ORIGINAL STUDY

acta orthopaedica belgica, 2023, 89 (1), 122-127

doi.org/10.52628/89.1.11119

Headless cannulated screw and external fixator in the treatment of type C distal femur fractures: Effect of early mobilization on clinical outcomes

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Distal femur fractures occur due to high-energy trauma in young patients and with low-energy traumas in osteoporotic elderly patients. Implants selected for use in the treatment of distal femur fracture should provide stable fixation and allow early mobilization especially at elder patients. We aimed to investigate the effects of the headless cannulated screw and external fixator combination on the early mobilization of the patients and postoperative complications. Twenty-one patients with Type C distal femur fracture were included in the study.The fracture lines were temporarily fixed with K wires. After the fracture reduction with headless cannulated screws a tubular external fixator with carbon fiber rods was applied to bridge the knee joint. The external fixators were removed at the 6th week follow-up, and the patients were forced to perform knee flexion as much as they could tolerate. The 6th month KSS scores of the patients were 44.3 (34-60) and the 18th month KSS scores were 77.5 (60-88).Preoperative VAS score was 8(7-10) and postoperative VAS score was 4(3-6).Knee flexion of the patients at 6th months was 95.9 (80-110 degrees) and at 6th months knee flexion was 114.5 (100-125 degrees). Superficial pin site infection was observed at 4 patients and regressed with antibiotic therapy. Combination of cannulated screws with an external fixator for joint restoration in type C distal femur fractures allows early mobilization and reduces postoperative morbidity.

Keywords: Distal femur fracture, headless cannulated screw, external fixator, early weight bearing.

INTRODUCTION

The increase in the elderly population and the desire of people to stay in social life in older ages increase the incidence of distal femur fractures(DFF)[5]. DFF occurs due to high-energy trauma in young patients with good bone quality. Low-energy traumas, such as simple falls, also cause fractures in osteoporotic elderly patients[13]. Although it constitutes 1% of all fractures and 3-6% of all femur fractures[18], it results in multiple complications, especially in elderly patients with comorbidities[14]. The general condition of the patient, involvement of the articular surface, presence of soft tissue damage require good pre-surgical planning, implant selection and surgical technique to reduce postoperative complications.

The results of treatment of distal femur fractures were very poor in the 1960s, as it was mostly treated conservatively[7]. The trend has shifted towards surgical treatment over time with new implants developed due to a better understanding of distal femoral anatomy and fracture biology[1]. Depending on what we have learned recently, the success of surgical treatment has increased from 52-54% in the 1960s to 75% in the 1970s and 80% in the 1980s[7].

The fact that there are multiple surgical implant options that can be used depending on involvement in the meta-diaphyseal region and joint also reveals the complex structure of DFF. Despite the use of external fixators, plate fixation, and intramedullary nails developed with technology, malunion can be seen at a rate of 5% in DFF especially in old patients[19]. Range of motion loss is another common complication, especially in younger patients who have sustained high-energy trauma[2].

Although it is more important especially in elderly, early rehabilitation of patients after stable fixation and reducing the patient's dependence on bed are important in terms of preventing postoperative complications after surgery.The implants to be selected in the DFF treatment will prevent these problems by providing stable fixation and allowing early movement in the patient.

In our study, we aimed to investigate the results of a stable headless cannulated screw and external fixator combination in the treatment of Type C distal femur fractures. Our hypothesis is that in addition to providing a stable fixation with the help of this combination, early mobilization of patients with an external fixator can prevent postoperative complications.

MATERIALS AND METHODS

This is a single center retrospective study which was conducted between January 2018 and January 2021. Twenty-one patients with Type C distal femur fracture (17 of them were type C1,3 of them were Type C2 and 1 of them were Type C3) was included in the study. The average waiting time for surgery was 2 days.The AO classification system was used for distal femur fracture classification.Patients with pathological fractures, accompanying proximal femur fractures, distal femur fractures other than type C according to AO classification, high grade skin lesions where extensor mechanism is damaged, open fractures and patients younger than 16 years of age were excluded from the study.

The institutional review board approved this single-center retrospective study with the number E-2022-271. All patients were informed, and their written informed consent was obtained. Our study has been performed by the ethical standards in the 1964 Declaration of Helsinki and its later amendments.

Concomitant comorbidities of the patients that may prevent surgery were dealt.Computed tomography with 3-D reconstruction (Figure 1) of affected knee joint together with standard AP and lateral radiographs (Figure 2) was done to be used in fracture classification and to determine comminution of the fracture side.

All surgeries were performed by the same surgeon (KB) and under general anesthesia (EAT).An anterior knee incision was used for the skin incision and a medial parapatellar arthrotomy was performed. After the patella was tilted retroverted laterally, fracture hematomas were removed, and the fracture lines were identified. Fracture reduction was confirmed with fluoroscopy after the fracture lines were temporarily fixed with K wires. In order to ensure the continuation of the reduction, 3.0 mm headless cannulated screws (Tasarim Medical®Istanbul) were applied with the help of fluoroscopy over the K wires used for fixation after drilling.According to the size of the bone fragment, 2.5, 3.0- and 4.3-mm headless screws of appropriate diameter were used. The number of cannulated screws was determined according to the extent of the fracture. After the fracture reduction and articular surface continuity were evaluated with visual and fluoroscopy, a tubular external fixator with carbon fiber rods (MAF, Femur Tibia Rod-Pin Fixator, Tasarim Medical®Istanbul) was applied to bridge the knee between the lateral of the femur and the medial of the tibia. Four 5.0 mm Schanz's nails were applied, 2 of them lateral to the femur and the other 2 to the medial tibia. Schanz nails were combined with 8 mm carbon fiber rods (Figure 3). During the stabilization phase of the external fixator, the knee was fixed at approximately 10 degrees of flexion. The stability of the external fixator, the length of the Schanz and the final condition of the fracture were evaluated by fluoroscopy, and the operation was terminated.

All patients were evaluated with VAS score before and after surgery. Knee functions of all patients were evaluated with knee society score(KSS) at

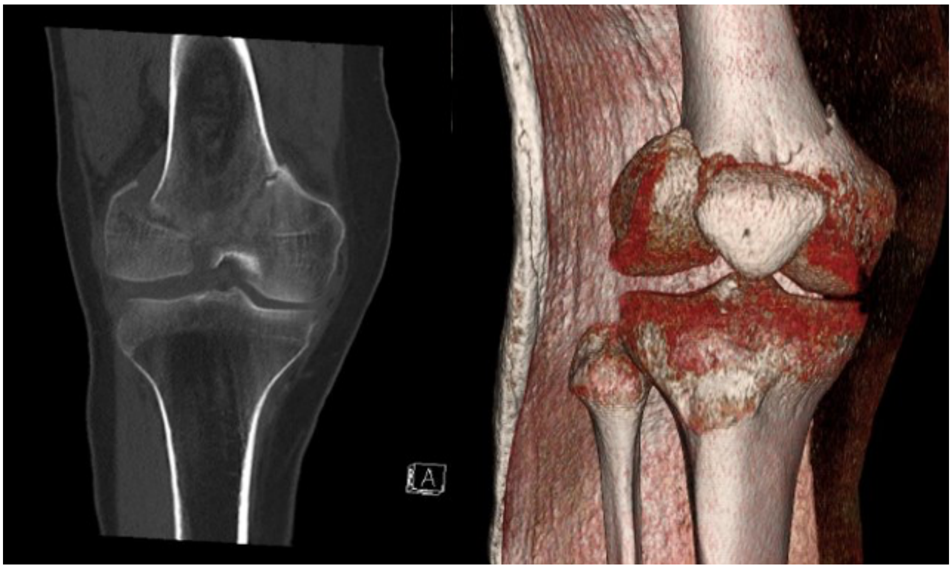

Fig. 1 — Preoperative Ct scan(a) and 3-D reconstruction(b) of one of our patients.

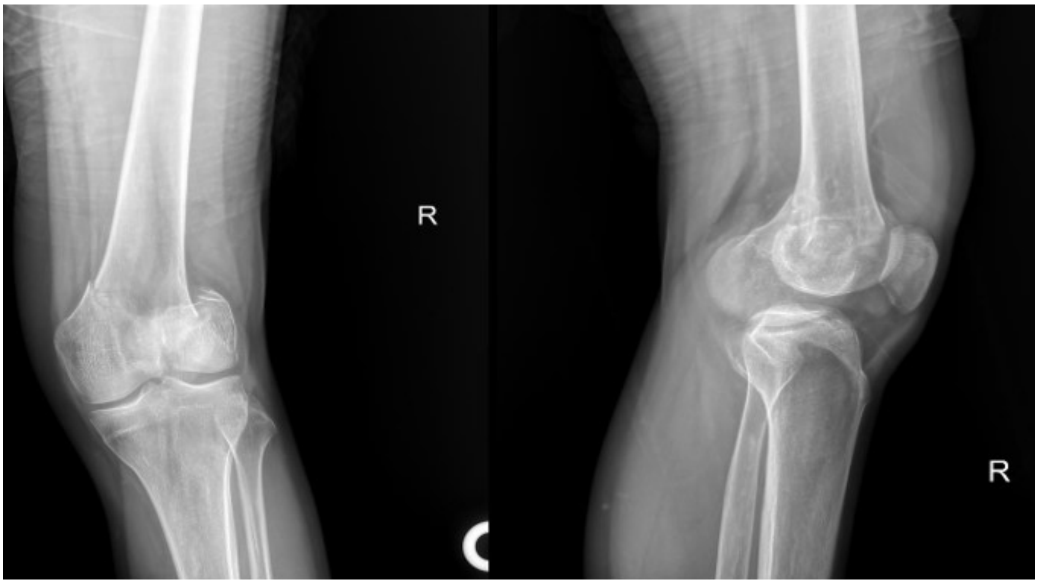

Fig. 2 — Preoperative AP(a) and lateral (b)x-rays of one of our patients.

6 and 18 months postoperatively.External fixators were removed after at postoperative 6th weeks. Clinical follow-ups were performed for radiological union.After the bone union was seen radiologically, the patients were encouraged for physical therapy. Patients were evaluated for knee range of motion at 6th and 18th months postoperatively.

RESULTS

21 patients were followed for 18 months.14 of the patients were male and 7 were female.The mean age of the patients was 38.8 (16-63 years). Active ankle movement was allowed for the first 48 hours. From the 2nd postoperative day, the patients were allowed to be mobilized with full weight bearing. Patients were discharged on average 3 days after surgery. The external fixators were removed at the 6th week follow-up, and the patients were forced to perform knee flexion as much as they could tolerate (Figure 4). Fracture union was observed radiologically in all patients.

The 6th month KSS scores of the patients were 44.3 (34-60) and the 18th month KSS scores were 77.5 (60-88). Preoperative VAS score was 8(7-10) and postoperative VAS score was 4(3-6).None of the patients were tobacco smokers. Knee flexion of the patients at 6th months was 95.9 (80-110 degrees)

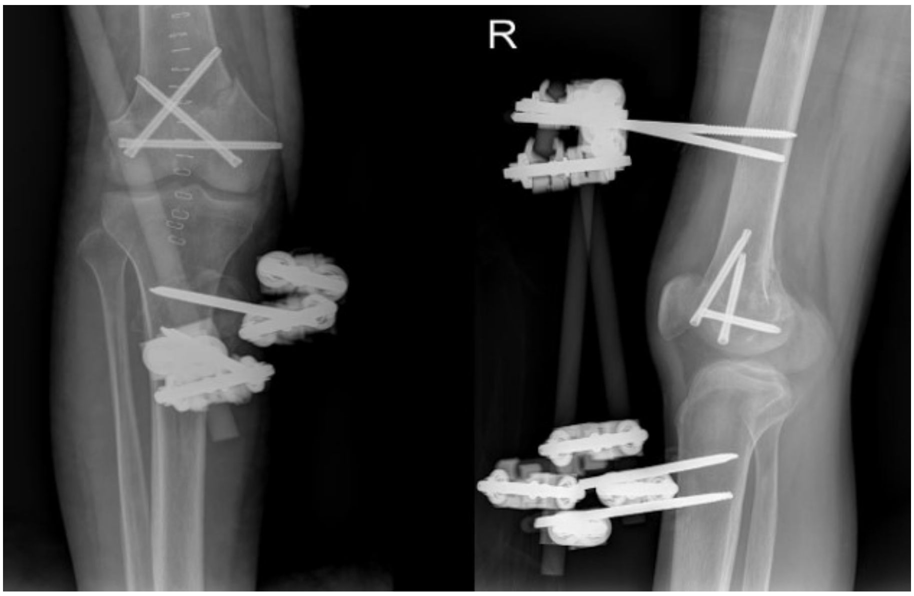

Fig. 3 — Early postoperative X-rays.

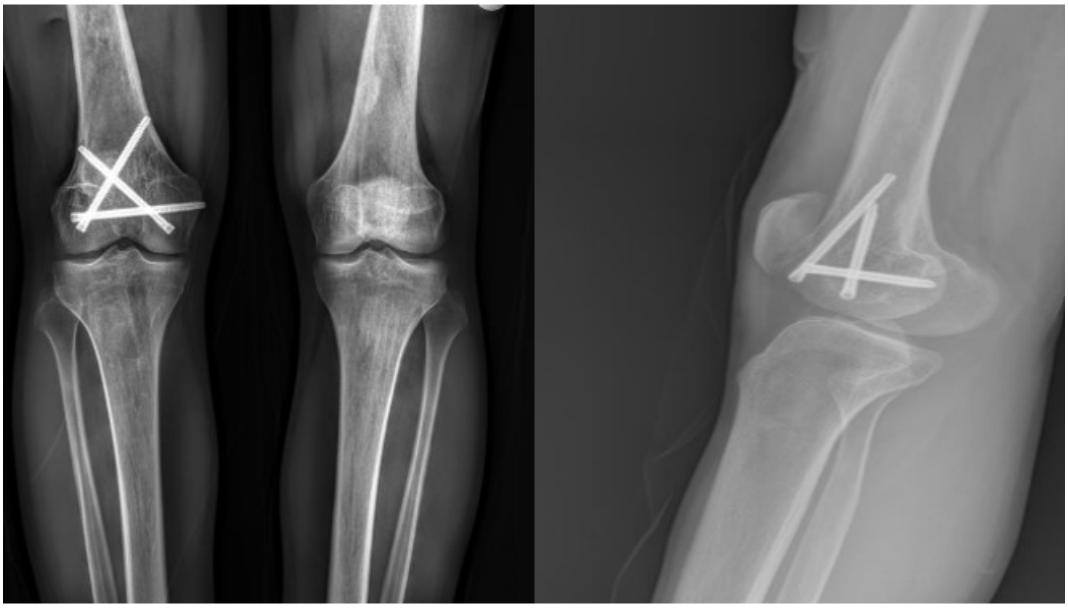

Fig. 4 — Postoperative 6th month x- rays.

and at 18th months knee flexion was 114.5 (100-125 degrees) (Figure 5). No limitation of knee extension range of motion was detected in any of our patients.

Superficial pin site infection was observed in the early period (within the first 5 weeks of surgery) in a total of 4 patients. In all patients, the infection regressed with appropriate antibiotic therapy. During the 18-month follow-up period, none of the patients had surgical implant-related problems such as deformity, chondrolysis, or screw cut-out.

DISCUSSION

Distal femur fractures are under the deforming effect of multiple muscles. While the quadriceps muscle causes shortening, the adductor and iliotibial band tend to create varus/valgus deformity in the coronal plane. The distal of the fracture is pulled by the two heads of the gastrocnemius, causing the "apex posterior" deformity, which is better visible on lateral radiographs[4,6]. Stable fixation is required in distal femur fractures that will resist the deforming

Fig. 5 — Knee flexion of one of the patients at the last follow-up.

effect of the muscle forces acting on this region and therefore will not cause malunion or nonunion. Malunion, which occurs due to infection or failure of implants, is one of the most seen complications of DFF and is seen at a rate of 7%[10,19]. Considering the risk of malunion on the one hand and the risk of knee motion restriction on the other hand, which is more common especially in young patients, it is necessary to evaluate implant alternatives very well.

Since the intra-articular involvement in DFF is as high as 36%, the aim should be not only to heal the fracture but also to restore the articular surface[16]. The use of cannulated screws for joint restoration in our patients causes compression along the entire length of the screw and provides more stability than conventional lag screws[17]. In the postoperative knee range of motion examination of the patients included in our study, they had full knee extension but approximately 10-20° flexion deficit (Figure 1). Venous thromboembolism related to immobilization[3] was not observed in any of our patients. Our hypothesis that early mobilization of patients by preservation of fixation with external fixator will have positive effects on fracture union and knee range of motion is consistent with the results of our study.

There are reports about the use of cannulated screws for joint restoration in distal femur fractures, especially Hoffa fractures, and condylar or bicondylar fractures[8,1,12,17]. In these studies, it was reported that less implant failure was experienced in headless cannulated screws compared to headed compression screws, and the results of anatomical reduction with headless screws were better.

An experimental study in a femur fracture model showed that two 6.5-mm cancellous screws provide the most rigid and stable fixation for fixation of unicondylar femur fractures[9]. According to the results of this study, four of the 3.5 mm cortical screws used to use small fragments have the same mechanical stability as two 6.5 mm screws.In our study, we used an average of 3 to 8 cannulated screws, depending on the extent of the fracture. We think that the reason why we did not experience stability problems even in 17 cases where we used 3 screws is our external fixator application. While the external fixator allows the patient to give full weight and mobilize early, it contributes to the stability by preventing the load on the fracture area.

Temporary bridge external fixator application in periarticular fractures is a frequently used method in orthopedic practice. Providing stability in the fracture area leads to healing of the surrounding soft tissue, reduction of pain, reduction of inflammatory reactions in the surrounding tissues, ease of care for the patient, and reduction of the risk of cardiopulmonary complications[15]. Temporary external fixator application is generally used as the initial treatment of two-stage treatment in complex fractures. The combination of temporary external fixator application with headless cannulated screw fixation is a subject that has not been studied yet in the current literature to the best of our knowledge. Our study is the first and only study on this subject.

The main limitations of our study are the small number of patients and the retrospective planning of the study. Other limitations of our study are that it was not multicentered and had a short follow-up period. The most important feature of our study is that, as far as we know, it is the only study in the literature that allows early movement with a combination of cannulated screw and external fixator in Type C distal femur fractures.

CONCLUSION

Combining the use of cannulated screws for joint restoration in type C distal femur fractures with the application of an external fixator that allows early mobilization and full weight bearing reduces postoperative mortality.

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