ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Is the Dynamic Condylar Screw System Effective in Fractures of Distal Femur?.

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ABSTRACT

Management of supracondylar fractures have changed with different intramedullary and surface devices. All type of management's donot give satisfactory results always. This study was aimed to find the effectiveness of Dynamic Condylar Screw in treating closed Supracondylar fracture of femur.16 closed supracondylar fractures of AO type A1, A2, A3, C1, C2 were fixed with Dynamic Condylar Screw and were prospectively studied. In a follow up of six months to two years, their functional and radiological outcome was excellent in seven cases, good in seven and fair in two cases. One case had wound infection and eight cases had residual knee stiffness of some degree. All fractures united. Dynamic Condylar Screw gives acceptable results in type A and C supracondylar fractures of femur. Incidentally we found result of all cases did not correlate with their AO type.

Keywords: AO Types A, C - supracondylar fracture- knee joint, soft tissue injury, dynamic condylar screw

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ISSN: 0975-8585

INTRODUCTION

Supracondylar fracture of femur is an enigma to treat. About a third of femoral fractures are supra-condylar fractures [1]. Most of them become comminuted, often extending into the knee joint. There is also severe soft tissue injury together with quadriceps mechanism injury. In such a situation, congruent reduction of fragments, rigid fixation conserving local biology, with good asepsis and an early mobilization form the essential components of good treatment. However in early days, in pre-antibiotic era, attempt to fix these complex fractures with inadequate internal fixation devices resulted in problems, like mal-union, nonunion and infection. This led to the preference for traction and cast bracing for these fractures at that time. Once better internal fixation devices and superior antibiotics were available like we have now, the balance got tilted towards operative management for these fractures. The different implants that are available now are Condylar blade plate [1], Blade plate [2], Dynamic Condylar Screw, Condylar Buttress plate, supracondylar Intramedullary nails [3], Flexible, Zickel's supracondylar device [4], Ender's rod, Rush rods [5], and the locking compression condylar plates [Fixed angle construct] [6],Less Invasive Skeletal Stabilization system [LISS] [7] and Ilizarov fixator [8,9]. Only few retrospective studies compare few methods of supracondylar fracture fixation [1]. But no prospective studies compare all these methods. An ultimate fixation unanimously appropriate to all these fractures is yet to arrive. The purpose of this study is to evaluate Dynamic Condylar Screw system's efficiency in managing closed fractures of the supracondylar and inter-condylar regions of femur and come to a logical conclusion regarding its effectiveness and failure rate.

METHODOLOGY

16 closed fractures of AO type A1, A2, A3, C1, C2 between 20 to 70 years were included in this prospective study. Of these twelve fractures were in male patients. The right side was involved in 12 cases of the entire group of 16. Most of them are road traffic accident victims. We excluded those fractures which were open, type B uni-condylar, type C3 supracondylar and segmental fractures. Four had inter-condylar extension. On receiving these patients, in the causality, history elicitation with simultaneous resuscitation and examination was done. Limb was splinted and X- rays were taken with traction in the anteroposterior and lateral views to classify the fractures and assess comminution. X-ray of pelvis with both hips was taken to rule out any pelvic injury as the mode of injury is usually violent. To stabilize the fracture lower tibial pin traction was applied. This group had one fracture of both bones leg and another patient with associated head injury. All patients were explained regarding the importance of early fixation and most patients were operated within five days. Five cases were operated only after three weeks the delay due to co morbid conditions or delayed presentation to our centre. During surgery, under epidural anesthesia, prophylactic antibiotics were given and tourniquet applied in the upper thigh. With patient supine , with a sand bag under the knee (figure 1) by lateral para-patellar arthrotomy, (Figures 2,3a and 3b) in type C1 C2 fractures, first the articular fragments were reduced (Figure 4) and fixed with 6.5 mm cancellous screws without interfering with condylar screw. The DCS (Dynamic Condylar Screw) guide pin passed is parallel to the knee joint and slope of patella femoral joint (Figures 5, 6). The other end of the guide wire can be palpated on the medial side condyle also. After reaming over this guide pin under the C-arm (5mm shorter than guide wire length),a DCS lag screw 5mm shorter than guide wire length was inserted so as the lag screw does not protrude from the medial side of the medial condyle (Figures 7,8) .An appropriate length DCS plate is slid over this screw and impacted against the shaft of femur (Figure 9) . The plate was fixed with cortical screws with the proximal fragment and locked to the condylar screw with the compression screw.(Figure 10) If necessary two more cancellous screws were applied through the plate into the distal fragment to increase its rotational stability. The wound was then closed (Figure 11). Postoperatively low molecular weight heparin was administered subcutaneously. Post operative pain relief was given with epidural till the fourth day and then the epidural catheter was removed after withholding the low molecular weight heparin for 6 hours.

From the second post-operative day knee extensor strengthening, gentle hip, knee and ankle mobilization were started. Continuous passive motion was started from the second post operative day. (Figure 12) The suction drain was removed after 48 hours and sutures were removed on the 12th day. Intravenous antibiotics were continued for four days and oral antibiotics were continued for 14 days. Patients were mobilized first non-weight bearing in the first week and were discharged. Later partial weight bearing was begun at eight weeks. At regular intervals they were evaluated for fracture healing, any change of alignment and implant position. After radiological union of bridging trabeculation across the fracture only full weight bearing is allowed. The fracture is declared clinically united, when a painless full weight bearing is possible.

ISSN: 0975-8585

RESULTS

Table 1 shows the details of our 16 cases and their outcome. Table 2 shows the details of scoring based on Neer's scoring system. Table 3 shows the results of our cases. All 16 cases united on a regular follow-up of 6 to 24 months (average follow up period was 13.77 months). The mean period taken for union is 12.5 weeks .Functional assessment was done using Neer et al functional scoring [3] where equal importance was given to pain, degree of movements, weight bearing, presence of shortening and angulations. Thus apart from movement the functions like full weight bearing, normal gait without limping and walking without aid, excellent weight bearing gave a maximum score of 4 in all our cases. In our study a follow-up of 6 months to 2 years with Neer's rating system [3], 87.5% had excellent to good results [like the patient illustrated in figures 1a -1e]. The average range of motion was 86.56 ^{o} ranging from 10 ^{o} – 130^{o}. We observed seven excellent, seven good and two fair results in these cases. The radiological assessment of the progression of union is done by assessing the callus formation.

One type A fracture due to wall collapse which was operated a week after injury got infected, the knee became stiff with movement of only 10^{0} – 30^{o} . This case ended in a fair result. Another case with superficial wound infection settled with intravenous antibiotics. Totally eight cases developed stiff knee, three of them requiring arthrolysis to improve the range of movement. The fracture in a 68 year gentleman got malunited with minimal disability with good knee motion. He was left alone. Eight cases with less than a cm shortening, did functionally well without any intervention.

Figure 1: Patient positioning with a sand bag under the knee joint

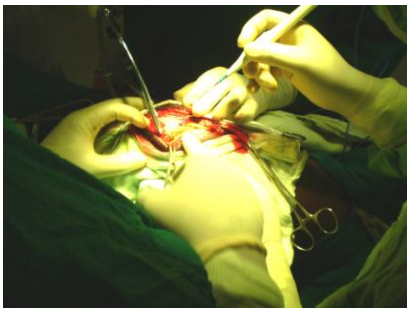
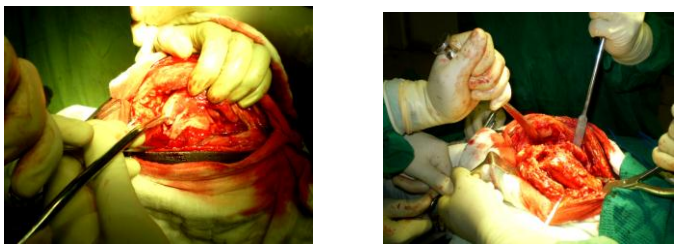


Figure 2: Skin incision and medial parapatellar exposure.



Figures 3 a and b. The exposure of the fracture site exposure

ISSN: 0975-8585

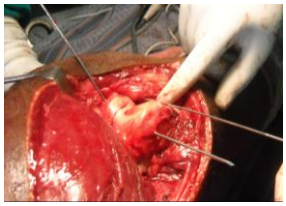


Figure 4: Intercondylar fragment reduction with multiple K wires, provisionally

Figure 5: Patello femoral axis K-wire being passed.

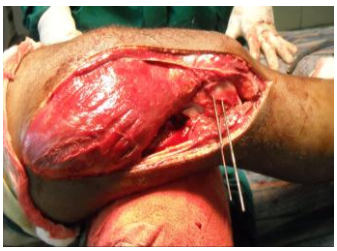


Figure 6: Guide pin placement into the condyle parallel to the knee joint and patello femoral axis K-wire

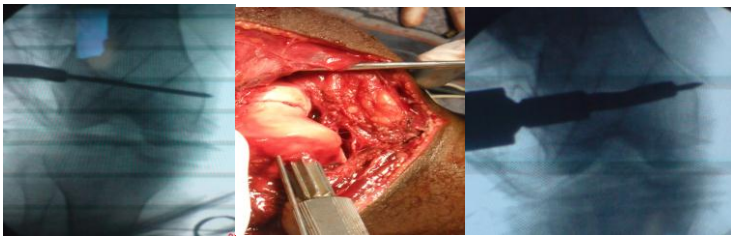


Figure 7.Triple reamer is passed over guide wire that is passed in figure 6.

Figure 8: The C-arm picture- Lag screw passed around the previous K wire is short of the medial cortex in this view. But as the anterior part of the femoral condyle is narrower, if passed further the tip may breach the medial cortex and irritate the soft tissue here.

Figure 9: Barrel plate is passed over the screw applied as in figure 8.

ISSN: 0975-8585

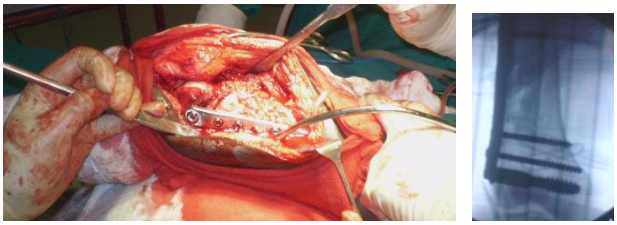


Figure 10: Final fixation showing the position of the DCS plate in wound and the intra operative C-arm view.

Figure 11: Skin closure

Figure 12: Patient is on CPM machine to achieve maximum possible movement post operatively without pain.

13a 13b 13c 13d

13e

Figure 13a to 13e shows[Case number 8] a 55 years old lady had AO type C1 supracondylar fracture left femur following a trivial fall at home.13a and 13b shows preoperative x-rays .Lower tibial pin traction was applied and dynamic Condylar Screw fixation done 3 weeks after injury. Knee mobilization started on 2nd post op day. Partial weight bearing started after 8 weeks. Full weight bearing started at 12 weeks after radiological union seen on x rays. Figure 13c shows 10 month postoperative x-ray. Figure 13d and 13e shows range of motion is 0- 130 degree, knee score is 19/20 in excellent functional results.

ISSN: 0975-8585

Table 1

S.No	Age	Mode	Side	AO Type	Associated Injuries	Delay	Mobilization	Union	R.O.M	FFD degree	Complication	Neer's Score	Result
1	37/M	RTA	Rt	A2	-	3 wk	2nd	14	0- 120	-	-	18	Excellent
2	27/M	RTA	Rt	A2	-	3 wk	2nd	12	0- 70	-	Knee stiffness	14	Good
3	22/M	RTA	Rt	A1	-	1 wk	1wk	12	0-100	-	Knee stiffness	17	Excellent
4	30/F	RTA	Lt	A1	-	1 wk	1wk	12	0-120	-	-	18	Excellent
5	53/M	RTA	Rt	A1	-	1 wk	1wk	12	0-100	-	-	16	Good
6	35/F	Fall	Rt	A2	-	2 wk	1wk	10	0-90	-	Knee stiffness	15	Good
7	28/M	Fall	Lt	A2	-	3 days	2nd	10	0-95	-	Knee stiffness	15	Good
8	55/F	Fall	Lt	C 1	-	3 wk	2nd	12	0-130	-	-	19	Excellent
9	42/M	RTA	Rt	A2	-	3 wk	1wk	14	0-90	-	Shortening	14	Good
10	55/M	Fall	Rt	A2	Head injury	2 wk	1wk	12	0-90	-	Knee Stiffness	14	Good
11	58/M	RTA	Lt	C 2	-	2 wk	1wk	12	0-120	-	Shortening, Knee stiffness	18	Excellent
12	68/M	Wall Collapse	Rt	A2	-	1 wk	2 nd	14	10-30	10	Infection Knee stiffness	12	Fair
13	50/M	RTA	Rt	A2	-	2 wk	1wk	14	0-95	-	-	16	Good
14	40/F	RTA	Rt	A3	#BB Rt Leg	3 wk	2nd	16 wk	0- 120	-	-	18	Excellent
15	20/M	RTA	Rt	C1	-	2 wk	1wk	10	0-125	-	-	18	Excellent
16	25/M	RTA	Rt	C2	-	1 wk	1wk	14	0-10	-	Knee stiffness	11	Fair

Table 2: Neer's rating system

Result	Score
Excellent	16 – 20
Good	12 – 16
Fair	8 – 12
Failure	4 – 8

Table 3: Scoring split up for the patients.

CHARACTER	SCORE	NO OF PATIENTS
Pain	4	2
	3	13
	2	1
	1	0
Movements (in degrees)	4	4
	3	8
	2	0
	1	4
Function	4	3
	3	13
	2	0
	1	0
Shortening (cm)	4	7
	3	8
	2	1
	1	0
Angulation (degrees)	4	8
	3	7
	2	1
	1	0

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ISSN: 0975-8585

DISCUSSION

As deliberated earlier five cases were operated late due to patients reaching our centre late or to the associated head injuries and co-morbid condition. Wide exposure with elevation of tibial tuberosity with extensor mechanism as recommended in comminuted distal femur fractures [2] was not required in any of our cases. This is possibly because Type B fractures were excluded in our series. We did not find any difficulty in regular lateral approach. We agree that Dynamic Condylar Screw as reported, give less varus deformity, knee stiffness and non unions compared to the other methods like Condylar buttress plate or Condylar blade plate [1]. The limitation of this study is there is no control group. Implants available for the distal femoral fractures have specific problems. With Condylar buttress plate, not only varus collapse is possible but this plate also needs more exposure resulting in infection and nonunion [7]. Fixed angle Condylar blade plate needs precise placement and hammering which may displace the fractures above. DCS require at least 4 cm of lower lateral cortex, and while applying its large diameter screw, more bone is removed making revision surgeries difficult. The DCS side plate and screw is thick and hence irritates ilio-tibial band [1]. Zickel nailing is preferred only for frail patients [10]. In more distal fractures, LISS (Less Invasive Skeletal Stabilization System) is more angular stable than Condylar Buttress plate or Dynamic Condylar Screw [7]. Supracondylar nailing is useful in pre-existing deformities of shaft of femur, giving biomechanical stability except only when fracture is too distal, in which case LISS comes handy [3,11,12]. Regular Supracondylar nailing is not useful in distal femoral fractures with split articular fragments [7] but a cruciate distal locking option can be effective [13]. To find such split fragments and coronal fractures oblique views are useful [14]. Rush nailing on a long follow up of 17 years have shown stability and even allow early knee motion [5]. In another series biological [indirect] reduction united all cases in less than 11 weeks [15]. In our series we specifically found that cases with more pre-operative displacement resulted in more stiffness, probably due to associated muscle injury and fibrosis. Such stiffness may also be due to delay in surgery, open reduction, poor compliance for mobilization. We did not have significant shortening or angulation as we used a rigid implant the DCS. There was no neurovascular injury, pulmonary complications, intra operative problems, incomplete reduction or nonunion in our cases.

Few authors used their own classification [5], Sensheimer classification [16] Schatzker and Lambert criteria [1]. We used AO classification and found it did not always correlate with the results. For example a case of AO- C2 type fracture (the eighth case in the table 1) gave a surprisingly good result. In another series Condylar blade plate fixations showed acceptable results with Neer's scoring, where shortening was due to purposeful impaction of fragments [4], we did not purposely impact our fractures for a reduction. In intercondylar fracture stiffness could not be judged whether it is due to the trauma or surgery [3]. Comparison of the radiographs of the uninjured limb is an as useful to assess results in another series of supracondylar fractures [4]. In yet another series, all 13 distal femur fractures with non-unions united with 3 types of fixations and with allograft struts and autologous graft [17].

CONCLUSION

Distal femoral fractures when anatomically reduced and rigidly fixed with DCS end in acceptable results. Those fractures with more displacement resulted in more degree of stiffness, probably due to associated muscle injury and fibrosis. Results of surgery always did not match the AO classification.

Abbreviations

DCS -Dynamic Condylar Screw, CBP -Condylar Buttress plate, Locking compression Condylar plates[LCP], Less Invasive Skeletal Stabilization system [LISS].

This study is approved by the ethics committee and is in accordance with the ethical standards laid down in Helsinki declaration of 1964.

Acknowledgement Prof. Dr. R. Rathinasabapathy, Head Department of Orthopedics and Traumatology, Thanjavur Medical College and Hospital

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