Asian journal of Pharmaceutical and biological research 2231-2218
http://www.ajpbr.org/
Volume 10 Issue 3
Sept-Dec 2021
10.5281/zenodo.5552193

OPTIMIZATION OF BLOCKING INTRAMEDULLARY OSTEOSYNTHESIS METHODS FOR FEMORAL FRACTURES

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Abstract. The analysis of complications after surgery with use of various fixation devices testifies to the need of conducting studies aimed at the definition of indications to the choice of fixation device for treatment of distal femur fractures. In the paper the comparative data of surgical treatment results of patients with distal femur fractures by means of bone fixators with angle stability (Gr. I; n=14) and locking intramedullary rod (Gr. II; n=13) are given. On the basis of results analysis indications for the choice of fixation device are formulated and grounded.

Keywords: distal femur fracture, LCP-DF (Locking Compression Plate Distal Femur), locking retrograde intramedullary nailing.

Introduction. The treatment of periarticular and intraarticular fractures today remains one of the topical and complex issues of traumatology. The incidence of fractures of the distal femur is approximately 6–8% among all skeletal fractures and about 12–25% among fractures of the femur [1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 30, 32, 34, 36, 54, 57]. Despite some success in the treatment of injuries of the musculoskeletal system, from 5 to 54% of cases of femoral fractures lead to various unsatisfactory outcomes - delayed consolidation, fracture nonunion, pseudarthrosis, limb deformity, persistent knee joint dysfunction [9, 11, 12, 15, 17, 20, 25, 26, 35, 41, 43, 44, 46, 51, 52].

Today, among traumatologists, supporters of the use of a plate and an intramedullary locking rod for the treatment of fractures of the distal femur can be conditionally distinguished [14, 16, 18, 19, 21, 22, 24, 28, 53, 55, 56, 58]. At the same time, there is no clear separation of indications for the use of one or another fixator. An analysis of complications after osteosynthesis with various fixators indicates the need for studies aimed at determining the indications for choosing a

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fixator in the treatment of fractures of the distal femur [23, 27, 29, 31, 33, 37, 38, 40, 42, 45, 47, 48, 49, 50].

The aim of this work is to evaluate the results of surgical treatment of patients with fractures of the distal femur, to determine the indications for choosing a fixator.

Materials and methods

A study was made of 27 patients with fresh fractures of the distal femur, who underwent surgical fixation of the fracture by submerged metal osteosynthesis in the period from 2018 to 2020.

We divided the patients into two groups depending on the type of fixator used - extraosseous or intraosseous.

• Group I included 14 patients with intra- and periarticular fractures of the femur, who underwent closed or open reposition of fracture fragments, extraosseous osteosynthesis with a plate with angular stability. In 9 cases, the MIPO technique (Minimally Invasive Plate Osteosynthesis - minimally invasive plate osteosynthesis) was used; in 5 cases, open reduction of fragments was required.

• Group II included 13 patients with intra- and periarticular fractures of the femur, who underwent closed or open reposition of fracture fragments and retrograde fixation with an intramedullary nail. In 9 cases, the technique of closed indirect reduction of fragments was used, fixation of the fracture without exposing the fracture zone; in 3 cases, access to the fracture site was performed to reposition the fragments; in 1 case, access to the fracture site was necessary to remove the migrated metal structure.

Fractures are distributed according to the AO / ASIF classification (Table 1).

Patient groups	Types of fractures										Total
	Segment	A1	A2	A3	B1	B2	B3	C1	C2	C3	
I	32	1	-	1	4	-	-	-	-	-	6
	33	1	1	2	1	-	-	2	2	-	8
III	32	1	-	3	-	-	-	-	-	-	4

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	33	1	4	1	-	-	-	1	1	1	9

The average age of the patients was 48.6 years:

• in group I - 53.7;

• in the II group - 43.5 years.

Upon admission to the hospital, the primary method for stabilizing fresh fractures was skeletal traction - 25 patients or a rod unilateral apparatus for extrafocal fixation (EF) - 2 patients. Final stabilization of a fresh fracture was performed:

• during the first day from the moment of injury - 1 patient;

• for 2–5 days - 2 patients;

• 6-10 days - 20 patients;

• 11–20 days - 4 patients, which was due to the need to stabilize the general condition of the patient.

Fracture fixation surgical technique

Outer osteosynthesis of metadiaphyseal fractures was performed using the MIPO technique - closed reposition of fragments under the control of an electron-optical converter (EOP), bridge fixation of the fracture from a short (up to 5 cm) lateral approach.

In type 33 fractures, the fragments were openly repositioned through the lateral parapatellar approach.

In case of type 33-C fractures, revision of the knee joint, reposition of intra-articular fragments, fixation of them with spongy screws, after which a plate was installed and the intra-articular block was fixed to the diaphyseal fragment, was performed. The axial parameters were verified under the control of the eye.

In 13 cases the LCP-DF plate was used, in one case the LISS plate was used. The plates were fixed along the lateral surface of the femur.

Blocking intramedullary osteosynthesis (BIOS) of the distal femur in all cases was performed with a retrograde nail from the medial parapatellar approach without reaming the bone marrow canal.

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For fractures 33-C, revision of the knee joint, condyles juxtaposition, and rod placement were performed.

For intra-articular fractures, a reconstructive rod with tie bolts was used to fix the condyles.

The insertion point of the rod is standard, in the intercondylar zone of the thigh. In one case, a primary dynamic BIOS was performed (fracture 32-A3), in all the others - a static BIOS of the distal femur with subsequent dynamization.

Research methods

In our work, we used X-ray and clinical research methods. Treatment results were assessed using the Mattis scale [3] and the Knee Score [5, 10]. The observation period for patients is up to 2 years after the operation.

In the scale for assessing the function of the knee joint after injury (Knee Score), the following indicators are considered:

1) subjective - pain at rest, prolonged forced position;

2) objective - range of motion, presence and severity of contracture, axis of the limb;

3) functional - the distance of movement, walking on stairs, the presence of external support when moving.

The orthopedic regimen included early active function in the knee joint (3-4 days after surgery), limited load on the limb.

Medical therapy is standard for trauma patients with fractures of the lower extremities.

Results and its discussion

Evaluation of treatment results according to the Matthis scale and the Knee Score scale showed similar treatment results in the first and second groups of patients.

Both tables show approximately similar treatment results in both groups. This is due to the fact that the analysis of the results in each of the groups was carried out

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without dividing by the type of fracture. The most interesting are indicators of treatment outcomes with a separate distribution by types of fractures.

With type 32 fractures, an equally good recovery of joint function is observed, while, due to the better biomechanics of the intraosseous fixator, in these types of fractures in group II, an earlier activation of patients was observed, which had a positive effect on the dynamics of restoration of the activity of the injured limb.

Fractures of type 33-A in patients treated with external osteosynthesis have a high percentage of recovery of the knee joint function - 79%; with the use of an intraosseous fixator, lower indicators of the function of the knee joint are noted - 62%.

The results of restoration of the function of the knee joint in case of comminuted intra-articular fractures of type 33 ‑ C with the use of an extra-bone fixator are about 70%, and with the use of an intraosseous nail - only 41%.

Complications during treatment

In group I, X-ray fusion of a fracture against the background of osteosynthesis with a plate with angular stability was obtained in 12 (85.7%) patients out of 14 at standard times, which are common for a fracture of this type and localization.

The following complications were observed in 2 patients:

• one patient (7.1%) had a fatigue fracture of the plate, for which later reosteosynthesis was performed with the same fixator;

• in another patient (7.1%) with a concomitant diagnosis of type I diabetes mellitus, the locking screws were pulled out of the bone, which caused a change in the fixation technique.

Both cases occurred among patients of the older age group (71 and 72 years) with the same fractures - type 32-B1 at 3.5 and 6 months after osteosynthesis. There was no secondary displacement or disruption of the limb axis.

In 2 patients, it was difficult to remove the extraal fixator (the effect of “cold welding” between the heads of the locking screws and the holes of the plate).

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In group II, X-ray analysis showed fracture union in all patients. In 12 (92.3%) cases, fusion occurred at the usual time for a fracture of this type and localization.

One patient (7.7%) with a double hip fracture had a rod fracture followed by reosteosynthesis.

In 4 patients, complications were observed that did not lead to an increase in the timing of the fracture union:

• in 1 (7.7%) patient, it was not possible to achieve anatomical articular reduction (fracture 33 – C2.3);

• 1 (7.7%) patient had an iatrogenic fracture of the proximal fragment (fracture 32 – A1.3);

• in 2 (15.4%) patients (fractures 33 – C), secondary displacement of the distal fragment with a violation of the femoral axis occurred.

Infectious complications were not observed in any group of patients.

When choosing a method for treating periarticular fractures, it should be borne in mind that the intraosseous canal of the femur has an elliptical shape - the sagittal diameter is larger than the frontal one. With this shape of the canal, the intraosseous rod is in close contact with the lateral and medial walls of the canal, which ensures stability of fixation. In the distal part of the femur, the intraosseous canal is widened in the frontal plane, which prevents tight contact of the nail with the bone in this zone. Thus, with intramedullary osteosynthesis of fractures of the distal femur, it becomes necessary to increase the rigidity of fixation of the distal fragment. In our study, for this purpose, we used universal retrograde rods, in which the distal blocking was performed with ChM® tie bolts and Targon retrograde rods with the possibility of fixing the distal fragment with 4 screws in one plane from Magma-Sich®. There are other designs of intramedullary fixators that allow to achieve an increase in rigidity in the distal femur, but these fixators are not officially presented in Uzbekistan.

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When comparing the results of surgical treatment with the use of various fixators, it was noted that with extra-articular metadiaphyseal fractures of type 32, fixation of the BIOS is more stable and allows earlier activation of patients. The use of a plate with angular stability in this case is less preferable, since the biomechanical axis of the limb passes medial to the plate, this somewhat limits the early loading, and if an attempt is made to load early before consolidation, fractures of the fixators are possible.

Intra-articular fractures of type 33-C require anatomical comparison of the intra-articular components of the fracture and rigid fixation of the articular block to the diaphyseal fragment. Analysis of complications in group II (in 2 patients there was a secondary displacement of the distal fragment with a violation of the femoral axis; in one patient the congruence of intra-articular fragments was not initially achieved; in all cases there were 33-C intra-articular fractures) suggests that in the case of fractures 33-C it is more expedient to perform an open reduction, achieve anatomical comparison of the fragments under the control of the eye, and fix the fracture with a plate. This provides greater stability of the osteosynthesis to secondary displacement of fragments, despite the possibility of some rod designs using tie bolts to fix the femoral condyles.

The most ambiguous is the algorithm for fixing type 33-A fractures. Currently, there is no consensus in the domestic and foreign literature regarding the fixation of fractures of the distal femur: traumatologists were conditionally divided into supporters of osteosynthesis with plates [8, 11, 14] and BIOS with a retrograde rod [7, 9, 12, 15].

In our study, we observed 4 patients with 33-A fractures in group I and 6 patients in group II. Fracture union was obtained in all cases.

There were no complications during plate osteosynthesis. Postoperative follow-up for up to 2 years showed restoration of function in the knee joint in all patients.

In the group where the osteosynthesis was performed with an intramedullary nail, in 1 case there was a secondary displacement of the fragments, the femur axis was broken. In our opinion, given the absence of special rods with increased rigidity of fixation of the distal fragment, it is more expedient to fix these fractures with plates with angular stability using minimally invasive technique (MIPO).

Conclusions

1. In extra-articular metadiaphyseal fractures of type 32, fixation of the BIOS with indirect fracture reduction is more preferable due to greater stability and less trauma to soft tissues.

2. In case of type 33-C intra-articular fractures, it is necessary to achieve anatomical reduction of articular fragments, preservation or restoration of the axial relationship of the femur and tibia, which is better achieved with open reduction. Fixation of intra-articular fractures should be carried out with an extra-bone fixator. In the treatment of elderly patients and in the case of unstable fractures (33 ‑ C2, C3), it is more expedient to use a plate with angular stability to prevent secondary displacement of fragments.

3. Fixation of fragments in type 33 ‑ A fractures with an angularly stable extrasteel plate (especially when using the MIPO technique) provides greater stability and fewer complications.

Conclusion

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