IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 7 Ver. 5 (July. 2018), PP 53-57
www.iosrjournals.org

Partial Patellectomy: A study on functional out come

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Abstract: *Fractures of the patella are one of the common fractures and they constitute almost 1% of all skeletal injuries, resulting from either direct or indirect trauma. Because of the subcutaneous anterior location, the biomechanical function and the high level of force transmission during extension and flexion, stable reconstruction of patellar fractures continues to represent a major surgical challenge. The poor outcomes quantified during the follow up can persist. The study group is of fractures of patella in which comminution of the fragments has been the prime inclusion criterion in 58 cases. The inclusion criterion are fracture patella of any pattern with comminuted fragments, normal pre injury status of the knee joint, normal skin on inspection. The exclusion criterion are compound fracture, associated fractures, pre existing arthritis of the knee. When partial patellectomy is chosen, as much of the patella as possible should be salvaged. Larger pieces can be secured together with interfragmentary screws to increase the size of the patellar remnant.*
Keywords*– Patella fracture, distal pole comminution, partial patellectomy, functional outcome.*

Date of Submission: 29-06-2018 Date of acceptance: 14-07-2018

I. Introduction

Fractures of the patella are one of the common fractures and they constitute almost 1% of all skeletal injuries, resulting from either direct or indirect trauma. The location of the patella makes it vulnerable to direct trauma. Injuries such as the knee striking the dashboard of a motor vehicle or from a fall on the anterior aspect of the knee can easily cause a fracture patella. These injuries often are grossly comminuted or displaced. Sometimes these fractures are associated with chondral injuries of distal femur and retinacular expansions. There is an indirect mechanism to the injuries, where in a violent contraction of the quadriceps with knee in flexion can result in a fracture. These fractures present in different patterns, like transverse, vertical, comminuted undisplaced and comminuted displaced. Most patellar fractures are caused by a combination of direct and indirect forces. The intact patella increases the leverage and efficiency of the extensor mechanism and articulates with the femoral trochlea. The most significant effects of fracture of the patella are loss of continuity of the extensor mechanism of the knee and potential incongruity of the patellofemoral articulation. Additional injuries to the adjacent bones are rare but can affect the articular surface of the distal femur. The most frequent indirect mechanism is a fall on the feet with eccentrically contraction of the quadriceps muscle.

Anatomic reduction and fixation with a tension-band technique is associated with the best outcomes; however, symptomatic hardware is a frequent complication. Open fractures are associated with more complications than closed fractures. These complications can be mitigated with timely debridement, irrigation, and internal fixation[(1)] .

Epidemiologic studies demonstrated that the incidence in men is twice as high as in women. Because of the subcutaneous anterior location, the biomechanical function and the high level of force transmission during extension and flexion, stable reconstruction of patellar fractures continues to represent a major surgical challenge. The majority of cases are caused by direct injury mechanism. Closed fractures of the patella represent the vast majority of this injury. However, up to 7% of the cases result in open fractures. The underlying mechanisms of open fractures are mostly high velocity accidents. These can result in devastating soft tissue conditions with comminuted fractures as well as additional ruptures of the reserve extensor mechanism. Open patellar fractures are associated with multiple accompanying injuries, namely fractures of the femur or acetabulum, traumatic dislocation of the hip joint or disruption of knee ligaments.

The patella is the largest sesamoid bone and is situated in the quadriceps tendon. It is one of the few bones without a periosteal surrounding. The proximal three-fourths of the patella are covered by a thick layer of cartilage, whereas the remaining distal pole is not part of the articular congruency. The adjacent quadriceps muscle consists of four muscles, of which the rectus femoris is the longest and most superficial. The deep layer

of the quadriceps tendon inserts at the proximal basis of the patella whereas the superficial fibers extend over the patella itself continuously to the tibial tuberosity.

The fascia lata spreads over the anterior surface of the knee and forms the patellar retinaculum along with aponeurotic fibers from lateral and medial vastus muscle. Deep transverse fibers of the joint capsule, known as the patellofemoral ligaments spanning from the patella to the femoral epicondyles also contribute to the patellar retinaculum . These fibers can help in some degree of active extension even in presence of a patellar fracture this is called as reserve extensor mechanism. Depending on the severity and the resistance of the extensor mechanism, either the patella or the adjacent tendons fail[(2)].

There are various scoring systems to measure the outcome after patella fracture like Knee Outcome Survey-Activities of Daily Living Scale SF-36 physical component score, SF-36 mental component , Short Musculoskeletal Function Assessment (SMFA) Function Index, or SMFA Bother Index. Various studies demonstrate that functional impairment persists after operative treatment of patella fractures. Both ORIF and PP demonstrated similar final range of motion, functional scores, and complication rates[(3)].Thus the poor outcomes quantified during the followup can persist :At a mean of 6.5 years after operative treatment for patella fractures, significant symptomatic complaints and functional deficits persist based on validated outcome measures as well as objective physical evaluations. The complexity associated with treating this common fracture and should help guide surgeons to better counsel patients on the expected long-term function after operative treatment of patella fractures[(4)].

As discussed earlier a combination of injuries can occur. Comminuted fracture of the lower patellar pole has characteristics of both patellar fracture and avulsion of the patellar tendon. Therefore, components of both injury types should be considered during treatment. None of the traditional techniques has proven sufficient alone. Preserving patellar height as far as possible can give better functional outcomes. Successful osteosynthesis of the comminuted lower patellar pole using the present technique reduces potential need for partial patellectomy, and preserves original length of the extensor mechanism[(5)]. Partial patellectomy (PP) and reattachment of the patellar ligament with transosseous suturing is the mainstay of surgical treatment for distal pole patellar fractures. An anchor suturing technique has recently been reported as an alternative to Partial Patellectomy in such fractures and allows for bone-to bone interface and possibly superior fracture healing than bone-to-tendon interface with PP. AS is non-inferior to PP for function and pain after distal pole patellar fractures and is superior to PP with regard to operative time. Common complications of this technique are hardware failure and infections[(6)].

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. The 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. Preoperative patellar traction followed by tension band wiring is a good procedure giving better results than either patellectomy or V-Y plasty[(7)].

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II. Materials And Methods

The study group is of fractures of patella in which comminution of the fragments has been the prime inclusion criterion in 58 cases. The inclusion criterion are fracture patella of any pattern with comminuted fragments, normal pre injury status of the knee joint, normal skin on inspection. The exclusion criterion are compound fracture, associated fractures, pre existing arthritis of the knee. On the day of presentation all the cases are thoroughly examined for any life threatening and limb threatening injuries. The radiographs are taken in AP and Lateral views to know the fracture pattern. Patients surgical fitness is evaluated by getting the surgical profile done. The limb with fracture patella is immobilized with a cylindrical POP slab in extension at the knee. All the cases in the study are taken up for partial patellectomy under spinal anaesthesia under tourniquet control.

Surgical technique :Make a longitudinal midline incision, our preference. If an area of skin is severely contused, attempt to avoid it or elected to excise a small area because skin closure produces no significant difficulty. The skin and subcutaneous tissue flaps are proximally and distally elevated to expose the entire anterior surface of the patella and the quadriceps and patellar tendons. If the fracture fragments are significantly separated, tears in the extensor expansion are presumed, and these are carefully explored medially and laterally with blunt dissection. All small, detached fragments of bone and soft tissues are removed. Inspection of the interior of the joint and especially the patellofemoral groove is done to rule out an osteochondral fracture.

Thorough irrigation of the interior of the joint is done with normal saline to remove blood clots and small particles of bone. Often, only the distal pole of the patella is fragmented, leaving a substantial and relatively normal proximal fragment. This fragment is an important part of the extensor mechanism and should

be preserved. The details of suture of the patellar tendon to the fragment should be observed carefully to prevent a tilt of the fragment, which can cause erosion of the trochlear groove. If at least one third of the proximal third of the patella is intact, it is preserved. Small flecks of bone can be left within the patellar tendon to make anchorage easier. The articular edge of the proximal fragment is trimmed and smoothened with a rasp. Beginning on the fracture surface of the proximal fragment just anterior to the articular cartilage, a 2-mm Kirschner wire or 2.5-mm drill bit are used to drill three parallel holes in a proximal direction (one hole in the center and one each in the medial and lateral thirds). Alternatively, we routinely use a Beathe pin is used to create the bone tunnels and pass the suture simultaneously.

Two heavy non absorbable sutures are weaved through the patellar tendon, one through the medial and one through the lateral half of the tendon. Then one suture end each is placed through the medial and lateral holes and two through the central hole. With the knee slightly hyperextended, the sutures are tied securely over the superior pole of the patella. The patellar tendon should evaginate and lie against the raw fractured surface of the patellar remnant near the articular surface. This prevents tilting of the fragment and contact of the raw surface with the femur. The repair with interrupted sutures is done for the synovium, ruptured capsule, and extensor mechanism from their outer ends toward the midline of the joint. Comminuted patellar fractures : For fractures showing intra operative proximal pole of the patella is comminution, leaving a single distal fragment consisting of half or more of the bone is essential. This fragment, provides the leverage.

After securing perfect haemostasis and after tourniquet is released, the wound is closed in layers. A mild compression Robertson Jones bandage is applied. The knee is immobilized in a groin to ankle cylindrical slab.
Post operative care**:** A posterior splint from groin to ankle provides sufficient immobilization during the early postoperative period. The patient is encouraged to perform quadriceps-setting exercises and within a few days should be lifting the leg off the bed. At 10 to 14 days, the sutures are removed and a cylinder cast or knee immobilizer is applied with the knee in extension. The patient is allowed to be ambulatory, using crutches when active muscular control of the leg has been obtained.

As muscle power returns, the crutches are discarded, usually at 6 to 8 weeks. The patient is allowed to ambulate while bearing weight as tolerated on the first postoperative day. Isometric and stiff-leg exercises are encouraged, beginning on the first postoperative day. The extent of active motion permitted in the immediate postoperative period is determined intraoperatively based on the fracture repair stability.

Active range-of-motion exercises can be performed when the wound has healed, at 2 to 3 weeks. Progressive resistance exercises can be begun and the brace discontinued at 6 to 8 weeks if healing is evident on radiograph in cases of proximal fragment comminution. Unrestricted activity can be resumed when full quadriceps strength has returned, at 18 to 24 weeks. In patients with less stable fixation or extensive retinacular tears, active motion should be delayed until fracture healing has occurred.

III. Results

The study results are assessed with pain, range of movement, quadriceps power, and ability to do daily activities and complications encountered. As the patient is allowed to walk with support , and cylindrical slab till 2-3 weeks the immediate complications like haemorrhage and wound healing are assessed. The dressings of the surgical wound are done at 3^{rd} , 5^{th} and 8^{th} days, suture removal is done from 11-14 days. Before this period patients are encouraged to do quadriceps drill and active ankle an toe movements. The pain at the surgical wound subsided gradually and medication can be discontinued after first week. From 20^{th} post operative days patients are encouraged to start Range of Movement exercises. Patients are encouraged to discard walking aids from 6^{th} week onwards.

Wound healing: Out of 58 cases taken up in the study wound healing with dry wound is noticed in 55 cases. There is superficial discharge seen in 2 cases and purulent discharge is seen in 1 case. The superficial discharge cases and purulent discharge cases could not be ambulated early. Both these wound complications required antibiotics for another week.

Out of 58 cases the pain has subsided gradually in 46 cases by 10^{th} post operative day and remaining 12 cases required additional pain medication till 20 days. The range of movements are started on day 21 for 55 cases and at 25^{th} day for 3 cases. The initial range of movements are 10^0 - 20^0 in 38 cases on active effort and very minimal in 20 cases including the cases which were showing wound complications. The range of movements increased to another 20^0 in 30 cases. And only slight increase of 10^0 is noted in 28 cases upto 6^{th}

post operative week. At sixth post operative month , in 41 cases came for follow up there is no significant improvement if range of movenemnts. The power of contractions remained at 4/5 in all the cases for the given range of movements.

IV. Figures And Tables

Functional Out come

Wound healing	Fractures		ROM in 3 weeks	Fractures
Good wound healing	55		$<10^0$-20^0	38
Superficial infection	2		$>10^0$	17
Pus discharge	1		0^0	3
Total	58			

V. Conclusion

When partial patellectomy is chosen, as much of the patella as possible should be salvaged. Larger pieces can be secured together with interfragmentary screws to increase the size of the patellar remnant. The proper site of insertion of the patellar tendon into the patellar remnant after partial patellectomy also has been controversial. Reinserting the patellar tendon anteriorly on the patella has been shown to cause excessive tilting of the lower pole of the patella toward the femoral articular surface and lead to patellofemoral arthritis. Saltzman et al. Recommended reattachment of the patellar tendon near the articular edge of the patella. However, Marder et al. found that posterior attachment of the patellar tendon near the articular surface caused tilting of the proximal pole of the patella toward the femoral articular surface and that anterior reattachment of the patellar tendon restored a more normal pattern of patellofemoral contact. Zhao et al. reported satisfactory results in 21 patients in whom the patellar tendon was reattached to the anterior cortex. In a cadaver model, the forces required to extend the knee were significantly higher when the patellar tendon was reattached near the articular surface, but forces were increased. Whatever site of reattachment is chosen, intraoperative radiographs should be evaluated carefully to ensure that the extensor mechanism is not excessively shortened and that the remaining patella is not tilted. Improvement was noted over the first 6 months noting deficits in strength, power, and endurance. The functional outcome after partial patellectomy is disabling proportionate to the patella excised. Every attempt should be made to retain as much patella as possible. The repair should be executed to maintain normal patellar tilt and sufficient augmentation of the reserve extensor mechanism also should be considered.

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Dr P.Anil Babu2 "Partial Patellectomy: A study on functional out come "IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 7, 2018, pp 53-57.