



International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(2): 1002-1006
© 2018 IJOS
www.orthopaper.com
Received: 21-02-2018
Accepted: 22-03-2018

Dr. A Anand
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Dr. G Mohan
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Dr. M Antony Vimal Raj
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Dr. S Makesh Ram
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Dr. R Jay Ganesh
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Correspondence

Dr. A Anand
Assistant Professor in
Department of Orthopedics,
Government Kilpauk Medical
College and Hospital, Chennai,
Tamil Nadu, India

Non-metallic fixation of patella fractures using high resistance suture materials

Dr. A Anand, Dr. G Mohan, Dr. M Antony Vimal Raj, Dr. S Makesh Ram and Dr. R Jay Ganesh

DOI: <https://doi.org/10.22271/ortho.2018.v4.i2o.141>

Abstract

Introduction: Patella fractures account for 0.5% to 1.5% incidence of all bone fractures. The gold standard procedure for the patella fractures so far is AO modified anterior tension band wiring with stainless steel and K-wires. The hardware related complication in this technique is high ranging from 0-60%. The purpose of the study is to evaluate the functional outcome for fixation done with high resistance suture material.

Methods: A prospective study was conducted in a group of 24 patients who were hospitalised in Govt Kilpauk Medical College and Hospital, Chennai in the Department of Orthopaedics between August 2015 and September 2017. The patella fractures included in the study were performed open reduction and internal fixation (ORIF) with FiberTape using a novel transosseous tunnel technique. The functional outcomes were evaluated with Tegner-Lysholm score and Bostman scoring. The clinical and radiological outcomes were evaluated as well.

Results: Among the 24 patients with patella fractures studied, all fractures united. The mean time of union is 3 months 8 days. 4 patients presented with minor complications like superficial infection, displacement < 4mm, anterior knee pain and extensor lag ~ 10°. Average scores: Lysholm – 96, Bostman – 27. All fractures united uneventfully. No hardware related complications or resurgery reported in the study.

Conclusion: The complete non-metallic fixation rules out the most important complication of metallic fixation, which is the symptomatic hardware. It also brought down the reoperation rates and the infection rates post-surgery considerably. Using a non-absorbable suture material also precludes the possibility of a second surgery needed for the implant exit. Hence, these high resistance suture materials like Fiber Wire and FiberTape can be used for efficient non-metallic fixation of patella on par with that of traditional metallic fixation with reduced complications and re-surgery rates.

Keywords: Tension band wiring, trans-osseous tunnel, non-metallic fixation

1. Introduction

Patellar fractures are relatively uncommon, representing approximately 1% of all skeletal injuries. [1, 2] Nonsurgical management is recommended for fractures with intact extensor mechanism, minimal intra-articular step-off, and minimal fracture displacement (1–4 mm). An incompetent extensor mechanism associated with a displaced or comminuted fracture with a torn extensor retinaculum is indicated for surgery. [3, 4] Operative treatment must provide stable patellar fracture fixation to allow early mobilization and prevent fracture displacement. Furthermore, articular congruity is essential to reduce the increased risk of posttraumatic osteoarthritis as a result of the high-contact forces in the patellofemoral joint. Several different techniques for internal fixation have been proposed and employed over the years, with different rates of success. Historically, the most commonly used technique for managing patellar fracture fixation is represented by the modified tension-band wiring technique. It involves longitudinal Kirschner wires (K-wires) and 18-gauge stainless steel wire in a figure-of-eight pattern looped over the anterior side of the patella. This technique neutralizes tension forces anteriorly produced by the extensor mechanism at knee flexion and converts them into stabilizing compressive forces at the articular surface. This construct represents the most widely used method of fixation for transverse and comminuted patellar fracture. Over the years, this technique was further modified by different authors using either K-wires or

cannulated screws with different stainless steel wire configurations. Even though substantially good clinical results have been reported, all techniques using metallic wires can result in symptomatic hardware, which represents the most frequent complication, with reported rates varying from 0 % to 60 %.^[5, 6] In fact, implants can irritate overlying soft tissue and cause pain, requiring a second surgery to remove the implant. In addition, a high incidence of infection has been reported.^[7] For this reason some authors have advocated the use of nonabsorbable sutures, such as braided polyester, to fix the fracture when using various techniques^[8]. Several advantages of using a suture over a wire have been shown in the literature, such as lower rate of revision surgery and higher patient tolerance of surgical material that does not irritate soft tissues as much as wire. Another advantage is represented by easier handling of suture materials for the surgeon, which could determine shorter operating and tourniquet time^[9, 10]. Few authors reported data concerning the use of tension-band fixations employing nonabsorbable sutures. Although no. 5 Ethibond and no. 5 Ti-Cron braided polyester sutures have been clinically and biomechanically studied for patellar fracture fixation, to our knowledge there are no data on the use of Fiber Wire sutures. The aim of this study is to evaluate clinical and radiological functional outcome of patients with transverse patella fractures who underwent open reduction and internal fixation (ORIF) using a novel trans-osseous double tunnel technique with high resistance non-absorbable suture material (FiberTape).

Materials and methods

Type of study: Prospective study of patients with transverse patellar fractures who underwent fracture fixation with FiberTape,

Study place: Department of Orthopaedics, Government Kilpauk Medical College and Hospital, Kilpauk, Chennai.

Study period: August 2015 to September 2017.

Study duration: 2 years.

Inclusion criteria:

1. Age more than 18 years
2. Fresh fractures (i.e. trauma to surgery within 2 days)
3. Minimum follow-up of at least 10 months.

Exclusion criteria

1. Age less than 18 years,
2. Evidence of an active infection,
3. Previous metal implantation in the ipsilateral knee,
4. Patients in whom an ipsilateral knee surgery was done prior to the recent trauma, and
5. Patients with other comorbidities like head injury which affects the rehabilitation

Surgical procedure

The patient was positioned supine in the operating table. Tourniquet was not applied as a routine. A midline longitudinal incision was used for all the cases. Before inspecting the fracture per se, the medial and lateral retinaculum were visualized and inspected for any tears associated with the trauma and which may need to be repaired. Then fracture site is visualized. Fracture hematoma is let out. Blood clots were removed from the fracture ends. The knee joint proper was inspected for any intra-articular loose fragments. Then preliminary fracture visualization is done under direct vision using reduction clamp. The patella articular surface is inspected for any incongruity. The fracture reduction is achieved after attaining perfect joint congruity.

Then two guide wires were inserted in the medial and lateral aspect of the patella. Then tunnels were created over the guide wires using the cannulated drill bit while the initial reduction is still maintained by the reduction clamps. The guide wires were then removed. No 5 Fibertape is fed onto the bead pin and introduced in the medial tunnel in a distal to proximal fashion and on its exit in the medial proximal end it is brought across to the lateral distal end and then using the bead pin the Fibertape finally arrives at the lateral proximal end and the high resistance suture material is then tied with the knot placed in the postero-superior aspect. Care must be taken to bury the knot under sufficient soft tissue cover to protect the superficial tissues from irritation and subsequent patient discomfort. The reduction clamp can be removed after the application of the knot. The fracture reduction is visualized for any step and the articular surface is inspected for any residual incongruity. The reduction was further checked with the help of C-arm. If found satisfactory, the retinacular repair can be done if its present. Knee flexion and extension is checked on table for the stability of the fracture reduction. Wound wash given thoroughly. Drain kept when necessary. Wound closed in layers. Sterile dressing done.



Pre-op



6 months follow up



1 year follow up

Results

The use of Fiber-Tape for the fixation of patella showed that the functional outcome of the cases were good. The scores evaluated for the functional outcome study was bostman and lysholm score. Average bostman score is 27. Average lysholm score is 90.6. There was no hardware related complications encountered in the course of the study. These are the most important results of the study.

Minor complications like superficial infection, knee pain, displacement <4mm were noted in the study. Among the 24 patients who were included in the study, 1 patient presented

with post-operative superficial infection which settled with intravenous antibiotics for 5 days. The patient was clinically normal and did not present with any further complications. The final scores of the patient were lysholm score – 88, bostman score – 27. All the patients presented with good union at the end of the follow up. Though 1 patient presented with post-operative fixation failure with fracture displacement of <4mm, it eventually united and did not influence the final union. Scores of the patient were Lysholm score – 85; bostman score – 25.

S. NO.	Age	Sex	Type of Fracture	Time To Union (In Months)	Final Rom	Follow Up Period	Scores		Complications	Outcome
							Lysholm	Bostman		
1.	45	M	Transverse	3m	0-130°	1yr 6m	94	28	-	Excellent
2.	65	F	Comminuted	3m	0-130°	1yr 2m	92	28	-	Excellent
3.	58	M	Comminuted	3m	0-130°	1yr 3m	96	29	-	Excellent
4.	69	M	Inferior Pole	3m 12d	0-120°	10m	90	28	-	Good
5.	34	M	Transverse	3m 8d	0-120°	11m	85	25	Displacement<4mm	Good
6.	44	F	Transverse	3m 15d	0-130°	1yr 3m	93	28	-	Excellent
7.	28	M	Comminuted	3m	0-130°	1yr	93	28	-	Excellent
8.	74	M	Transverse	3m 8d	0-130°	1yr 2m	82	25	-	Good
9.	54	M	Transverse (Type 1 Compound)	3m 12d	0-120°	1yr 4m	94	29	-	Excellent
10.	49	F	Transverse	4m	0-130°	1yr 5m	88	27	Superficial infection	Good
11.	66	F	Inferior Pole	3m 10d	0-130°	1yr 2m	95	30	-	Excellent
12.	77	M	Transverse (Type 2 Compound)	3m	0-130°	1yr	86	25	-	Good
13.	45	M	Comminuted	4m	0-120°	11m	87	26	Anterior knee pain	Good
14.	55	M	Transverse	3m	0-130°	10m	93	28	-	Excellent
15.	33	F	Transverse	3m	0-130°	1yr	94	28	-	Excellent
16.	41	M	Transverse (Type 1 Compound)	3m	0-130°	1yr 1m	91	28	-	Excellent
17.	68	M	Transverse	3m 11d	0-130°	1yr 5m	93	29	-	Excellent
18.	29	F	Comminuted	3m 8d	0-130°	1yr 4m	92	28	-	Excellent
19.	19	F	Transverse	3m	0-110°	1yr 2m	95	29	-	Excellent
20.	36	M	Comminuted	3m 25d	0-120°	1yr	80	21	-	Fair
21.	75	M	Inferior Pole	3m 10d	0-130°	1yr 5m	96	30	-	Excellent
22.	28	M	Transverse	3m	0-130°	11m	95	29	-	Excellent
23.	57	M	Transverse	3m	0-130°	1yr 3m	92	28	-	Excellent
24.	69	F	Comminuted	4m 5d	10-130°	1yr	79	20	Anterior knee pain	Fair

Discussion

Patella fractures have been treated by various methods over the past century. The gold standard technique followed till now is the application of stainless steel wire figure of eight configuration anterior tension band placed anteriorly after inserting two axial K-wires through the patella.

The number of implant related metallic complications were very high in these patients as there was a high incidence of K-wire migration and the stainless steel wire knots that were not buried properly produced skin irritation, ulcers and infections. These complications ranged from 0-60 %.^[11, 12] All these factors played an important role in influencing the removal of the implant. LeBrun *et al.* reported in a case series of 27 patients with a mean follow up of 6.5 years, the hardware removal rate was 52%.^[13] The significant finding common in all of these studies in the lower incidence of postoperative complications compared to conventional studies^[14-16].

The main obstacle in the use of suture technique is the uncertainty that prevailed over the concept of rigid fixation. To establish the tensile strengths of various suture materials various authors studied the biomechanical properties of the

non-absorbable suture materials. Chatakonda *et al.* established that stainless steel wire had significantly higher tensile strength when compared to TiCron non absorbable suture materials (34.91 vs 14.80 kg). McGreal *et al.* subjected the cadaveric patella for 20,000 cycles of alternating flexion and extension cycles and concluded that the braided polyester suture material is an effective alternative to stainless steel wire in tension-band fixation of patella^[17]. Patel *et al.*, in his study concluded that while comparing stainless steel with that of high resistance non absorbable polyester suture materials, the results showed equal strength in both the materials in terms of quality of fixation^[18]. Later studies were made for the new materials like Fiber Wire evaluating their strength when compared to that of stainless steel for patella fracture fixation: Wright *et al.* demonstrated biomechanically that a double-stranded Fiber-Wire presents with a significantly higher initial load to failure than the stainless steel wire. The biomechanical test also established that Fiber Wire maintained its initial stiffness until failure^[19]. This was confirmed by our study: Using a FiberTape patella fixation, we found no significant fracture displacement following knee

mobilization. These findings were evident in our study due to the fact that the FiberTape that was used in the study did not yield any fracture displacement following post-operative knee mobilization. Among the 24 patients in our study, one patient presented with mild loss of reduction post-surgery (<4mm). This could be attributed to the fact that there may be adhesion and adjustment of the suture material through the surrounding peripatellar soft tissue which can happen even during simple application of load such as during quadriceps muscle contraction. Any significant loss of reduction, linked to FiberTape breakage or failure, did not occur in the study. This clearly establishes the effectiveness of suture material. In addition, all treated fractures healed at an average of 3 months 8 days postoperatively. The study therefore establishes the fact that the high resistance non-absorbable suture material can act as a stable safe and highly efficient alternative to the conventional method of fixation.

Kumar *et al.*, analysed a case series of 63 patella fractures who were treated by the conventional methods of fixation to elaborate on the findings of implant related complications.^[20] During the study, it was found that nearly one third of the patient required implant removal due to implant related complications and the rate went upto 40% for young individuals with age < 60 years. All these factors resulted in implant removal and re-surgery in these patients eventually. The timing of implant removal was a mean of 11 months (range 3-20). However no cases in our present study with suture material needed re-surgery due to implant related complications or failure. Kumar's study reiterated the necessity for developing a new treatment strategy for surgical management of patellar fractures that eliminates the implant-related complications and hence the need for revision surgeries. The common doubt with the use of suture material fixation of patella fractures is the effectiveness and sturdiness of the suture material in holding the fracture fragments together post-operatively when high loading forces are transmitted across the patella. Wright *et al.*, conducted a biomechanical study to solve this issue. He compared the strengths of double and single-stranded fiber wire with that of the routine 1.8mm stainless steel wire used for the tension band wiring of patella. The study demonstrated that Fiber Wire, both single- or double-stand, is more resistant than the stainless steel and that an *in vivo* study is justified and will result in greater patient satisfaction and decreased reoperation rates. The limitation of the study is that the study was primarily conducted in the transverse fractures, however, these findings can be extrapolated to comminuted fractures as well. In line with the previous studies, no cases presented with fracture displacement due to implant failure in our series. In this present study, the implant used is superior in strength to the one used by Wright *et al.*, in their study and hence produced excellent outcomes without exhibiting any material failure. Few studies evaluated the combined use of metallic implants like K-wire and cannulated screws with that of the high resistance sutures in place of stainless steel wires. The studies gave good functional outcomes, but the rate of implant removal was still on a higher side.^[21] Gosal *et al.*, performed a study comparing two groups for patella fracture fixation, one metallic group and the other a non-metallic group and concluded that the metallic group had higher infection and morbidity rates when compared to the non-metallic group and hence the study supported the use of non-metallic implants for patella fractures^[22].

Limitations of the study that must be taken into account are this study is a single-center study with a relatively small

sample of patients. Minor complications were observed (pain, knee stiffness) were observed during the course of the study and all of them were conservatively treated and unrelated to the type of osteosynthesis performed. None of the patients presented with symptoms of discomfort secondary to implant that required re-surgery. Another limitation is there is no control group in the study. The total number of patients included in the study were 24. Among those, males were 16 and females were 8. According to fracture classification, transverse were 14, comminuted were 7 and inferior pole were 3. According to the age, number of patients above 50 were 12 and below 50 were 12.

Conclusion

The above study clearly demonstrates that the high resistance suture materials can be used as a potential alternative or may even be better to the existing prevalent fixation of patella fractures with stainless steel and wires. FiberTape fixation presents a lot of advantages over the traditional stainless steel and wire fixation. Biomechanically, FiberTape has demonstrated tensile strength and stiffness equal to stainless steel and in certain specific parameters proved even more stronger than the stainless steel. Intraoperatively, lesser soft tissue dissection is needed for the patella fractures fixed with FiberTape. Hence, this procedure significantly reduces the intraoperative blood loss and also reduces the operative procedure time. The complete non-metallic fixation rules out the most important complication of metallic fixation, which is the symptomatic hardware. It also brought down the reoperation rates and the infection rates post-surgery considerably. Using a non-absorbable suture material also precludes the possibility of a second surgery needed for the implant exit. Hence, these high resistance suture materials like Fiber Wire and FiberTape can be used for efficient non-metallic fixation of patella on par with that of traditional metallic fixation with reduced complications and re-surgery rates.

References

1. Bulchoz RW, Heckman JD. Rockwood & Green's Fractures in Adults. Spanish 5th ed. Madrid, Spain: Marban Libros, 2007, 1776.
2. Galla M, Lobenhoffer P. Patella fractures. *Chirurg*. 2005; 76:987-997
3. Boström A. Fracture of the patella. A study of 422 patellar fractures. *Acta Orthop Scand*. 1972; 143(suppl):1-80.
4. Catalano JB, Iannaccone WM, Marczyk S. Open fractures of the patella: long-term functional outcome. *J Trauma*. 1995; 39:439-44.
5. Appel MH, Seigel H. Treatment of transverse fractures of the patella by arthroscopic percutaneous pinning. *Arthroscopy*. 1993; 9:119-21.
6. Smith ST, Cramer KE, Karges DE, Watson JT, Moed BR. Early complications in the operative treatment of patella fractures. *J Orthop Trauma* 1997; 11:183-87.
7. Gardner MJ, Griffith MH, Lawrence BD, Lorich DG. Complete exposure of the articular surface for fixation of patellar fractures. *J Orthop Trauma*. 2005; 19:118-23.
8. Chiang CC, Huang CK, Chen WM, Lin CF, Tzeng YH, Liu CL. Arthroscopically assisted percutaneous osteosynthesis of displaced transverse patellar fractures with figure-eight wiring through paired cannulated screws. *Arch Orthop Trauma Surg*. 2011; 131:949-54.
9. Wild M, Thelen S, Jungbluth P. Fixed-angle plates in

- patella fractures-a pilot cadaver study. *Eur J Med Res.* 2011; 16:41-46.
10. Reider B, Marshall J, Koslin B. The anterior aspect of the knee joint. *J Bone Joint Surg Am.* 1981; 63(A):351-56.
 11. Carpenter JE, Kasman R, Matthews LS. Fractures of the patella. *Instr Course Lect.* 1994; 43:97-108.
 12. Melvin JS, Mehta S. Patellar fractures in adults. *J Am Acad Orthop Surg.* 2011; 19:198-207.
 13. LeBrun CT, Langford JR, Sagi HC. Functional outcomes after operatively treated patella fractures. *J Orthop Trauma.* 2012; 26:422-26.
 14. Hoshino CM, Tran W, Tiberi JV. Complications following tension-band fixation of patellar fractures with cannulated screws compared with kirschner wires. *J Bone Joint Surg Am.* 2013; 95:653-59.
 15. Hughes SC, Stott PM, Hearnden AJ, Ripley LG. A new and effective tension-band braided polyester suture technique for transverse patellar fracture fixation. *Injury.* 2007; 38:212-22.
 16. Qi L, Chang C, Xin T. Double fixation of displaced patella fractures using bioabsorbable cannulated lag screws and braided polyester suture tension bands. *Injury.* 2011; 42:1116-20.
 17. Yotsumoto T, Nishikawa U, Ryoike K, Nozaki K, Uchio Y. Tension band fixation for treatment of patellar fracture: novel technique using a braided polyblend sutures and ring pins. *Injury.* 2009; 40:713-17.
 18. McGreal G, Reidy D, Joy A, Mahalingam K, Cashman. The biomechanical evaluation of polyester as a tension band for the internal fixation of patellar fractures. *J Med Eng Technol.* 1999; 23:53-56.
 19. Patel VR, Parks BG, Wang Y, Ebert FR, Jinnah H. Fixation of patella fractures with braided polyester suture: a biomechanical study. *Injury.* 2000; 31:1-6.
 20. Wright PB, Kosmopoulos V, Cote RE, Tayag TJ, Nana AD. FiberWire is superior in strength to stainless steel wire for tension band fixation of transverse patellar fractures. *Injury.* 2009; 40:1200-03.
 21. Kumar G, Mereddy PK, Hakkalamani S, Donnachie NJ. Implant removal following surgical stabilization of patella fracture. *Orthopedics* 2010; 12:33.
 22. Melvin JS, Mehta S. Patellar fractures in adults. *J Am Acad Orthop Surg.* 2011; 19:198-207.
 23. Gosal HS, Singh P, Field RE. Clinical experience of patellar fracture fixation using metal wire or nonabsorbable polyester-a study of 37 cases. *Injury.* 2001; 32:129-35.