

Complex AO type C3 distal femur fractures: Results after fixation with a lateral locked plate using modified swashbuckler approach

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ABSTRACT

Background: Complex AO type C3 fractures of the distal femur are challenging injuries, fraught with complications such as malunion and stiffness. We prospectively evaluated a consecutive series of patients with complex AO type C3 distal femur fractures to determine the clinoradiological outcome after fixation with a single locked plate using modified swashbuckler approach.

Materials and Methods: 12 patients with C3 type distal femur fractures treated with a lateral locked plate, using a modified swashbuckler approach, were included in the study. The extraarticular component was managed either by compression plating or bridge plating (transarticular approach and retrograde plate osteosynthesis) depending on the fracture pattern. Primary bone grafting was not done in any case. The clinical outcome at 1 year was determined using the Knee Society Score (KSS). The presence of any secondary osteoarthritis in the knee joint was noted at final followup.

Results: All fractures united at a mean of 14.3 ± 4.7 weeks (range 6–26 weeks). There were no significant complications such as nonunion, deep infection, and implant failure. One of the patients underwent secondary bone grafting at 3 months. The mean range of motion of the knee was $120^\circ \pm 14.8^\circ$ (range 105° – 150°). Seven patients had excellent, three patients had good and two patients had a fair outcome according to the KSS at 1 year. At a mean followup of 17.6 months, three patients showed radiological evidence of secondary osteoarthritis of the knee joint. However, only one of these patients was symptomatic.

Conclusion: The results of complex C3 type distal femur fractures, fixed with a single lateral locked plate using a modified swashbuckler approach, are encouraging, with a majority of patients achieving good to excellent outcome at 1 year.

Key words: Distal femur fracture, complex distal femur fractures, intraarticular distal femur fractures, swashbuckler approach

MeSH terms: Femoral fractures, bone plates, fracture fixation, trauma

INTRODUCTION

Management of AO type C3 distal femur fractures with multifragmentary articular involvement is challenging, with most series reporting average to poor results and frequent complications such as malunion, knee stiffness, and secondary osteoarthritis.¹⁻¹¹ Only a few studies¹⁻⁶ have exclusively reported the outcome of complex

C3 type fractures of the distal femur, with only three such studies^{1,2,5} published in English literature. Various surgical approaches have been suggested to achieve an adequate exposure of the distal femoral articular surface, including medial/lateral parapatellar approaches,^{7,12} swashbuckler approach,¹³ tibial tubercle osteotomy,^{5,14} and combined medial and lateral approaches.³ External ring fixators have been used with mixed results by several previous authors^{1,2} to address the comminution in these complex injuries. Some have used dual medial and lateral plates in these.³⁻⁵ Most previous authors have employed primary bone grafting to enhance union in these complex fractures.^{1,4} The use

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of swashbuckler approach for C3 fractures has not been reported yet in the literature.

We have reported the results in a consecutive series of patients with C3 type distal femur fractures, operated by a single surgeon in a tertiary level trauma center, with a single lateral locked plate (distal femur locking compression plate [DF-LCP]), using a modified swashbuckler approach, without primary bone grafting.

MATERIALS AND METHODS

12 consecutive adult patients operated with open reduction and internal fixation of distal femur fractures with multifragmentary articular involvement (AO/OTA type 33C3), between September 2012 and March 2014 were included in this prospective study. Extraarticular fractures (type A), partial articular fractures (type B) and simple articular fractures (type C1 and C2) of the distal femur were not included in the study. Patients with ipsilateral fractures in the same lower extremity and pathological fractures were excluded from the study to avoid confounding of results. Open fractures were not excluded.

All patients were initially managed according to advanced trauma life support guidelines.¹⁵ The fractured limb was splinted in a Bohler-Braun frame, with the application of skin traction. Patients with open wounds received immediate wound lavage and were put on intravenous antibiotics. Patients were taken up for surgery after routine preoperative workup. All the patients were operated within 10 days of the initial trauma.

Radiological evaluation included anteroposterior and lateral X-rays of the femur with knee, along with a pelvic X-ray to rule out proximal fractures. Computed tomography (CT) scans with three-dimensional reconstruction were done, whenever feasible, to better delineate the fracture anatomy and to allow detailed subgroup classification. Four of the 12 patients could not afford a CT scan and were operated based on plain films.

The AO/OTA classification¹⁶ was used to further classify the C3 fractures up to the subgroup level, based on the severity of extra-articular involvement [Figure 1]. The extra-articular component was also described according to the AO/OTA subgroup classification of 33A fractures [Figure 2], which is more detailed and useful in the management of the extra-articular component.

Operative procedure

All the patients were operated in the supine position on a radiolucent table by the senior author (AA), who also has a considerable experience in knee arthroplasties [Figures 3 and 4]. The swashbuckler approach described

by Starr *et al.*¹³ was used in all cases. We made a few modifications to the original approach. An anterolateral, rather than an anterior midline, incision was made. If eversion of the patella was tight, the lateral attachment of the patellar tendon was released to ease eversion, similar to our practice in total knee arthroplasties. We used a leg-holding tray from our total knee arthroplasty set [Figure 3] to facilitate limb positioning in varying degrees of flexion. In full flexion, an excellent exposure of the distal articular surface of the femur (including the posterior part of the medial femoral condyle) is obtained [Figures 3 and 4].

The articular block was reconstructed first, which was subsequently reattached to the metadiaphysis. The distal femur articular surface was carefully inspected for all fracture lines, and the fracture classification was confirmed. The provisional reduction was done with pointed clamps and K-wires, followed by insertion of lag screws. The usual sequence of reduction was first, any sagittal split of posterior condyles, followed by the coronal splits (Hoffa/trochlear fragments), addressing the intercondylar component last.

Osteochondral fragments were fixed with headless or countersunk screws (for large fragments >1 cm) or K-wires (for intermediate fragments 5–10 mm). Our patient population cannot afford biodegradable pins, otherwise we would have preferred them over K-wires. K-wires were put in a divergent fashion, preferably purchasing the far cortex (bicortical) and were cut flush with the articular surface (lost K-wire technique). Small osteochondral fragments (<5 mm) were excised. Chondral fragments were similarly fixed with K-wires or excised.

After anatomical reconstruction and rigid fixation of the articular block, attention was diverted to the extra-articular fracture, with repeat assessment of the fracture pattern. Our philosophy of management of the extra-articular component in distal femur fractures is as follows. We prefer open reduction and compression plating (hybrid fixation) for simple metaphyseal fractures (AO types A1.2, A1.3) or those with an intact wedge (AO type A2.1). Fractures with wedge comminution (AO type A2.2, A2.3) or segmental comminution (AO type A3.1, A3.2, A3.3) were managed by indirect reduction and bridge plating using transarticular approach and retrograde plate osteosynthesis (TARPO) technique.⁷ The length, alignment, and rotation were carefully restored similar to the normal side. Medial dissection was avoided in all cases to preserve the biology, and primary bone grafting was not done in any case. The anterolateral incision can be easily extended proximally, as in a standard lateral approach, if open compression plating of the fracture is to be done.

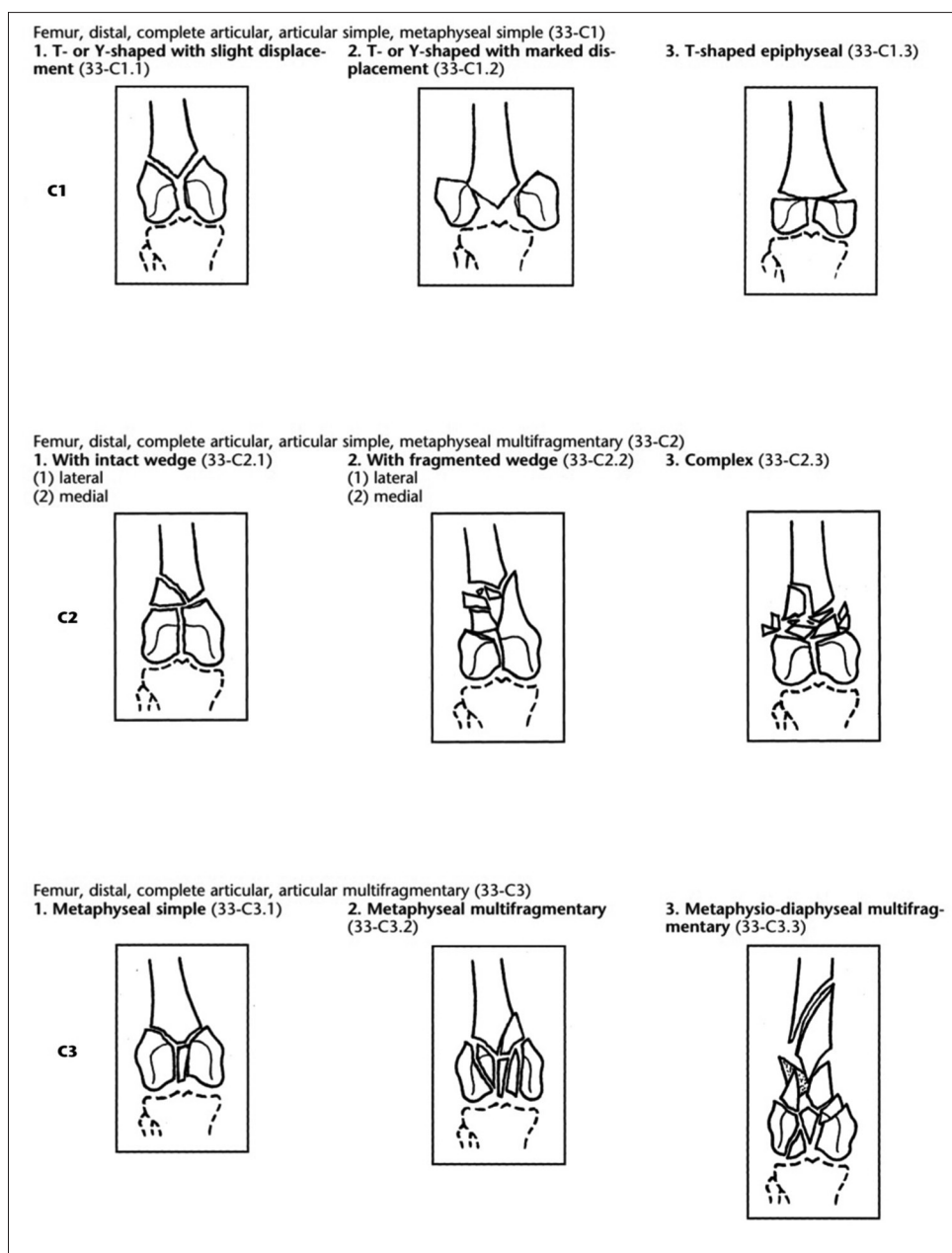


Figure 1: AO/OTA classification of distal femur type C fractures

The implant used was a distal femur LCP made of stainless steel (SSEPL, Vadodara, India). It provides provision of inserting up to three 6.5 mm locking cancellous screws, and up to four additional 5 mm locking screws in the articular block. We aimed to put four to five locked screws in the articular block, and four bicortical screws in the metadiaphysis (in case of compression plating) or three to five locking screws (in bridge plating). The working length of a bridge plate was kept at least 2.5 times the working length of the fracture, with a screw density ratio of 0.4–0.5.

Postoperative rehabilitation

The knee was mobilized on the 1st or 2nd postoperative day, depending on the degree of postoperative pain. Touchdown

or partial weight-bearing was begun, depending on the fracture stability, and progressed to full weight bearing upon fracture union at 6–12 weeks. The patients were discharged only after 90° flexion of the knee was achieved, usually by the 4th or 5th postoperative day.

Clinicoradiological evaluation

The clinical and radiological evaluation was done by the junior author (VK), who was not a part of the operating team. The patients were clinically examined at the time of discharge from hospital for any malrotation or limb length discrepancy. A limb malrotation <5° and a limb length discrepancy <5 mm were difficult to detect clinically and were considered normal. A repeat clinical examination was

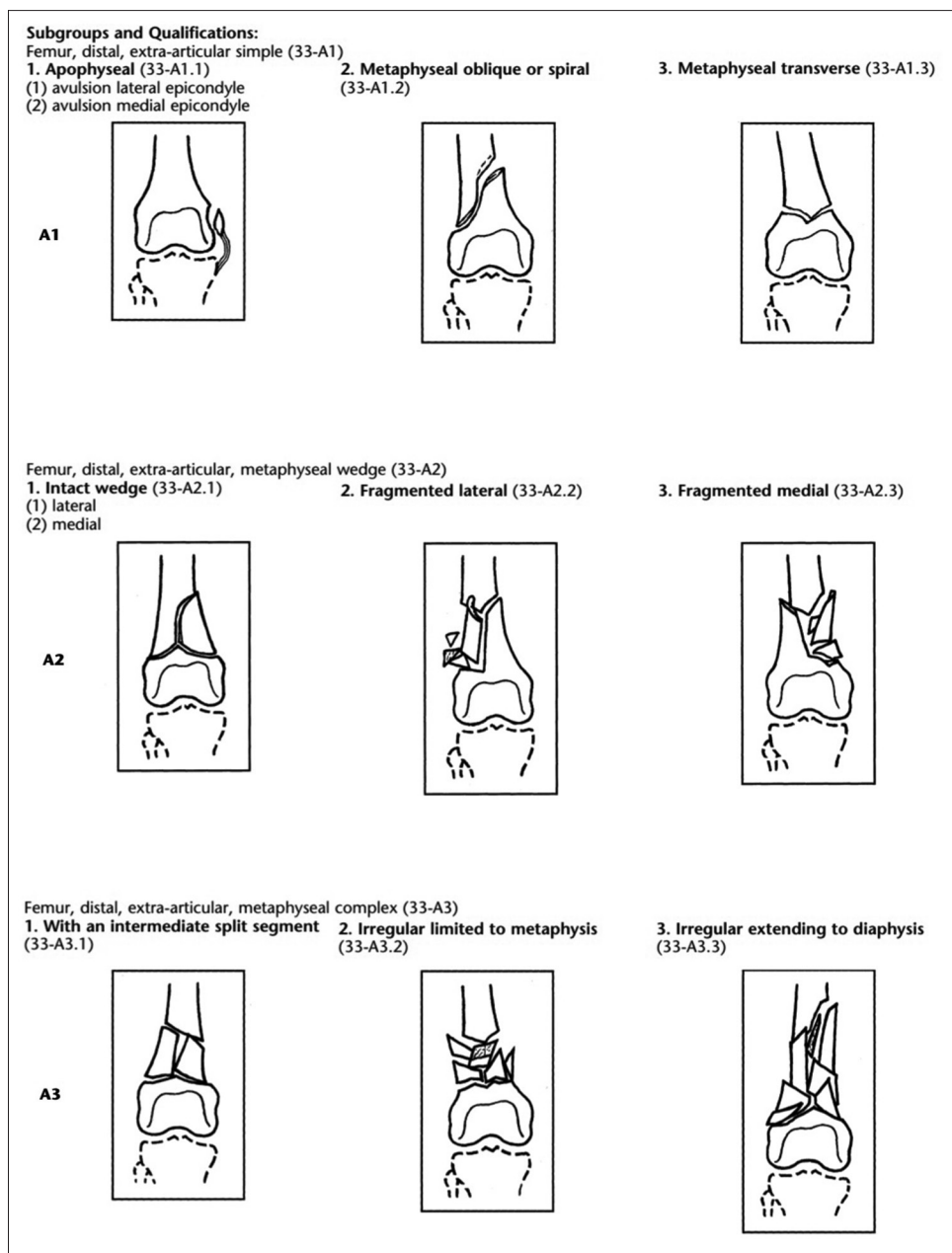


Figure 2: AO/OTA classification of distal femur type A fractures

done at the final fracture healing to note any further change in limb length and rotation.

AP and lateral radiographs of the femur with knee were taken immediately after surgery and were evaluated for fracture alignment, both in the coronal and sagittal planes. Fracture alignment in the coronal plane was measured by the valgus angle between the anatomic axes of the femoral and tibial shafts. A 5°–10° valgus angle was considered as normal as in the Knee Society Score (KSS).¹⁷ The alignment in the sagittal plane was measured by noting the angulation between the anterior cortices of the proximal and distal fragments. Sagittal plane angulation within 5° of the opposite side was considered as normal.

The patients were followed up at every 6 weeks until bony union was achieved at both the articular and metaphyseal fracture sites, and the subsequent followup was done every 3 months for the 1st year, biannually in the 2nd year, and annually thereafter. AP and lateral radiographs of the femur with knee were taken at each visit and evaluated for callus formation/progression and fracture union. In cases with simple articular and extra-articular fractures, managed by open compression plating, direct bone healing can be difficult to determine radiologically and was determined using clinical criteria such as painless weight-bearing and absence of pain/tenderness at the fracture site. Any loss of reduction, plate lift-off, screw back-out or screw/plate breakage was recorded. Any

other complication such as superficial or deep infection was also recorded.

At 1 year followup, the KSS¹⁷ was recorded, including the knee and functional subsets. A Knee Society Knee Score between 80 and 100 was regarded as excellent, between 70 and 79 was regarded as good, between 60 and 69 was regarded as fair, and <60 was regarded as poor.¹⁸

The 1-year and subsequent radiographs were also evaluated for any change of secondary osteoarthritis, such as narrowing of joint space, development of osteophytes, and subchondral cysts or sclerosis, both in the tibiofemoral and patellofemoral compartments. Skyline views of the knee were included in these to evaluate for patellofemoral arthritis.

Statistical analysis

Statistical analysis was done using the SPSS 19.0 statistical software (IBM SPSS, New York, USA). Only descriptive analysis was done to calculate the mean and the standard deviation of the demographic and outcome variables. Due to the limited number of patients in each AO subgroup (there was only one patient in 33C3.3 subgroup), no

further subgroup analysis of the outcome parameters was done.

RESULTS

The mean age of the patients was 44.3 years. The mechanism of injury was a high-energy trauma (either road traffic accident or fall from height) in ten patients. Two of these patients had polytrauma and were transferred to us after the management of craniocerebral and chest trauma respectively. Two patients with additional long bone fractures in the ipsilateral limb (femoral neck in one and tibial fracture in one) were excluded from the study. One other patient with a 33C3.1 fracture was lost to followup after 12 weeks and was excluded from the study. The patient had attained a good range of motion (ROM) of the knee, with no loss of reduction at followup.

According to the AO classification, five fractures were type C3.1, six fractures were type C3.2, and one fracture was type C3.3 [Table 1]. One patient had an associated avulsion of the anterior cruciate ligament, two patients had avulsion of the lateral collateral ligament, and one patient had avulsions of both the anterior cruciate and medial



Figure 3: (a-c) Preoperative X-rays anteroposterior and lateral views of knee joint and computed tomography scans (case no. 4) showing the patella entrapped in the lateral condyle. (d) Clinical photograph showing Patient positioning and draping with leg-holding tray. (e) Intraoperative photograph showing articular exposure and reconstruction. (f) Immediate postoperative anteroposterior and lateral X-rays of knee joint showing implant *in situ*. (g) Three months postoperative X-rays anteroposterior and lateral views showing fracture consolidation. (h and i) Clinical photograph showing range of motion of the knee at 3 months

collateral ligaments. All ligament avulsions were repaired with screws or pull-out sutures. One of the patients required a partial meniscectomy.

The patients were followed up for at least 1 year after the injury, with a mean followup of 17.6 months (range 12–25 months). All fractures united at a mean time of 14.3 weeks (range 6–26 weeks). One of the patients (case no. 8) did not show any callus formation at the metaphyseal fracture site even after 12 weeks of surgery and was bone grafted secondarily. He subsequently achieved union within 3 months. No other secondary surgery was required in any patient. Five of the patients

had $<90^\circ$ flexion at 6 weeks followup, though all patients were discharged with $>90^\circ$ flexion after surgery. They were instructed to perform ROM exercises under the supervision of a physiotherapist. Three of them (case no. 1, 5, and 7) returned at 12–14 weeks with $<90^\circ$ flexion, with the fractures showing good union. Their knees were manipulated under anesthesia, with audible adhesiolysis and restoration of full flexion ($>130^\circ$) on table. All of them maintained a good ROM subsequently.

There was no mortality noted in the followup period. None of the patients showed implant/screw breakage. Two of the patients showed back out of one of the locking screws at



Figure 4: (a-c) Preoperative X-rays anteroposterior and lateral views of knee joint and computed tomography scans (case no. 1) showing the trochlea inverted 180° and entrapped posteriorly. (d) Intraoperative photograph showing articular reconstruction. (e) Intraoperative photograph showing extensive medial comminution. (f) Immediate postoperative anteroposterior and lateral X-rays showing implant *in situ*. (g and h) Three months postoperative X-rays showing fracture consolidation. (i and j) Clinical photographs of patient showing range of motion of the knee at 3 months

Table 1: Clinical details of the patients

Serial number	Age (in years)	Sex	Mechanism of injury	Associated fractures	Open/closed	AO/OTA classification		Meniscal tears	Ligament injuries
						Extra-articular fracture pattern	Subgroup (intra articular fracture pattern)		
1	36	Male	RTA	Ipsilateral distal radius fracture	Closed	A3.2	C3.2	No	ACL, MCL avulsion
2	55	Female	Fall at home	No	Closed	A1.3	C3.1	No	No
3	46	Male	Fall from height	No	Closed	A3.2	C3.2	Lateral, excised	LCL avulsion
4	24	Male	RTA	No	Closed	A1.2	C3.1	Lateral, stable	No
5	38	Male	Fall from height	No	Grade IIIa open	A1.2	C3.1	No	ACL avulsion
6	39	Male	RTA	Ipsilateral clavicle fracture	Closed	A3.2	C3.2	No	No
7	76	Female	Fall at home	No	Closed	A2.1 (1)	C3.2	No	No
8	52	Female	RTA	No	Closed	A2.2	C3.2	No	No
9	28	Male	RTA	No	Closed	A1.2	C3.1	No	No
10	42	Male	RTA	No	Grade IIIa open	A2.3	C3.2	Medial, stable	LCL avulsion
11	60	Male	RTA	Contralateral hip fracture	Closed	A1.2	C3.1	No	No
12	36	Female	Fall from height	No	Closed	A3.3	C3.3	No	No

RTA=Road traffic accidents, MCL=Medial collateral ligament, ACL=Anterior cruciate ligament, LCL=Lateral collateral ligament, OTA=Orthopedic Trauma Association

6 and 12 weeks followup, but their fractures were healing well and no screw exchange was needed. Both of them united uneventfully on subsequent followup. None of the patients developed a deep surgical site infection. One patient developed a superficial infection, which settled with regular wound care and oral antibiotics.

Only one patient showed a limb length discrepancy (shortening) >5 mm. Table 2 shows the immediate postoperative alignment of the operated leg in the coronal, sagittal and axial planes. Only one patient showed a loss of reduction at followup. The primary fixation in this case was in 5°–10° varus and had to be accepted during the course of the fixation due to extensive medial comminution involving the epiphysis [case no. 1, Figure 4]. The alignment was maintained at 6 weeks, but a further varus collapse to around 15° varus was noted at final fracture healing at 14 weeks. The patient had resumed full weight-bearing at 8 weeks against our advice. The alignment was maintained between the immediate postoperative and final assessments in all other patients.

The outcome was rated as excellent in seven patients, good in three patients and fair in two patients according to the KSKS [Table 3] at 1 year. The average knee ROM was 121° (range 105°–150°). Three patients showed radiological changes of osteoarthritis, two in the tibiofemoral compartments [Table 3, case no. 3 and 5] and one in

the patellofemoral compartment [Table 3, case no. 6]. Only one of these patients experienced pain during routine day-to-day activities, while the other two were asymptomatic. One other patient [Table 3, case no. 7] had asymptomatic osteoarthritis in the knee at the time of injury which showed no progression during followup.

DISCUSSION

Intraarticular fractures of the distal femur are challenging injuries. These require an extensive surgical approach to visualize and reduce the articular fragments, particularly in complex fractures. The insult to the periarticular soft tissues caused both by the initial trauma and subsequent surgical approach, causes difficulty in early postoperative rehabilitation predisposing to knee stiffness. Hence, the outcome of intraarticular fractures of the distal femur remains unpredictable, and these are fraught with complications such as malunion, nonunion, stiffness, and secondary osteoarthritis.

Multiple surgical approaches have been described previously to obtain a good exposure of distal femoral articular surface, including medial parapatellar approach,¹² lateral parapatellar (anterolateral) approach,⁷ tibial tubercle osteotomy,^{5,14} and combined medial and lateral approaches.³ The latter two approaches are too extensive and frequently lead to complications, such as delayed wound healing, flap necrosis and delayed healing of osteotomy [Table 4]. The parapatellar approaches provide a sufficient articular exposure but involve splitting of the quadriceps mechanism, which may lead to scarring or adhesions. Moreover, they are difficult to extend proximally, if open compression plating of the extra-articular fracture is planned. The proximal extension of a medial parapatellar approach, as described by Henry,¹⁹ involves cutting through the rectus tendon, which may not be desirable.

Table 2: Coronal, sagittal, and rotational alignment of the operated limbs immediately after surgery

Alignment	Coronal alignment	Sagittal alignment	Rotational alignment
Normal	10	-	-
<5° malalignment	1	9	11
5-10° malalignment*	1	3	1
>10° malalignment	-	-	-

*Only three patients had malalignment, with one patient each having both sagittal and coronal/rotational malalignments

Table 3: Clinical results of the study cohort

Serial number	Time to union (in weeks)	KSS at 1 year				ROM at 3/12 months (degrees)	Total followup (months)	Radiological OA	Pain
		KSKS	KSFS	Total KSS	Outcome				
1	14	77	80	157	Good	85/110	18	No	None
2	6	95	90	185	Excellent	140/150	25	No	None
3	12	68	70	138	Fair	105/115	12	Yes, tibio-femoral	None
4	13	90	90	180	Excellent	110/125	23	No	None
5	14	65	70	135	Fair	80/115	24	Yes, tibio-femoral	Mild
6	17	85	80	165	Excellent	95/110	12	Yes, patello-femoral	Occasional
7	12	85	80	165	Excellent	85/110	23	Yes, preexisting	Occasional
8	26	90	90	180	Excellent	125/130	13	No	None
9	13	95	90	185	Excellent	130/135	12	No	None
10	18	73	80	153	Good	100/105	17	No	None
11	14	95	90	185	Excellent	110/115	13	No	None
12	13	70	80	150	Good	125/125	19	No	None

KSS=Knee Society Score, KSKS=Knee Society Knee Score, KSFS=Knee Society Functional Score, ROM=Range-of-motion, OA=Osteoarthritis

Starr *et al.*¹³ described a modified anterior “swashbuckler” approach to the distal femur, which facilitated complete exposure of distal femur articular surface and quicker rehabilitation. We use an anterolateral skin incision for all distal femur fractures as a “universal” approach. It can be limited to the standard lateral approach for simple fractures, extended distally as a swashbuckler approach in complex fractures, and extended proximally for open compression plating as in standard lateral approach. Starr *et al.*, in their original report, had avoided the use of tourniquet, citing that “it can prevent medial retraction of quadriceps muscle.”¹³ However, with our modified technique, we did not face any difficulty in retraction of the quadriceps, even in cases in which a tourniquet was applied.

The outcome of distal femur fractures has improved in recent times, with the use of biological and indirect reduction techniques and percutaneous osteosynthesis with bridge plates, usually locked ones. Zlowodzki *et al.*²⁰ in a systematic review of different fixation techniques in the operative management of acute nonperiprosthetic distal femur fractures found that the use of locked plates is associated with a decreased relative risk of nonunions and infections as compared to compression plates. However, they found an increased relative risk of fixation failures and secondary surgical procedure with the use of locked plates.²⁰ Several other studies have expressed concerns that locking plates may cause callus inhibition, with reported nonunion rates up to 20% in distal femur fractures.^{21,22} Furthermore, the precontoured locked plates may not conform to the bony contours in all patients and may lead to malalignment.²³ Bridge plating by TARPO technique requires a demanding surgical technique and extensive use of intraoperative

imaging.⁷ In our experience, fractures of the distal femur (both types A and C) without extra-articular comminution (A1.2, A1.3, and A2.1) have a good outcome with open compression plating (hybrid technique), which remains our procedure of choice for these, for reasons of technical ease, accurate pretraumatic alignment and more reliable healing. We reserve the use of bridge plating by TARPO technique for fractures with extra-articular comminution.

We have analyzed the reported outcomes of complex C3 type fractures in previously published studies [Table 4].¹⁻⁶ Most of them reported a varying proportion of patients (7.7%–16.7%) with poor results due to complications such as superficial infection, flap necrosis and stiffness. Sirbu *et al.*⁶ in a study of C3 fractures fixed by a lateral locked plate using TARPO approach reported 100% good to excellent results, though with a lower mean flexion of the knee (108°) as compared to our series (120°). This may be explained by the different outcome scores employed in the two studies. As previously reported by other authors, patients’ knee function assessed by the KSS is noted as less optimal as compared to the Neer score.²⁴ A standardized and validated outcome scoring system needs to be developed for distal femur fractures to allow comparability across studies. We attribute the good knee flexion obtained in our series to anatomical articular reduction, rigid fixation of articular fracture lines and early mobilization. Concomitant addressal of ligament injuries, as was done in our series, is important for early rehabilitation as patients are apprehensive to move unstable joints.

Most previous studies¹⁻⁴ on C3 fractures of the distal femur have employed the use of primary bone grafting to enhance

Table 4: Results of C3 type fractures of distal femur fixed using different techniques

Study (year)	Number of patients*	Surgical technique	Mean time to union#	Outcome score	Excellent/good/fair/poor results (%)	Mean flexion (°)	Complications (%)
Hutson and Zych (2000) ¹	16	ORIF-Ilizarov, bone grafting (18.8%)	24	Sanders	12.5/56.2/31.2/0	92	Secondary bone grafting (12.5), infection (3), stiffness (50), quadricepsplasty (31.2)
Ramesh <i>et al.</i> , (2004) ²	13	Ilizarov fixation, fibular strut, bone grafting	19	Neer	30.8/46.2/15.4/7.7	77	Secondary bone grafting (7.7), pin tract infections (38.5)
Lin <i>et al.</i> , (2010) ³	11	U-shaped incision, double plating, bone grafting	18.9	Merchan	36.4/45.4/9.1/9.1	-	Flap necrosis (18.2)
Zhang <i>et al.</i> , (2012) ⁴	12	Anteromedial approach, double plating, bone grafting	21	Merchan	33.3/50.0/8.3/8.3	-	None reported
Khalil and Ayoub (2012) ⁵	12	Tibial tubercle osteotomy, double plating, bone grafting	18.3	Sanders	16.7/41.7/25.0/16.7	112	Superficial infection (16.7), delayed wound healing (16.7), delayed osteotomy healing (16.7), delayed union (33.3), stiffness (16.7)
Sirbu <i>et al.</i> , (2014) ⁶	16	TARPO approach, lateral locked plate	12.6	Neer	56.2/43.8/0/0	108	Secondary bone grafting (12.5), malalignment >5° (18.8), LLD >1 cm (12.5)
Current study	12	Swashbuckler approach, lateral locked/hybrid plate	14.3	KSS	58.3/25.0/16.7/0	120	Secondary bone grafting (8.3), malalignment >5° (25)

*With completed follow-up, #In weeks. TARPO=Transarticular approach and retrograde plate osteosynthesis, KSS=Knee Society Score, LLD=Limb length discrepancy

union. With the advent of minimally invasive reduction techniques and bridge plating, primary bone grafting is now rarely used in trauma to minimize patient morbidity. We used the TARPO technique for comminuted extra-articular fractures and did not employ primary bone grafting in our series. Only one patient required secondary bone grafting at 3 months, which was due to technical reasons (slight gap left at fracture site).

In our experience, a single lateral locked plate gives sufficient stability for most distal femur fractures, even with extensive comminution. Before the advent of locking plates, there was a propensity for varus collapse with a single lateral plate in comminuted fractures, and double plating with bone grafting was recommended.¹² However, a single locked lateral plate gives sufficient axial and torsional rigidity,²⁵ even in cases with medial comminution, and the use of dual plates is no longer required.

The strength of our study is the inclusion of only the most complex fractures of the distal femur (AO type C3). The study was a prospective one, with all cases operated by a single surgeon, using a single surgical approach, and the same type of implant, eliminating any confounding of results due to variation in surgical technique, reduction skills, or implant properties.

The main limitation of our study is the small sample size. Since we have only included the complex C3 type distal femur fractures, the total number of patients was limited in our study, similar to other such studies.¹⁻⁶ Another limitation in our study is the short followup period. The true incidence of posttraumatic osteoarthritis can be estimated only by a long term study though early trends are reflected in our study.

CONCLUSION

Our study shows a good to excellent functional outcome of complex C3 type distal femur fractures, fixed with a single lateral locked plate, using a modified swashbuckler approach.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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