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Features of arthroscopic-assisted reduction of tibial plateau fractures

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ABSTRACT

Introduction. Surgical treatment of tibial condyle fractures have been little studied and it represents difficulties up to now. Aim. The aim of the present work was improvement of results of surgical treatment of tibial condyle fractures. Methods. Surgical treatment of tibial condyle fractures is done on total of 65 patients in the department of Sport trauma of Centre of traumatology and Orthopaedics arthroscopy. Results. Good and satisfactory outcomes were achieved in all the patients received arthroscopy treatment. The use of MRI and MSCT in the diagnosis of intra-articular fractures of the knee joint, and the analysis of their results contribute to the choice of the optimal surgical treatment. Arthroscopy of intra-articular fractures of the tibial condyles allows for an accurate diagnosis, visual control of the reduction, that is characterized by minimal surgical traumatism, minimal risk of infectious complications, leaves a minimal cosmetic defect, and helps to shorten the length of hospital stay and early rehabilitation of patients. Recommendation. Suggested methods are high effective and can be recommended in practical medicine.

Research Article

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Arthroscopy,
Knee joint

INTRODUCTION

Intra-articular fractures of the proximal tibia are a serious problem due to the wide variety of complex injury patterns and, therefore, require a varied treatment protocol. The literature describes various classifications and treatment options that do not provide any recommendations for the surgical approach and management [1, 2, 3]. The diagnosis and treatment of complex fractures of the tibial plateau remains a major challenge in orthopedics and traumatology. The significant proportion of fractures of the tibial condyles, accounting for 2 to 5% of all fractures, up to 30% of all injuries of the lower extremities and up to 60% of joint injuries, determines the relevance of the problem of treating victims of this category [1, 2].

The incidence of tibial plateau fractures is 10.3 per 100,000 people annually. The average age of patients with tibial plateau fractures is 52 years. The distribution of tibial plateau fractures is bimodal: men under the age of 50 are more likely to experience this injury due to high-energy mechanisms and are often associated with soft tissue injuries. While women over 70 years of age have an increased likelihood of fractures due to the failure of the tibial plateau due to falls [3]. Damage to soft tissues correlate with increased displacement of fragments in fractures of the tibial plateau [4, 5, 6]. The prevalence of concomitant meniscus injuries in fractures of the tibial plateau varies according to various sources from 38.9% to 99.0% [3, 7].

Tibial plateau fractures are common clinically. The most common mechanism of injury is injury to the knee joint by force in an extension or flexion position. However, some tibial plateau fractures are caused by axial force in the hyperextension position of the knee joint, resulting in depression of the anterior tibial plateau and soft tissue damage. This type of injury is more serious, and the mechanism of injury and treatment is different from that of fractures of the tibial plateau during extension and flexion [8, 9].

In 1974, Shetty et al. [10] proposed a classification based on a two-dimensional representation of the fracture. Its classification using six types of principles has become one of the most commonly used classification systems for tibial plateau fractures. More than four decades after this initial publication, we are reviewing each type of fracture in the light of information provided by computed tomography, which is now the standard tool for assessing joint fractures [5, 10]. As a rule, the diagnosis of knee injuries begins with a conventional X-ray. According to the Ottawa Knee Rules, radiography can reliably determine the presence or absence of a fracture [1, 7].

Multislice computed tomography (MSCT) and Magnetic resonance imaging (MRI) are systematically analyzed and compared with standard radiography as methods to determine the nature of the fracture, the degree of displacement and size of bone fragments, and to assess the degree of destruction of the articular surface. The ability to detect concomitant injuries of the knee joint menisci and cruciate, collateral ligaments, as well as hidden fractures in the preoperative period, in order to make an accurate diagnosis and select the appropriate method of surgical treatment [3, 8].

MRI can also detect damage to the menisci, anterior and posterior cruciate ligaments, collateral ligaments, demonstrating incomparable advantages over radiography and computed tomography [4, 9]. MRI detects the presence of bone contusions and hidden fractures, which are impossible to make a diagnosis using standard radiography. The presence of bone marrow edema (contusion) indicates that there is damage to the articular cavity and ligaments, which require assessment by MRI [4, 6]. Multislice computed tomography and MRI have great potential in imaging and should be used in complex fractures of the tibial plateau [6].

The aim of this study was to improve the results of the treatment of fractures of the tibial plateau, through the use of modern diagnostic methods and arthroscopic treatment.

MATERIALS AND METHODS

The study was based on 65 patients with fractures of the tibial condyles who received treatment in the sports injury department of the RSNPMTSTO for the period 2015-2020. External condyle fractures accounted for 69% (n=45), internal condyle fractures - 30.7% (n=20). Fresh fractures were detected in 46 (70.7%) patients, old fractures in 19 (29%) cases who complained of instability of the knee joint in the frontal plane, irregularity of the limb axis, varus or valgus deformity, and hypotrophy of the soft tissues of the thigh and shins.

In order to determine the complexity, nature of the fracture and the tactics of fracture treatment, the following instrumental imaging methods were used: radiography, MSCT and MRI. In addition, the patients underwent densitometry and Doppler ultrasonography of the lower extremities. In 19 (29%) patients, X-ray showed a fracture without displacement of bone fragments, MRI or MSCT showed intra-articular fractures of the condyles with displacement of bone fragments (Figure 1 and 2).

Figure 1. The X-ray does not show a fracture of the lateral condyle of the tibia

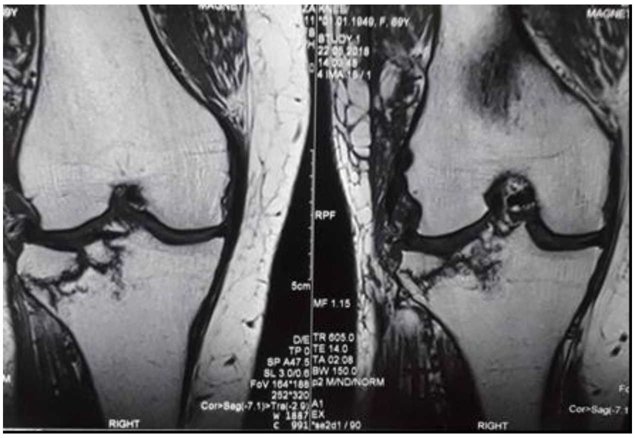

Figure 2. MRI examination reveals a fracture of the external condyle

RESULTS

Knee arthroscopy was performed in 51 (78.5%) cases. For fresh fractures of the tibial condyles, diagnostic arthroscopy was performed, the fracture was repositioned under the control of an arthroscope and fixed with cannulated cancellous screws. In 19 (29%) patients with improperly fused and fused condyle fractures without deformity of the knee joint, diagnostic arthroscopy was performed, and then osteotomy was performed along the fusion line (Figure 3). The invention consists of a cruciate ligament repair guide with an additional lateral arch. On the lateral arch there are guide holes that are directed to the intercondylar space of the tibia, and guide wires pass through the hole to determine the line of the osteotomy. Osteotomy was performed using a chisel. After the

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osteotomy, the tibial condyles are mixed with a sliding way to the level of the articular cartilage (Figures 4 and 5). After matching the condyle, the plateau is restored and fixed with one or two cancellous screws or a plate. The joint is immobilized with a plaster cast.

The combination of fractures with soft tissue injuries of the knee joint was observed in 11 (22%) cases with injuries of the lateral meniscus, 6 (12%) with injuries of the medial meniscus, 10 (20%) with injuries of the anterior cruciate ligament, 2 (4%) with injuries of the posterior cruciate ligament, 9 (18%) with damage to the lateral lateral ligament. In case of paracapsular damage to the anterior horns, the menisci were sutured with "P" -shaped sutures (in 2 patients). In other cases, a partial meniscectomy of the damaged part of the meniscus was performed. The fracture was repaired under the control of an arthroscope. Osteosynthesis was performed with cancellous screws.

In case of incorrectly fused fractures of the condyles with varus or hallux valgus, an osteotomy was performed at the apex of the deformity in 6 (12%) patients, and the deformity was eliminated with the help of the Ilizarov apparatus by building up a three-angled regenerate. Deformity correction was started 7-10 days after surgery. In all cases, after removal of the sutures, on the 12-14th day, the development of the knee joint was started.

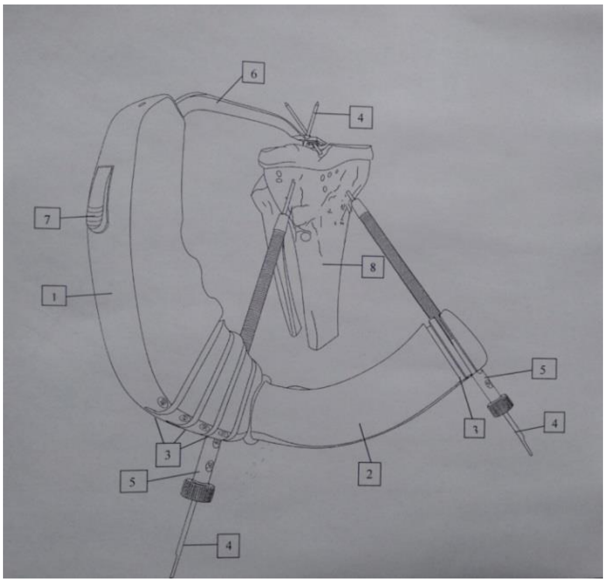

Figure 3. Diagram of osteotomy at the fusion site. 1.Handle, 2. Lateral guide bow, 3.Pilot holes, 4.Spoke, 5.Cannulated rod, 6.Guide arc, 7.Locking button Tibia

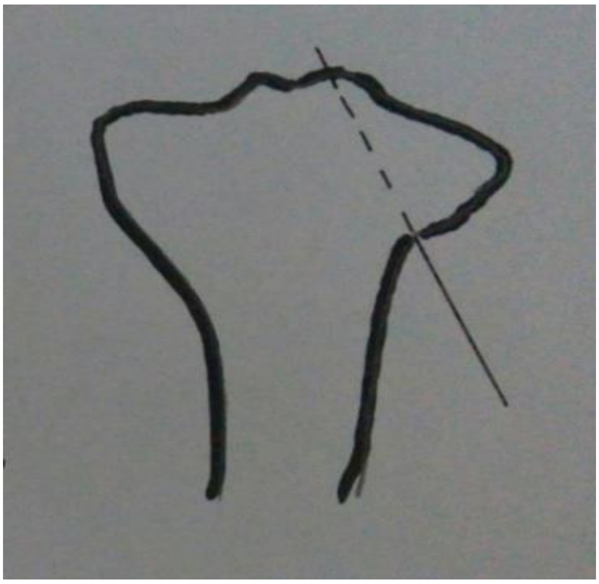

Figure 4. Incorrectly fused tibial condyle before surgery

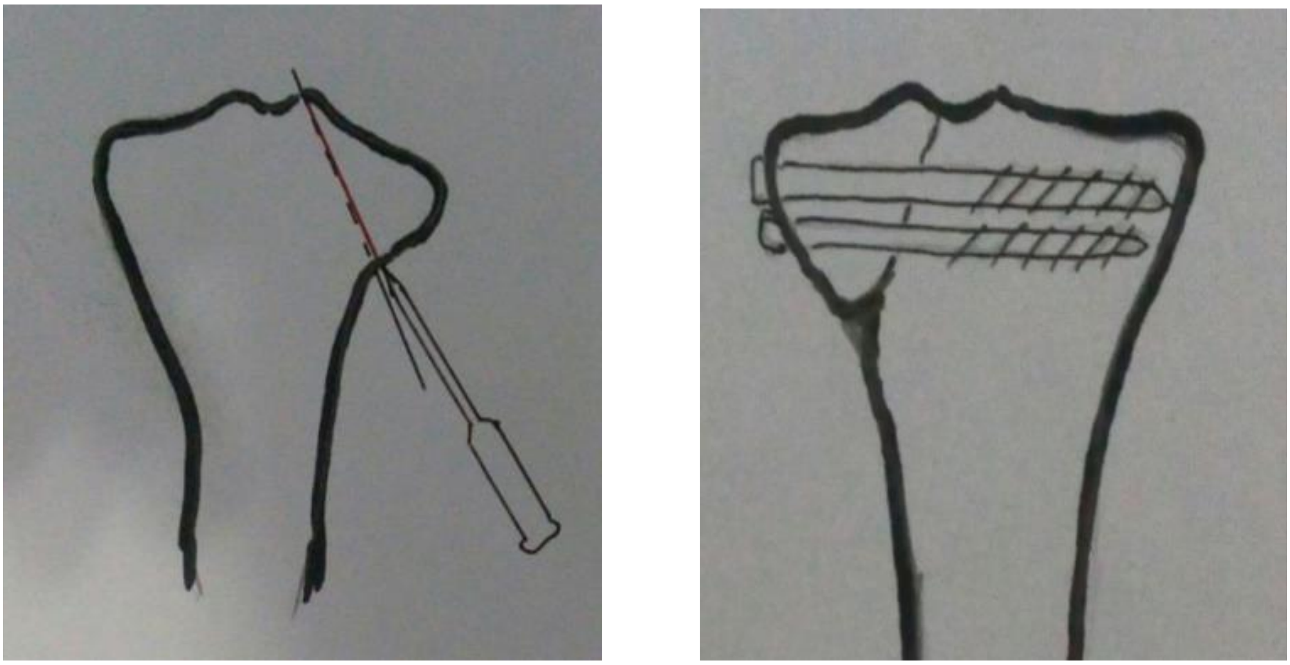

Figure 5. Osteotomy and screw fixation

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Clinical case 1

Patient A was injured when falling from a height. The radiograph showed a comminuted fracture of the internal condyle with displacement of bone fragments (Figure 6). Arthroscopy and osteosynthesis were performed with cancellous screws (Figure 7-10). Early development and late loading began on the damaged joint. The plaster cast was removed after 2 weeks and the development of the knee joint began. After 2 months, she began to load on the injured limb. On the 3rd month after the operation, the patient walked, loading on the limbs, flexion is possible by 70 degrees, extension by 180 degrees (Figure 11).

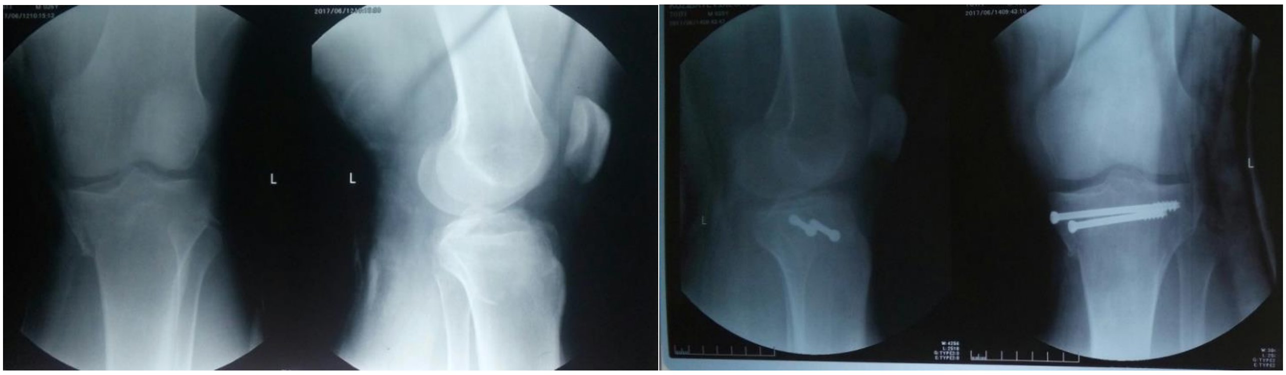

Figure 6. X-ray of the fracture of the condyle of the left tibia.

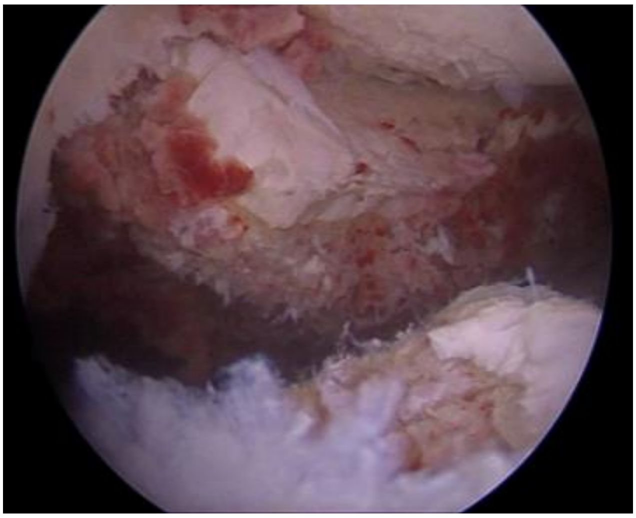

Figure 7. Osteosynthesis of the condyle of the left tibia with cancellous screws.

Figure 8. Arthroscopic picture of tibial condyle fracture.

Figure 9. Arthroscopic picture of osteosynthesis of a fracture of the tibial condyle with a screw.

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Figure 10. Picture after osteosynthesis with a screw of a fracture of the tibial condyle

Clinical case 2

Patient B. was injured when falling from a height. He was treated with a fracture of the lateral condyle of the tibia with satisfactory position of bone fragments (Figure 11). A month later, the plaster cast was removed and the development of the joint began. After the pain and instability of the knee joint worried. An MRI scan revealed an incorrectly fused fracture of the lateral condyle of the tibia (Figure 12). Diagnostic arthroscopy of the knee joint was performed and the impression of a plateau with displacement of the anterior part of the lateral condyle of the tibia was determined (Figure 13). Afterwards, osteotomy of the external condyle and osteosynthesis with cancellous screws were performed. On the 14th day after the operation, the stitches and plaster cast were removed. After that, the development of the knee joint was started without loading the limb.

Figure 11. Radiography of the fracture of the condyle of the right tibia.

Figure 12. MRI picture of the fracture of the right tibia.

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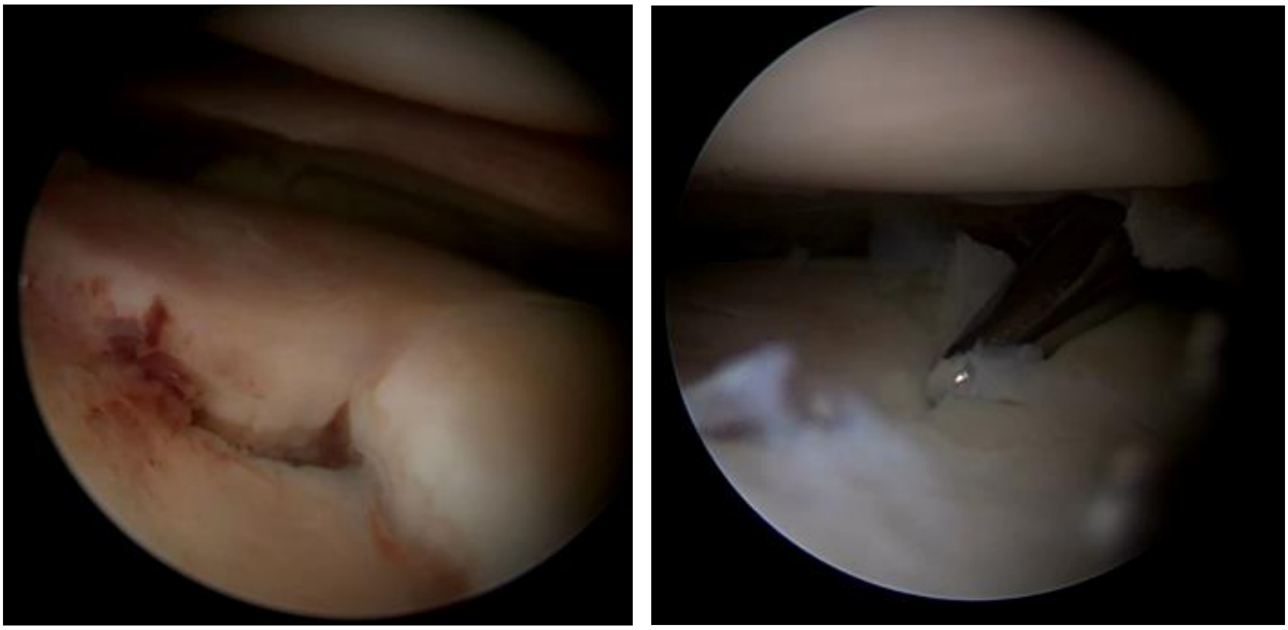

Figure 13. Impression of a plateau with a displacement of the anterior part of the lateral condyle of the tibia.

DISCUSSION

Treating Tibial plateau fractures is a challenge even for experienced surgeons. An understanding of the classification systems, mechanism of injury and various approaches is important for optimal patient care. Understanding the mechanism of injury could simplify many steps in the treatment of the complex tibial plateau fractures [11].

Position of the knee with respect to the direction of the deforming forces defines the severity of injury and the fracture pattern. The most common injury pattern described is the extension valgus force causing a lateral condyle split or a split+depressed fracture pattern (33%), the second being flexion varus (19%) and the third most common pattern is the extension varus (17%) pattern. Classifications helping in recognizing the fracture patterns and MOI have been recommended in aiding surgical approach and deciding the fixation protocol [12].

Additional benefits of the procedure include adequate visualization of the joint throughout, removal of chondral debris and hematoma through irrigation, and the opportunity to treat any meniscal pathology by routine arthroscopic methods. Perhaps most importantly, a formal arthrotomy is not necessary, and this allows rehabilitation and, consequently, cartilage healing to progress more rapidly

Although arthroscopic management of selected tibial plateau fractures appears to be efficacious, not all plateau fractures are amenable to this technique. Careful analysis of the fracture pattern should be performed before undertaking the procedure. In cases of medial plateau fractures, a portion of the procedure may be performed. However, fixation may require the use of a buttress plate or external fixation once reduction is performed. A buttress plate would involve an incision over the medial tibia. However, the incision may still remain extraarticular, and as noted above, disruption of the menisci is not necessary. Fixation with lateral screws appears to be adequate fixation for isolated lateral plateau fractures. This has not only been borne out in our series but also in that of Jennings.

The criteria for the effectiveness of treatment were flexion, extension, and stability of the knee joint in the frontal plane in the position of unloading and loading, statics of walking, and the disappearance of pain when walking. The immediate results were studied at 3 and 6 months in 35 (70%) patients. Long-term results were studied in 17 (34%) patients out of 50 treated patients. Good results were observed in 48 (96%) patients, satisfactory in 2 (4.1%) patients (in whom additional plastic surgery of the bag-ligamentous apparatus was performed).

Clinical and radiological examination of intra-articular fractures of the tibial condyles is clearly insufficient. Today, in clinical practice, MRI and MSCT are considered highly informative methods for visualizing hidden X-ray-negative chondral fractures and soft tissue injuries of the knee joint. The experience of the surgeon is one of the determining factors.

CONCLUSION

The use of MRI and MSCT in the diagnosis of intra-articular fractures of the knee joint, and the analysis of their results contribute to the choice of the optimal surgical treatment. Arthroscopy of intra-articular fractures of the tibial condyles allows for an accurate diagnosis, visual control of the reduction that is characterized by minimal surgical traumatism, minimal risk of infectious complications leaves a minimal cosmetic defect, and helps to shorten the length of hospital stay and early rehabilitation of patients. Rehabilitation measures must be started from the first days of the postoperative period, immediately involving active movements in adjacent joints. The initial stage of recovery should take place under the guidance of the attending physician, who has complete information about the details of the damage and the features of the osteosynthesis performed.

DECLARATIONS

Ethical approval

The review board and ethics committee of RSCS named after acad. V.Vakhidov approved the study protocol and informed consents were taken from all the participants.

Acknowledgements

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Authors' contributions

All authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

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