



ORIF with Tension band wiring in transverse fractures of the patella-A prospective study

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ABSTRACT

Fractures of the patella account for 1% of all fractures and can be managed by both conservative and surgical means. By this study, we aimed to evaluate the functional outcome following ORIF (Open reduction and internal fixation) of transverse patellar fractures with TBW (Tension band wiring). Thirty patients with patellar fractures who presented between June 2011 to June 2014 were managed surgically and were followed up for three years. Functional analysis was performed using the Lysholm scoring system. The patients in our study had a mean age of 42.86 years ranging from 19 to 71 years. There were 18 males and 12 females in our study with the right knee being more commonly affected. The mean surgical time was 57.66 minutes ranging from 45 to 70 minutes, and the average blood loss was 180.5 ml ranging from 160 to 210 ml. We were able to achieve a 100% union rate in our series with the average time to fracture union being 11.83 weeks. The mean Lysholm score was 87.80 ± 11.20 . All patients were satisfied with the functional outcome and were able to return to activities of work and daily living to the best possible extent. ORIF with TBW is an effective treatment option in the management of transverse fractures of the patella, and it gives good radiological and functional outcomes to the patients.



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INTRODUCTION

Fractures of the patella account for 1% of all fractures and most of them are seen in the age group of 20 to 50 years (Boström, 1972). Transverse fracture patterns are the most common type seen, and the mode of injury could either be by direct or indi-

rect forces. A direct injury occurs following a fall or a dashboard injury-causing failure in compression. An indirect force happens due to a rapid knee flexion against a contracted quadriceps muscle (Levack *et al.*, 1985; Carpenter *et al.*, 1993; Melvin and Mehta, 2011). Conservative management can be done in undisplaced fractures, vertical fractures and fractures with an intact extensor mechanism with a knee brace or a tube slab for a period of 4 to 6 weeks followed by knee mobilization. Displaced fractures with disruption of the extensor mechanism would require surgical intervention (Wild *et al.*, 2010; Rathi *et al.*, 2012). Surgical management would aim to restore the articular congruity of the patella by an anatomical reduction and to restore the continuity of the extensor mechanism (Tandogan *et al.*, 2002; Gardner *et al.*, 2005). ORIF can be done using cannulated cancellous screws, cerclage wiring and by the TBW technique. Cancellous screw fixation is indicated in cases of simple

fracture patterns, and cerclage wiring is preferred in intricate fracture patterns associated with gross comminution where TBW would not be possible. TBW is the most commonly used technique and has the mechanical advantage of converting the tensile forces into compressive forces. It allows restoration of the articular surface to an anatomical level and promotes early mobilization of the knee joint to prevent knee stiffness. This study was performed to evaluate the functional outcome following ORIF with TBW in the management of transverse fractures of the patella.

MATERIALS AND METHODS

This study was a prospective study of 30 patients with transverse fractures of the patella who presented between June 2011 to June 2014 treated with ORIF with TBW with a follow-up period of 3 years. This study was approved by the ethical committee of our institution. All skeletally mature patients with transverse fractures of the patella willing for surgery and regular follow up were included in our study. The exclusion criteria were comminuted and vertical fracture patterns, compound fractures and patients with active infection or inflammation in the affected limb. The patients were admitted and were evaluated clinically and radiologically. A thorough neurovascular examination was performed, and the integrity of the extensor mechanism was checked by asking the patient to perform a straight leg raising test. Standard radiographs of the affected knee were taken in AP, lateral and oblique projections. CT scans were not routinely done. All fractures were classified according to the OTA classification, and the fracture type was documented in the patient case records (Figure 1).

Routine blood investigations were done, and the patients were worked up for the surgical procedure. The procedures were performed under regional anaesthesia under I.v. Antibiotic cover. Injection Cefazolin 1gm was given at the time of giving anaesthesia and was continued for three days postoperatively. The surgeries were performed by the same orthopaedic surgeon who was well versed with the procedure. Through a midline approach, the patella was exposed, and the fracture site was cleared of blood clots and soft tissues, and the articular surface of the patella was inspected. The fracture reduction was made with a reduction clamp. Fluoroscopic images were taken to confirm the accuracy of the articular surface reduction. Two 1.5 mm K wires were then passed parallel to each other, and an 18 gauge cerclage wire was passed in a figure of 8 fashion keeping the knee in complete extension and was

tensioned to achieve compression at the fracture site. The knee was put through a range of motion to check for stability of the fixation. After giving a wound wash and ensuring haemostasis, wound closure was done in layers, and sterile dressing with compression bandage was applied. The patient was made to recline in bed on the same day of surgery in the evening, and the knee and ankle were actively mobilized.

Quadriceps strengthening exercises were started, and the patients were mobilized on day 1 with full weight-bearing walking. Wound inspections were done on day 3, and 5 and sutures were removed on day 12. The patients were then discharged and asked to review at prescribed intervals where serial radio graphs were taken to assess for signs of fracture union. The Functional assessment was done with the Lysholm score. All findings were documented in the case records. Data analysis was performed using IBM SPSS Version 22.0. Armonk, NY: IBM Corp software. The Chi-square test compared categorical variables. A P value of <0.05 was considered to be statistically significant.

RESULTS AND DISCUSSION

The mean age of the patients in our study was 42.86 years ranging from 19 to 71 years. There were 18 males and 12 females in our study with the right side being more commonly affected, as seen in 19 patients. Road traffic accidents were the most common mode of injury followed by slip and fall and sports injuries (Figure 2). According to the OTA classification C1 was the most common fracture pattern seen (Figure 3).



Figure 1: OTA Classification

The mean time frame from the injury to the presentation was four days ranging from 1 to 9 days while the mean time frame from presentation to performing the surgical procedure was three days ranging from 2 to 8 days. The mean surgical time was

Table 1: Patient demographics and data

S.No	Age	Side	Sex	Mode of injury	AO Type	Surgical time (mins)	Blood loss (ml)	Time to union (weeks)	Lysholm score
1	25	R	M	SAF	C1	54	180	10	95
2	27	R	M	RTA	C1	48	200	11	98
3	41	R	F	RTA	C2	60	190	10	74
4	56	L	M	SAF	C1	70	200	14	96
5	59	R	M	RTA	C1	58	170	13	98
6	64	L	F	RTA	C1	64	170	12	78
7	58	R	M	RTA	C2	62	190	11	95
8	71	R	F	RTA	C1	58	185	11	98
9	32	L	F	RTA	C1	49	175	12	86
10	41	R	M	RTA	C1	45	160	11	87
11	49	L	M	RTA	C1	62	180	10	84
12	33	R	M	SAF	C1	60	210	10	96
13	36	L	F	SAF	C2	70	200	11	97
14	41	R	M	RTA	C1	54	210	12	95
15	45	R	M	RTA	C1	58	180	11	85
16	46	L	M	Sports	C1	58	175	11	95
17	54	R	F	SAF	C1	62	175	13	87
18	60	L	F	RTA	C3	64	160	12	97
19	38	R	M	RTA	C1	60	175	11	90
20	19	R	M	RTA	C2	61	165	13	95
21	26	L	M	RTA	C1	70	200	11	97
22	31	R	M	SAF	C1	68	210	14	92
23	43	R	F	RTA	C2	64	210	12	98
24	44	R	M	RTA	C3	66	195	13	95
25	58	L	M	Sports	C1	70	175	14	97
26	40	R	M	RTA	C1	45	170	13	95
27	29	L	F	RTA	C3	54	180	11	98
28	36	R	F	Sports	C1	56	190	12	97
29	39	R	F	RTA	C1	60	210	14	95
30	44	L	F	Sports	C1	58	200	13	98

RTA- Road traffic accident; SAF-Slip and fall.



Figure 4: A. Preoperative radiograph. B. 2 weeks AP. C. 2 weeks lateral. D. Radiograph at 6 months AP showing good union at the fracture site.

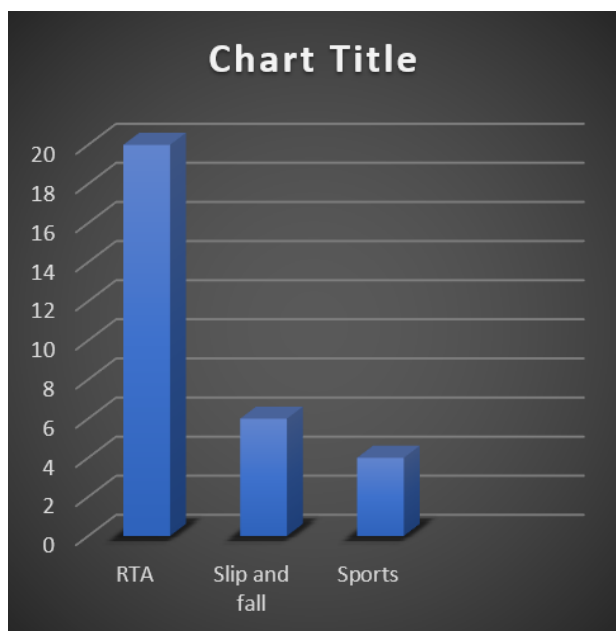


Figure 2: Mode of injury

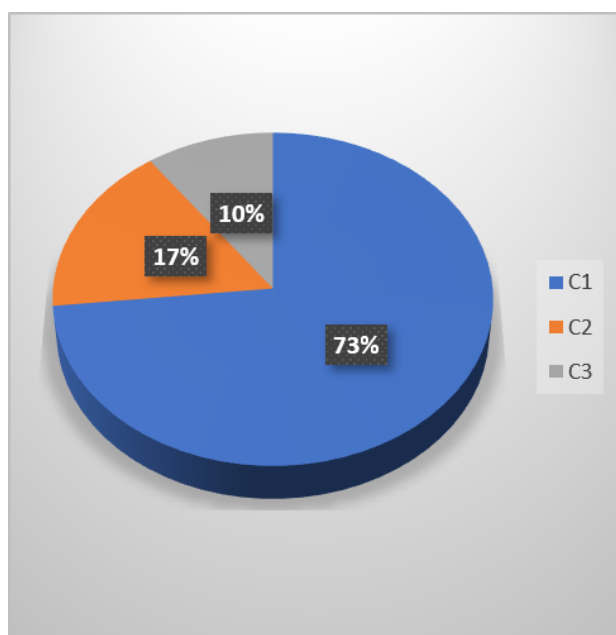


Figure 3: AO fracture classification

57.66 minutes ranging from 45 to 70 minutes, and the average blood loss was 180.5 ml ranging from 160 to 210 ml. We were able to achieve a 100% union rate in our series with the meantime to fracture union being 11.83 weeks which ranged from 10 to 14 weeks (Figure 4).

The average knee movement achieved was 112° of flexion with a range of 110 to 130°. The mean Lysholm score was 87.80±11.20. We had excellent results in 21 patients while 7 had a good result and 2 with a fair result (Table 1).

We had minor complications such as superficial skin

infections in 2 patients, skin necrosis in 1 patient while two patients had an extensor lag of 10 and 15°, which did not affect the functional outcome. We had no major complications such as nonunion, malunion, implant failure or deep infection seen in our study. We did not lose any of our patients to follow up.

Fractures of the patella account for 1% of all fractures and can be managed by both conservative and surgical means. Conservative management can be done in undisplaced fractures, vertical fractures and fractures with an intact extensor mechanism with a knee brace or a tube slab for a period of 4 to 6 weeks followed by knee mobilization. Displaced fractures with disruption of the extensor mechanism would require surgical intervention. ORIF can be done using cannulated cancellous screws, cerclage wiring and by the TBW technique. Cancellous screw fixation is indicated in simple transverse fractures fracture patterns where the partially threaded 4 mm screws bring about compression at the fracture site. Complications such as screw migration and breakage of the screws have been reported in the literature. Cerclage wiring is preferred in complex fracture patterns associated with gross comminution where TBW would not be possible. The stability provided by cerclage wiring is not as good as that of TBW and is associated with poorer functional outcomes (Hoshino *et al.*, 2013; Taylor *et al.*, 2014; Agarwala *et al.*, 2015). Partial patellectomy can be done in fractures of the lower pole where the fracture fragment is too small to provide for a fixation. Complete patellectomy is reserved for cases with complex fracture patterns associated with extensive comminution where salvage of the patella is not possible and is followed by repair of the extensor mechanism.

TBW is the most common procedure done for transverse fracture patterns where two parallel K wires are passed followed by cerclage wiring in a figure of 8 fashion to achieve compression at the fracture site. Various techniques of wiring such as placement of double loops, different points of placement of loops along with different materials other than the regular stainless steel wires have been reported in various studies with good success rates and functional outcomes (Qi *et al.*, 2011; Ong *et al.*, 2008; Us and Kinik, 1997). While tightening the cerclage wires, compressive strains are produced on the anterior surface of the patella while tensile strains are produced on the posterior surface. The basic principle of TBW is that the tensile forces are converted into compressive forces during flexion of the knee. Knee flexion is deemed to be as important as the surgical technique used to facilitate the proper functioning of the ten-

sion band. Egol et al. studied 49 patients with patellar fractures and reported a 100% union rate at the end of 1 year. The mean range of knee flexion was 113° , and the average Lysholm score was 82 ranging from 56 to 100.

None of the patients required hardware removal and no complications were reported in the study (Egol et al., 2014). In Zhang et al. (2019) study of 51 patients, they reported a 100% union rate with all fractures healing with an anatomical reduction. They reported complications such as superficial skin infections, delayed fracture union with a patient having a wire breakage, but the fracture union was uneventful. Camarda et al. (2016) studied 17 patients and also reported a 100% union rate with the meantime to the union being 9.2 ± 2 weeks. No fixation failures were seen while two patients had a slight loss of reduction of less than 4 mm. The mean Lysholm score was 91 ± 5.7 ranging from 83 to 100. They reported one patient with a superficial skin infection which was uneventful. In our series of 30 patients, we also achieved a 100% union rate with the meantime to fracture union being 11.83 weeks ranging from 10 to 14 weeks. The average knee flexion achieved was 112° , ranging from 100 to 130° . We had minor complications such as superficial skin infections in 2 patients, skin necrosis in 1 patient while two patients had an extensor lag of 10 and 15° , which did not affect the functional outcome. We had excellent results in 21 patients while 7 had a good result and 2 with a fair result.

CONCLUSION

We conclude by stating that TBW is an effective fixation technique in the management of simple and transverse fracture patterns of the patella. It acts on the principle of conversion of the tensile forces to compressive forces on knee flexion, and it facilitates early and active mobilization of the knee joint and gives good functional outcomes to the patients.

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Conflict of interest

The authors declare that they have no conflict of interest for this study.

Ethical approval

Approval taken from the ethical committee

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