ORIGINAL ARTICLE

Surgical Treatment of Impression-compression Fractures of Tibial Condyles

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Abstract

Objective: The Department of Traumatology of the SRCT "WTO" - the Center of Traumatology of the Republican Clinical Hospital - has been developed and successfully applies various clinically substantiated assemblies of the spoke and rod external fixation devices on the basis of G.A. Ilizarov method. The assemblies are easy to use, convenient, and comfortable for patients. **Experimental:** We have presented and justified the problem of surgical treatment of tibial condyle impression-compression fractures. They showed the features of transosseous osteosynthesis by external fixation devices at various kinds of fractures, depending on the destruction of tibia plateau articulate surface. **Results and Discussion:** They performed the analysis of operative treatment among 65 patients with impression-compression fractures of the proximal articular part of the tibia. During the treatment, they applied clinical, X-ray (including X-ray tomography data), and biomechanical (the research on the NeuroCom Balance Master diagnostic and treatment complex) research methods. The analysis of treatment outcomes among 65 patients with the consequences of impression compression fractures of the tibial condyles showed good reposition capabilities of the methods developed and applied by us and the arrangements of the spoke-rod devices of external fixation. **Conclusions:** Excellent and good results of treatment were achieved in 72.3% of cases of severe intraarticular lesions. Transosseous osteosynthesis by external fixation devices can be used for various types of knee joint fractures.

Key words: External fixation device, impression-compression fractures of tibial condyles, knee joint, transosseous osteosynthesis

INTRODUCTION

The fractures of the tibial condyles account for >60% of all intra-articular fractures of knee joint region, and in the vast majority of cases, such lesions have the character of multi-splintered impression-compression fractures.[1-3]

Speaking about the modern approach to the treatment of severe impression-compression fractures of the tibial condyles, it is necessary to take into account the type and the nature of the fracture, the degree of intra-articular destruction of tibia plateau, and the possibility of concomitant damage of the knee joint ligamentous apparatus.[4,5]

The treatment of such fractures is often associated with considerable difficulties. A characteristic feature of impression-compression fractures is the primary defect development of tibial proximal metaphysis at the moment of trauma. This requires not only a complete restoration of bone articular surface congruence that makes up the knee joint but also the restoration of the metaphyseal part of the condyle the defect of which appeared at the time of injury.

According to the existing classifications, the fractures of the tibia proximal articular part are divided into the fractures from cleavage and the fractures from fragment pressing

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(impression-compression fractures). At that, the fractures from cleavage are not accompanied by the formation of a condyle defect and rarely combine with damage of the knee joint ligaments. The restoration of articular surface congruence is not difficult as a rule. Taking this into account, it is possible to apply successfully both closed transosseous osteosynthesis with external fixation devices and an open fracture repositioning the osteosynthesis with modern submersible structures (the plates with angular stability of screws).[6]

In the case of polyfragmental compression-compression fractures, a special approach is required to ensure a close comparison of the damaged condyle (condyles) fragments to the restoration of the tibial plateau articular surface. As a rule, the absence of exact reposition of fragments leads to the expansion of regenerate excess tissue around each of them, which is the condition for the development of severe deforming arthrosis and persistent contractures of the knee joint. Unresolved post-traumatic defects of the metaphyseal part of the condyles often lead to a rough deformation of the tibia plateau articular surface and also contribute to the development of deforming joint arthrosis.[7-11]

The use of submersible structures (compression screws and plates) at impression-compression, especially multi-splintered fractures of the tibial condyles, does not always ensure the desired result. It should be noted here that one of the features of polyfragmental fracture consolidation is the development of primary resorption around each of the fragments. The same resorption often develops around the screws of the submersible immobilizers. This leads to the instability of fixation, the migration of screws, and thus, the insolvency of osteosynthesis.[12-14]

According to G.A. Ilizarov, transosseous osteosynthesis is currently the method of choice during the treatment of polyfragmentary, impression-compression fractures of the tibial condyles. The methods of transosseous osteosynthesis make it possible to ensure a stable fixation of the condyle fragments, if necessary, to complete the compression during the treatment. At that, the use of spokes in the area of damage almost does not make additional traumatization of bone tissue. Depending on the type and the nature of fracture, a closed or an open reposition is performed, and the resulting defect is filled with a bone autograft or osteoinductive plastic material.

The Department of Traumatology of the SRCT "WTO" - the Center of Traumatology of the Republican Clinical Hospital has been developed and successfully applies various clinically substantiated assemblies of the spoke and rod external fixation devices on the basis of G.A. Ilizarov method. The assemblies are easy to use, convenient, and comfortable for patients.

STUDY MATERIALS AND METHODS

The materials of the study were 72 patients with impression-compression fractures of the proximal articular part of the tibia treated at the Traumatology Clinic of the Research Center of Tatarstan "WTO" - the Center of Traumatology of the GAUZ RKB MH RT in 1999–2014. In most cases, these were polyfragmentary fractures of one or both condyles. There were 46 women and 26 men. 38 patients had the lesions of the left knee joint and 34 patients had the lesions of the right knee joint.

On admission, the assessment was made of the patient general condition, a clinical and radiological study of the injured knee joint. During the treatment, they applied clinical, X-ray (including X-ray tomography), and biomechanical (the research by NeuroCom Balance Master diagnostic and treatment complex) research methods.

EXPERIMENTAL

Treatment of tibial condyle impression-compression fractures

Depending on fracture type and nature and the degree of tibial plateau articular surface destruction, they used open intervention or closed repositioning of the fracture. In all cases, transosseous osteosynthesis was used by external fixation devices.

At splintered fractures with an extensive destruction of the tibial articular surface, the reposition was applied under visual control, replacing the defect of the metaphyseal part of the condyle with a bone autograft from the iliac crest or osteoinductive material (we used LiTar or Lyoplast for this purpose). When the reposition was achieved with the restoration of congruence in the knee joint, the spokes with stops were introduced through the fractured zone of the condyles, the bone Shantz screw rods were inserted into the femur at the level of the distal metadiaphysis, and similar screw rods were inserted into the tibia at the level of its c/3 diaphysis. All the elements of fixation to the bone were fixed on the brackets installed on the device supports; the supports, in turn, were connected in pairs by threaded rods. They performed the installation of a three-section external fixation device.

With a moderate degree of the condyle articular surface indentation, we used closed transosseous osteosynthesis with the application of the external fixation device developed by us with the spine-rod arrangement, which ensures the achievement of reposition with articular surface congruence restoration of the knee joint bones (RF Patent for invention No. 2402296).

They performed moderate traction along the axis of the lower limb on the operating orthopedic table to eliminate gross displacements of the fragments due to the tension of the capsular-ligament apparatus of the knee joint. With residual displacements of the fragments, Shantz screw rods were

inserted into the condyle displaced fragment perpendicular to the fracture plane, which were fixed on the reposition blocks mounted on the ring support of the device. The insertion of the screw rods into the femoral and tibial bones was carried out according to the described procedure. Furthermore, they mounted a three-section external fixation device. The reposition of the condyle with the congruence restoration in the knee joint was achieved by the movements along the rod in reposition blocks. On the achievement of reposition through the metaphysis of the tibia, spokes with stops were introduced to increase the stability of fixation [Figure 1]. As a rule, they did not observe the significant defects of the metaphyseal part of the condyles, requiring the replacement of the defect during such fractures. The duration of treatment by the device was 2.5–3 months.

After the dismantling and the removal of the device, the whole course of rehabilitation therapy is needed, including physiotherapy, massage, therapeutic physical training, manual, and continuous passive and active-passive therapy.

All patients were taken for the dispensary control with a periodic examination in the clinic. In this case, a clinical X-ray evaluation of joint restoration was used, as well as the assessment of the supporting, dynamic function restoration of the lower extremity, and the restoration of balance in the vertical rack, which were carried out through NeuroCom Balance Master medical-diagnostic apparatus (at the hospital for war veterans). The biomechanical studies were carried out with the purpose of a more accurate estimation of limb function restoration, as well as for the diagnosis of possible posttraumatic complication development and, first of all, the development of deforming arthrosis in the knee joint.

A clinical example

The patient Ch., born in 1954, c/r 2465, was taken to the clinic of the RKB Traumatology Center on March 12, 2009; she fell on the right knee joint. On admission, the following diagnosis was made: Closed impression-compression fracture of the anterior part of the outer condyle of the right tibia. The patient was operated on March 16, 2009: Closed transosseous osteosynthesis of the external condyle fracture in the right tibia by an external fixation device. The reposition was achieved on the operating table. Outpatient treatment was performed since March 2, 2009. The device is dismantled and removed during the 3rd month after the operation. Restorative treatment courses were prescribed. The clinical outcome of the treatment is assessed as a good one [Figure 2a-e].

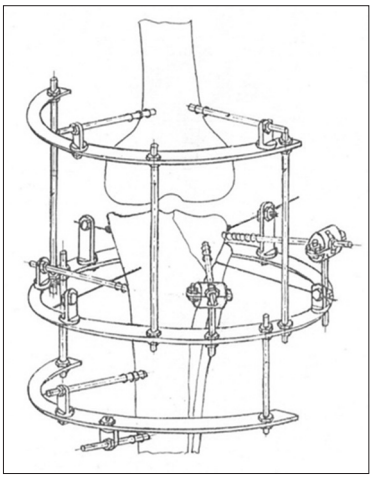

Figure 1: The scheme of transosseous osteosynthesis and the layout of the external fixation device for impression-compression fractures of the tibial condyles

The dynamics of biomechanical studies confirmed the restoration of the lower limb function [Figures 3a and b, 4a and b].

RESULTS AND DISCUSSION

They performed clinical X-ray and biomechanical analysis of treatment results among 65 patients with impression-compression fractures of the proximal area of tibia. The observation period was from 1 to 15 years since the time of the damage and performed operation.

At the clinical radiologic evaluation of treatment outcomes, they evaluated pain (its absence, presence, and intensity), walking ability, limb load, patient activity with the restoration of the habitual rhythm of life, the restoration of the ability to work, the attitude to sports (as was revealed on the basis of history data), the painfulness during palpation and the performance of active and passive movements in the knee joint, deformation, the condition of the thigh and shin muscles (atrophy presence or absence), the restoration of the limb axis, local vascular disorders (absence or presence of edema), the results of movement measurement

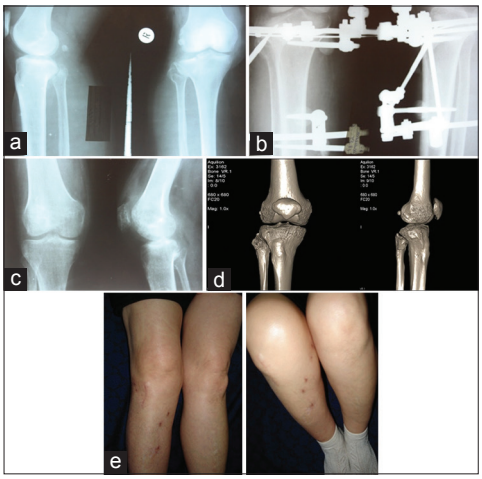

Figure 2: The radiographs and the photographs of the patient Ch., born in 1954, m/r 2465 (a) before treatment, type of injury, (b) during treatment in external fixation device, (c) the immediate outcome of treatment, (d) RKT 3 years after injury, (e) clinical outcome of joint function treatment-restoration

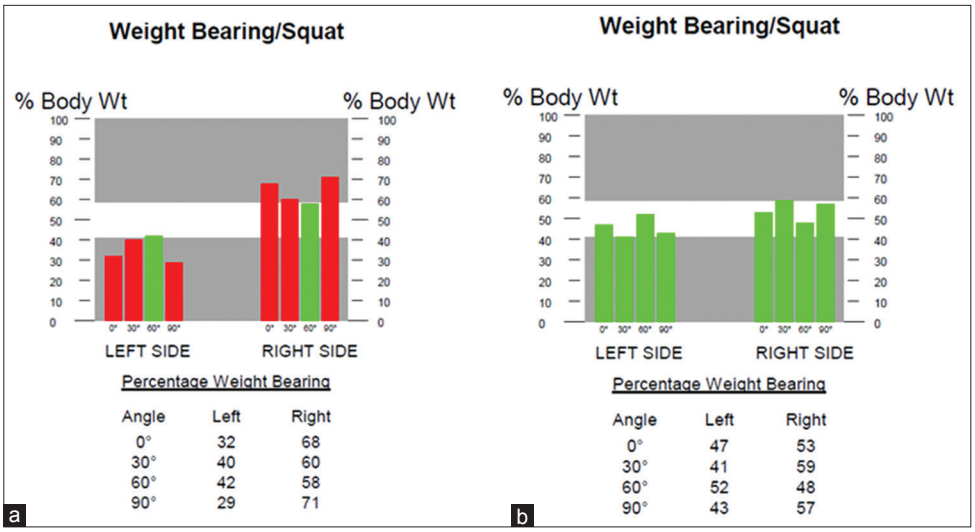

Figure 3: The data of the lower limb supporting function study (a) after the initial course of medical rehabilitation, (b) the restoration of the supporting function after the staged medical rehabilitation 3 years after the injury

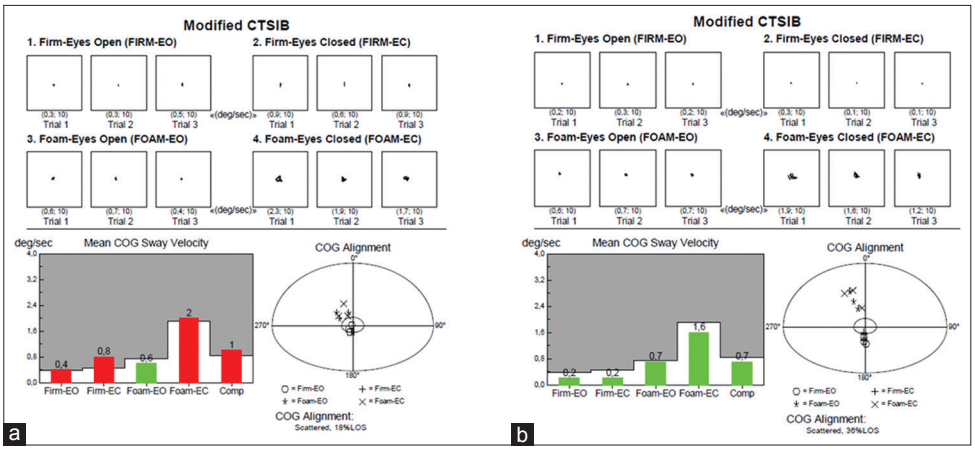

Figure 4: The data of balance research in the vertical rack (a) after the initial course of medical rehabilitation, (b) the recovery of the balance after the staged medical rehabilitation 3 years after the injury

Table 1: Comparative evaluation of patient treatment outcomes with different types of impression-compression fractures of the tibial condyles

Fracture type	Evaluation of treatment outcomes				Total
	Perfect	Good	Satisf.	Poor	
Impression-compression fractures	8	19	10	4	41
The fractures with a moderate zone of the joint surface indentation	8	12	4	-	24
Total number of fractures	16	31	14	4	65

in the knee joint by degrees, and the restoration of the foot arches. During radiologic examination, they evaluated the quality of fracture repositioning in the proximal articular part of the tibia, the fusion of fragments, the state of the X-ray articular fissure of the knee joint, and the absence or the presence of osteoporosis. The biomechanical evaluation of immediate and long-term results of treatment made it possible to reveal the number of support disorders, dynamics (of walking), and balance before the appearance of obvious clinical manifestations, which indicated the development of post-traumatic articular pathology. Over time (2–3 years or more), the biomechanical symptoms of joint disorders progressed. It should be noted that, after the course of medical rehabilitation, these violations stopped or tended to decrease. In a number of cases (impression-compression fractures of the condyles with a slight indentation zone), a complete clinical recovery ensued.

The results of impression-compression fracture treatment of the tibial condyles are shown in Table 1.

As follows from the data of Table 1, excellent and good results during the treatment of impression-compression fractures of the tibial condyles were achieved in 47 injuries (72.3%); satisfactory were achieved in 14 cases (21.5%); and unsatisfactory outcomes were noted in 4 cases of fractures due to the secondary displacement of fragments, displacement of the limb axis, and development of severe knee deforming arthrosis. The greatest number of satisfactory and unsatisfactory outcomes was occurred during the treatment of severe impression-compression multisplintered fractures of the condyles. The results of reconstructive-restorative operations were noted as satisfactory.

CONCLUSIONS

Thus, the analysis of treatment outcomes among 65 patients with the consequences of impression-compression fractures of the tibial condyles showed good reposition capabilities of the methods developed and applied by us and the arrangements of the spoke-rod devices of external fixation. Excellent and good results of treatment were achieved in 72.3% of cases of severe intraarticular lesions. At the same time, biomechanical tests of treatment result evaluation allow to reveal a number of support disorders, dynamics, the balance at early terms after clinical recovery, until the appearance of obvious clinical manifestations, which indicates the development of post-traumatic articular pathology in the form of deforming arthrosis of the knee joint. The performance of repeated, step-by-step courses of medical rehabilitation can reduce the risk (and in some cases, prevent it) of severe contracture and deforming arthrosis development of the knee joint.

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