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ORIGINAL ARTICLE

Arthroscopically Assisted Reduction and Internal Fixation of Tibial Plateau Fractures

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ABSTRACT

Background: The goal of this study is to evaluate the results of arthroscopically assisted reduction and internal fixation of tibial plateau fractures in selected cases of tibial plateau fractures.

Patient and methods: A prospective study with thirty patients of selected tibial plateau fractures was conducted between April 2013 and April 2017.Independent sample student's t-test was done to assess the parameters like age, follow-up and duration of surgery. The results were expressed as mean with standard deviation and $p<0.05$ was considered as statistically significant.

Results: According to Rasmussen clinical score which depends on (Pain Walking, capacity, Extension, Range of motion, and Stability) 19 patients (63.3%) were rated as excellent, 10 (33.3%) good, and 1 (3.3%) fair. There was no poor result.

Conclusion: Fractures of tibial plateau have a wide range of associated soft tissue injuries. With the aid of arthroscopy, results in this series were satisfactory. Using arthroscopy in these cases is a safe and valuable procedure that gives accurate diagnosis and adequate treatment in a single stage surgical procedure.

Keywords: Tibial; plateau; fracture; Arthroscopy

INTRODUCTION

Fractures of the tibial plateau represent about one percent of all fractures **[1]** .Treatment of these fractures can be difficult for orthopaedic surgeons. These fractures can lead to impaired function of the injured knee. Success depend on fracture reduction, achievement of ligamentous stability, management of associated lesions. **[2]**.

Extensive soft tissue dissection accompanied by open reduction and internal fixation (ORIF) , may lead to many complications such as poor wound healing, arthritis and sepsis **[3].** Meniscal tears or anterior cruciate ligament (ACL) tears or avulsion cannot be diagnosed and treated in a correct way because of limited exposure. Arthroscopy-assisted reduction and internal fixation (ARIF) in the management of proximal tibial articular fractures was first introduced by **Caspari et al.** **[4]** and **Jennings [5]**. Using arthroscopy in assisting reduction and fixation is used in a large scale in the management of tibial plateau fractures**. [6]** Arthroscopy-assisted reduction and internal fixation (ARIF) has shown many benefits over open reduction and internal fixation (ORIF) regarding ideal reduction by direct visualization, because it is a less invasive procedure, and easy diagnosis and management of intra-articular lesions.

Different literature shows good short-term to medium-term functional plus radiologic results. Arthroscopy-assisted reduction and internal fixation (ARIF) clinical results are not clear to be superior than open reduction and internal fixation (ORIF). Arthroscopy-assisted reduction and internal fixation (ARIF) has higher risk for development of compartment syndrome during examination or treatment using arthroscope **. [7]**

PATIENTS AND METHODS

This study included thirty patients of both sexes These cases were done in Zagazig university hospital in the peiod from April 2013 to April 2017.All the cases attended the follow up. Tibial plateau fractures are classified into 6 types **[8].** Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion Criteria:

Patient with tibial plateau fracture and with articular displacement > 3 mm or varus or valgus >5 degrees or condylar widening .Age ranges from 18-50 years.

Exclusion criteria:

Patients with open fractures, Patients with high energy fractures with severe comminution, Patients with age below 18 or above 50 years, and 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 **[9]**.

Technique used is a combination of those techniques described by **Lubowitz et al. [10] and Burdin [1]** .Supine position was used, with the injured leg in a knee holder, elevated over the end of the operating table. A tourniquet was applied. The image intensifier and screen were situated on the opposite side of the patient. Parapatellar, lateral and medial, arthroscopic portals were used. A continuous flow of physiological saline under gravity pressure. After irrigation of the injured knee, The degree of the fracture displacement and associated intra-articular lesions was estimated under direct visualization of the arthroscope .

Under direct visualization of the arthroscope, the fractures were reduced and associated intra-articular lesions were assesed accurately. For split lateral tibial plateau fractures a limited lateral exposure, or using joystick technique, was used. Depression fractures reduction with the assistance of an anterior cruciate ligament (ACL) tibial guide making tunnel for depressed area then bone grafting or bone substitutes were used to fill the defect. Fixation by canulated screws or plate.

Rasmussen clinical criteria depend of the subjective state of the knee according to the patient, plus the objective state of the knee. (pain, , extension, walking capacity total range of movement and stability of the knee) are scored. A maximum score of 6 points is attributed in each category.

A score ranging from 30 to 27 points considered as an excellent result, A score of 26 to 20 points considered as a good result. A score from 19 to 10 points is cosidered as fair. A score of less than 10 points is cosidered poor.

Patients also were submitted to the following x-ray views: antero-posterior, lateral views then: assessed according to Modified Rasmusen criteria for radiological assessment including articular depression, condylar widening, varus or valgus angulation and osteoarthrosis, with maximum score of 10 which is graded into excellent (9-10), good (7-8), fair (5-6) and poor (<5).

Statistical Analysis:

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean ± SD & (Minimum-maximum), and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). Student's t-test was used to compare between two groups of normally distributed variables. Anova(F) test was used to compare between more than two independent groups of normally distributed variables. LSD (least significant difference) of PAIRWISE between each group. All tests were two sided. p-value < 0.05 was considered statistically significant (S), and pvalue ≥ 0.05 was considered statistically insignificant (NS).

RESULTS

There were 11 patients (36.7%) with fractures right tibial plateau, and 19 patients

(63.3%) presented with fractures of left tibial plateau. The Mechanism of injury: 19 cases caused by road traffic accident, 6 cases caused by fall from height and 5 cases due to simple fall. According to Schatzker' classification, this study included the 6 types of tibial plateau fractures as follow. Shatzker I : 7 cases (23.3% of all cases), Shatzker II: 14 cases (46.7%), Shatzker III: 5 cases (16.7%), Shatzker IV: One case (3.3%), Shatzker V: 2 cases (6.7%), Shatzker VI: One case (3.3%). **Associated lesions** : there were 4 cases of ACL injury, 1 case of tibial avulsion managed by trans osseous sutures, 2 cases of partial tear managed by conservative treatment, 1 case of complete tear which needed secondary reconstruction, there were 3 cases of medial ligament injuries, 1 case of tibial avulsion managed by fixation by a staple, 2 cases managed by conservative treatment, there was 1 case of Lateral ligament injury managed by repair, there were 5 cases of Lateral meniscal injury, 4 cases were managed by partial meniscectomy and 1 case managed by meniscal repair, there were 2 case of medial meniscus injury managed by Partial meniscectomy.

Table (1) shows detailed overview of patient characteristics, types of lesions and results.

According to Rasmussen clinical score, 19 patients (63.3%) were rated as excellent, 10 (33.3%) good, and 1 (3.3%) fair. There were no poor results. (Table 2)(figure 1).

According to radiological modified Rasmussen clinical score, 18 patients (60%) were rated as excellent, 8 (26.7%) good, and 4 (13.3%) fair. Mean total score was 8.6 ± 1.5, ranging from 6 to 10 (Table 3) (figure 2) . All seven patients with a Schatzker type I fracture had an excellent result, Seven out of fourteen patients with a Schatzker type II fracture, had an excellent result and seven had a good result. The five patients with a Schatzker type III fracture: four patients scored an excellent result and one patient good results. One excellent result were achieved in one patient with a Schatzker type IV fracture. The two patients with a Schatzker type V fracture scored a good result. The one patient of shatzker VI scored fair result (figure 3).

There were 8 patients (26.7%) with complications, three patients had palpable hardware, one patient had fluid extravasation, one had DVT, one had loss of reduction, two patients had infection.

Table (1) — Detailed overview of patients characteristics, types of lesions and results

Case	Age	M/F	Mechanism of trauma	Schatzker type	Associated lesions	Treatment of associated lesions	Follow-up (months)	Rasmussen score
1	50	M	RTA	II	–	–	36	30
2	42	M	RTA	II	–	–	12	27
3	29	M	RTA	V	ACL avulsion	suture	29	26
4	35	M	RTA	I	–	–	32	28
5	55	F	Fall from height	VI	–	–	36	20
6	5	M	RTA	IV	Medial meniscus	Partial	24	27

	2				lesion	meniscectomy		
7	36	M	RTA	II	–	–	40	28
8	22	M	RTA	II	–	–	36	22
9	25	M	Fall from height	I	Lateral meniscus lesion	Partial meniscectomy	28	30
10	38	F	RTA	III	–	–	30	28
11	20	M	RTA	III	–	–	30	30
12	50	M	Simple fall	III	Medial ligament tear	conservative	34	23
13	54	M	Simple fall	I	–	–	34	28
14	55	M	Simple fall	II	–	–	12	29
15	55	F	Simple fall	II	ACL tear	conservative	12	25
16	35	M	RTA	I	Lateral ligament tear	repair	22	30
17	26	M	RTA	I	–	–	24	28
18	20	M	RTA	I	Medial meniscus lesion	Partial meniscectomy	24	28
19	22	M	RTA	V	ACL Partial tear	conservative	36	26
20	18	M	RTA	II	ACL Partial tear + medial ligament tibial avulsion	Conservative Fixation by staple	24	29
21	27	M	RTA	III	medial ligament Partial tear	Conservative	24	28
22	18	M	RTA	II	–	–	36	30
23	51	F	Fall from height	II	Lateral meniscus lesion	Partial meniscectomy	36	25
24	41	M	Simple fall	II	–	–	30	23
25	32	F	Fall from height	II	Lateral meniscus lesion	Partial meniscectomy	36	23
26	20	M	Fall from height	III	Lateral meniscus lesion	repair	36	27
27	33	M	Fall from height	II	–	–	24	30
28	40	M	RTA	I	Lateral meniscus lesion	Partial meniscectomy	30	30
29	52	M	RTA	II	–	–	30	25
30	45	F	RTA	II	–	–	36	25

Table (2): Rasmussen clinical score

	Mean ± SD (range)
Pain	5.3 ± 0.7 (4-6)
Walking capacity	5.4 ± 0.8 (3-6)
Extension	5.4 ± 0.76 (3-6)
Range of motion	5.5 ± 0.7 (4-6)
Stability	5.3 ± 0.7 (4-6)
Total	26.9 ± 2.9 (18-30)
Outcome	
Fair	1 (3.3%)
Good	10 (33.3%)
Excellent	19 (63.3%)

Table (3): Radiological modified Rasmussen criteria

	>10mm		**6-10mm**		**<5mm**		**non**	
	number	**%**	**number**	**%**	**number**	**%**	**number**	**%**
Articular depression	0	0	0	0	8	26.7	22	73.3
Condylar widening	0	0	0	0	10	33.3	20	66.7
Varus valgus	**>20 degree**		**10-20 degree**		**<10 degree**		**non**	
	number	**%**	**number**	**%**	**number**	**%**	**number**	**%**
	0	0	1	3.3	9	30	20	66.7
Osteoarthritis	**Progress by >1 grade**		**Progress by 1 grade**		**No progress**			
	number	**%**	**number**	**%**	**number**	**%**		
	0	(0%)	4	13.3%	26	86.6%		

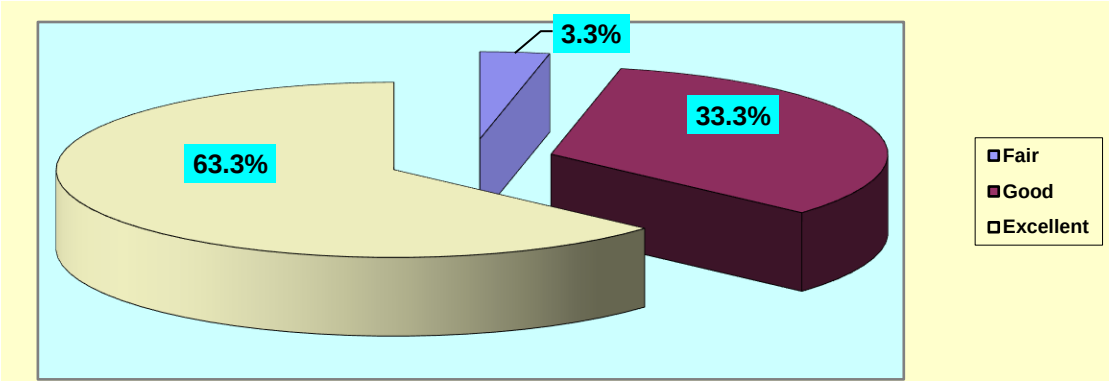

Figure (1): Outcome of Rasmussen clinical score

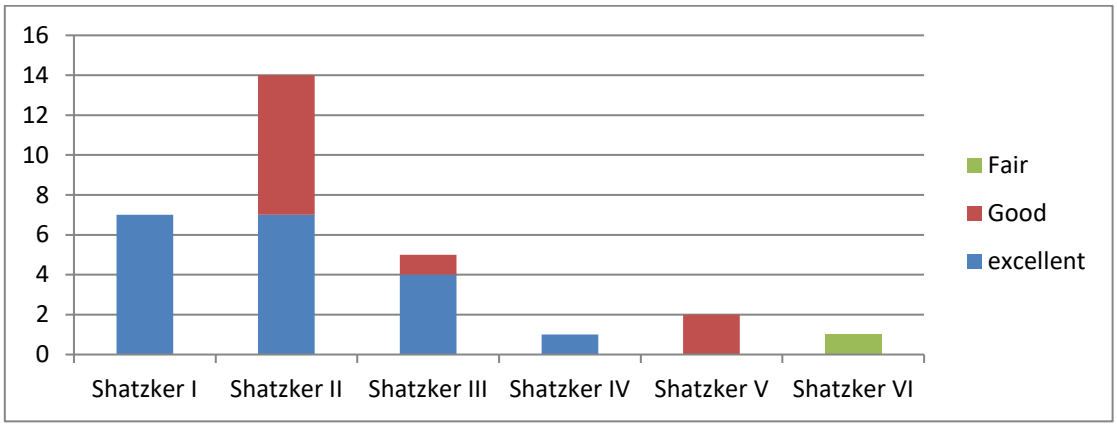

Figure (2): Results of rasmussen score according to shatzker classification

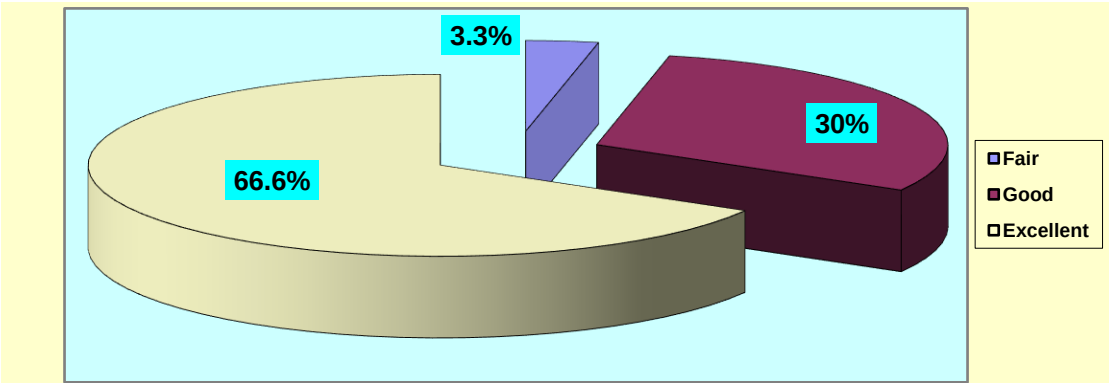

Figure (3): Total score and description

DISCUSSION

In the current study, surgical reduction was done for fractures with a step-off > 3 mm. Many studies **[11]** have shown that restoring articular surface congruity and residual laxity of the knee after management of tibial plateau fractures were two of the most significant predictors of future knee function.

Long-term results rely on anatomic reduction of the tibial articular surface**.[12]** Traditional open reduction for treatment of tibial plateau fractures has several drawbacks. Arthrotomy of the knee and transection of the meniscus have to be done during open reduction and internal fixation (ORIF) to achieve better visualization of the displaced articular surface, leading to stiffness,

postoperative pain, and wound complications. **[7]** .Satisfactory short- to medium-term clinical and radiologic results of arthoscopic reduction and internal fixation have been reported based on many studies **[13].**

One main advantage of the use of arthroscopy in plateau fractures is to assess articular depression elevation. In this study the mean pre-operative condylar widening 6.8 mm (range 0 to 20) and the mean post-operative condylar widening was 0.7 mm range(0 to 4 mm), with statistically high significant difference ($P < 0.01$). Preoperative fracture depression averaged 5.7 mm (range, 0 to 20 mm) and at the end of follow-up averaged 1.1 mm (range, 0 to 4 mm), with one cases of loss of reduction.

In this study according to the Rasmussen clinical score we obtained satisfactory (good to excellent) results in 29 cases(97%)and 1 case(3%) fair result and modified Rasmussen radiological criteria, we obtained satisfactory (good to excellent) results in 26 cases (87%), and 4 case (13%) fair, with no poor results.

Gill et al. treated 29 patients with tibial plateau fractures in skiers by Arthroscopy-assisted reduction and internal fixation (ARIF) that included Shatzker types I, II, III, and IV fracture. The mean postoperative Rasmussan clinical score was 27.5. At a mean follow up of 24 months, 76% of cases rated their result as excellent and 16% as good **[14]**.

Oz et al., treateted 28 patients with tibial plateau fractures by Arthroscopy-assisted reduction and internal fixation (ARIF) and used the (Hospital for Special Surgery knee scores).Results were 80% excellent, 15% good, 5% fair, and 0% poor **[15].**

Van Glabbeek et al. used Rasmussen clinical score in of 20 cases, (7 type I, 9 type II, 1 type III, 2 type IV, and 1 type V fracture) .18 out of 20 patients scored an excellent (15 patients), or a good (3 patients) result. **[16].**

Hung et al. in a study of 31 patients with fractures of the tibial plateau treated by Arthroscopy-assisted reduction and internal fixation (ARIF). There were (1 type I, 9 type II, 7 type III, 9 type IV, 3 type V, and 2 type VI fractures). Excellent results in 25 patient using (Hospital for Special Surgery scores), 4 were good, and 2 were fair **[17]**.

Chan et al. in a study using Arthroscopy-assisted reduction and internal fixation (ARIF) with bilateral buttress plate fixation of 11 type V and 7 type VI tibial plateau fractures. Results were 22% ,excellent, 67% good, and 11% fair **[18].**

Management of ligamentous injury in cases of tibial plateau fractures is an important issue. Most studies **[1,2]** recommend one-stage surgical fixation for ACL bony avulsion. Most authors did not recommend performing ACL reconstruction in case of ACL midsubstance tear at the time of fracture fixation because it may induce more soft tissue injury in addition to the existing damage around the knee. If there was anterior instability after fracture healing, a second-stage ACL reconstruction was recommended. However, most patients with associated ACL injuries did not need secondary reconstruction **[20, 6].**

Elabjer et al.[21], in a study of 75 patients Schatzker type I–III with tibial plateau fractures. Cases were divided into 2 categories: one category was managed with arthroscopically-assisted reduction and internal fixation (ARIF) and the other category with open reduction and internal fixation (ORIF). 40 cases in the Arthroscopy-assisted reduction and internal fixation (ARIF) category and 35 in the open reduction and internal fixation (ORIF) category. The average clinical and radiological Rasmunssen scores show no statistically significant difference between the two groups. Arthroscopy-assisted reduction and internal fixation (ARIF) seems to offer a more accurate evaluation and management of associated intraarticular lesions.

CONCLUSIONS

Fractures of tbial plateau have a wide range of associated soft tissue injuries. With the aid of arthroscopy, results in this series were satisfactory. Using arthroscopy in these cases is a safe and valuable procedure that gives accurate diagnosis and adequate treatment in a single stage surgical procedure.

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No Conflict of Interes :there in no financial or personal relationships with other people or organizations that could inappropriately influence (bias) the authors' actions.

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