Osteoporosis, comminution and bone loss, compromise stability with delayed mobility and poor functional outcomes. Open reduction and internal fixation (ORIF) with anatomic distal femoral (DF) locking plate permits early mobilization. However, this usually necessitates bone grafting (BG). Biological fixation using minimally invasive techniques minimizes periosteal stripping and morbidity.

Materials and Methods: 31 patients with comminuted periprosthetic DF fractures were reviewed retrospectively from October 2006 to September 2012. All patients underwent fixation using a DF locking compression plate (Synthes). 17 patients underwent ORIF with primary BG, whereas 14 were treated by closed reduction (CR) and internal fixation using biological minimally invasive techniques. Clinical and radiological followup were recorded for an average 36 months.

Results: Mean time to union for the entire group was 5.6 months (range 3-9 months). Patients of ORIF group took longer (Mean 6.4 months, range 4.5-9 months) than the CR group (mean 4.6 months, range 3-7 months). Three patients of ORIF and one in CR group had poor results. Mean knee society scores were higher for CR group at 6 months, but nearly identical at 12 months, with similar eventual range of motion.

Discussion: Locked plating of comminuted periprosthetic DF fractures permits stable rigid fixation and early mobilization. Fixation using minimally invasive biological techniques minimizes morbidity and may obviate the need for primary BG.

Key words: Biological fixation, distal femur, locking plate, periprosthetic fracture, total knee arthroplasty

MeSH terms: Femoral fractures, bone plates, arthroplasty, knee

INTRODUCTION

Periprosthetic fractures occur relatively rarely,^{1,2} but can pose significant challenges in approach and treatment.¹⁻³ Of these fractures,^{2,3} supracondylar fractures of femur after total knee arthroplasty (TKA) are the most common and present unique treatment challenges. The limited bone available for adequate distal fixation (due to the underlying prosthesis) and the relative osteoporosis and comminution usually seen in this region contribute to difficulties in management.^{4,5} Treatment options have

traditionally been conservative (immobilization/plaster cast application), open/closed reduction (CR) and internal fixation and revision arthroplasty⁶ These fractures were initially shown to be associated with anterior notching of the femur during the primary and revision^{4,7} TKA. However, factors attributable to the development of these fractures are many.^{3,4,7-9} These include osteoporosis, female gender, poor patient compliance, inflammatory conditions such as rheumatoid arthritis (RA), intraoperative cortical perforation/notching, preoperative femoral deformities, biomechanics of the limb after joint arthroplasty, revision surgery, co-existent osteolysis.^{3,4,7-9}

The aim of treatment of periprosthetic supracondylar femoral fractures is to provide early function and rehabilitation and avoid complications.^{8,10} Conservative treatment is now rarely advocated.¹⁰⁻¹² Osteoporosis, comminution and bone loss compromise stability of standard trauma implants.^{3,11,13,14} Conventional plates and nails do not provide adequate stability to permit early mobility or weight bearing and are prone to high rates of fixation failure.^{4,10,15,16} Supracondylar femoral nails have shown the best results in many series¹⁷⁻²⁰ when performed using a proper surgical technique. The anatomic distal femoral locking compression plates (DF-LCP) have

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somewhat simplified management of this otherwise difficult clinical entity, as they afford angular stability through rigid fixation of the fragments, while yet permitting mild elasticity of the fracture (stimulating callus formation)^{5,21,22} and can be used using an open or a closed technique.^{23,24} The less invasive stabilization system (LISS) system has been used with variable results in different surgical hands, but is not without its share of complications.^{20,25,26} Open reduction and internal fixation (ORIF) of this fracture usually involves soft tissue stripping near the prosthesis, de-vascularizing the already weakened supracondylar femoral region,^{3,6} Due to the extensive stripping sometimes needed to attain good anatomic reduction and due to the associated severe comminution, there is a high risk of delayed union and nonunion.^{11,14,15} Primary bone grafting (BG) is therefore usually indicated and almost routinely performed.^{2,5,10,11} The biological fixation using minimally invasive technique prevents soft tissue injury, minimizes need for primary BG and reduces morbidity.²³⁻²⁵

We analysed results of comminuted periprosthetic distal femoral fractures by distal femoral locking plate.

MATERIALS AND METHODS

31 consecutive patients with periprosthetic supracondylar femoral fractures operated between October 2006 and September 2012 were included in this study. Eight males and twenty three females, with an average age of 71.5 years (range 58-82 years) with primary cemented total knee replacements (TKR) sustained periprosthetic femoral fractures at an average of 78 months (range 18-144 months) postoperatively. Twenty five patients had cruciate-sacrificing TKR and six patients had cruciate-retaining TKR at the time of primary surgery. Causes for the fracture were minor falls

at home ($n = 20$), direct blunt trauma by an object ($n = 4$) and a road traffic accident ($n = 7$) [Table 1a].

Inclusion criteria were displaced fractures with radiologically stable prostheses who were medically fit for surgical fracture fixation procedure. All patients had comminuted fractures proximal to the femoral prosthesis, with some diaphyseal extension. All the femoral prostheses seemed radiologically well fixed and this was confirmed intraoperatively (with consent to revise if the component was found loose). 26 patients were American Society of Anesthesiology grade III and above, with co-morbidities such as diabetes mellitus, cardiac disease, chronic kidney disease, chronic bronchitis and polyarticular RA [Table 1a]. 23 patients were operated under combined spinal epidural anesthesia, whereas eight had general anesthesia. Of the 31 patients, 17 were operated using an open reduction method (ORIF group), while 14 were fixed biologically by (CR group). The approach was chosen on preoperative reducibility of the fracture under image guidance. In the ORIF group, skin incision followed the previous scar, with standard medial parapatellar approach. The fracture was reduced and fixed with the DF-LCP plate (Synthes Inc., Bettlach, Switzerland) applied on the lateral surface of the distal femur [Figure 1a-c]. All ORIF group patients were bone grafted at the time of surgery (cancellous chips harvested from ipsilateral iliac crest). Patients in the CR group were placed supine with suitably positioned towel rolls under the knee and thigh (9 patients) or on the fracture table with traction (5 patients) and their fractures reduced preoperatively under image intensifier. Minimally invasive technique was used to apply the DF-LCP plate (Synthes Inc., Bettlach, Switzerland) on the lateral surface in spanning mode [Figure 2a-c]. None of these fractures were primarily bone grafted.

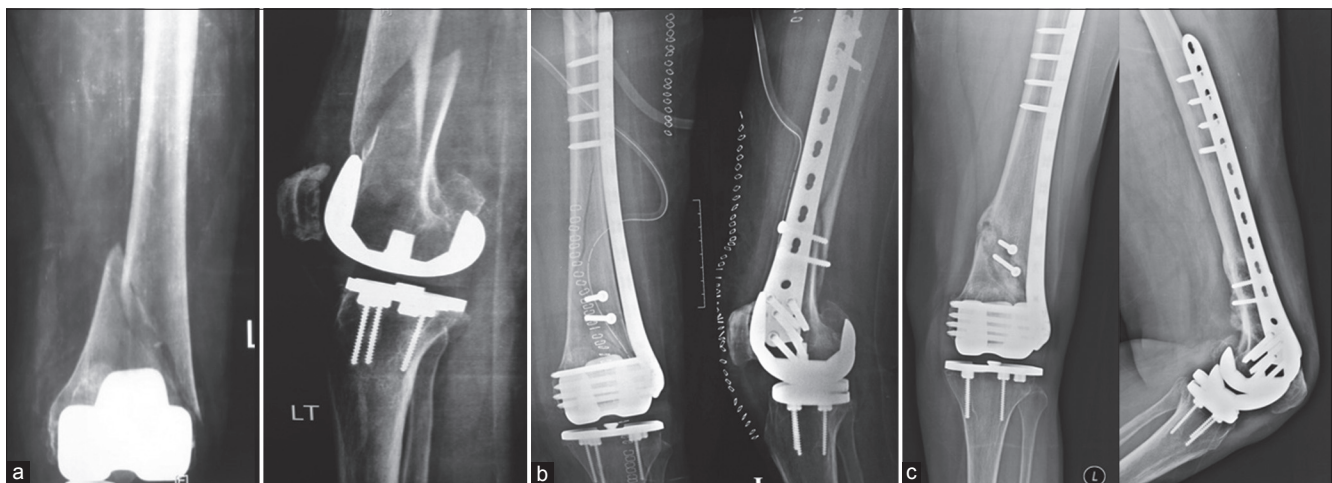


Figure 1: X-ray of knee joint with femur anteroposterior and lateral views showing (a) supracondylar periprosthetic fracture around total knee arthroplasty (b) Immediate postoperative X-ray of fracture fixed by open reduction and internal fixation (biological plating) (c) At 6 months postoperatively fracture showing union

Table 1a: Demographic details of patients

Age (Years)	Sex	Primary surgery	Implant type	Time to fracture (months)	Premorbid findings			Preoperative morbidity				Surgery ORIF/CR
					Etiology	Preoperative ambulatory status	Independent ADL	DM	HTN	CAD	Other	
74	M	B/I TKR	CS	37	Fall	St	Yes	-	Yes	-	-	ORIF
69	F	Rt. TKR	CS	56	Fall	Un	Yes	Yes	Yes	-	RA	ORIF
78	F	Lt. TKR	CS	18	RTA	Un	Yes	-	Yes	-	-	ORIF
71	F	Rt. TKR	CRe	109	Fall	Un	Yes	Yes	Yes	Yes	CKD	ORIF
78	M	Lt. TKR	CS	108	Blunt trauma	Un	Yes	Yes	Yes	-	-	ORIF
55	F	B/I TKR	CRe	18	Fall	Un	Yes	-	-	-	RA	CR
66	F	Lt. TKR	CS	62	RTA	Un	Yes	-	-	-	-	ORIF
82	M	Lt. TKR	CS	144	Blunt trauma	St	Yes	-	Yes	Yes	-	ORIF
67	F	B/I TKR	CS	84	Fall	W	No	Yes	Yes	Yes	RA	ORIF
71	M	Lt. TKR	CS	64	Fall	Un	Yes	Yes	Yes	-	-	CR
69	F	B/I TKR	CS	96	Fall	Un	Yes	Yes	Yes	-	RA	CR
74	F	Rt. TKR	CS	56	Fall	Un	Yes	-	Yes	-	Bronc	ORIF
60	F	Lt. TKR	CS	116	RTA	Un	Yes	-	-	-	-	ORIF
78	F	Lt. TKR	CS	24	RTA	Un	Yes	Yes	Yes	-	-	ORIF
71	F	Lt. TKR	CS	102	Fall	St	Yes	-	Yes	-	-	ORIF
78	F	B/I TKR	CS	60	Fall	Un	Yes	Yes	Yes	-	RA	CR
65	F	Rt. TKR	CS	112	Fall	Un	Yes	Yes	-	-	-	ORIF
66	F	Lt. TKR	CRe	121	Fall	Un	Yes	-	Yes	-	-	CR
71	M	B/I TKR	CS	71	Fall	Un	Yes	Yes	Yes	Yes	Bronc	CR
67	F	Lt. TKR	CS	84	Fall	Un	Yes	Yes	Yes	-	-	ORIF
72	F	B/I TKR	CRe	64	Fall	Un	Yes	Yes	Yes	Yes	RA	ORIF
69	F	Rt. TKR	CS	104	Fall	Un	Yes	-	Yes	-	-	ORIF
79	F	Rt. TKR	CRe	60	RTA	Un	Yes	-	Yes	-	RA	CR
69	F	Lt. TKR	CS	80	RTA	Un	Yes	-	Yes	-	-	CR
78	M	Lt. TKR	CS	64	Fall	St	Yes	-	Yes	Yes	-	CR
71	F	B/I TKR	CS	104	Fall	Un	Yes	-	Yes	-	RA	CR
78	M	Lt. TKR	CS	58	Blunt trauma	Un	Yes	Yes	Yes	-	CKD	CR
77	F	Lt. TKR	CS	60	RTA	Un	Yes	Yes	Yes	Yes	-	CR
66	F	B/I TKR	CS	110	Fall	Un	Yes	-	-	-	-	CR
81	M	Lt. TKR	CRe	50	Blunt trauma	St	Yes	Yes	Yes	-	CKD	CR
67	F	B/I TKR	CS	122	Fall	Un	Yes	-	Yes	-	-	ORIF

TKR=Total knee replacement, CS=Cruciate-sacrificing, CRe=Cruciate-retaining, RTA=Road traffic accident, Un=Unsupported, St=Stick, W=Walker frame, ADL=Activities of daily living, DM=Diabetes mellitus, HTN=Hypertension, CAD=Coronary artery disease, RA=Rheumatoid arthritis, CKD=Chronic kidney disease, Bronc=Chronic bronchitis, ORIF=Open reduction internal fixation, CR=Closed reduction

Postoperatively, a standardized physiotherapy regimen was conducted for all patients (both groups), with passive and active-assisted knee bending, quadriceps and range of motion (ROM) exercises and nonweight bearing walking (walking frame) was started from days 2 to 4 (as per pain tolerance). Deep venous thrombosis prophylaxis was instituted in all cases as per our institutional protocol (subcutaneous enoxaparin once daily from the evening of surgery till discharge). Patients were discharged at an average of 4.5 days postoperatively (range 3-9 days). All patients were evaluated clinically and radiologically at 6 weekly intervals up to 6 months (or until fracture union) and 6 monthly thereafter. Average followup was 42 months (range, 6-72 months) in the ORIF group and 30 months (range, 6-60 months) in the CR group.

Outcome measures included radiological fracture union (including time to union), associated complications (deformity, limp, stiffness), need for secondary surgical procedure (BG, refixation); clinical and functional scoring (modified knee society scores [KSS]), pain and overall patient satisfaction (using visual analog scale). Results were classified as excellent, good and poor based on these parameters. Patients needed to have all the criteria of that category (or higher) to be classified such [Table 2].

RESULTS

In the 17 patients of the ORIF group, mean time to radiological union was 6.4 months (range 4.5-9 months) [Figure 1c]. The mean modified KSS clinical score improved

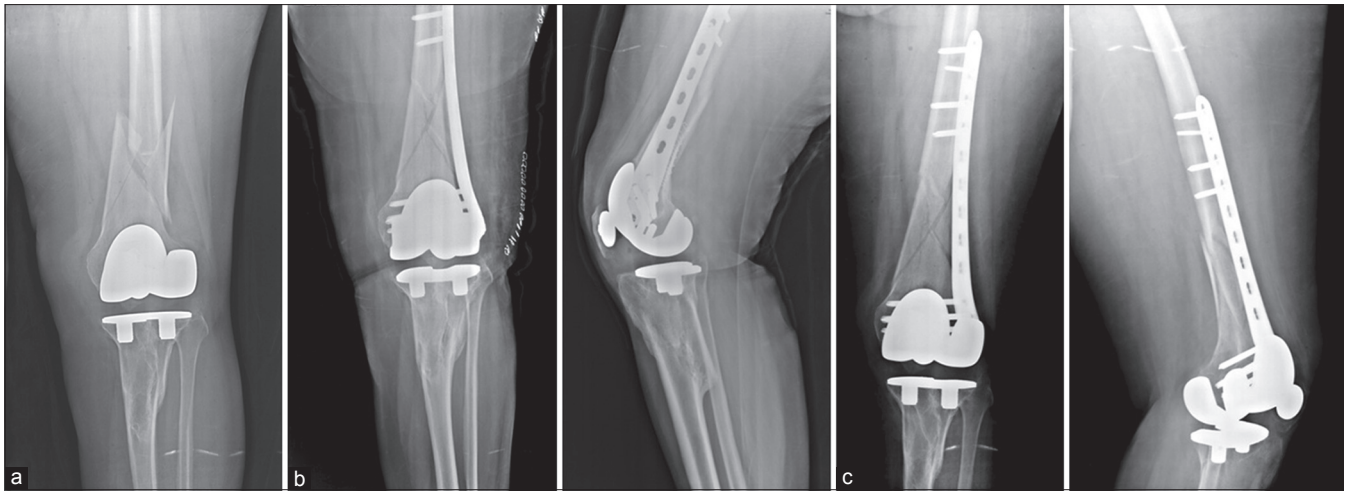


Figure 2: (a) Preoperative X-ray of knee joint with thigh showing supracondylar periprosthetic fracture in total knee arthroplasty (b) Immediate postoperative X-ray anteroposterior and lateral views showing fracture fixed by closed reduction (biological plating) (c) At 4.5 months followup postoperative X-ray anteroposterior and lateral views of same patient showing union

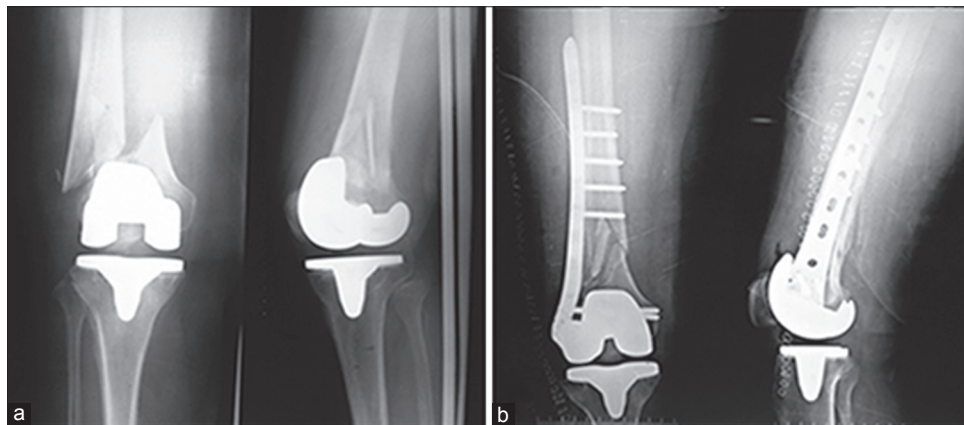


Figure 3A: X-rays of knee joint with thigh anteroposterior and lateral views showing (a) periprosthetic fracture in total knee arthroplasty (b) open reduction and internal fixation of periprosthetic fracture

from 56 at 6 months to 72 at 12 months, while mean function scores improved from 51 at 6 months to 62 at 12 months. Mean pain scores improved from 2.1 at 6 months to 0.9 at 12 months. The mean ROM achieved at the final followup was 90° (range 55-100°). Two patients had superficial infection, of which one needed prolonged antibiotics for 6 weeks and this patient eventually developed persistent antalgic limp, while the other settled (without any sequela) after an additional week of oral antibiotics. One patient had persistent knee stiffness (ROM of 5-60°) due to pain, with a persistent stiff-legged antalgic limp in spite of no clinical or radiological evidence of any pathology. One other patient had delayed union (no evidence of callus and persistent fracture gap at 4.5 months) [Figures 3A and 3B (a)] and underwent a resurgery in the form of additional plating and BG [Figure 3B (b)]. She eventually demonstrated radiological union after an additional 4.5 months, but had persistent painless limp. These three patients were considered poor results (complication rate of 17.6% [3/17]). Except for the two patients with persistent stiff-legged

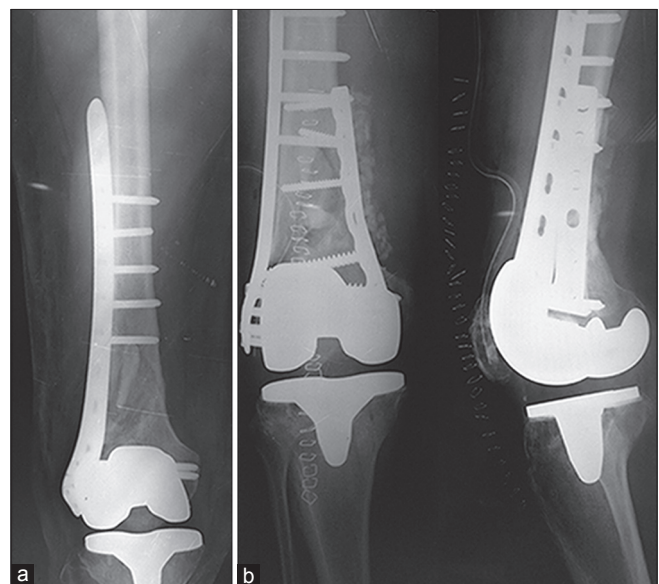


Figure 3B: (a) X-rays knee joint with thigh anteroposterior view showing nonunion at 4.5 months (b) Postoperative X-rays of resurgery showing additional medial plate, secondary bone grafting

antalgic limp, all other patients (15/17) were satisfied with their surgery, with a satisfaction rate of 88.2%.

In the fourteen patients of the CR group, mean time to radiological union was 4.6 months (range 3-7 months) [Figure 2c]. The mean modified KSS clinical score improved from 74 at 6 months to 79 at 12 months, while mean function scores improved from 62 at 6 months to 72 at 12 months. Similarly, pain scores improved from 1.0 at 6 months to 0.3 at 12 months. The mean ROM achieved at final followup was 100° (range 60-110°). No patient had infection or knee stiffness. However, one patient had a mild valgus malalignment. She had persistent pain and radiological evidence of delayed union (absent callus at 4.5 months), but refused BG; with eventual union but

persistent painless limp at 7 months and was considered a poor result (complication rate of 7.1% [1/14]). This patient was the only one dissatisfied with the procedure, leaving us with a patient satisfaction rate of 92.8% (13/14). No patient was lost to followup [Table 1b].

Analysis of our results revealed an overall union rate of 96.8% (30/31), with secondary BG procedure needed in only 1 patient (resurgery rate of 3.2%). Overall, we achieved a good or excellent clinical result in 87.1% (27/31 patients), with a low rate of complications, viz., superficial infection in 6.5% (2/31), persistent knee stiffness in 3.2% (1/31) and persistent knee pain in 6.4% (2/31) respectively. Barring 2 patients in the ORIF group (persistent stiff-legged antalgic limp) and one in

Table 1b: Results (n=31)

Case	6 months FU				12 months FU				Time to radiological fracture union (months)	Complications	Need for resurgery
	Clinical score	Functional score	Pain score (VAS)	ROM (°)	Clinical score	Functional score	Pain score (VAS)	ROM (°)			
1	42	37	3	0-90	70	55	1	0-95	7.5	Nil	-
2	52	43	2	10-90	74	57	2	5-100	6	Nil	-
3	70	61	2	0-110	80	79	0	0-100	6	Nil	-
4	46	55	3	10-50	68	57	1	0-90	6	Superficial infection	-
5	70	55	1	10-80	84	63	0	0-100	6	Nil	-
6	82	51	1	5-100	84	65	0	5-100	5	Nil	-
7	36	37	3	0-100	68	45	1	0-100	4.5	Nil	-
8	48	47	2	0-75	66	57	2	0-90	7.5	Superficial infection	6 weeks antibiotics
9	38	25	4	10-60	34	29	3	5-60	9	Persistent painful knee stiffness	-
10	80	61	0	0-95	84	75	0	0-105	4.5	Nil	-
11	88	53	0	0-80	90	69	0	0-90	3	Nil	-
12	54	53	2	0-90	80	71	0	5-105	6	Nil	-
13	60	57	1	5-100	82	77	0	0-100	6	Nil	-
14	88	81	0	0-100	90	87	0	0-100	4.5	Nil	-
15	31	43	3	0-90	68	61	1	0-100	6	Nil	-
16	78	55	2	5-80	80	61	1	5-90	5	Nil	-
17	42	41	3	5-100	70	59	1	5-100	9	NU at 4.5 months	ReORIF+BG
18	86	69	1	0-100	88	87	0	0-105	4	Nil	-
19	62	37	2	0-75	64	69	0	0-80	5	Nil	-
20	72	63	3	5-60	72	71	1	0-100	7.5	Nil	-
21	70	65	2	0-80	84	63	0	0-100	6	Nil	-
22	64	54	1	0-80	68	68	1	0-80	6	Nil	-
23	38	32	3	5-60	66	45	2	0-60	7	Delayed union, malalignment	Advised, refused
24	68	77	0	10-120	78	80	0	5-115	3	Nil	-
25	76	71	1	0-100	80	81	0	0-110	4.5	Nil	-
26	62	73	0	10-90	74	84	0	0-90	4.5	Nil	-
27	68	69	2	0-100					6	Nil	-
28	80	75	1	5-100					3	Nil	-
29	90	77	0	0-100					4.5	Nil	-
30	76	71	1	0-90					5	Nil	-
31	56	57	1	0-90					6	Nil	-

ORIF=Open reduction internal fixation, VAS=Visual analogue scale, ROM=Range of motion, BG=Bone grafting

Table 2: Modified system followed in this study

Result	Radiological union	Final followup				Special criteria					Patients
		KSS clinical score	KSS function score	Pain score (VAS)	Ability to sit (ROM arc)	Independent ADL	Return to prefracture mobility	Satisfaction with procedure	Complications	Re-surgery	
Excellent	Yes	>70	>50	0-1	Easily (>90)	Yes	Yes	Very satisfied	None	No	25
Good	Yes	51-69	41-49	2	With mild difficulty (61-90)	Yes	Yes	Somewhat satisfied	Not affecting ambulation/ADL	No	2
Poor	No	<50	40	>2	With severe difficulty/unable (<50)	No	No	Not satisfied	Affecting ambulation/ADL	Yes	4

KSS=Knee society score, VAS=Visual analogue scale, ROM=Range of motion, ADL=Activities of daily living

the CR group (valgus malunion with persistent painless limp), all other patients seemed to be satisfied with their procedure, giving us an overall 90.3% (28/31) patient satisfaction rate.

Twenty four of the 31 patients (77.4%) had an excellent result according to our modified assessment system, while 3 (9.7%) had a good result [Table 2]. All fractures eventually united. Mean time to union was 5.6 months (range 3-9 months). At final followup, all but one patient had returned to their prefracture mobility status. No patient underwent revision TKA for any cause during the followup period.

DISCUSSION

Supracondylar femoral fractures are the most common of all periprosthetic fractures around a TKA prosthesis.¹⁻³ Incidences reported³ have ranged from 0.3% to 2.5% after primary TKA and 1.6-38% after revision TKA. The incidence increases in RA, presumably due to the associated osteopenia/osteoporosis, which is more evident if the patient has been on recent or concurrent corticosteroid treatment.^{1,27} Patients with previous surgery on the distal femur (revision of femoral osteotomy, fracture of the distal femur, arthrodesis), those with significant loss of bone stock (posterior stabilized prosthesis), or poor bone quality (RA) and elderly patients with neurological impairment and frequent falls, are all at higher risk.^{1,4,27} Anterior femoral notching has repeatedly been blamed,⁷ but this is a contributing cause only when associated with other risk factors.⁴

The aim of treatment in fractures of the distal femur proximal to the TKA prosthesis is to achieve a painless stable knee without significant residual malalignment or malfunction.^{3,10,13} Early mobilization and function are essential in obtaining a good result.^{10,13} Though the system described by Rorabeck and Taylor² is followed, a classification system that takes into account the prosthetic stability, the distal bone quality and fracture reducibility helps in better categorization of the surgical management

of these fractures and thus a treatment algorithm for these difficult fractures can be developed.^{3,27}

Many different treatment options have been introduced over time.^{24,25,28-32} Intramedullary nails are best for proximal fractures, fixed-angle devices for fractures originating at the component and revision arthroplasty for very distal fractures or those with implant loosening.^{27,33} Retrograde intramedullary rod fixation appears to be the treatment of choice when feasible.^{17-20,26} Even complex DF fractures above TKAs treated by retrograde femoral nailing have demonstrated uncomplicated postoperative followups with early return to weight-bearing.^{11,14-20} The other advantages of nailing include use of the previous incision, maintenance of an undisturbed periosteal blood supply with consequent early fracture consolidation (biological healing) and early weight bearing.^{17-20,26} However, retrograde nailing may not be compatible with all TKA designs and thus alternate fracture fixation implant options exist.^{25,29-32}

Challenges in the surgical management of fractures by ORIF are associated comminution at the fracture (with bone impaction and bone loss, at times)⁵ Consequently, this fixation may need to be protected in a cast brace till radiological evidence of bone healing. Plate osteosynthesis has been regarded as an acceptable procedure in patients >70 years of age with periprosthetic femoral fractures, even with slightly loosened prostheses.^{16,24,34,35} The purported advantages included reasonably acceptable success rates, a short preoperative waiting period and faster recovery.^{11,24,35} However, results depend primarily on the basic principles of good anatomic reduction and rigid fixation with care taken to prevent varus deformity and/or posterior displacement of the femoral component.^{23,26} Early mobilization and weight bearing is frequently not permissible as these constructs are not load sharing and provide inadequate angular stability.¹⁵ Many a time, standard plate or nail constructs achieve limited distal fixation, leading to loss of fixation and varus angulation.^{23,26} Other traditional implants like the lower femoral (cobra) plates and the condylar blade plates³⁶ are too bulky. The angular-stable locked plates seem to overcome this disadvantage. Early

results with the LISS have been superior vis-à-vis standard plates in osteoporotic bone,^{11,20,25} though there are potential problems with the minimally invasive technique.²⁶

Reoperation for fixation failure has been shown to occur at a mean of 22 months after initial fixation of a periprosthetic femoral fracture and therefore immediate postoperative stability of constructs is of moderate clinical importance only.^{13,15} Our nonunion rate of 3.2% is very low (one patient developing nonunion and needing a secondary procedure) with no fixation failure (0%). Though our follow up is short (average 36 months), none of the patients in our series has needed revision for fixation or TKA implant failure (0% revision TKA rate).

Considering the associated comminution and poor bone quality seen in patients with this fracture, routine primary BG has been recommended.^{11,14,15} Associated loss of bone stock may demand augmentation by structural allografts^{27,37} or metallic augments. Recent studies^{23,24} have however suggested that adjuvant bone graft materials may not be routinely necessary when treating periprosthetic femur fractures using lateral plates and biological reduction and fixation techniques. In our CR group, we have achieved bone union without need of primary or secondary BG in every patient. In a study by Erhardt³⁴ *et al.* described a noncontact bridging plate with polyaxial screws and angular-stable construct with 90% union rates. The results obtained in our series match the excellent results obtained with supracondylar nailing as well that with locked contoured plates in other series.^{16,23,24}

Further, when used biologically (as a slide plate after achieving adequate fracture reduction), it has shown to reduce, if not obviate, the need for BG, as seen in our patients in the CR group, where no patient needed primary (or secondary BG), thus minimizing the morbidity associated with a second surgical procedure on this elderly patient. Just as the clinical and functional recovery is faster following nailing, patients treated by biological plating also have faster return to function and mobility, as shown in the higher (though not statistically significant) 6-month modified KSS clinical and functional scores in the CR group when compared to the ORIF group seen in our series.

The analysis of the results in our series (albeit only of 31 cases) have let us examine the cause of failure and predict outcomes following surgical management of an implant-stable periprosthetic supracondylar femoral fracture and the amenability of these fractures to biological fixation methods. The reducibility of a fracture is a practical problem and influences the surgical approach and fixation device. This can be subjective and some surgeons may claim to reduce all fractures closed, whereas many will attempt a CR and if unsuccessful, would proceed to ORIF. Our classification system and surgical protocol relies on this treatment-based approach. Ability to preoperatively reduce a fracture under image guidance can permit a surgeon to attempt the biological minimally invasive method to fix these fractures. This algorithm [Figure 4] has been influenced by the classification system proposed by Kim²⁷ *et al.* and the algorithm defined for management of periprosthetic fractures around a hip replacement by

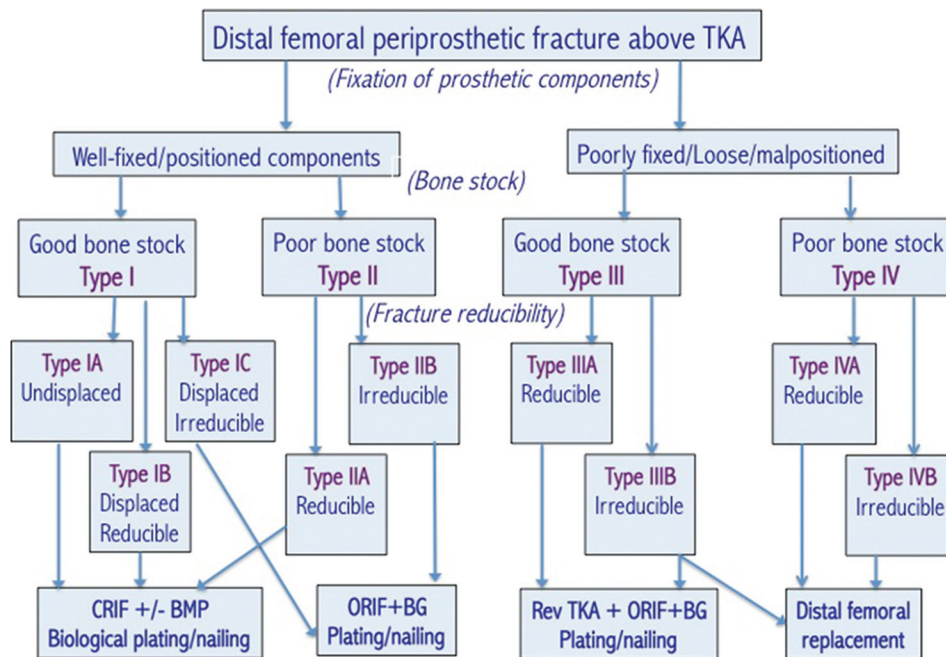


Figure 4: Practical treatment-based classification and treatment algorithm for periprosthetic fractures of the distal femur

Corten *et al.*³³ Further, indications (and contraindications) for biological plating and need for additional primary BG have also been better defined [Figure 4].

The DF-LCP plate used with appropriate surgical principles provides adequate fracture fixation, permits early mobilization and when combined with a minimally invasive technique may obviate the need for primary BG. However, optimal implant choice is dictated by the type and level of fracture, the stability and type of TKA implant and the familiarity and experience of the surgeon with biological and locking plate principles.

Though our study sample size is small and the results short-term, we recommend the DF LCP plate as a suitable fixation device for fixation of supracondylar periprosthetic femoral fractures.

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