

**MANAGEMENT OF DISTAL FEMORAL FRACTURES USING DYNAMIC CONDYLAR SCREWS**

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**ABSTRACT**

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**BACKGROUND**

Fractures of distal end of femur are complex injuries which are difficult to manage & are unstable and comminuted. Despite advances in implants treatment of distal femoral fractures remains a challenge.

**AIMS**

This study was done to analyze the functional outcome & complications associated with surgical management of fractures of distal end of femur in adults using Dynamic Condylar Screw (DCS).

**SETTINGS & DESIGN**

It was a prospective clinical study done at BMCH, Chitradurga.

**METHODS**

The present study included 25 patients with 13 Supracondylar and 12 Intercondylar fractures of femur. They were operated after stabilization using Dynamic Condylar Screw.

**RESULTS**

The study showed maximum presentation between 4<sup>th</sup> and 5<sup>th</sup> decade with mean age of 39.2 years with sex incidence of 11.5:1 (M:F). Mode of injury was RTA in 17, simple fall in 5, fall from height in 2 and assault in 1 patient. Patients presented to hospital within 0 to 4 days of injury. Left side was involved in 12 and right side in 13 cases. There were 9-A1, 3-A2, 1-A3, 2-C1, 8-C2 and 2-C3 fractures. Six patients had compound fracture. Patients were operated from 3 days to 40 days after admission at an average of 12.36 days. Results were found to be excellent in 8, good in 9, moderate in 3 and poor in 5 patients. Complication in form of valgus angulation, shortening, splintering of proximal femoral fragment, deep infection, Implant failure and lateral angulation at fracture site, Non-union with deep infection were noticed. Average range of knee flexion was 104° and average time to radiological union was 13.42 weeks.

**CONCLUSION**

This study showed that DCS is a good method of treating closed type A1, A2, A3, C1 and C2 fractures. Type C3 and compound fractures treated by this method had more poor results. DCS provides rigid fixation and good purchase in osteoporotic bone. Early mobilization prevents knee stiffness.

**KEYWORDS**

Dynamic Condylar Screw (DCS), Femoral fracture/surgery, Fracture fixation, Internal/methods.

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**INTRODUCTION:** Increase in road traffic accidents and associated high velocity trauma is an ever growing problem. There is accompanying increase in number and severity of fractures, and the distal femur is not an exception. Knee joint is more vulnerable for injuries in vehicular accidents.

In elderly patients, fractures of distal end of femur may occur after a minor slip and fall on a flexed knee because of osteoporotic bones.

These fractures are complex injuries and have historically been difficult to treat. These fractures often are unstable and comminuted and tend to occur in either elderly or multiply injured patients. Because of the proximity of these fractures to knee joint, regaining full knee motion and function may be difficult.<sup>1</sup>

It is now recognized by most orthopaedic surgeons that distal femoral fractures are best treated with reduction and surgical stabilization.<sup>2</sup>

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Dynamic condylar screw provides freedom in the plane of flexion and extension, hence is technically less demanding than fixed angle device. It provides interfragmentary compression and also gives good purchase in osteoporotic bone.<sup>1</sup>

In this study we report the result of surgical management of distal femoral fractures in adults using Dynamic Condylar screw.

#### **OBJECTIVES:**

1. To study the functional outcome of fractures of distal end of femur in adults surgically treated with Dynamic Condylar Screw.
2. To study the complications of Dynamic Condylar Screw in fractures of distal end of femur in adults.

**METHODS:** Twenty five patients having distal femoral fractures with 13 Supracondylar and 12 Intercondylar fractures of the femur were treated by open reduction and internal fixation with the Dynamic Condylar Screw system at BMCH, Chitradurga.

#### **Inclusion Criteria:**

- Fresh and old cases of Distal femoral fractures which are of closed type.
- Open type of Distal femoral fractures will be included in the study after healing of wound.

Cases will include all Supracondylar and Intercondylar extensions of distal femoral fractures.

#### **Exclusion Criteria:**

- Age below 18 years.
- Patients not willing for surgery.
- Patients not medically fit for surgery.

A careful history was elicited from the patient and/or attenders to reveal the mechanism of injury and the severity of trauma. The patients who had Supracondylar and Intercondylar fractures of distal 15 cm of femur were selected for the study.

Vital signs were recorded. Systemic examination was done. Local examination of the fractured limb in majority of the cases revealed lateral rotation of the limb, swelling at the fracture site, tenderness, abnormal mobility, crepitus and shortening from 1 cm to 2 cm. Distal neurovascular status was assessed by palpating dorsalis pedis and posterior tibial artery and asking the patient to dorsiflex and evert the foot. Out of 25 patients all were fresh fractures, and they presented to hospital within 0 to 4 days of trauma.

X-ray of lower half of thigh including knee joint AP and lateral views were taken. Muller's classification<sup>3</sup> was used. There were 9 type A1, 3 type A2, 1 type A3, 2 type C1, 8 type C2 and 2 type C3.

Patients with open wounds were graded according to Gustilo Anderson classification. There were 6 compound fractures, of which 1 was Gustilo's type I and 5 were Gustilo's type II. Culture sample was collected. Wound was

thoroughly cleaned with copious amount of normal saline and Hydrogen peroxide followed by painting with Povidone iodine and surgical spirit. If the wound was dirty primary debridement was done. This was followed by primary wound closure. Intravenous antibiotics, injection Cefotaxime 1 gram and Injection Amikacin 500mg twice daily were used till the wound healed. Injection Tetglob (Tetanus Immunoglobulin) 500 IU IM and single dose of Tetanus toxoid was given. The injured limb of all the patients were immobilized by skin traction or skeletal traction and injectable analgesics were given to relieve pain.

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975 that was revised in 2000. Written informed consent was taken from all the participants and the study was approved by the Institutional Ethics Committee.

**Operative Technique<sup>4,5</sup>:** The operative technique followed was as per procedure in Figure 1 & 2.

**Bone Grafting:** In 4 cases bone graft was used. In one case Iliac bone graft, in 2 cases ipsilateral patella and in one case ceramic bone graft was used.

**After Treatment:** All the patients were given higher antibiotics and analgesics. Required amount of IV fluids were given. Depending on the amount of operative blood loss and post-operative Hb%, compatible blood transfusion was given. Suction drain was removed after 24-48 hours. The wound was inspected after 5 days and sutures removed on 10<sup>th</sup> post-operative day and also check X-ray is taken.

Post-operative immobilization was done using above knee plaster of paris (POP) slab or cast in 8 cases. It was applied in cases where fracture was comminuted and fixation was not very stable. The POP cast was removed after 3-6 weeks and knee motion exercises were started. Patients were started on static quadriceps exercises on the same day. Continuous passive motion exercises is started on 2<sup>nd</sup> post-operative day. Active range motion exercises are started on 5<sup>th</sup> post-operative day. Patient was allowed to walk using crutches or walker and only touch down weight bearing was allowed. Patients were discharged with advice to do active quadriceps exercises and not to bear full weight.

**Follow Up:** All the patients were followed up regularly at an interval of 4 weeks for the first 3 months and later at 2 monthly intervals.

**Statistics:** The Result was expressed in terms of numbers and percentage. Descriptive statistics was used to analyze the data using SPSS Software version 20.

#### **OBSERVATION AND RESULTS:**

**Age Distribution:** The average age was 39.2 years with a range of 19 years to 79 years.

**Sex Distribution:** There were 23 male patients and 2 female patients.

Type	No. of Patients	Percentage
RTA	17	68
Fall from height	2	8
Simple fall	5	20
Assault	1	4
<b>Total</b>	<b>25</b>	<b>100</b>

**Table 1: Mode of injury**

Associated injuries	No. of Patients
Ipsilateral patella fracture	3
Ipsilateral intertrochanteric fracture	1
Fracture both bones both legs	1
Contralateral segmental fracture of leg	1
Contralateral fracture tibia	1
Old tibial plateau fracture	1
Contralateral humerus fracture	1
Ipsilateral fracture both bones forearm with fracture clavicle	1
Head injury	2

**Table 2: Associated injuries**

Side	No. of Patients	Percentage
Left	12	48
Right	13	52
<b>Total</b>	<b>25</b>	<b>100</b>

**Table 3: Side affected**

Type	No. of Patients	Percentage
A1	9	36
A2	3	12
A3	1	4
C1	2	8
C2	8	32
C3	2	8
<b>Total</b>	<b>25</b>	<b>100</b>

**Table 4: Number of patients in each fracture group**

Type	No. of Patients	Percentage
Simple	19	76
Compound	6	24
<b>Total</b>	<b>25</b>	<b>100</b>

**Table 5: Number of patients in each fracture type**

19 patients (76%) had simple fractures and 6 patients (24%) had compound fractures.

**Type of Open Fracture: Table 6:** Of the 6 patients 1 had Gustilo's type I and 5 had Gustilo's type II fractures.

Type	No. of Patients	Percentage
Gustilo's Type I	1	16.67
Gustilo's Type II	5	83.33
<b>Total</b>	<b>6</b>	<b>100</b>

**Table 6: Type of open Fracture**

**Complications:**

**Intra-operative:**

- a) **Deformity:** In one case 5<sup>0</sup> valgus deformity and in one case 10<sup>0</sup> valgus deformity occurred due to error in the angle of insertion of guide pin.
- b) **Shortening:** Shortening of 1 cm to 2 cm occurred in 4 patients post operatively. In 1 patient who was operated late because of head injury, spikes of fracture site was nibbled to achieve reduction which resulted in shortening. In other 3 cases shortening was due to comminution.
- c) **Splintering of Femur:** In one patient with oblique supracondylar fracture a 4.5mm lag screw was passed from lateral cortex after obtaining reduction. The head of screw was not sunk properly and the plate was applied. During final tightening there was splintering of proximal femoral fragment which was managed by applying encirclage wire.

There was no splintering of condyles during reaming or insertion of screw.

**Post-operative Complications:**

**Deep Infection:** There were 3 cases of Deep infection, which persisted even after appropriate antibiotic treatment after culture and sensitivity. Of these 3 cases 2 were Gustilo's type II compound fractures. In one patient with infection who had also gone for non-union, infection was controlled after implant removal and application of external fixator. In another patient infection was controlled after removal of implant after one year.

**Delayed Complications:**

- a) **Implant Failure:** In one patient who had a fall at 2 months after the operation, the screws from the proximal fragment came out and there was lateral angulation at fracture site. It was managed with reduction under general anaesthesia and application of high groin cast. The fracture was united in 16 weeks. Still some lateral angulation persisted which resulted in shortening of 2cms.
- b) **Non-union:** One patient in our series went for non-union. He also had deep infection.

**Condition at Discharge:** All the patients were ambulant using crutches or a walker, except 4 patients. The reasons for these 4 patients being non-ambulant were - one patient had fractures of both the legs, one patient had segmental fracture of the opposite leg and two of the patients had associated upper limb injuries. Five patients had quadriceps lag of 5<sup>0</sup> to 10<sup>0</sup>.

**Radiological Union:** Time to healing, defined as the time to the formation of circumferential bridging callus across the fracture. The average time to healing was 13.42 weeks in 24 patients, ranging from 10 weeks to 16 weeks. One patient went for non-union.

**Movements of Knee Joint:** Five patients had quadriceps lag ranging from 5° to 10°. Average knee flexion was 104°. Average range of flexion for patients in type A was 107.30 and for type C was 100.41.

**Pain:** Six patients in this series had pain in the knee.

**Weight Bearing:** The duration of non-weight bearing ranged from 4-6 weeks. This was followed by partial weight bearing till the signs of radiological union were seen after which full weight bearing was allowed. The average time to full weight bearing was 13 weeks.

**Quadriceps Strength:** Twenty patients out of 25 patients had normal quadriceps muscle power. Four patients had grade 4 and 1 patient had grade 3 power.

**Functional Results:** The results were evaluated according to the Schatzker and Lambert criteria.<sup>6</sup>

Overall results were excellent in 8 (32%) patients, good in 9 (36%) patients, moderate in 3 (12%) patients and poor in 5 (20%) patients. (Table 7)

Result	No. of Cases	Percentage
Excellent	8	32
Good	9	36
Moderate	3	12
Poor	5	20

**Table 7: Results for all the fracture groups**

Type	No.	Excellent	Good	Moderate	Poor
A1	9	1	6	1	1
A2	3	3	0	0	0
A3	1	0	0	0	1
C1	2	2	0	0	0
C2	8	2	3	2	1
C3	2	0	0	0	2

**Table 8: Results for each fracture group**

There were 6 compound fractures, 1 was Gustilo's type I and 5 were Gustilo's type II. Of these excellent and good results were found in only 2 cases, rest 4 had poor results.

Result	No. of Cases	Percentage
Excellent	1	16.67
Good	1	16.67
Moderate	0	0
Poor	4	66.67

**Table 9: Results for compound fractures**

**DISCUSSION:** 25 cases of distal femoral fractures with 13 Supracondylar and 12 Intercondylar fractures of the femur were treated by open reduction and internal fixation using the Dynamic Condylar Screw system. They were followed up for an average of 10.8 months. The purpose of the study was to evaluate the end result of treatment in these patients.

**Age Distribution:** The average age of all cases in this series was 39.2 years. Fracture was more common in age groups between 41-50 years.

**Sex Distribution:** There were 23 male and 2 female patients, showing male preponderance. This is because in Indian social system its mainly the male population which is involved in outdoor activities.

**Associated Injuries:** 11 patients (44%) had associated injuries, denoting that the injury was due to high energy trauma.

**Side Affected:** In this series there is slight preponderance for right-sided fractures.

**Types of Fracture:** As reported by many others, comminuted fractures were found to be the most common type. In young patients comminution occur with high velocity injury. In elderly osteoporosis may be the reason for comminution.

**Duration of Hospital Stay:** The duration of hospital stay in our series was almost similar to that of Neer, et al<sup>7</sup> and Giles JB, et al.<sup>8</sup> (Table 10)

Author	Duration of hospital stay in days
Giles JB, et al <sup>8</sup>	17
Stewart, et al <sup>9</sup>	33
Neer, et al <sup>7</sup>	21
Present study	22.5

**Table 10: Duration of hospital stay**

**COMPLICATIONS:**

**1. Infection:** In this series there were 3 cases (12%) of deep infection which was not controlled even after appropriate antibiotics. Out of these 3 cases, 2 had presented with Gustilo's type II compound fracture. Two of these patients also had associated head injury. One of these patients landed in non-union which was managed with external fixator. In one the infection was controlled after implant removal.

The studies by Shewring DJ and Meggitt BF<sup>10</sup> and by James B Giles,<sup>8</sup> et al had no post-operative infection. The study by Siliski JM, Mahring M and Hofer HP<sup>11</sup> noticed deep infection with compound fractures and all of those 3 patients had poor results, which is similar to our study.

- Shortening:** Shortening had occurred in 5 patients ranging from 1 to 2 cms. Average of 0.28 cm shortening occurred.
- Deformities:** Valgus deformity of 5° to 10° occurred in 2 patients. Giles JB, et al<sup>8</sup> noted more than 5° angulation in 3 patients in his series.
- Non Union:** One case with deep infection went for non-union. Shewring DJ and Meggitt BF<sup>10</sup> noted 2 cases of nonunion in their series.
- Implant Failure:** One case in our series landed in implant failure because of fall 2 months after surgery. This resulted in giving away of proximal screws and lateral angulation at fracture site. It was managed with reduction under general anaesthesia and application of high groin cast, union occurred in 16 weeks.
- Neuro vascular Injury:** None of our patients had any pre-operative or post-operative neurovascular injury.
- Osteoarthritis of knee:** There was no case of osteoarthritis of knee in our series, which probably needs a longer study period to comment upon.

**Movement of Knee Joint:** The average range of knee motion was 104°. Five patients had extension lag ranging from 5° to 10°. Patients with Type A fractures had good range of movements compared to type C fractures. (Table 11)

Author	Implant	Range of Motion
Giles JB, et al <sup>8</sup>	DCS	120°
Shewring DJ and Meggitt BF <sup>10</sup>	DCS	112°
Kolmert L, Egund N and Person BM <sup>12</sup>	Semielastic device	92°
Gellman RE, et al <sup>13</sup>	IMSC	104°
Watanabe Y <sup>14</sup>	IMSC	102°
Lucas SE, et al <sup>15</sup>	IMSC	100°
Present Study	DCS	104°

**Table 11: Average Range of Knee Motion in Different Studies**

**Radiological Union:** The average time to union was 13.42 weeks with a range of 10 to 16 weeks. Comminuted fractures compared to simple fractures took more time for union. (Table 12)

Author	Implant	Union in Weeks
Giles JB et al <sup>8</sup>	DCS	17.2
Shewring DJ & Meggitt BF <sup>10</sup>	DCS	11.3
Pritchett JW <sup>16</sup>	DCS	12
Gellman et al <sup>13</sup>	IMSC	12
Present study	DCS	13.42

**Table 12: Time to Radiological Union in Different Studies**

In our study, excellent result was seen in 32% and good results were seen in 36%. Excellent results were less and good results were more but when clubbed together it was almost similar to the results of Pritchett JW<sup>16</sup> and Kolmert L, Egund N and Person BM.<sup>12</sup> (Table 13)

Author (Implant)	Excellent	Good	Moderate	Poor
Pritchett JW <sup>16</sup>	53.4%	26.6%	6.7%	13.3%
Yang RS, Liu HC and Liu TK <sup>17</sup>	61.3%	23.7%	9.7%	5.3%
Joseph FR (Zickel device) <sup>18</sup>	30.0%	58.0%	8.0%	4.0%
Shelbourne KD and Brueckmann FR (Rush Pins) <sup>19</sup>	53.1%	30.6%	11.2%	5.1%
Kolmert L, Egund N and Person BM (Semielastic Device) <sup>12</sup>	41.4%	31%	17.3%	10.3%
Gellman, et al (IMSC) <sup>13</sup>	17.4%	65.2%	8.7%	8.7%
Christodoulou. A. (IMSC) <sup>20</sup>	51%	31%	9%	9%
Study series (DCS)	32%	36%	12%	20%

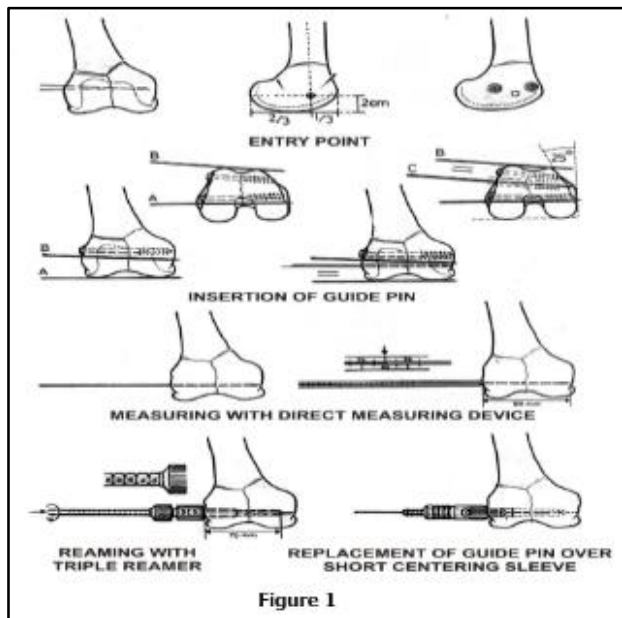
**Table 13: Comparison of Results in Percentage with Other Implants**

In our study both the type C3 patients had poor results. In 6 compound fractures one had excellent result, one had good result and 4 had poor results.

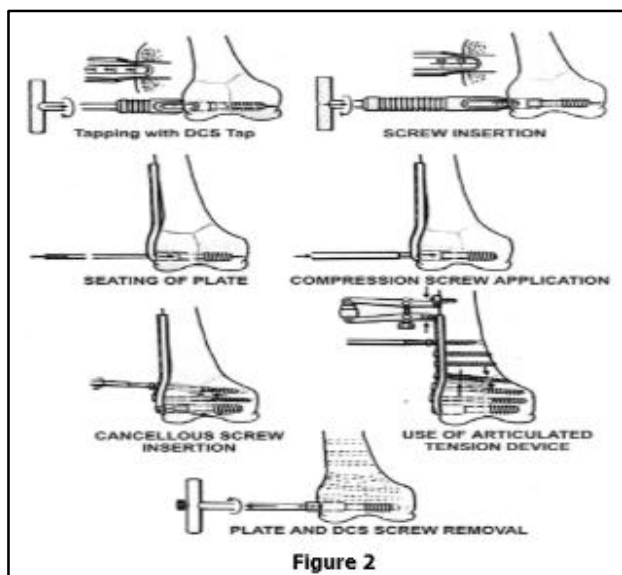
**CONCLUSION:**

- The study was conducted to assess the functional outcome and complications of DCS in the treatment of distal femoral fractures in adults.
- We have found that these fractures are often comminuted. The fracture results from high energy trauma in young and in elderly due to Osteoporosis. Some of these fractures were open fractures.
- Analysis of our results showed that, it is a good method of treating closed Type A1, A2, A3, C1 and C2 fractures. Type C3 fractures and compound fractures treated by this method had more poor results.
- The Dynamic Condylar Screw system gives a rigid fixation and lag screw provides good purchase in osteoporotic bone. Early mobilization of the knee joint can be started and stiffness can be prevented.
- Complications in form of deep infection, non-union and implant failure can be encountered.
- We conclude that Dynamic Condylar Screw system is a good implant for the management of Muller's Type A1, A2, A3, C1 and C2 fractures of the distal femur.

**Figure 1 & 2: Describing the operative technique of DCS.**



**Figure 1**



**Figure 2**

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