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The role of Arthroscopy in Mini-Invasive Treatment of Tibial Plateau Fractures

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Abstract

The tibial plateau is one of the most critical load-bearing area in the human body. The aim of this work was To evaluatethe effect of using knee arthroscopy as an assisting tool in achieving anatomic reduction and improving the results of treatment tibial plateau fractures. This prospective study involved 20 patients with fractures of the tibial plateau underwent knee arthroscope. All patients were followed up for at least 6 months. Modified Rasmussen clinical criteria consist of the subjective state of the knee according to the patient, and the objective state of the knee. Osteoarthritis grading according to Resnick and Niwoyama criteria for grading of osteoarthrosis. Mean clinical score was 27.85 (± 2.455) while mean radiological score was 8.3 (± 1.418). Eleven patients (55%) and thirteen patients (65%) had excellent clinical and radiological outcomes respectively. there are statistically non-significant relations between clinical and radiological outcomes and schatzker type. Also, there is statistically non-significant correlation between time till operation and Ramsussen clinical and radiological scores. using knee arthroscope as an assisting tool in reduction of tibial plateau fractures with internal fixation can give satisfactory clinical and radiological results.

Keywords: Tibial Plateau Fractures, Arthroscopy, Modified Rasmussen criteria.

1. Introduction

The tibial plateau is one of the most critical load-bearing area in the human body. Fractures of tibial plateau affect knee aligment , stability and motion. Early detection and appropriate treatment of these fractures are critical in minimizing patient disability and reducing the risk of documented complications particularly post traumatic arthritis [1].

Tibial plateau fractures involve the proximal tibia in its articular and meta-epiphyseal segments. Management is difficult because of the severe displacement of the bony fragments, the concomitant depression and impaction of the cancellous subchondral bone, and the inevitable associated cartilage injury [2].

When treating intra-articular fractures, the goal is to obtain a stable joint permitting early range of motion for cartilage nourishment and preservation. Various modalities of treatment have been used over the years these include traction, closed treatment with cast bracing. Surgical procedures include percutaneous screw fixation, ORIF and more recent techniques; arthroscopically assisted reduction with grafting after elevation of depression and fixation [3].

The aim of this work was To evaluatethe effect of using knee arthroscopy as an assisting tool in achieving anatomic reduction and improving the results of treatment tibial plateau fractures.

2. Patient and Method

This prospective study involved 20 patients with fractures of the tibial plateau underwent knee arthroscope. All patients were followed up for at least 6 months.

2.1. Inclusion criteria

- **Sex:** Both sexes.
- **Age:** 18-50 years old.
- Patients with articular displacement > 3 mm or valgus > 5 degrees or condylar widening.
- Patients with tibial plateau fractures (type II, III) according to the Schatzker's classification which is currently of the most widely used classification and was the first to make the distinction between medial and lateral plateau fractures. Tibial plateau fractures are classified into 6 types (4).

2.2. Exclusion criteria

Patients who met the following conditions were excluded:

- Previous fractures of the same-side knee.
- Vascular injury or neurological pathologies that could delay.
- Healing or alter functional recovery.
- Patients with open fracture.
- Patients with high energy fractures with severe comminution.
- Patients who are not fit for surgery.
- Patients with age below 18 or above 50 years.
- Patients with ipsilateral femoral or tibial shaft fractures.

The indications for reduction and fixation in this study based mainly on degree of joint instability, articular depression and condylar widening as follow**:**

1. Lateral tilt of the plateau > 5° compared to the other uninjuried side.
2. Condylar widening > 5 mm.
3. Step-off of articular surface > 3 mm.

Modified Rasmussen clinical criteria consist of the subjective state of the knee according to the patient, and the objective state of the knee. Assessment includes pain, walking capacity, knee extension, range of motion, stability and power of the quadriceps, with maximum score of 30 which is graded into excellent (28-30), good (24-27), fair (20-23) and poor (<20).

Osteoarthritis grading according to Resnick and Niwoyama criteria for grading of osteoarthrosis which includes 4 grades (0-3).

Complications can be divided into early (loss of reduction, deep veinthrombosis, infection) or late (nonunion, implant breakage, post-traumaticarthritis). Most early complications can be viewed as biological failures, while latefailures are often associated with mechanical problems.

3. Results

Age of the studied patients ranged from 18 to 50 years with mean 36.35 years. Male represented 70% of them.

Seventy five percent of patients had lesions due to road traffic accidents. Forty percent had no associated lesions. Remaining 60% of them had associated lesions. Four patients had been treated conservatively while five patients underwent partial meniscustomy

Half of patients had schatzker II and one fifth of patients had type I.

All patients underwent fixation by screws and only three of them needed bone graft. Time till operation ranged from 7 to 10 days with mean 8.2 days.

Two patients had been complicated in the form of articular surface depression (<5mm).

Ramsussen clinical and radiological scores were used to evaluate operative outcomes. Mean clinical score was 27.85 (± 2.455) while mean radiological score was 8.3 (± 1.418). Eleven patients (55%) and thirteen patients (65%) had excellent clinical and radiological outcomes respectively.

Time for partial weight bearing ranged from 6 to 10 weeks with mean 7.3 weeks. Time for full weight bearing ranged from 9 to 16 weeks with mean 12.95 weeks.

There is statistically non-significant relation between clinical outcome and schatzker type (27.3%, 27.3%, 45.5% had excellent outcome had Schatzker type I, II and III respectively. Two patients with fair outcomes had grades II and V. Good outcome were distributed as following 71.4% type II, 14.3% type III and 14.3% type I.

There is statistically non-significant relation between radiological outcome and schatzker type (30.8%, 46.2%, 23.1% had excellent outcome had Schatzker type I, II and III respectively. Two patients with fair outcomes had grades II. Good outcome were distributed as following 40% type II and 60% type III.

There is statistically non-significant correlation between time till operation and Ramsussen clinical and radiological scores.

Table (1) Distribution of the studied patients according to outcome.

		N=20 (%)
Clinical outcome	**Fair**	2 (10)
	Good	7 (35)
	Excellent	11 (55)
Ramsussen clinical score	**Mean ±SD**	27.85 ± 2.455
	Range	21 – 30
Radiological outcome	**Fair**	2 (10)
	Good	5 (25)
	Excellent	13 (65)
Ramsussen radiological score	**Mean ±SD**	8.3 ± 1.418
	Range	5 – 10

Table (2) Relation between clinical outcome and Schatzker type.

Schatzker type	**Clinical outcome**			**p**
	Fair	**Good**	**Excellent**	
	N=2(%)	**N=7 (%)**	**N=11(%)**	
I	0 (0)	1 (14.3)	3 (27.3)	
II	2 (100)	5 (71.4)	3 (27.3)	0.253
III	0 (0)	1 (14.3)	5 (45.5)	

Table (3) Relation between Radiological outcome and Schatzker type.

Schatzker type	**radiological outcome**			**p**
	Fair	**Good**	**Excellent**	
	N=2(%)	**N=5 (%)**	**N=13(%)**	
I	0 (0)	0 (0)	4 (30.8)	
II	2 (100)	2 (40)	6 (46.2)	0.226
III	0 (0)	3 (60)	3 (23.1)	

Table (4) Correlation between time till operation and Ramsussen clinical and radiological scores.

	Time till operation	
	r	**p**
Ramsussen clinical score	0.093	0.695
Ramsussen radiological	0.063	0.791

4. Discussion

Many studies of tibial plateau fractures have discussed the associated soft tissue injuries. Tscherne and Lobenhoffer [4] reported a 33% rate of ligament lesions and a 21% rate of lateral meniscus lesions, and Bennett and Browner [5] reported a 56% incidence of soft tissue injury in combined non displaced and displaced tibial plateau fractures. In the study of Kode et al. [6], MRI showed 2 complete ligamentous tears (9%) and 15 partial ligamentous tears (68%) among the 22 patients. MRI also documented meniscal injuries in 12 (55%) of the 22 patients.

Honkonen [7] found an 11% rate of ligament injuries and a 50% rate of meniscal lesions, mainly in the lateral menisci. A 38% rate of ACL injuries and a 19% rate of collateral ligament injuries were found in Hung et al. [8] series and the lateral menisci were more susceptible to trauma as well, with an incidence of 31%.

Van Glabbeek et al. [9] evaluated the results with arthroscopically assisted operative treatment of tibial plateau fractures after a mediumterm follow-up. They reported 20 patients with 20 fractures with a mean follow-up time of 39 months (27-64 months). All fractures were evaluated according to the Schatzker classification. Under arthroscopic guidance, the fractures were reduced and associated intra-articular lesions were addressed appropriately. For split fractures a limited lateral approach, or the joystick technique, was used. Depression fractures were reduced with the aid of an anterior cruciate ligament (ACL) tibial guide. Postoperatively, immediate mobilisation and continuous passive motion was encouraged. A hinged brace provided stability and the patients were not allowed to bear weight for at least six weeks. They reported 50% soft tissue injuries, of them 35% meniscal lesions and 15% anterior cruciate ligament injuries, while Chan et al. [10] reported 72% of soft tissue injuries of which there were 61% of meniscal injuries and 11% of ligamentous injuries.

Gardner et al. [11] by MRI examination of 103 cases of tibial plateau fractures had only 1 patient (1%) with complete absence of any soft tissue injury. Seventy-nine patients (77%) sustained a complete tear or avulsion of 1 or more cruciate or collateral ligaments. Ninety-four patients (91%) had evidence of lateral meniscus pathology. Forty-five patients (44%) had medial meniscus tears.

Zaki et al. [12] reported 71% of soft tissue injuries in tibial plateau fractures. The menisci were injured in 57% of subjects, the anterior cruciate ligament (ACL) in 25%, the posterior cruciate ligament (PCL) in 5%, the lateral collateral ligament (LCL) in 3%, and the medial collateral ligament (MCL) in 3%.

In a study of 21 tibial plateau fractures treated arthroscopically over a 5-year period, patients had only mild postoperative pain. Sixteen patients had good outcomes. It was concluded that arthroscopic diagnosis and treatment of tibial plateau fractures offers many advantages with few complications [13]. Handelberg et al. [14] reported that 21 (81.5%) had good or excellent results of ARIF of 27 cases tibial plateau fractures at the 2-years follow-up. Chan et al. (15) suggested that diagnosis of associated soft-tissue lesions and their subsequent treatment improved clinical outcome.

Dall'Oca et al. [16] compared the results of patients treated with arthroscopic assisted reduction and internal fixation to those of patients treated with the open method. The study was conducted on one hundred patients. They were followed up for seventy-three months on average. They found that sixty-nine of 100 patients in our study had associated intraarticular lesions. Of the remaining 31 patients, without associated lesions, 20 of them belonged to group B while 11 patients belonged to group A. A lesion of the meniscus was found in 57 knees: a medial meniscus tear in 13 knees; a lateral meniscus tear in 34 knees and bilateral meniscal tears in 10 knees. Thirty-two menisci were sutured, 21 partially resected and 4 totally removed. Ruptures or avulsions of ligaments were found in 25 knees, including 14 anterior cruciate ligament avulsions, 3 posterior cruciate ligament ruptures, 1 lateral collateral ligament avulsion at the fibular insertion, 7 medial collateral ligament partial ruptures and 3 combination of anterior cruciate ligament and medial collateral ligament partial ruptures. Eight anterior cruciate ligament lesions were treated arthroscopically, 6 lesions were treated with a secondary reconstruction of the ligament. The lateral collateral ligament avulsion was fixed.

Zawam and Gad [17] determined the results of arthroscopic assisted reduction and internal fixation in 25 patients with tibial plateau fractures. They found that there were 8 patients with lateral meniscus lesions, 2 patients with medial meniscus lesions, and 2 patients with partial A.C.L rupture.The torn menisci were sutured using outside in or all-inside techniques, in case of meniscal-capsular separation. In the case of central tears, partial meniscectomy was done. The partial A.C.L injuries were treated conservatively.

In our study, half of patients had schatzker II and one fifth of patients had type I. Dall'Oca et al. [16] compared arthroscopic assisted reduction internal fixation (ARIF) treatment with open reduction internal fixation (ORIF) treatment in patients with tibial plateau fractures. They studied 100 patients with tibial plateau

fractures (54 men and 46 women) examined by X-rays and CT scans, divided into 2 groups. Group A with associated meniscus tear was treated by ARIF technique, while in group B ORIF technique was used. The follow-up period ranged from 12 to 116 months. The patients were evaluated both clinically and radiologically according to the Rasmussen and HSS (The Hospital for Special Surgery knee-rating) scores. Scores related to each Schatzker type of fractures were obtained: 29.75, 27.71 and 28.62, respectively, for Schatzker I, II and III types of fracture.

According to postoperative complications, two patients had been complicated in the form of articular surface depression (<5mm).

Tibial plateau fracture itself may involve several major complications, from the moment of injury until the postoperative period, and careful evaluations should be performed to minimize such catastrophies. Compartment syndrome and neurovascular injury are two great misfortunes, for both the patient and the orthopedic surgeon. Surgical treatment should be delayed until the subsidence of swelling. A quick bone window and adequate fluid drainage intraoperatively served for decompression, and the tourniquet time was as minimal as possible. Another major concern with the traditional method of open reduction was the condition of the soft tissue and wound infection, which could reach a rate as high as 50 % [18].

In the study conducted by Pogliacomi et al. [19], two patients (11%) were complicated by joint depression. In Roerdink, et al., [9] patients (30%) was complicated by secondary displacement, but without affecting the outcome. Also, his study was conducted only on patients more than 55 years old.

Zawam and Gad [17] found that one patient had a superficial infection, which was treated by antibiotics and repeated dressings. Another case was complicated by articular surface depression (4 mm) due to early weight bearing against the instructions and the patient refused surgical revision.

Ramsussen clinical and radiological scores were used to evaluate operative outcomes. Mean clinical score was 27.85 (± 2.455) while mean radiological score was 8.3 (± 1.418). Eleven patients (55%) and thirteen patients (65%) had excellent clinical and radiological outcomes respectively.

Gill et al. [20] described 29 tibial plateau fractures in skiers treated with ARIF that included types I, II and III fracture patterns. The mean postoperative Rasmussan score was 27.5 (range, 21 to 30). The average age of the patients was 45. At a mean follow up of 24 months, 76% of patients rated their result as excellent and 16% as good.

The results were good when compared with other methods of treatment which reported by others to range from 80% to 90% satisfactory results, although they used different rating systems [21].

Siegler et al. [22] reviewed twenty-one patients with a mean follow-up of 59.5 months (range,24—138 months); satisfaction was good except for return to sports activity. Type I—III Schatzker closed tibial plateau fractures were included in this study. The mean Rasmussen clinical score was 25.5.

Dall'Oca et al. [24]found that the average Rasmussen clinical score is 27.62 ± 2.60 (range 19–30) in group A and 26.81 ± 2.65 in group B.

Zawam and Gad [17] found that the mean clinical Rasmussen score among the 25 patients was 26 (range, 24-30). Nineteen patients (76%) had excellent results, (4 type I, 8 types II, and 7 types III), and 6 patients (24%) had good results (1 type I, 3 types II ,2 types III). Radiologic results were excellent in (14 cases) 56 % and good in (11 cases) 44%. They concluded that arthroscopic assisted reduction and fixation of tibial plateau fractures have the advantages of checking the adequacy of reduction, avoiding the need for detachment of the meniscus, and allowing for accurate diagnosis and management of associated knee injuries.

In the current study, there are statistically non-significant relations between clinical and radiological outcomes and schatzker type. Also, there is statistically non-significant correlation between time till operation and Ramsussen clinical and radiological scores.

Scheerlinck et al. [23] carried out percutaneous, arthroscopically and fluoroscopically-assisted osteosynthesis of fractures of the tibial plateau in 52 patients, of whom 38 were assessed using the HSS knee score and standing radiographs. They reviewed 31 AO type-B fractures and seven type-C fractures after a mean follow-up of five years (1 to 14). Fixation was achieved using percutaneous screws and/or an external frame; 33 associated intra-articular injuries, diagnosed in 21 out of the 38 patients, were treated arthroscopically. Subjectively, 94.7% of the patients reviewed were satisfied. According to the HSS knee score 78.9% of the results were excellent, 13.2% good, 7.9% fair and none was poor. Narrowing of the joint space was found in 28.9% of the injured and 5.3% of the unaffected knees and axial deviation of 5° to 10° in 15.8% of the injured and 10.5% of the unaffected knees. Of the 52 fractures, reduction was incomplete in one, and in two secondary displacement occurred, of which one required corrective osteotomy. Deep-venous thrombosis occurred in four cases. The technique has proved to be safe but demanding. It facilitates diagnosis and appropriate treatment of associated intra-articular lesions.

Asik et al. [24] reviewed the arthroscopy-assisted surgical treatment of tibial plateau fractures and determined the factors that influence the overall clinical and radiographic results in 45 patients with closed tibial plateau fractures. The fracture involved articular depression in 27 patients in whom lifting and bone grafting with autogenous corticocancellous iliac bone graft was required. In 23 patients there were also meniscal lesions, which were treated by partial resection in 16 and repaired in 7. Internal fixation was performed using screws in 36 knees and plate in 10 knees. Radiological results were evaluated according to the Resnic-Niwoyama criteria; mean follow-up was 36 months (range 14–72). There was no intraoperative

complication in the series, but postoperatively there were one infection and one loss of correction. Results were satisfactory in 89% of cases, according the Rasmussen criteria. They concluded that arthroscopy is an excellent and minimally invasive method for assessment and treatment of tibial plateau fractures. Experience in operative arthroscopy and fracture management is essential to avoid complications and improve long-term results. Dall'Oca et al. [16] suggested that there are no differences between ARIF and ORIF treatment in Schatzker type I fractures. ARIF technique may increase the clinical outcome in Schatzker type II–III fractures.

5. Conclusion

Using knee arthroscope as an assisting tool in reduction of tibial plateau fractures with internal fixation can give satisfactory clinical and radiological results.

References

[1] M.B.B.S.Svidyadhara. Tibial plateau fractures. J Bone Joint Surg, 2016.
[2] W.Norman Scott. Tibial plateau fractures The knee. Mosby.VOL.2,PP.1369–1391,2015.
[3] C.Dall'Oca, T.Maluta, F.Lavini. Tibial plateau fractures: Compared outcomes between ARIF and ORIF. Strat Traum Limb Recon.VOL. 7,PP. 163-175,2016.
[4] H.Tscherne , P.Lobenhoffer. Tibial plateau fractures: management and expected results. Clin Orthop.VOL. 293,PP. 87–100,2018.
[5] W.F.Bennett, B.Browner. Tibial plateau fractures: A study of associated soft tissue injuries. J. Orthop. Trauma.VOL. 8,PP. 183-188,2020.
[6] L.Kode, J.Lieberman, A.Motta. Evaluation of tibial plateau fractures: efficacy of MR imaging compared with CT. Am J Roentgenol.VOL. 163(1),PP. 141-7,2017.
[7] S.E.Honkonen. Degenerative arthritis after tibial plateau fractures. J Orthop Trauma.VOL. 9,PP. 273-277,2017.
[8] S.S.Hung, E.K.Chao, Y.S.Chan. Arthroscopically assisted osteosynthesis for tibial plateau fractures. J Trauma.VOL.54,PP.356-363,2018.
[9] F.Van Glabbeek, R.van Riet, N.Jansen. Arthroscopically assisted reduction and internal fixation of tibial plateau fractures: report of twenty cases. Acta Orthop Belg.VOL. 68,PP.258–64,2018.
[10] Y.Chan, L.Yuan, S.Hung. Arthroscopic-assisted reduction with bilateral buttress plate fixation of complex tibial plateau fractures. Arthroscopy.VOL. 19,PP.974-984,2019.
[11] M.J.Gardner, S.Yacoubian, D.Geller. The incidence of soft tissue injury in operative tibial plateau fractures: a magnetic resonance imaging analysis of 103 patients. J Orthop Trauma.VOL. 19(2),PP. 79-84,2015.
[12] M.Zaki, C.Chung-Hsun, Y.Sheng. Arthroscopic Evaluation of Soft Tissue Injuries in Tibial Plateau Fractures: Retrospective Analysis of 98 Cases. Arthroscopy.vol. 22(6),pp. 669- 675,2016.
[13] J.E.Jennings. Arthroscopic management of tibial plateau fractures. Arthroscopy.vol. 1(3),pp.160-168,2017.
[14] F.Handelberg, P.Casteleyn, P.DeRoeck. Arthroscopic assessment and treatment of tibial plateau fractures. Arthroscopy.vol. 7,pp. 318,2014.
[15] Y.S.Chan, C.H.Chiu, Y.P.Lo. Arthroscopy-assisted surgery for tibial plateau fractures: 2- to 10-year follow-up results. Arthroscopy.vol.24,pp.760–768,2015.
[16] T.Ahadi, G.Raissi, M.Yavari, Prevalence of ulnar-to-median nerve motor fiber anastomosis (Riché-Cannieu communicating branch) in hand: An electrophysiological study. Medical journal of the Islamic Republic of Iran,vol.30,pp.324,2016.
[17] S.H.M.Zawam , A.M.Gad. Arthroscopic assisted reduction and internal fixation of tibial plateau fractures. Open Access Macedonian Journal of Medical Sciences.vol. 7(7),pp.1133-1137,2019.
[18] E.A.Stokel, K.K.Sadasivan. Tibial plateau fractures: Standardized evealuation of operative results. Orthopedics.vol. 14,pp. 263-270,2017.
[19] F.Pogliacomi, M.A.Verdano, M.Frattini. Combined arthroscopic and radioscopic management of tibial plateau fractures: report of 18 clinical cases. Acta Bio Medica Atenei Parmensis.vol. 76(2),pp.107-14,2019.
[20] T.J.Gill, D.M.Moezzi, K.M.Oates. Arthroscopic reduction and internal fixation of tibial plateau fractures in skiing. Clin Orthop Rel Res.vol. 383,pp. 243-249,2018.
[21] Y.S.Chan, C.H.Chiu, Y.PLo. Arthroscopy-assisted surgery for tibial plateau fractures: 2- to 10-year follow-up results. Arthroscopy.vol. 24,pp.760–768,2015.
[22] J.Siegler, B.Galissier, P.S.Marcheix. Charissoux JL, Mabit C, Arnaud JP. Percutaneous fixation of tibial plateau fractures under arthroscopy: A medium term perspective. Orthop Traumatol Surg Res.vol. 97,pp. 44-50,2016.
[23] T.Scheerlinck, C.S.Ng, F.handelberg. Medium-term results of percutaneous, arthroscopically-assisted osteosynthesis of fractures of the tibial plateau. J Bone Joint Surg (Br).vol. 80-B,pp. 959-64,2018.
[24] M.Asik, O.Cetik, U.Talu. Arthroscopy-associated operative management of tibial plateal fractures. Knee Surg, Sports Traumatol, Arthrosc.vol.10,pp.364-370,2020.