Original Article

Patellar nonunions: Comparison of various surgical methods of treatment

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Abstract

Background: Nonunion of patella is an uncommon entity prevalent more commonly in developing countries. Many of them have a functional knee joint and only those with a wide gap and failed extensor mechanism need surgery. We report an analysis of nonunion of fracture patella treated by 3 surgical method.

Materials and Methods: 35 patients of nonunion/delayed union of patella with significant gap and failure of quadriceps mechanism, underwent three different methods surgically: 1) V–Y plasty and tension band wiring (n=10); 2) patellar traction followed by tension band wiring without V–Y plasty (n=15); and 3) patellar traction followed by partial or total patellectomy (n=10). We compared the results of the treatment in terms of Knee Society Score (KSS), Melbourne patella score, time of union, pain, range of movement, quadriceps power, and ability to do daily activities and complications encountered.

Results: The 15 cases of patellar traction followed by tension band wiring showed the best results in terms of time to return to normal activities and complications encountered. Cases with patellectomy showed the next best results but they had a longer period of rehabilitation with ultimately lesser patient satisfaction. V–Y plasty gave the worst results both in complication rate and function return.

Conclusion: Preoperative patellar traction followed by tension band wiring is a good procedure giving better results than either patellectomy or V–Y plasty.

Key words: Nonunion patella, patellar traction, V–Y plasty, patellectomy

Introduction

A patella fracture is genrally treated by internal fixation, hence infrequently goes into nonunion. Nonunion patella is not so uncommon in developing countries. Some fibrosis may occur between the fracture fragments and patient may become functional with a less than optimal quadriceps mechanism and may never seek treatment. But sometimes the gap, created by the pull of the two parts of the transverse fracture patella by the quadriceps above, is too large for any fibrous union. This leads to a failure of the quadriceps mechanism which is the reason why patients with nonunion of patella seek treatment.[1,2]

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The strong quadriceps muscle pulls up the proximal fragment of the patella leading to a functional shortening of the quadriceps mechanism and contracture. Hence in nonunion of patella open reduction and internal fixation by tension band wiring poses difficulty. The options are few and none of them gives a very good result. Patellectomy is the commonest treatment practiced, but difficult repair of quadriceps mechanism leads to less than full range of functional movement. The return to activities of daily life (ADL) is delayed. Patellectomy in young patients puts them at the risk of early degenerative arthritis of the knee joint. Therefore, we were inclined to perform osteosynthesis. We performed both TBW wherever possible and partial patellectomy where the distal fragment was too small. We also did total patellectomy in some cases and compared the results of the three techniques. We report a retrospective analysis of these 3 different surgical methods for the management of nonunion of fracture patella

Materials and Methods

We operated 41 cases of nonunions of patella, however only 35 cases could be followedup hence included in the present analysis. All patients were below 60 years (range 18–56 years) of age and were engaged in an active daily

life before the fracture and had no concomitant fracture or ligamentous laxity around the knee. We included only two part non communited transverse fractures in our study. The mode of injury was an indirect trauma in 32 cases and direct in the rest of the cases. The average time of presentation was 5 months (range 2–23 months) after trauma. Majority of the patients (25/35) were males and left side (20/35) was involved. Cases with any associated fractures of the knee or open fractures were not considered for this study. Fourteen of them had been treated primarily by osteopaths, 13 with a plaster cast, while the rest had received no treatment at all. None of them had received any surgical intervention at any point of time. The average gap at presentation was 5 cm (range 3-13 cm).

These cases were treated with three different methods: group 1) The first 10 cases with tension band wiring with V–Y plasty; group 2) the next 15 cases with patellar traction followed by tension band wiring without V–Y plasty; and group 3) 10 cases, where articular congruence could not be achieved intraoperatively, treated with patellar traction followed by partial or total patellectomy.

We compared the results of the treatment in terms of time of union, pain, range of movement, quadriceps power, and ability to do daily activities, Knee Society Score (KSS), Melbourne patella score, and complications encountered. Followup with check X–rays was done at 4,8,12 and then every 3 months. Union was assessed by a separate radiologist who reported the status based on the serial X–rays. Minimum followup period for evaluation is 2 years and average followup period is 3.4 years (range - 2 to 6.5 years).

Operative procedure

Group 1 (n=10): In our first few cases, while trying to fix the fracture without preoperative traction, we encountered difficulty in reducing the fracture fragments because of the contracture of the quadriceps. It was only after tissue release and an extensive V–Y plasty [Figure 1] that we could bring the displaced fragments close enough to sustain an SS wire TBW. The limb was immobilized in a long knee brace for 4 weeks, followed by gradual rehabilitation.

Group 2 (n=15): We applied preoperative patellar traction. A 3.5-mm Steinman pin was inserted with the help of a hand drill very carefully in the mid substance of the upper pole fragment of patella under local anesthesia. This was done under C-Arm guidance or without it in experienced hands. If the upper pole was too small or osteoporotic, the pin could also be given just above and posterior to the upper pole [Figure 2]. Then, 5 lb traction was applied to this pin which was increased gradually up to 10 lb. This was done over 5–21 days during which the

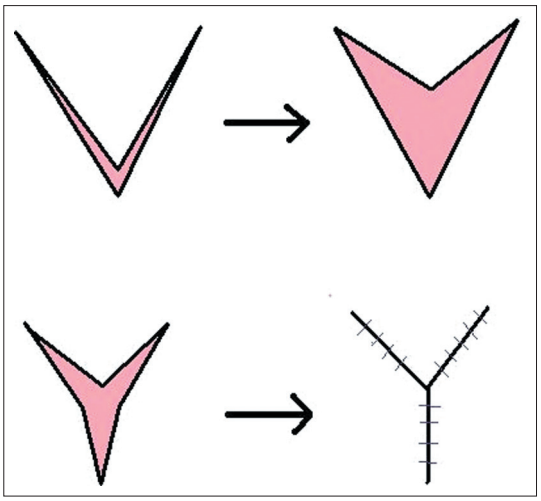

Figure 1: Diagram representing V–Y plasty

patient did active knee bending to increase the quadriceps power. Proper pin tract care was necessary. Average gap of patellar fragments at presentation was 5 cm (range 3–12 cm) which was comparable in all three groups. Traction was removed when the palpable gap between the two fragments, in extension, was less than 1 cm [Figure 3]. The average duration of traction was 8 days (range 5–18 days).

The pin was removed just before the operation and a tension band wiring with 2 K wires and one figure of 8 stainless steel wire was done. No bone grafting was used in any of the procedures. Freshening of the fracture ends provided a healthy bleeding cancellous surface for good union in all cases. Due to the lengthening of the quadriceps, easy apposition of the extensor retinaculam was possible using standard suturing techniques. Active knee bending and gradual weight bearing was given after 48 h or when the patient was able to do so.

Group 3 (n=10): When the distal part of the fracture had almost no bone left (six cases), we opted for a partial patellectomy. When there was a gross degeneration of the articular surface or a large articular gap due to irregular bone destruction which could not be managed by reshaping the bone, we opted for a patellectomy (four cases). Both these procedures were done only after the patient had been on patellar traction regimen. In these cases, active knee bending was allowed only after 6 weeks, along with weight bearing.

Results

On a subjective scale of operative difficulty, graded as 0 for fresh fractures and 3 as most difficult. V-Y plasty with TBW was graded as 3 while patellar traction followed by TBW and patellectomy were graded as 1. Average range of motion (ROM) at 3 months postoperative, average time

Figure 2: Application of patellar traction: (a) Initial insertion with hand; (b) insertion with drill; (c) after Insertion; (d) with the traction set; (e) X-ray with pin *in situ*; and (f) on-bed traction

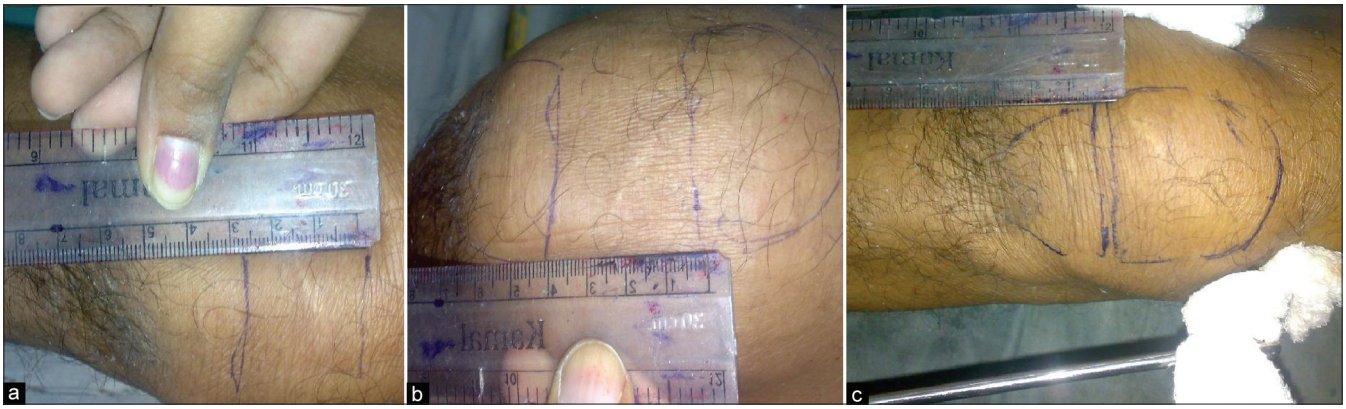

Figure 3: Patellar gap (a) extension – 3 cm; (b) flexion – 4 cm (c) <1 cm 5 days post traction

to return to daily activities, average time of union, average increase in KSS and Melbourne patella score 6 month postoperative were recorded and displayed in Table 1 and Figures 4 and 5.

Four major complications Nonunion, Infection, persistent pain, and extensor lag have been compared for the three groups and presented in the table below [Table 2].

Table 1: Comparison of results of three procedures

	Avg ROM 1 year postoperative	Avg time for return to ADL (Months)	Avg time of union (Months)	Avg increase in KSS 1 yr postoperative	Avg increase in MPS 1 yr postoperative
V – Y plasty and TBW (n=10)	80	4.2	5.5	30	12
Patellar traction and TBW (n=15)	130	1	5.3	52	24
Patellectomy (n=10)	110	6	0	42	18
*Fresh fracture TBW (n=70)	130	1	2.5	0	0

Avg= average, ROM= range of motion, KSS= Knee society score, MPS=Melbourne patella score, TBW=Tension band wiring, *Separate cases, operated by the same surgeon, but not a part of this study

Table 2: Complications encountered

	Nonunion (%)	Infection (%)	Persistent pain (%)	Extensor lag (%)
V – Y plasty with TWB (10)	2 (20)	5 (50)	5 (50)	4 (40)
Patellar traction with TWB (15)	-	1 (6.660)	1 (6.66)	1 (6.660)
Patellectomy (10)	-	-	2 (20)	4 (40)

TBW=Tension band wiring

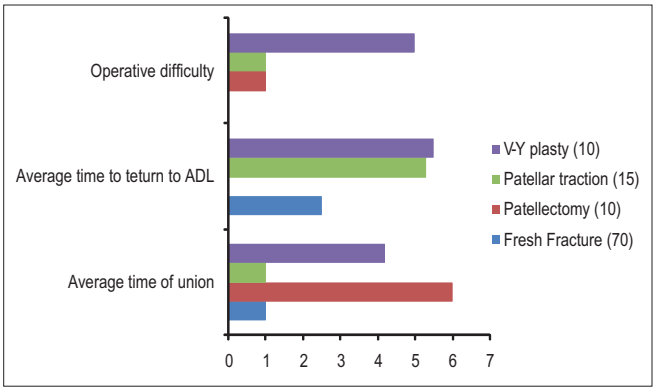

Figure 4: The bar diagram shows short term results

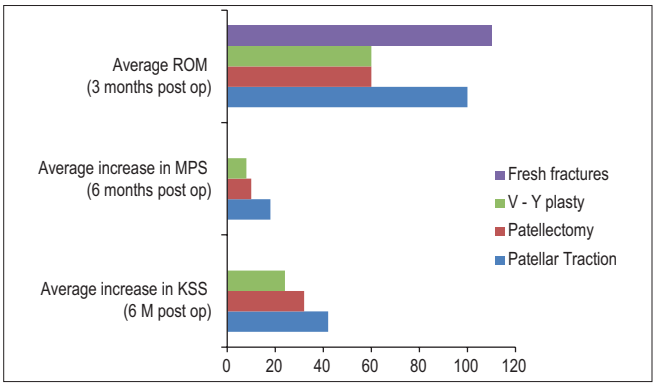

Figure 5: The bar diagram shows long term results

The 15 cases of patellar traction followed by tension band wiring showed better results in terms of range of motion (130°) and time to return to normal activities (1 month) than the other 2 groups [Table 1, Figure 6]. The operative difficulty was also very less (Grade I) as compared to V-Y Plasty (Grade III), as this required no extra soft tissue release other than fracture site clearance. There were two cases of nonunion in the V–Y plasty group and none in the patellar traction group. The exact cause of the nonunion could not be determined as there was infection as a confounding factor in both these cases. The average time of union (excluding the cases of nonunion) was almost similar in both the techniques (5.5 months for V- Y plasty and 5.3 for patellar traction group).

Patellar traction followed by patellectomy [Figure 7] (partial and total) was technically not difficult but led to prolonged periods of immobilization and subsequently longer time of rehabilitation (6 months as compared to 1 month for patellar traction group). Therefore, the average period of return to daily activities was six times longer (6 months) as compared to the patellar traction cases(1 month). Also, the postoperative range of movement at 1 year was significantly less (110°) [Figure 5] as compared to the patellar traction group (130°). Other long term complications for patellectomy were persistent pain (20%) and extensor lag (40%), which were significantly higher than patellar traction with TBW group (6.66% for both) [Table 2]. All patients with an extensor lag had quadriceps strength of grade 4, while the rest all had a grade 5 power. We found extensor lag as a better functional measurement of quadriceps function than its power for this study. Since most patients were pain free before the operation, the presence of persistent pain itself was a significant finding for us. All patients with persistent pain rated their pain as annoying to uncomfortable [Visual Analogue Scale (VAS) 2–4], but none rated it as dreadful (VAS 6).

Tension band wiring with V–Y plasty was the most difficult operation primarily because bringing the fragment together without preoperative traction was tedious and unpredictable [Figure 8]. This led to increased operative time and soft tissue damage, and complications like wound dehiscence, exposing the quadriceps in 50% cases [Figure 6], and persistent nonunion in 20% cases [Table 2]. The postoperative ROM (80°) and time for return to ADL (4.2 months) were also poor although the time of union (5.5 months) was similar to that of the patellar traction group (5.3 months), although this time was more than double of a fresh fracture (2.5 months) [Table 1, Figure 5]. There was also persistent pain (50%) and extensor lag (40%) in a significant number of these cases which may again be attributed to infection in most cases [Table 2]. The increase in the KSS and Melbourne patella score at 1 year

Figure 6: Patellar traction + TBW group (a) Preoperative X-ray shows nonunion of patella (b) postoperative X-rays after TBW and (c) after union with implant removal at followup (d) clinical photograph shows scar (e) extension; (f) flexion; (g) squatting; (h) crossed leg sitting

Figure 7: Results of patellar traction followed by patellectomy: (a) preoperative X-ray with almost no distal fragment; (b) patellar traction *in situ*; (c) partial patellectomy by Perry *et al.*'s technique; (d) postoperative flexion; and (e) extension with extensor lag

Figure 8: Results of V–Y plasty + TBW: (a) Pre-op X-ray; (b) post-op X-ray after TBW; (c) X-ray after union and implant removal; (d) scar with discharging sinus; (e) flexion; (f) extension

postoperative was also consistent with other findings. The KSS increased by an average of 52 points for the patellar traction group, while the increase was only 30 and 42 points for the V–Y plasty and patellectomy group, respectively. Similarly the average Melbourne patellar score increased by 24 points, 12 points, and 18 points for the three groups, respectively.

Discussion

Delayed presentation of fracture patella has a reported incidence of 2.4%,[3] but very few of them actually have a functional disability.[1] Noncompliance, delayed care, geographical inaccessibility to care, and financial constraints are the various reasons why this rare condition is still common in developing countries.[2,4,5] There is no consensus on the standard treatment of such fractures. Nonsurgical management is one option, but may not always lead to good results[2] in terms of function return and union rate. Surgical options include a single stage operation in the form of V–Y plasty followed by either osteosynthesis or patellectomy.[6,7] All these studies vote in favour of surgical procedure and report good to excellent result, though none of them compare the procedure with a two staged procedure. We, on the other hand, got disappointing results for single staged procedures. The staged procedures which make use of Ilizarov fixators[4] or JESS fixators[7] for quadriceps lengthening have also been described. But both of them are single case reports. Dhar *et al*. did a patellectomy after removing the Ilizarov fixator. We doubt the utility of the expensive external compression device systems when the same can be achieved by a simple pin traction. In the single case described by Singhal *et al*.,[12] there was pin loosening in two of the four pins used for the procedure. We believe that one pin instead of four helps not only in reducing the chance of infection but also in reducing the chance of weakening the bone, especially if one fragment is smaller than the other. Furthermore, in both these techniques, the distal pins are inserted in the distal fragment which applies equal pressure on the patellar tendon which is not the tissue at fault.[6,8] We doubt the pliability of this tissue and expect the complication of rupture of the already friable patellar tendon if excessive force is applied. With gravity providing the counter force in the patellar traction, there is never a chance of patellar tendon rupture. Nathan *et al*.[9] systematically reviewed five articles in their recent publication and found that surgical management in the form of TBW is the best management for high demand patients. The article does not discuss or compare any two staged procedure

The patellectomy which is the most commonly prescribed treatment always comes with the inherent problem of a longer period of rehabilitation and a less than functional range of motion.[9] This was true for our cases also. Another problem was persistent pain especially during the initiation

of extension. It is also common knowledge that patellectomy leads to an overloaded joint biomechanically. Patellectomy essentially decreases the length of lever arm of quadriceps mechanism, leading to undue stress on the knee joint during extension.[10] This leads to early degenerative changes and is therefore a relative contraindication for young individuals.[10,11]

The problem with osteosynthesis in these cases is not the nonunion itself, but rather the quadriceps contracture leading to a wide separation of the fracture fragments. Apposition of these two fragments is very difficult. Various techniques have been described to sort out this problem. V–Y plasty is the commonest practiced technique for such conditions and we also tried this technique with variable results. The first problem that we faced with this technique was that there was no preoperative means of judging the amount of contracture and fibrosis inside when we opened the joint. Thus, we could not judge in one go the exact length of V–Y plasty needed, which is all so important for a successful V–Y plasty. We tried to make a rough judgment on the preoperative patellar gap, but it was often misleading. Finally, we reached the conclusion that only preoperative decisions, are plausible. This leads to increased operative time and postoperative complications. Also, the extensive soft tissue release not only weakened the already compromised quadriceps but also led to increased chances of infection. Another complication that we encountered was a gap nonunion.

To obtain better results, we applied preoperative patellar traction to bring the proximal fragment down and achieve lengthening of quadriceps contracture.

We were concerned about the lengthening capacity of the contracted quadriceps with this kind of a traction and also about the pin holding capacity of the patella. Pin tract infection and patellar tracking were other concerns. Our results in this study showed that the quadriceps respond extremely favourably to traction. We even managed one case with an extension gap of 12 cm and another open fracture with infection, nonunion and extensive fibrosis with this technique. There was one case of pin tract infection in a diabetic patient, for which the pin was removed immediately. The operation was done 7 days after the pin removal. We were apprehensive about the recontracture of the quadriceps, but to our surprise, the patella came down easily and there were no peroperative or postoperative problems with that case. No pin cut through or patellar mal tracking occurred in any of our cases. In fact, the results were so satisfactory that there was almost no extra release in any of the cases, and except for the freshening of the fracture site and excision of fibrosis at the gap nonunion site, the tension band wiring was as easy as a primary case.

The postoperative results of this technique reflected on our peroperative evaluation. The rehabilitation was as quick as that of fresh fractures in large series of Carpenter *et al*[12] and Benjamin *et al.*[13] Final range of movement and return to ADL were much better than in the other two techniques. They are also comparable to primary fixation of fresh patellar fractures.[14-16]

Patellectomy is a technically easier operation, but it has a major disadvantage of prolonged rehabilitation. Also, it is contraindicated in younger individuals. Tension band wiring has this distinct advantage of immediate post-op rehabilitation, but TBW only works if the quadriceps mechanism is restored near to its normal anatomy, which was almost never possible with V–Y plasty, leading to the failures. Patellar traction gives us a simple technique with which we avoid these complications and leads to good results uniformly. Even 1 month of patellar traction is not an added morbidity as the active knee bending while on traction serves to rehabilitate the weak quadriceps. We attribute the excellent results in part to this rehabilitation also.

Therefore, we conclude that preoperative patellar traction followed by patellar osteosynthesis serves as the best option for these cases of delayed presentation/nonunion cases in all aspects.

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