International Journal of Research in Orthopaedics
Sancheti M. Int J Res Orthop. 2023 Jan;9(1):132-137
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20223451

Original Research Article

Fracture supracondylar femur treated with various modalities of treatment-an exploratory study

Mukesh Sancheti*

Department of Orthopaedics, KIMS-Kingsway Hospitals, Nagpur, Maharashtra, India

Received: 25 November 2022
Revised: 10 December 2022
Accepted: 16 December 2022

***Correspondence:**
Dr. Mukesh Sancheti,
E-mail: drmukeshsancheti@rediffmail.com

ABSTRACT

Background: Present study looked at functional outcomes and rate of complications in cases of adult supracondylar-intercondylar femur fractures treated with different treatment modalities at a tertiary care government hospital.
Methods: The study was conducted over 2 years wherein 23 patients with fracture in intercondylar-supracondylar region were included. The different implants and surgical techniques used in the study were: Condylar blade plate, dynamic condylar screw (DCS) with side plate, buttress plate single, supracondylar nail technique and TARPO technique. Neer's criteria was used to compare functional outcome with different modalities of treatment.
Results: Eight out of 11 patients treated using DCS with side plate-showed excellent results as per Neer's criteria. Excellent results were observed in 3 out of 4 fractures fixed with GSH supra-condylar nail, 3 out of 3 in those fixed with TARPO technique, 0 out of 3 in patients managed using buttress plate and 1 out of 2 patients treated with blade plate.
Conclusions: Closed method of reduction followed by internal fixation (TARPO technique and GSH nail) is better than open reduction (Buttress plate, DCS with side plate and condylar blade plate) for the management of fracture supracondylar femur. DCS with side plate by open method is at par with GSH nail and TARPO technique for knee ROM and rate of complications. It is recommended that, the Neer's criteria should not be utilised in isolation for the purpose of comparing outcomes in cases of fracture supracondylar femur.

Keywords: Fracture, Supracondylar, Intercondylar, Femur

INTRODUCTION

Fractures just above knee are known to be challenging and technically demanding for orthopaedists. Supracondylar-condylar fractures of femur are difficult to treat, as they are prone to delayed union, non-union or mal-union, joint contractures, knee instability and painful internal fixation etc.[1,2] The available options to treat these fractures have seen varying success, as they differ in terms of method (closed versus open), surgical approach, choice of implant and course of post-operative management etc.; ultimately leading to dissimilar and unpredictable outcomes.[3,4]

There has been an ever-evolving need to systematically study controversies around management of supracondylar femur fractures. Most of the studies done in the past to solve these controversies have had many drawbacks, e.g., most of them were retrospective, inconsistent and incomparable outcome measures, they ended up comparing open versus closed treatment or efficacy of single implant or lack of long-term outcome follow-up of various available implants and techniques etc.[5-7]

Taking into consideration the complex nature of fracture, availability of different modalities of treatment and controversies there-off; the present study was planned with

the objective of studying the functional outcomes and rate of complications in cases of adult supracondylar-intercondylar femur fractures treated with different treatment modalities at a tertiary care government hospital.

METHODS

Present observational study was conducted with mentioned objective in a tertiary care government teaching hospital (Government medical college and hospital, Nagpur) in central India between July 2002 and July 2004 (2 years).

Following selection criteria were adopted for the study: Inclusion criteria- age more than 17 years, both open and closed fractures, all types of fractures in intercondylar-supracondylar region, patients with associated ligament injury of knee (with negative points for postoperative instability), and patients treated with following modalities of treatment-Patients treated with all the surgical techniques using DCS with side plate, TARPO, Blade plate, single buttress plate, GSH nail. Exclusion criteria-any fracture above the distance as defined by AO group from articular fracture, patients with concomitant fractures in same limb, patients with concomitant head/chest/abdomen injury and requiring primary management for the same, pathological fractures and patients who refused to consent.

The classification used in this study was Muller's classification modified by A.O. group and adopted by orthopaedic trauma association.[8] Modified Gustillo-Anderson classification was used for classification of open fractures.[9] Neer's criteria was used to compare functional outcome with different modalities of treatment.[10] The different implants and surgical techniques used in the study were: Condylar blade plate, DCS with side plate, buttress plate single, supracondylar nail technique and TARPO technique.

The study was initiated after formal approval from the institutional ethics committee (IEC). After employing the mentioned selection criteria and excluding those lost to follow-up, 23 patients were enrolled in the study as participants and data considered for final analysis. The information was collected from all the participants in a pre-tested questionnaire after eliciting written informed consent. The information collected for each patient was age, sex, side of the fracture, associated injury, mode of injury, type of fracture, associated medical concerns, time of surgery (days from date of trauma to surgery), the implant used, supplementary implant, if any, surgical approach, operative time, intraoperative blood loss, duration of immobilization, duration of hospitalisation and period of follow-up. The follow-ups were done every 6 weeks and the patients were examined clinically and radiologically with respect to union, non-union, knee range of movements, extension lag, mal-alignment, rotational deformity, leg length discrepancy, weight bearing status, pain score, function score, motion score, anatomic score and complications, if any. The total Neer score was calculated using the mentioned variables and results scored as following: Excellent- >85, satisfactory-70-85, unsatisfactory- 55-69 and failure- <55.

The data was entered in Microsoft excel and analysed using SPSS (Version 15). A $p<0.05$ was considered as statistically significant. The data confidentiality was maintained through-out the study.

RESULTS

Most of the patients were in the age group of 25-50 years (<25 years- 1, 25-50 years- 18, >50 years- 4), with average age being 42.6 years. Twenty participants were males and only 3 were females (Table 1).

Table 1: Demographic details of the participants.

Variables	N	Percentage (%)
Gender distribution		
Male	20	87
Female	3	13
Age distribution (Years)		
< 25	1	4.3
25-50	18	78.2
> 50	4	17.5

Nine patients had sustained open injuries in supracondylar region and remaining 14 were closed fractures. Out of the 9 open fractures, 6 were grade III and 3 were grade II. Total 10 cases were having associated ipsilateral upper limb or opposite limbs injury. High velocity road traffic accident was the predominant mode of injury responsible in 17 cases, while the other 6 patients had history of fall from height. Out of 23 total cases, 8 fractures were C-III, 6 were C-II, 4 were A-III and 5 were A-II type, as per the Muller's classification as modified by AO group. There were no fractures of C-1 and A-I type. With regards to time of surgery, 17 patients were operated in between 8 to 15 days and 5 cases with Grade III-B open injuries were operated after 15 days. For these 5 cases, initial management consisted of debridement, skeletal traction, active watch for 10-12 days followed by internal fixation. In one patient, initial external fixator was applied as soft tissue damage was severe. After split skin graft of raw area, fixator was removed. Patient was kept in skeletal traction and daily pin tract dressing was done until healing and then fracture was internally fixed.

With regards to method of fixation, 11 out of 23 cases were fixed with DCS and side plate by open lateral surgical approach. Supplementary CC screw fixation was done in 10 out of these 11 patients. Four cases were treated with GSH supracondylar nail. Three fractures were fixed with single buttress plate, with 2 plates being applied by lateral approach and one case by medial approach. Two cases were managed with blade plate using lateral approach. As for the surgical approach, while lateral surgical approach was used in majority (15) of the cases; in 3 patients each

the TARPO and patellar tendon splitting approach was used. Medial and medial parapatellar approach was used in 1 case each (Table 2).

Table 2: Method of fixation of the fractures, (n=23).

Method of fixation	N	Percentage (%)
DCS and side plate	11	47.80
With supplementary CC screw fixation	10	43.5
Without supplementary CC screw fixation	1	4.35
GSH supracondylar nail	4	17.40
Midline patellar tendon splitting percutaneous approach	3	13.05
Patellar medial para-patellar incision	1	4.35
Buttress plate	3	13.05
Lateral approach	2	8.70
Medial approach	1	4.35
TARPO	3	13.05
Blade plate	2	8.70

The operative time ranged between 90 to 180 minutes. The operative time and blood loss was influenced by the fracture pattern, extent of comminution and requirement of bone grafting, the fixation method employed and the implant used (higher with buttress plate and blade plate) (Table 3).

Table 3: Parameters affecting operative time and blood loss.

Parameters	Average operative time (hours)	Average blood loss (ml)
Fracture pattern		
A-II	2.15	300
A-III	2.15	150
C-II	2.3	200
C-III	3.0	450
Bone grafting		
Yes	3.3	550
No	2.4	400
Type of fracture		
Open	2.35	400
Closed	2	0
Method of fixation		
DCS with side plate	2.23	-
GSH supracondylar nail	2.23	-
Buttress plate	3.5	-
TARPO	2.0	-
Blade plate	3.0	-

The duration of immobilization depended on fracture pattern, quality of fixation, implant used and patient comfort. In most patients treated with DCS and side plate using lateral or TARPO technique, blade plate and supracondylar nail, mobilization was started between 2-10 days postoperatively. The patients treated with buttress plate, mobilization was started after around 2 to 2.5 months; the extremity was kept in posterior slab followed by toe to grain cast to prevent displacements due to less rigid, unstable and poorly aligned fixation. The period of hospitalization ranged between 20 to 30 days (mean-28.5 days) and it was majorly dictated by time required for management of other associated injuries and complications following treatment. Those with open injuries (mean-33.0 days) had longer duration of hospitalization as compared to closed fracture cases (mean-24.0 days). It was also higher in patients initially treated either by external fixation or debridement and then fixed internally.

The mean period of union was 15 weeks and 3 days. Out of 23 cases, 18 fractures united between 12 to 20 weeks duration. Out of remaining 5 cases, 4 had union in approximately 26 weeks, two of which were treated with buttress plate, one with external fixator followed by DCS and side plate 1 with debridement followed by DCS and side plate. One case, which took 6 months for union, was treated with single medial buttress plate. Earliest union i.e., between 10-14 weeks was seen in 12 cases; 9 of which were treated with DCS and side plate and 3 with GSH nail. Earliest to unite of the 12 were those treated with TARPO technique (10-12 weeks).

Mal-union was observed in 6 patients, all were valgus deformities of 10^0 to 20^0. Three out of these six cases were treated with buttress plate, one with GSH nail, one each with external fixator followed by DCS and side plate and debridement followed by DCS and side plate.

With regards to knee range of motion and extension lag, 19 out of total 23 patients achieved active ROM of 90^0 flexion or more. Out of these 19, 10 cases were treated with DCS and side plate using lateral approach, 3 were treated with TARPO technique, 3 were treated with GSH nail, 2 with blade plate and 1 with buttress plate. Maximum ROM (130^0) was observed in the case treated with GSH nail using midline percutaneous patellar splitting approach. The 4 cases with ROM of $<90^0$, 2 were treated with single buttress plate, 1 with external fixator followed by DCS and side plate and 1 with GSH nail. Out of 23 cases, 4 had mal-alignment of more than 10^0, 3 out of these were treated with buttress plate and 1 case by external fixator followed by DCS and side plate. Exterior rotational deformity was observed in only 1 patient treated with buttress plate. True limb length discrepancy of $\geq$1 cm seen in 5 patients, 3 of which were treated with buttress plate, 1 with external fixator followed by DCS and side plate and one with GSH nail. Extension lag of 10^0 or more was observed in 5 cases; 2 of which were treated with single buttress plate, 1 with GSH nail, 1 with DCS and side plate and 1 with external fixator followed by DCS (Table 4).

Table 4: Range of motion and incidences of mal-alignment, rotational abnormality, leg length discrepancy and extension lag across methods of fixation.

Parameters	DCS with side plate	GSH supra-condylar nail	Buttress plate	TARPO	Blade plate
Range of motion >90^0	10	3	1	3	2
Range of motion <90^0	1	1	2	0	0
Mal-alignment ≥ 10^0	1	0	3	0	0
Rotational abnormalities	0	0	1	0	0
Leg length discrepancy ≥ 1 cm	1	1	3	0	0
Extension lag	2	1	2	0	0

Table 5: Neer's score across different modalities of treatment.

Modalities of Treatment	N	Excellent	Satisfactory	Unsatisfactory	Poor
DCS with side plate	11	8	2	0	1
GSH supra-condylar nail	4	3	0	0	1
Buttress plate	3	0	0	2	1
TARPO	3	3	0	0	0
Blade plate	2	1	0	1	0

The average duration of full weight bearing was 21 weeks. 17 of the 23 patients started full weight bearing with or without support within 12-20 weeks of duration. The 6 cases with delayed weight bearing were treated with buttress plate (3), DCS and side plate (2) and external fixator followed by DCS (1).

The Neer's scores for various modalities of treatment studied were categorised as follows: Excellent in 15 cases, satisfactory in 2 cases, unsatisfactory in 3 cases and poor in 4 cases. Results are summarised in Table 5.

As for complications, no cases of non-union were observed in present study. A total of 6 cases of mal-union and delayed union observed in study, as detailed earlier. One case treated with blade plate had deep infection causing chronic osteomyelitis and discharging sinus. Another case treated with DCS debridement and side plate developed superficial infection. Both the cases were managed accordingly. No incidences of knee instability/ failure of fixation were observed in study. One patient treated with GSH nail had painful internal fixation at distal locking site.

DISCUSSION

The management of fracture of supracondylar region of femur, despite recent advances in the surgical approaches, remains controversial. The present study forayed into comparing the functional outcomes and rates of complications across different treatment modalities in cases of adult supracondylar-intercondylar femur fractures.

Age group of participants in the present study is in contrast to the usually reported bimodal age distribution.[11-13] The male gender predilection is also more than previously reported by western researchers. As many as 17 out of 23 patients suffered the fracture due to high velocity road traffic accident, which indicates further that the young (25-50 years), male, travelling population in India is more susceptible to these fractures, which are often associated with open injuries of either the fracture site or other limb/organ.

In the present study of 23 participants, following Muller's classification as modified by AO group, 8 belonged to C-III, 6 to C-II and 4 to A-III category. This reflects that most of the injuries in supracondylar femur area are complex, intra-articular, associated with high degree of comminution, bone loss and hence difficult to fix internally. The outcomes of surgeries in the present study were expectedly relatively unsatisfactory in the C-III or A-III fractures, results similar to those previously reported.[11-13] Time to surgery after injury was also important, as it was observed that the cases in which the fixation was delayed due to various reasons had relatively poor outcomes.

With regards to method of fixation, out of 11 cases treated with DCS and side plate, the outcome was excellent to satisfactory in 10 cases, with only one poor result. Most of these cases were closed injuries and were fixed comparatively expeditiously. No fracture went into non-union and the time required for union was relatively lesser too, owing to anatomical alignment, rigid fixation and bone grafting. Weight bearing was between 16-20 weeks, which is earlier than buttress plate and condylar plate and late as compared to GSH nail and TARPO fixation, which may reflect advantage of closed over open fixation. The outcome achieved in terms of knee range of motion was similar to other modalities. The results with respect to DCS plate and side plate fixation were comparable or better than previously similar studies.[11-14]

Excellent results were observed in the present study in 3 out of 4 cases treated with GSH nail. The 3 cases were

operated via closed reduction within 10 days of injury. The operative time was the least of the lot with no blood loss and no requirement of bone grafting. The duration of hospitalization and time required for union, knee mobilization and weight bearing was least amongst all the cases, along with those treated with TARPO technique. No infection, mal-union, rotational deformity or non-union were observed. The fantastic results achieved in 75% of the cases treated with GSH nail in the present study is still either comparable or inferior to those obtained at centres with higher volume and more experience of GSH nailing for fracture supracondylar femur.[15-17]

All 3 patients treated with TARPO technique using DCS and side plate had excellent results. It is to be noted that; these cases were of closed injuries, had no to minimal articular involvement and were fixed within 12 days of injury. The operative time was less with minimal blood loss and no requirement of bone grafting, except in one case. The relatively early union and weight bearing may be attributed to the closed technique inherent to TARPO technique, with minimal soft tissue stripping. There was no extension lag, mal-alignment, rotational deformity, non-union or infection in any of the cases and the range of motion achieved outclassed other methods of fixation. The results observed with TARPO technique in the present study are much better than previously similar studies.[19-20]

The results obtained with single buttress plate were all poor to unsatisfactory, but there were significant challenges in these cases in the form of higher age with osteoporotic bones, open injuries and intra-articular comminution beyond the limit of internal fixation. All the 3 cases required bone grafting during surgeries which went up to an average of 3.5 hours with more blood loss. They were delayed beyond 20 days in 2 cases due to medical reasons. The hospitalization, time for union and weight bearing were all stretched; with mal-union observed in all 3 cases. The results of present study are contrastingly poor for single buttress plate when compared with previous reports, which has apparently more to do with kind of cases operated.[14,20]

Only 2 cases were treated with condylar blade plate, which were open injuries first managed with debridement and closure followed by delayed internal fixation. The overall results were much superior to single buttress plate, but inferior to other methods.

CONCLUSION

In conclusion, better results seen with TARPO technique and GSH nail as compared to blade plate and buttress plate suggest that close method of reduction followed by internal fixation is better than open reduction. But final results of DCS with side plate by open method are at par with GSH nail and TARPO technique when knee ROM and rate of complications are taken into account. As per time of union and weight bearing and the infection rate, closed methods like TARPO and GSH nail have definite upper hand. Few points are to be noted though while comparing the Neer score across methods of fixation: Specific methods of fixation were employed for particular fracture types only (e. g., buttress plate in those fractures not amenable to other methods). No complex C-III type of fracture was fixed by GSH nail and TARPO technique in the present study, a fact which may unduly skew the results in their favour. Neer's criteria also does not take into account the quality of bone and its osteogenic capacity and the extent of associated soft tissue injury which influences outcome parameters majorly e. g., most of the fractures treated with GSH nail, DCS and TARPO technique were not requiring plastic surgery procedures, with resultant early mobilization, less operative time and less blood loss.

Recommendations

It is recommended that, the Neer's criteria should not be utilised in isolation for comparing outcomes; as results were also affected by other associated fractures to opposite lower limbs and upper limbs, resulting at times in delayed weight bearing and increased period of hospitalization. Further studies on the topic with bigger sample sizes are recommended for validation.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Yang RS, Liu HC, Liu TK. Supracondylar fractures of the femur. J Trauma. 1990;30(3):315-9.
2. Stover M. Distal femoral fractures: current treatment, results and problems. Injury. 2001;32:3-13.
3. Gangavalli AK, Nwachuku CO. Management of distal femur fractures in adults: an overview of options. Orthop Clin. 2016;47(1):85-96.
4. Von Keudell A, Shoji K, Nasr M, Lucas R, Dolan R, Weaver MJ. Treatment options for distal femur fractures. J Orthop Trauma. 2016;30:S25-7.
5. Ehlinger M, Ducrot G, Adam P, Bonnomet F. Distal femur fractures. Surgical techniques and a review of the literature. Orthop Traumatol Surg Res. 2013;99(3):353-60.
6. Wähnert D, Hoffmeier K, Fröber R, Hofmann GO, Mückley T. Distal femur fractures of the elderly—different treatment options in a biomechanical comparison. Injury. 2011;42(7):655-9.
7. Cegonino J, Garcia Aznar JM, Doblare M, Palanca D, Seral B, Seral F. A comparative analysis of different treatments for distal femur fractures using the finite element method. Computer Methods in Biomechanics and Biomedical Engineering. 2004;7(5):245-56.
8. Müller ME, Nazarian S, Koch P, Schatzker J. The comprehensive classification of fractures of long bones. Springer Sci Business Media. 2012;6.

9. Yim GH, Hardwicke JT. The evolution and interpretation of the Gustilo and Anderson classification. JBJS. 2018;100(24):e152.
10. Neer Charles S, Grantham SA, Shelton ML. Supracondylar fracture of the adult femur: a study of one hundred and ten cases. JBJS. 1967;49(4):591-613.
11. El-Kawy S, Ansara S, Moftah A, Shalaby H, Varughese V. Retrograde femoral nailing in elderly patients with supracondylar fracture femur; is it the answer for a clinical problem? Int Orthop. 2007;31(1):83-6.
12. Kolmert L, Wulff K. Epidemiology and treatment of distal femoral fractures in adults. Acta Orthopaed Scandinavica. 1982;53(6):957-62.
13. Pritchett JW. Supracondylar fractures of the femur. Clin Orthop Rel Res. 1984;1(184):173-7.
14. Sanders R, Regazzoni P, Ruedi TP. Treatment of supracondylar-intracondylar fractures of the femur using the dynamic condylar screw. J Orthop Trauma. 1989;3(3):214-22.
15. Dunlop DG, Brenkel IJ. The supracondylar intramedullary nail in elderly patients with distal femoral fractures. Injury. 1999;30(7):475-84.
16. Kumar A, Jasani V, Butt MS. Management of distal femoral fractures in elderly patients using retrograde titanium supracondylar nails. Injury. 2000;31(3):169-73.
17. Ingman AM. Retrograde intramedullary nailing of supracondylar femoral fractures: design and development of a new implant. Injury. 2002;33(8):707-12.
18. Krettek C, Schandelmaier P, Miclau T, Bertram R, Holmes W, Tscherne H. Transarticular joint reconstruction and indirect plate osteosynthesis for complex distal supracondylar femoral fractures. Injury. 1997;28:A31-41.
19. Henry SL. Supracondylar femur fractures treated percutaneously. Clin Orthop Rel Res. 2000;375:51-9.
20. Shelton ML, Grantham SA, CS Neer II, Singh R. A new fixation device for supracondylar and low femoral shaft fractures. J Trauma Acute Care Surg. 1974;14(10):821-35.

Cite this article as: Sancheti M. Fracture supracondylar femur treated with various modalities of treatment-an exploratory study. Int J Res Orthop 2023;9:132-7.