Library Progress International *Print version ISSN 0970 1052*
Vol.44, No.1, January-June 2024: P.431-440 *Online version ISSN 2320 317X*

Original Article *Available online at www.bpasjournals.com*

Observations On The Outcome Of Perry's Load-Sharing Patello-Tibial Cable Augmentation In Comminuted Lower Pole Patellar Fractures Managed By Partial Patellectomy

Dr Seeyan M Shah[1], Dr Asif Nazir Baba[2], Dr.Azad Ahmad Shah, Dr Iftikhar H Wani, Dr. Naseem-ul-Gani , Dr Asif Nazir Baba[2]

[1,2] MS (Orthopaedics), Department of Othopaedics, Government Medical College, Srinagar
1seeyanshah@gmail.com,2drasifbaba@gmail.com,

How to cite this article: Seeyan M Shah, Asif Nazir Baba,Azad Ahmad Shah, Iftikhar H Wani, Naseem-ul-Gani ,Asif Nazir Baba (2024) Observations On The Outcome Of Perry's Load-Sharing Patello-Tibial Cable Augmentation In Comminuted Lower Pole Patellar Fractures Managed By Partial Patellectomy. *Library Progress International*, 44(1), 431-440.

Abstract

Introduction: Lower pole patellar fractures are usually avulsion fractures and have associated tears of the joint capsule with damage to the extensor mechanism. Due to this reason, most of these fractures require surgical treatment in the form of internal fixation or partial patellectomy. However, these methods have high rates of knee stiffness due to the need of prolonged immobilization after surgery. Partial patellectomy with patella-tibial cable augmentation using the modified Perry's technique aims to get better functional results by encouraging early knee movements.

Aim: The present prospective study was conducted to evaluate the results of partial patellectomy with patella-tibial cable augmentation using modified Perry's technique in comminuted lower pole patella fractures.

Materials and Methods: Thirty adult patients with fractures of the lower pole of the patella underwent load sharing patello-tibial cable augmentation after partial patellectomy and the results were noted.

Results: The results were evaluated using the Bostman score at 9 months and the score ranged from 23 to 30, with a mean score of 28.3. Twenty-one (70%) patients had an excellent result and nine (30%) patients had a good result with no patient having an unsatisfactory outcome. The most common complication encountered was the breakage of the wire (16.66%). The results of the study show the use of a load-sharing wire or cable offers significant advantages over conventional lower pole excision and cast application in terms of stability and rehabilitation.

Conclusion: Augmentation with patellotibial wire following partial patellectomy helps to shorten the rehabilitation time and return to work in patellar fractures avoiding cumbersome immobilisation.

Keywords: Lower pole patella, partial patellectomy, Perry's technique, load sharing cable,

Introduction

Patella is the largest sesamoid bone in the body. It increases the force of the quadriceps apparatus by improving the leverage and also protects the anterior articular surface of the distal femur. Patella fractures constitute about 1% of all fractures [(1)]. The inferior pole of the patella is devoid of articular surface coverage. Fractures of the inferior pole of the patella are less common injuries and account for 9.3% to 22.4% of all fractures of the patella [(2)]. Most of these fractures have associated tears of the joint capsule and damage to the extensor mechanism. Due to this reason most of these fractures require surgical treatment. The aim is to recreate the normal anatomy, patellar height, and patella-femoral relationship.

Many methods have been used to manage these fractures while retaining the patellar fragments. These include interwoven sutures and basket plate [(3)], rim plating technique [(4)], screw fixation with titanium cable or steel wire [(5)], angle-stable locking plates [(6)], and novel tension band and patellotibial tubercle cerclage [(7)]. However, most of these fractures are grossly comminuted and fixation is not always possible. Partial patellectomy with reattachment of the patellar tendon with transverse sutures is one of the oldest methods of managing such grossly comminuted fractures [(8)]. Partial patellectomy requires prolonged immobilization to protect the tendon repair from the powerful forces generated by the quadriceps mechanism.

Early mobilization of the knee, while at the same time protecting the repair, remains the key to achieving a good functional result. Perry et al described a patellotibial cable to augment the fractures of the patella managed with tension band wiring [(5)]. A modification of the same technique can be used to protect the tendon repair while at the same time starting early mobilization. It helps to transfer tensile loads directly from the patella to the tibia, bypassing the bone tendon reconstruction while at the same time allowing ROM. The present study was done to evaluate the functional results of patients with grossly comminuted inferior pole patella fractures using the modified Perry's technique.

Materials and Methods

The prospective study was conducted in the Hospital for Bone & Joint Surgery, the associated hospital of the Postgraduate Department of Orthopedics, Government Medical College, Srinagar, from May 2019 to June 2022. The hospital is the major trauma centre catering to the Kashmir valley and parts of Ladakh and Jammu region, covering a population of 8 million. The study included skeletally mature patients with comminuted inferior pole fractures of the patella which were not amenable to internal fixation. Inferior pole fractures were defined as fractures with extra-articular involvement with proximal extension of less than half of the patella on the superficial surface. Patients with ipsilateral or contralateral fractures of the femur, tibia, ankle, or dislocation of the knee; pelvic or spinal trauma; open fractures or previous patella surgery were excluded from the study. The selected patients were managed with partial patellectomy and modified Perry's procedure and were followed up for a minimum of 9 months.

Surgical Technique

The fracture was approached through a longitudinal midline incision and the joint was cleared of loose fragments of bone and cartilage **(Fig 1)**. The edges of the tendon were trimmed, taking care to preserve any small flecks of bone within the patellar tendon and the articular edge of the proximal fragment was trimmed and smoothened. Transosseous reattachment was done with 3 parallel tunnels using No. 5 Ethibond. Transverse 2 mm holes were drilled transversely across the proximal pole of the patella and the tibial tubercle. The knee was hyperextended to relax the patellar tendon. A 16G stainless steel wire was passed through each of the drill holes and making sure it crossed anterior to the patella tendon while forming a figure-of-eight configuration **(Fig 2)**.

Patients were put in a hinged long knee brace and allowed to bear weight as tolerated. Passive ROM was started on the first post-op day up to 40° with the knee protected by a hinged long knee brace. The passive ROM was gradually increased and by the 4-5th Post-op day, about 90° was achieved. When passive ROM beyond 90° was achieved, active movements were started.

Patients were followed regularly, weekly for the first month, and then monthly. At each follow-up, patients were examined regarding their range of motion and any complications. Wires were removed after 3 months under local anesthesia . The final follow-up was done at 9 months using the Bostman score [(8)] which includes ROM, pain, impact on work, thigh atrophy, assistance in walking, effusion, history of giving way, and stair-climbing **(Table 1)**. The results were classified into three groups- excellent (score 28-30), good (score 20-27), and unsatisfactory (score less than 20).

Results

A total of 32 adult patients fulfilling the inclusion criteria were managed with the modified Perry's technique. Two patients were lost to follow-up and the remaining 30 patients completed the follow-up and were included in the study results. There were 19 males and 11 females in the study. The age of the patients ranged from 20 years to 58 years, with an average age of 36. 2 years. The right side was involved in 17 patients and the left side in 13 patients.

The most common mechanism of injury was road traffic accident (17 patients) followed by falls on the ground (11 patients). All the patients achieved more than 90^o range of motion within the first week. The final ROM ranged from 115^o to 145^o. The Bostman score [(8)] calculated at 9 months ranged from 23 to 30, with a mean score of 28.3 **[Table 1]**. Overall, 21 (70%) patients had excellent results, and 9 (30%) patients had good results. No patient had an unsatisfactory result. The most common complication was the breakage of the wire **(Fig 6)**. Five patients (16.66%) presented with a broken wire before 3 months of the procedure, probably due to aggressive physiotherapy. All of them were males and aged less than 40 years. However, all these patients were functionally excellent with no complications. Two patients had pain that was related to the load-sharing cable. The pain was not severe enough to inhibit rehabilitation and the cable was removed as an outpatient procedure.

One patient developed a superficial infection which was managed with antibiotics and dressings. This delayed his physiotherapy but he achieved a good result at the final follow-up. One patient developed stiffness but responded well to physiotherapy and regained full ROM. None of the patients developed extensor lag or had patella baja on radiographs. One patient developed a re-fracture of the patella following a fall on his knee.

DISCUSSION

For a normal unassisted gait, the presence of a functional extensor mechanism is crucial which is disrupted in case of lower pole patella fractures. Intact patella improves quadriceps mechanism by increasing effective lever arm [9]. Preservation of comminuted inferior pole by osteosynthesis often fails because of multiple fragments and lack of adequate stability of implant [10].Such fractures have been traditionally dealt with by inferior pole excision (partial patellectomy) and repair of patellar tendon to the rest of patella by transosseous sutures [11]. But due to strong tensile forces generated by quadriceps mechanism, immediate and aggressive postoperative rehabilitation is not possible as tendon bone repair is inherently too weak to sustain such tensile forces. Therefore, either patient tends to develop some sort of loss of range of motion or rehabilitation is delayed with increased expenditure and loss of work days.

We used a cable to share the tensile load across reduced and internally stabilized patellar fractures. Our technique is an amalgam of techniques described previously. One similar technique described by **McLaughlin** [12] involved patella-to-tibia fixation using a wire and a bolt which he used for patellar ligament repairs. **Konchada et al** [13] in their prospective study treated comminuted inferior pole fractures with partial patellectomy and transosseous suturing of patellar tendon with remaining patella. They didn’t use any protective patellotibial cable. Although their results were similar to ours but duration of rehabilitation was almost double. **Levy et al.** [14] described a technique involving a Dacron vascular graft to share the load across patellar ligament repairs.

In another technique**, McConnell** [15] replaced the patellar tendon functionally and called it a “temporary patellar tendon substitution technique” for patellar fractures. In this technique, the wire extending from the proximal pole of the patella to the tibial tubercle also functions to maintain the reduction of the fragments, and the wire is not crossed over the anterior aspect of the patellar tendon causing problems with flexion of the knee as the wire gets displaced posteriorly, thus preventing the wire from sharing the load across the fracture site.

Kastelec and Vaselco [16] in their comparative study found basket plate fixation of inferior pole fractures had better results than partial patellectomy probably because of prolonged postoperative immobilisation. By using protective patellotibial cable, prolonged immobilisation is avoided and results comparable to basket plate fixation can be achieved with lesser cost of implant. **Heim and Pfeiffer** [17] described a similar technique for fractures of the inferior pole of the patella but the wire is described as functioning as a tension band and not as a load-sharing device.

Our technique of using the load-sharing cable isolates the patella and patellar ligament from extrinsic tensile loads like the risk of distraction during straight leg raising by the patient and greatly decreases the need for extremely stable fixation in these fractures allowing the surgeon to fix together small pieces in comminuted fractures and stabilize them with inter-fragmentary fixation, which would otherwise have failed. The advantage of the load-sharing cable is that kinking with a resultant decrease in tensile strength does not occur.

Some disadvantages of our technique of using a load-sharing cable which are well documented but we didn't encounter include weakening of the patella and patellar ligament due to stress shielding. We have not seen the weakening of the patella or patellar ligament that has led to failure. Another important and relatively expected complication is patellofemoral pain secondary to the patella-baja produced by tightening of the cable. Patients with patella baja can have limited knee range of motion, anterior knee pain, significant weakness with active knee extension, and an extensor lag.[18]

In our study, persistent patellofemoral pain has not been encountered, probably because the patella baja produced by this technique was minimal due to minimal lenghtening done of tendon intra-operatively.

All patients underwent a vigorous rehabilitation program, which included immediate postoperative continuous passive motion, followed by active range of motion and weight bearing as tolerated.

Pain due to impinging load sharing cable is probably because the cable is crossed over the patellar ligament and can cause patellar tendonitis. We believe that the cable must be crossed anteriorly over the patellar ligament to prevent its posterior displacement with knee flexion.

The use of a load-sharing wire or cable offers three significant advantages: (a) Adjunctive cast application is unnecessary. (b) The surgeon can concentrate on an anatomic reduction of the patellar fracture, with less concern for a loss of fixation. (c) It allows early aggressive rehabilitation of these patients.

Conclusion

Augmentation with patellotibial wire following partial patellectomy helps to shorten the rehabilitation time and return to work in patellar fractures. This procedure helps to avoid the cumbersome cast immobilisation for prolonged time in such patients and helps to achieve excellent results in majority of patients with minimal documented complications.

REFERENCES

1 Bostrom A. Fracture of the patella. A study of 422 patellar fractures. Acta Orthop Scand Suppl. 1972;143:1–80.

2 Andrews JR, Hughston JC: Treatment of patellar fractures by partial patellectomy. South Med J 70:809-817, 1977

3. Matejcˇic´ A, et al. Internal fixation of patellar apex fractures with the basket plate: 25 years of experience. Injury (2015)

4. He QF, Pan GB, Yu ZF, Yao WX, Zhu LL, Luo CF, et al. Novel rim plating technique for treatment of the inferior pole fracture of the patella. Orthop Surg. 2021;13:651–8.

5. Perry CR, Mccarthy JA, Kain CC, Pearson RL. Patellar fixation protected with a load-sharing cable. J Orthop Trauma. 1988;2(3):234–40.

6. Moore TB, Sampathi BR, Zamorano DP, Tynan MC, Scolaro JA. Fixed angle plate fixation of comminuted patellar fractures. Injury. 2018;49:1203–7.

7. Zhang ZS, Li PF, Zhou F, Tian Y, Ji HQ, Guo Y, et al. Comparison of a novel tension band and Patellotibial tubercle Cerclage in the treatment of comminuted fractures of inferior pole of the patella. Orthop Surg. 2020;12:224–32.

8. Bostman O, Kiviluoto O, Nirhamo J. Comminuted displaced Fractures of the patella. Injury. 1981;13:196-202

9. Nicolas SB, Chris Casstevens, Michael TArchdeacon, et al. Fix It or Discard It? A Retrospective Analysis of Functional Outcomes After Surgically Treated Patella Fractures Comparing ORIF With Partial Patellectomy. J Orthop Trauma 2015: 29(2); 80-84.

10. Camille Connelly, MD, Nathan Monaco, MD, John D. Wyrick, MD, and Theodore T. Le,Fix It or Discard It? A Retrospective Analysis of Functional Outcomes After Surgically Treated Patella Fractures Comparing ORIF With Partial Patellectomy

11. Scolaro J, Bernstein J, Ahn J. Patellar fractures. Clin Orthop Relat Res. 2011; 469(4):1213-5. Patellar fractures

McLaughlin HL: Repair of major tendon ruptures by buried removable suture. Am J Surg 74:758-764, 1947

12. Konchada S, Mishra D, Sinha VK, Pradhan S. Management of comminuted extraarticular inferior pole patella fractures with partial patellectomy and patellar tendon repair by transosseous sutures. International Journal of Medical Science and Public Health. 2017;6(11):1578–1583.

13. Levy M, Goldstein J, Rosner M: Amethod ofrepair for quadriceps tendon or patellar ligament (tendon) ruptures withoutcast immobilization. Clin Orthop 218:297-301, 1987

14. McConnell BE: An operation for fractures of the patella us- ing the temporary patellar tendon substitution technic. South Med J64:1:87-89, 1971

15. Kastelec M, Veselko M. Inferior patellar pole avulsion fractures: Osteosynthesis compared with pole resection. J Bone Joint Surg Am. 2004;86-A(4):696-701.

16. Heim U, Pfeiffer KM: Small Fragment Set Manual, ed. 2. Berlin-Heidelberg-New York-Tokyo, Springer-Verlag, 1981.

17. Barth KA, Strickland SM. Surgical Treatment of Iatrogenic Patella Baja. Curr Rev Musculoskelet Med. 2022 Dec;15(6):673-679. doi: 10.1007/s12178-022-09806-y. Epub 2022 Nov 29. PMID: 36445621; PMCID: PMC9789255.

PICTURES

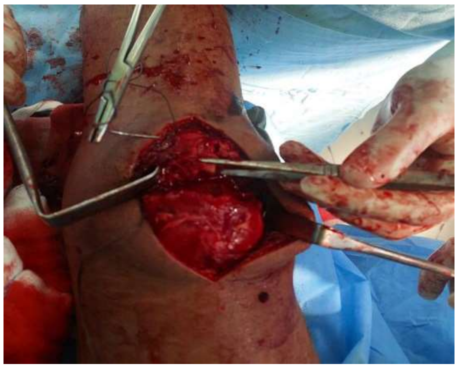

Fig 1 Patellar tendon re-attached to the distal end of the patella by trans-osseous sutures using Ethibond.

Fig 2 Patellotibial wire bypassing repair site of the tendon.

Fig 3 Lateral view radiograph of the knee showing lower pole Patella Fracture

Fig 4 Anteroposterior Knee radiograph of the same patient

Fig 5 Immediate Post-operative AP and Lateral Knee radiograph showing Patello-tibial cable augmentation.

Fig 6 Follow up radiographs showing breakage of wires at 2 and 1 month follow –up respectively.

Patient 1

Fig: Anteroposterior and Lateral radiograph of the patient showing lower pole patella fracture

Fig: Immediate post-op radiographs of the same patient

Fig: Follow-up radiograph showing cable breakage at 2 months

Fig: Clinical picture showing full ROM at 9 months follow-up

Patient 2

Fig: Anteroposterior and Lateral radiograph of the patient showing lower pole patella fracture

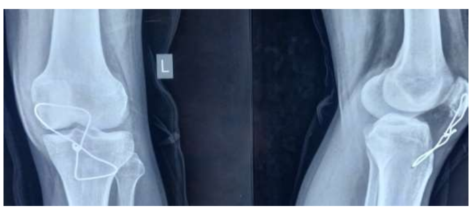

Fig: Antero-posterior and Lateral radiograph of the same patient at 1 month follow up

Fig: Clinical picture showing full ROM at 9 months follow-up

Table 1: Patient Details

Case no.	Age (years)	Sex	Side of Injury	Mode of Trauma	Time to surgery (Days)	Complications	Bostman's Score at 3 Months	Final outcome
1	25	M	R	RTA	3		28	Excellent
2	28	M	R	Fall	3		29	Excellent
3	23	M	R	RTA	5		30	Excellent
4	37	F	L	Direct hit	10	Stiffness	27	Good
5	35	M	R	Fall	3		27	Good
6	22	F	R	RTA	3	Wound infection	28	Excellent
7	29	M	R	Fall	5		29	Excellent
8	30	M	L	RTA	3	Breakage of wire	30	Excellent
9	24	M	R	RTA	5		30	Excellent
10	34	M	R	Fall	3		29	Excellent
11	39	F	L	RTA	5	Impingement	23	Good
12	50	M	R	RTA	3		29	Excellent
13	38	M	L	Fall	3	Breakage of wire	29	Excellent
14	56	F	L	RTA	10		26	Good
15	33	M	R	RTA	3		29	Excellent
16	28	M	L	RTA	6		27	Good
17	37	M	R	Fall	3	Breakage of wire	29	Excellent
18	41	M	L	RTA	3		29	Excellent
19	32	F	R	RTA	3		29	Excellent
20	35	F	R	Assault	4		30	Excellent
21	24	M	R	Fall	6	Impingement	27	Good
22	47	F	L	RTA	4		29	Excellent
23	39	M	L	Fall	3	Breakage of wire	30	Excellent
24	38	M	R	Fall	3		29	Excellent
25	34	F	L	RTA	3		27	Good
26	25	F	R	RTA	3		29	Excellent

27	24	M	L	Fall	3		29	Excellent
28	36	F	L	RTA	4		25	Good
29	32	M	L	Fall	6	Breakage of wire	30	Excellent
30	40	F	R	RTA	3		27	Good