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Distal femoral nailing (DFN) for difficult and intra-articular distal femur fractures

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ABSTRACT
Purpose. To evaluate outcome of distal femoral nailing for distal femur fractures.
Methods. The clinical and radiological outcome for 10 patients treated at the Calcutta medical research institute,kolkata . Follow-up for a mean duration of 9 months.
Results. There were no cases of non-union. Overall assessment of clinical outcome based on the criteria of Schatzker and Lambert was graded excellent in 6 patients, good in 3 patients, fair in 1 patient
Conclusion. Supracondylar nailing for fixation of supracondylar (Arbeitsgemeinschaft für Osteosynthesefragen [AO] type A) and less comminuted intercondylar (AO type C1 and C2) fractures is recommended by the authors.
Key words:femoral fracture; internal fixators; treatment outcome

I. INTRODUCTION

In distal femur fracture it is very difficult to maintain bony alignment, due to the very high pull of quadriceps and calf muscles. Screw purchase of the distal fragment may not be adequate due to the lack of good cortical bone. Neer et al.[1] 1967 recommended a conservative approach to supracondylar fractures because of high rate of local complications and a low patient satisfaction. Early conversion to cast bracing after a period of traction was later introduced,[2,3] claiming to offer better functional outcomes compared with prolonged casting across the knee. Later, fixation with a lateral condylar blade plate, it allowed fixation of intra-articular fractures and early mobilisation of the knee joint.[4,5] However, soft tissue disruption with open reduction and periosteal stripping for placement of the implant may interfere with the healing process, resulting in a delay in union or non-union. Bone grafting was frequently indicated[5,6] and wound infection was not uncommon with this approach.[4,7,8] Flexible intramedullary nailing, [9,10] modified antegrade nailing,[11,12] and external fixation[13] allowed fracture fixation with minimal exposure of the fracture site. However, axial and rotational stability of these implants were inferior, and early mobilisation of the limb could result in loss of reduction. Retrograde insertion of a standard femur nail did not allow fixation of very low fractures in addition, and free hand interlocking of the proximal end could be difficult.

Supracondylar nailing was initially introduced for the treatment of low femur shaft fractures. Due to the distal position of the interlocking screws, they were later used for distal femur fractures. Fixation of intercondylar fractures was also possible with additional compression screws to stabilise the intra-articular fragments. In cases with severe metaphyseal comminution, supracondylar nailing offers a more biological method of fixation with less devitalisation of soft tissue. However, outcome evaluation of this treatment has been limited.We reviewed the medical records of 10 patients treated with supracondylar nailing for distal femur fractures at our institution over a 6-months period, to determine overall outcome in this patient group.

II. METHODS

Distal femur fracture of 10 patients reconstructed with supracondylar nail. Indications for supracondylar nail fixation included distal femur fractures with severe comminution or segmental fractures, the presence of pre-existing deformity that rendered lateral plate fixation difficult, and selected intra-articular fractures.

Position is supine on a standard operating table under fluoroscopy guidance. Knee flexion was achieved by placing sterile drape , saline bolttle under the knee. In one case with limited hip movement we operate in hanging limb position at the end of operating table. No tourniquet was used. For extra-articular fractures, a midline infra-patellar incision extending through the patellar tendon was used, to access the entry point on the intercondylar notch. For displaced intercondylar fractures, an anterior midline skin incision with para-patellar arthrotomy was performed for open reduction. The 2 condylar fragments were initially fixed with 6.5 cancellous screws. If the fracture extended close to or through the intercondylar notch, the entry hole of the nail had to be created by connecting multiple drill holes, in order to avoid splitting of the 2 condyles. The distal interlocking screws of the nail provided additional fixation to the condylar fragments. In open fracture we try to reduce the fragment through wound under guidance of fluoroscopy after tho-

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rough wash and debriedement. Knee joint mobilisation without weight bearing was allowed after the second postoperative day.

Fracture union and alignment were judged on clinical and X-ray findings.

The criteria recommended by Schatzker and Lambert[5] was used for overall outcome evaluation.

Schatzker and Lambert scoring system

Excellent-full extension	Flexion loss less than 10°
	No varus, valgus or rotary deformity
	No pain
	Perfect joint congruency
Good-not more than one of the following	Loss of length not more than 1.2 cm
	Less than 10° varus or valgus
	Flexion loss not more than 20°
Fair—any 2 of the criteria in Good category	
Failure—any of the following:	Flexion to 90° or less
	Varus or valgus deformity, exceeding 15° joint incongruency
	Disabling pain no matter how perfect the x-ray

Classification

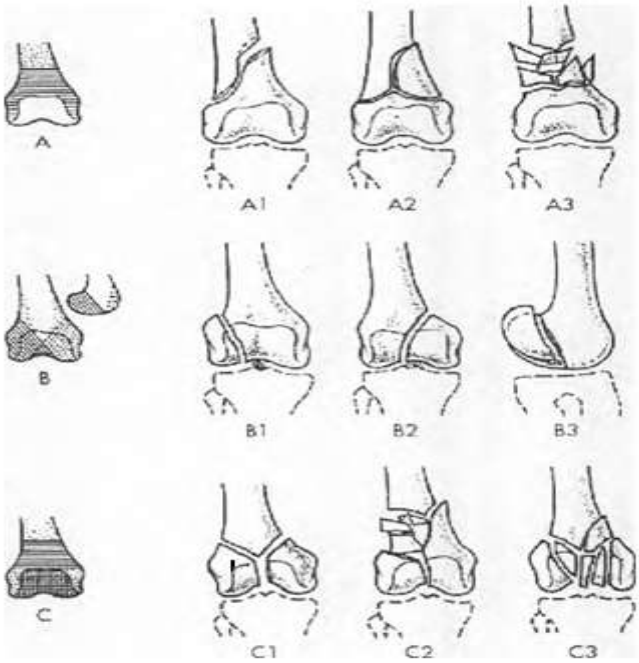

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Table
Patient details and outcome of Distal femoral nailing for distal femoral fracture

Case No.	AO* type	Sex/Age	Fracture type	Side	Knee ROM(^{0})	Outcome
1	A3	M/44	Closed	Right	120	Excellent
2	C3	M/30	Closed	Right	100	Good
3	A2	F/36	Closed	Left	120	Excellent
4	A1	M/30	Closed	Right	130	Excellent
5	A1	F/42	Closed	Left	130	Excellent
6	A3	F/65	Closed	Right	95	Fair
7	A1	F/70	Closed	Left	100	Good
8	C2	M/36	Closed	Right	130	Excellent
9	C2	F/61	Closed	right	100	Good
10	C3	M/42	Closed	Left	130	Excellent

III. RESULTS

The mean age of the patients was 45.5 years (range, 30–70 years). There were 5 men and 5 women. There were 6 supra condylar (AO type A) fractures and 4 inter-condylar (AO type C) fractures (Table). All fracture are closed except case 5 which have 6 cm open wound with fresh fracture without any sign of infection. All patient injured in high velocity road traffic accidents. The mean operation time was 2 hours (range, 1–4

hours). Maximum time is taken to operate case 2 (Photograph below) takes nearly 3 hours. Suction drains were used in 1 case (case 5) and they were removed between one to 2 days after surgery. In most patients, knee movement commenced 1 day after surgery. The duration before partial weight bearing varied, because about half of the patients had additional injuries affecting their lower limb.

The mean duration of follow-up was 13 months . There was no primary or secondary bone grafting. Full weight bearing was allowed only when the fracture was assessed as clinically and radiologically united. The mean time required to achieve union was 5 months (range, 2-9 months). Fracture alignment, limb length measurement, and range of knee movements were based on the last recorded clinical evaluation. One patient developed a knee flexion contracture of 45 degree, while the remainder were able to fully extend their knee. The mean range of knee movement on last review was 115.5 degree (range, 95–130 degrees).

One patient developed tibial site pin tract infection because of the patient was came to us after 9 days with traction and by that time tract was already infected. We removed that pin and debride the pin tract after 21 days that was completely healed.

There were one case of superficial or infection, we debride it on post op day 9 and vac applied. It was healed after 20 days. There were no instances of implant breakage or loss of fracture alignment during the healing process.

Based on the criteria recommended by Schatzker and Lambert,[5] the outcome was assessed as excellent in 6 cases, good in 3 cases, and fair in 1

cases. The outcome in case 6 was fair due to loss of knee movement postsurgery. Due to her other comorbidities (electrolytes imbalance, poor glucose control, post operative psychosis), she was unable to do proper exercises she develop knee FFD of 45 degree. At 12-month follow-up, the patient could only achieve 95 degrees of passive knee movement despite intensive physiotherapy and 5 degree of FFD still remains.

One patient with multiple trauma associated tibia and fibula fracture same side dealt with plating. Both fractures united without any complication.

IV. DISCUSSION

The time to union of 5 months with no case of non-union seen in this study compares favourably to other treatment methods reported in the literature. Many trauma surgeons recommend primary bone graftingfor comminuted fractures or those with significant cortical defects, but in this 10 cases there is no bone graft given. All fractures united without secondary procedures to enhance union.

Closed reduction, minimal fracture exposure little additional injury to the adjacent soft tissue, especially the periosteum, and fracture haematoma was preserved in most cases.

The load sharing mechanism of intramedullary nailing promotes secondary bone healing, and bone from medullary reaming extravasated into the fracture site serves as a bone graft. All these factors likely contributed to the good union rate seen and the low incidence of soft tissue complications, especially infection.

There have been very few outcome studies on distal femur fractures treated with retrograde intramedullary nailing.

Markmiller et al[17] done 16 intramedullary nailing of which 33-A 11 cases and 33 C 5 cases. 14 (87.5%)cases have excellent result,one patient with a fair result (6.25%), and one patient with a poor result (6.25%). The outcome of treatment was graded according to the 12-month followup results of the Lysholm-Gillquist score; classified as excellent for 90 points or more, good between 80 and 89 points, fair between 70 and 79 points, and poor with less than 70 points.

Lauri et al (2005) [18] present a series of 46 distal femoral nail after a mean follow-up of 9 months. The final union rate was 95%, with a mean union time of 17.5 (8–68) weeks. Restoration of the limb axial alignment and length was inadequate in two cases, whereas three losses of reduction and one non-union were observed. Two cases of distal locking screw breakage were also observed.

Gao k et al.[19] with 17 cases of DFN all but one of the fractures in the RN group united (94.1%) within 6 months. The nonunion in the RN group was managed with augmentative Distal femoral locking plate and autologous iliac bone graft. The nonunion united 5 months after revision surgery.

Janzing et al.[16] recently studied outcomes for 24 elderly patients with distal femur fractures treated with supracondylar nailing. Using the Neer scoring system criteria,[1] they reported excellent or good results in 16 (89%) patients. Only 4 of the 24 patients had intra-articular fractures. Nine of our 13 (71%) patients had excellent or good results based on Schatzker's scoring system.[5] However, nearly half of them (6 out of 13) had intra-articular fractures.

Angular malunion, in either the coronal or sagittal plane, may develop due to inadequate reduction or subsequent displacement during bone healing.[9,17] Schatzker and Lambert[5] classified fracture alignment of less than 10 degree varus or valgus as good in their out-come evaluation. In our series, good alignment was achieved in all cases. We did not observe any breakage of implants, and loosening of a distal screw was noted in only one case.

Varus/valgus force is significantly reduced with intramedullary nailing compared with use of the lateral blade plate system. Four cortical fixations are also possible, with 2 well-placed distal interlocking screws. Moreover, intramedullary positioning of the nail also provides 3-point fixation of the fracture to prevent flexion/extension displacement of the distal fragment. The combination of early union and stability of fixation seen with this approach effectively reduces the risks of angular malunion.

Siliski et al.[7] reported that 15 of 52 patients in their series of distal femur fractures treated with plate fixation had limb shortening of 1 to 3 cm. Shortening was intentional in 11 patients to allow impaction for better bone healing.

In our series, we aimed to restore original bone length. Intentional fracture impaction was not necessary in any case.

Of the 6 patients with extra-articular fractures, 2 experienced a mild degree of pain after walking for a short distance. Two of these patients had pre-existing osteoarthritis of the knee, while the other patient had a previous fracture of the same femur that was malunited.

In patient with multiple fractures, simultaneous fracture fixation in more than one limb may be desirable. Supracondylar nailing is performed

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supine on a normal operating table, allowing simultaneous procedures for upper limbs and the opposite lower limb. When there is an indication for life-saving procedures, such as craniotomy or laparotomy, repositioning of the patient is not necessary for subsequent fracture fixation.

Long-term effects on the knee joint following nail entry through the intercondylar notch are not clear. Although we did not observe any significant deterioration of joint congruency or reduction in the thickness of the articular space based on X-ray evaluation, no conclusion can be reached since the number of cases was small and the duration of follow-up relatively short. Moreover, it would be difficult to separate the effect of trauma from that of intercondylar nail entry. The benefits of maintaining good fracture alignment and early joint mobilisation with the use of supracondylar nailing may prove to be more important overall for the long-term integrity of the knee joint.

V. CONCLUSION

Distal femoral nailing is useful for fixation of supra-condylar and less comminuted intercondylar fractures. With minimal disruption to soft tissue, and good purchase of the distal bone fragment, this approach provides stable fracture fixation, allowing early joint mobilisation. The rate of union is high, with a low incidence of complications. The simplicity of the procedure also facilitates fracture fixation in patients with multiple trauma, including those with multiple fractures

IMAGE GALLERY

Case 1 (33A3)

Case 2 (33C3)

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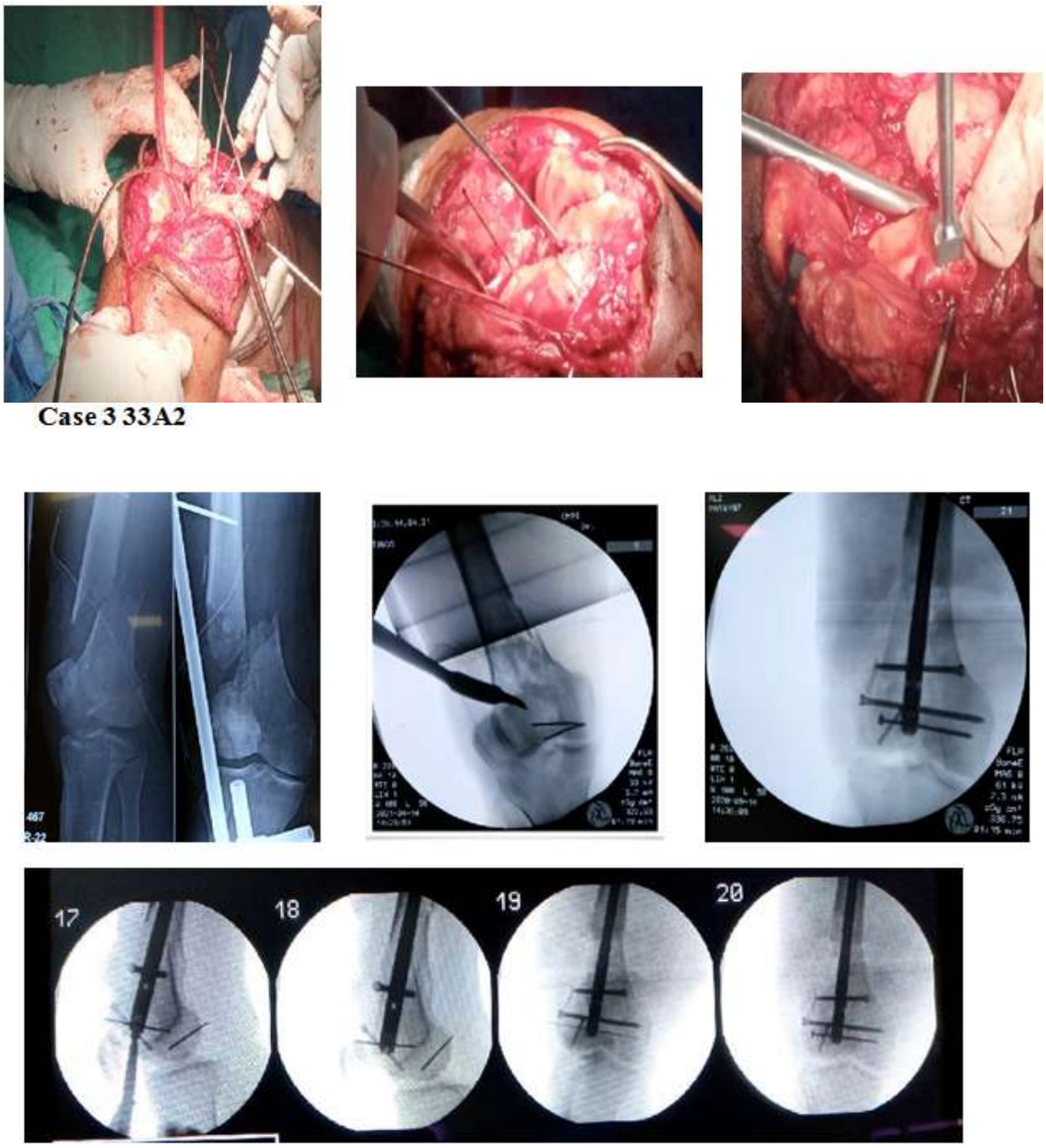

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