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A COMPARITIVE STUDY TO EVALUATE FUNCTIONAL MOVEMENT OF KNEE JOINT AFTER DIFFERENT MODALITIES OF TREATMENT OF PATELLAR FRACTURES.

Orthopaedics

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ABSTRACT

Aims and objectives: This is a prospective study comprises of 28 cases of fracture patella done in MLB Medical College Jhansi, U.P. between Sep 2016 to Sep. 2018 to evaluate the knee functions of various methods of treatment of fracture patella with similar pattern of injury.: Out of 28 patients, 22 males and 6 females, youngest patient is was 14 years oldest patient was 60 years with average age 37 years, predominantly right side affected.

Material & method : Equal no. of transverse 14 and comminuted fracture 14 were recorded / undisplaced with intact extensor mechanism treated conservatively with excellent to good result 85%.

Conclusion: Transverse incision has advantage over longitudinal in partial patellectomy length of patellar ligament should be maintained and to be sutured near articular surface. Total patellectomy good result 72%, 28% fair results. Some loss of strength of quadiceps muscle .

KEYWORDS

INTRODUCTION

Patella is the largest sesamoid bone in human body developed in quadriceps femoris tendon, situated in front of the lower end of the femur, 1 cm. above the knee joint.

Fracture of the patella constitute approximately 1% of all skeletal injuries.

While treating the patellar fracture it is not the bone fracture but treatment of extensor mechanism. Insurance of continuity of extensor mechanism with its most effective functional state is our goal.

Fracture of patella when displaced, associated with tears of medial and lateral retinaculum, those tears being an important part of injury must be repaired to restore the normal function of the knee.

According to mechanism of injury[1] there are two major mechanism direct and indirect trauma. Direct blow, fall on to the knee, knee hitting the dashboard and direct blow during vehicular trauma leads to comminuted, stellate and incomplete fracture with little displacement because medial and lateral expansions are not torn. With certainty articular cartilage of contact area is damaged by this mechanism, patient may be able to extend the knee against gravity.

Patellar fractures from indirect trauma occurs in act of stumbling, falling or jumping, when unexpected rapid knee flexion occur against a fully contracted quadriceps and intrinsic strength of patella is exceeded by pull of musculotendinous and ligamentous unit[2].

Present study has been taken to evaluate the knee joint function after various methods of treatment.

AIMS AND OBJECTIVES

1. To evaluate the knee functions of various methods of treatment.
2. To compare the knee functions after various treatment. Regims with similar pattern of injury.
3. To discuss the merits and demerits of various procedure.
4. To evaluate the functional capabilities of knee joint after various treatment modalities used, with particular emphasis on range of knee flexion.

MATERIAL AND METHODS

This prospective study comprises of 28 cases of fracture patella admitted in Orthopedics Ward, MLB Medical College Jhansi during Sept. 2016 to Sep. 2018.

Inclusion criteria

In our study inclusion criteria were isolated patella fracture in adult patient (skeletally mature)

Exclusion criteria

Were associated periarticular tibial or femoral condyle fracture, skeletal immature patient, old malunion or non union patella.

All patients were treated as indoor patient and clinically examined thoroughly. Continuity of the quadriceps mechanism was evaluated, whether patient could do active extension of knee was judged. Radiograph of injured knee, AP lateral and skyline view were taken and posterior slab was given. Routine lab investigation were done. X-ray were evaluated for fracture pattern, displacement and comminution. All fracture were classified according to fracture morphology.

There are various methods of treatment for fracture patella. In present series following procedure were performed.

Out of 28 cases, 13 were treated by conservatively, 7 by total patellectomy, 6 by partial patellectomy, 2 by osteosynthesis methods.

Conservative Treatment

This procedure was attempted in 13 cases. Conservative treatment was done in

1. Fracture of indirect violence in which the injury takes the form of nothing more than a transverse fissure. There is no displacement of fragments and no injury to medial or lateral expansions.
2. Transverse fracture with fragments without significant displacement, minimal disruption of the articular surface (undisplaced fracture are those with separation of the fragments of less than 3 mm or articular incongruity (step off) 2 mm or less with intact extensor mechanism.
3. Undisplaced vertical, peripheral, comminuted fracture with intact extensor mechanism.

If haemarthrosis was painful and tense, it was aspirated under total aseptic condition followed by application of POP/slab cast.

Method

Immobilization of limb in above knee cylindrical cast with knee in extension but not in hyper extension was done for six weeks.

During cast partial weight bearing was allowed with support of crutches. Quadriceps exercises with straight leg raising exercise were begun as soon as pain subsides after injury usually 1-2 days after injury during cast.

After 6 weeks cast was removed followed by gentle but progressive range of motion exercises. Later intensive continuous exercise programme was started with range of motion on CPM and quadriceps strengthening exercises.

Operative Treatment
This procedure was done in 15 cases
Total patellectomy in 7 cases
Partial patellectomy in6 cases
Osteosynthesis in 2 cases

Total Patellectomy
This procedure was done in 7 cases. It was done in -
1. Patients with a severely comminuted displaced. Fracture of patella where no large fragment remains which is articular and extensor mechanism is disrupted.

Technique
Soft tissue overlying the patella is often injured from direct violence at time of fracture. Operative treatment is delayed if there is severe compromise of the skin so that post operative wound healing could be at risk.

Patella was exposed through a transverse curved incision approximately 12.5 cm long with apex of the curve on the distal fragment.
1. It give enough exposure for patella as well as for ruptured extensor mechanism.
2. Cosmetic result is superior after a transverse incision.
3. It also has a advantage of better healing Less tendency to form thick hypertrophic scar.
4. Cutaneous branch of saphenous nerve does not damage by transverse incision.

Subcutaneous tissue with skin is reflected to expose prepatellar ligament. Now incision is given to joint. Excise all the comminuted fragments, preserving as much as the patellar and quadriceps tendons as possible. Clear the joint of bone chips and debris by thorough irrigation, Place 1 No. ethibond suture material through margins of patellae and quadriceps tendons and through the medial and lateral extensor expansions in a purse string manner. Supplemental interrupted suture are used to repair the capsular rupturs to further appose the quadriceps and patellar tendon ends.
Now wound is closed in layers.

Post Operative Management
Post operative plaster immobilization was used for3 weeks. Position of knee in plaster was in full extension. During cast, isometric and stiff leg exercises were advised immediately after operation, A window was made through cast to check dress and stitch removal. After 3 weeks cast was removed and range of motion exercises and intensive muscle strengthening exercises were begun. Weight bearing during cast is not prohibited.

Partial Patellectomy
This procedure was done in6 cases. It was done in
1. When one large fragment containing the significant articular surface is associated with comminuted polar fragment, that cannot be stabilized with internal fixation.

Technique
- Care of soft tissue overlying is done as described before.
- Patella was exposed through transverse curved 12.5 cm. long incision as described before.
- If proximal half or more of patella is intact preserve it and trim away the edges of capsule and tendon. Smooth the articular edge of the proximal fragment. Comminuted fragments of interior pole were excised.
- Now two longitudinal drill holes are made in proximal patellar fragment starting from fracture surface just anterior to the Articular cartilage.
- A woven stitch begun at the tibial insertion of the Tendon and then woven along the medial and lateral tendon margins, suture is then passed through vertical drill holes in proximal fragment. 2 no. ethibond suture material was used for repair.

By this, Tendon will come in contact principally with the articular edge of the fragment and not its anterior edge. By This Tilt of the fragment is prevented and its raw surface does not contact with femur Occasionally the proximal pole of patella is comminuted, leaving a single distal fragment consisting of half or more of the bone. Now quadriceps tendon is approximated with distal bone fragment near its articular edge by applying same principled outline above.
Suture tied over the superior pole of patella.

Post-Operative Management
- After haemostasis, wound is closed over negative suction drain and POP splint applied.
- Post operative plaster immobilization was used for 3 weeks. Position of knee in plaster was in full extension.
- During case, isometric quadriceps and stiff leg exercises were advised immediately after operation. After 3 weeks cast was removed and range of motion exercises and intensive muscle strengthening exercises were begun.
- **Osteosynthesis** this procedure was done in 2 cases. Mod. Tension band wiring in one and Lag screw fixation in other case. These methods were employed in simple transverse fractures with two big displaced fragments.

Modified Tension Band Wiring
Approach the patellar fracture in usual fashion after S.A. or G.A. with Tourniquet over mid thigh. Explore the extent of the rentinacular tear and thoroughly lavage the joint[3]. Major proximal and distal fragments are brought together and reduction was achieved. Accurate reduction with special attention to restore a smooth articular surface was confirmed by passing a index finger over posterior articular surface through medial and lateral rentinacular tears and by image intensifier.
Fracture reduction was held finally with towel clip. Now drill two K-wires (2mm) from inferior pole to superior pole through each fragment[4]. These wires are placed parallel as possible and emerge out just medial and lateral to quadriceps tendon, leave the ends of the wire long, protruding beyond the patella.

Now pass a strand of 18 gauge wire transversely through quadricep tendon attachment. As close to bone as possible" deep to protruding K-wire (Most common error in this technique is the failure to bring tension band directly into contact with the proximal and distal poles of the patella, leaving intervening soft tissue.

Then band strand is passed over anterior surface of patella then transversely through the patellar tendon attachment on Inferior fragment deep to the protruding K-wire and then back over the anterior surface of patella and tighten it firmly. Bend the upper ends of the two K-wire acutely anteriorly and cut them short. Now rotate the K-wire 180° and with an impactor embeded the bend ends into superior margin of the patella posterior to the wire loops[5]. Torn retinaculum repaired.

Cut the - protruding ends of K-wires short inferiorly and repair the retinacular tears with multiple interrupted sutures.
After haemostasis, wound is closed over negative suction drain.

After treatment
Limb is placed in extension in a posterior plaster splint, if rentinaculum has not been extensively torn, gentle range of motion exercises of knee are begun at 5 to 7 days. If extensive retinaculum has torn, motion is delayed for 2-3 weeks. Isometeric quadriceps and stiff leg exercise are encouraged immediately after surgery.
Patient is allowed to walk with crutches after 2-3 days.

Lag screw fixation
Now one drill hole is made through superior pole of patella crossing through fracture site and emerge out from inferior pole, measuring the accurate size of lag screw to be inserted. Now accurate sized lag screw is passed from superior pole, long screw should not be used as it may create irritation. After fixing one screw, second screw was passed in similar manner parallel to previous screw, Retinaculum were repaired.

FOLLOW UP
This study consists of follow up of maximum 24 months. In the present series the assessment of knee function was performed on the following criteria.
1. Pain : Whether pain is continous even in rest or weather it is only present in walking, pain during walking may be all the time or may be after prolonged walking.
2. Swelling: Present all the time or appear after walking.
3. Gait : Patient can walk with support or without support or short stance phase gait.
4. Condition of Scar: Healed up properly or hypertrophied. If there was any evidence of infection.
5. Effusion: Detected by Patellar tap and fluctuation.
6. Loss of fixation : Loss of fracture fixation and reduction is a disheartening complication after open reduction and internal fixation. This complication is most commonly due to

unrecognized or under appreciated fragment comminution usually involving the distal pole.

This condition allows the fixation wires to slide through the substance of distal or screw pole with contraction of quadriceps.

Fortunately no any cases in my series went under this complication. This problem is best prevented by avoidance of open reduction and internal fixation when the quality of bone is questionable.

Knee Stiffness
Some slight loss of knee motion after patellar fracture is the rule rather than the exception. Generally only a few degree of flexion is lost while full extension is maintained. Early motion exercise may help to reduce the incidence of post operative stiffness. Prolonged immobilization of a knee, that has been treated operatively can lead to post operative contracture.

Post Operative Osteoarthrosis
Because of the magnitude of loads across the patellofemoral joint, post traumatic osteoarthrosis following patellar fracture is not uncommon but long term follow up of 10-30 years is required to evaluate this complication.

Causes of this complication are
1. Residual joint incongruity
2. Increase contact stresses.
3. Injured articular surface at the time of fracture

Quadriceps Strength
Some reduction in quadriceps strength after patellectomy is usual outcome. It is due to combined effect of reduction of lever arm after patellectomy and quadriceps atrophy. But in osteosynthesis cases this complication is unusual, early motion exercises reduces the chances of quadriceps atrophy.

Technique
Patient was asked to sit on a quadriceps table with both legs hanging by the edge of table. Now a leg strap was tied near the ankle of the normal limb. The strap was connected with a rope to a spring dynamometer tied at the back of the patient. At the level of ankle under sufficient tension at 90° flexion of knee. Patient was asked to pull the dynamometer by extending the knee and quadriceps strength was recorded in kilograme and same procedure was performed in the operated limb and strength of operated limb is compared with normal limb strength, assuming strength of normal limb 100% and operated limbs strength is expressed as % loss.

Wasting of Quadriceps
Determined by measuring the mid thigh circumference at same level. Differences between the two was recorded.

Range of movements
Estimated by Goniometer and compared with normal side.

Stair climbing
Normal or any difficulty necessitating assistance during climbing up and down the stairs.

Work affected
Whether to returned original jobs or not.

Radiological
X-ray done for degenerative changes or calcification of patellar tendon or patello-femoral joint alignment.

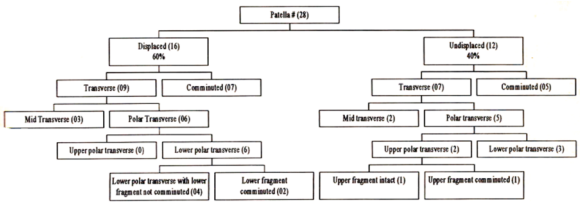
OBSERVATION
In present series, out of 28 patients, the youngest patient was of 18 years, oldest patient was of 60 years. Average age was 36.9 yrs. Average age for male was 35.7 years and for female 41.3 yrs. Maximum number of patients were from 3rd and 4th decade. Male were predominating females in number. 21% were female and 79% were males.

In this series affection of right patella was more frequent than left. Ratio is R: L :: 2:1, Right patella is involved twice than left.

Most of the fractures were after direct trauma to knee either following fall on to knee, RTA, Assault or fall from stairs. 25% cases after indirect injury following fall on ground.

Out of 28 patients 24 were closed and only 4 patient were with wound over patella making them compound.

Pattern of fracture



In this series, most of the patients had displaced transverse fracture out of this polar transverse fracture were the maximum. Comminuted fracture of patella was second most common pattern of fracture. In any type, displaced fractures were out numbering the undisplaced fracture except upper Polar transverse. All the upper polar transverse fracture were undisplaced variety. No case of upper polar transverse displaced fracture was recorded in this series.

Most of the surgeries were completed within 2 weeks. When if skin condition was good at the time of admission, surgery was done within 72 hours, 2 cases were done after 2 months of injury because they presented late in hospital.

Only one case after partial patellectomy developed post operative infection in gap of suture line. Infection was superficial and healed well with repeated cleaning and dressing and appropriate antibiotics.

Follow up
Results were evaluated using criteria given by Dr. Marya K.S. 1987 which is based on :-

Table 1

S.No	Criteria	Excellent	Good	Fair	Poor
1.	Pain	No	Occasional aching	Occasional	Constant
2.	Limitation of knee flexion	<10%	Upto 30°	Upto 90°	>90°
3.	Extensor r lag	No	No	<10°	>10°
4.	Quadriceps wasting	No	Upto 1.5cm	Upto 2.5cm	>2.5cm
5.	Quadriceps power	Normal	Normal	30-45% decrease	>45% decrease

RESULTS
TABLE 2
(After using criteria given by Dr. Marya K.S. 1987)

Grading	Conservative	TP	PP	Osteosynthesis
Excellent	05	02	01	Screw
Good	06	03	02	TBW
Fair	02	02	01	-
Poor	-	-	02	-
Total	13	07	06	02

Uniform excellent to good results were obtained with conservative treatment. In surgical treatment the maximum excellent to good results were obtained with Osteosynthesis and Total patellectomy. Partial patellectomy came out to give fair to poor results in 50% while only 16% cases had excellent and 33% cases had good results after PP. Total patellectomy gave better results than partial patellectomy but poorer results than osteosynthesis and conservative treatment. Best results are obtained after osteosynthesis. 100% cases had good to excellent results.
1. Incidence of pain
2. Limitation of knee flexion
3. Extensor lag
4. Quadriceps wasting quadriceps power

DISCUSSION
Birgittae in 1989, reported mean age at accident was 36 years
In present series, mean age of female is 41.3 years and of male is 35.7

SEX INCIDENCE
Present series of 28 cases consists 22 males and 6 females. 79% of were

males, 21% were females. Thomson (1942) reported an incidence of M:F was 2:1. Wilkinson J.[23] (1977) reported that there was 68% males and 32% females.

SIDE OF FRACTURE

In present series, predominance of right patella to left is seen right patella is involved twice than left ratio is 2:1. Many studies declared no predominance of side[6].

No particular reason could be traced out for predominance of patellar fracture on right side in present series.

MODE OF TRAUMA & TYPE OF INJURY

In this series fall on ground is commonest mode of trauma and fall from height had rarest cases[7]. Incidence of transverse fracture is slightly more than comminuted fracture, while incidence of displaced fracture is more than undisplaced fracture.

Now it is universally accepted that most patellar fracture are as a result of a combination of direct and indirect trauma. Rarely does anyone hit a dash board with a relaxed quadriceps[8].

NATURE OF FRACTURE

In present series, out of 28 cases. 4 cases were recorded compound (14%). Similar incidence of compounding was reported by Wilkinson (1977) he found 3 compound fracture in his series of 31 case[9-10].

Out of 13 cases of conservatively treated had intact extensor mechanism except one which had torn extensor mechanism.

Intactness of extensor mechanism in the patellar fracture is a sole character to decide the treatment guide lines either operative or conservative[11-12]. In operative group, decision of patellectomy in respect to osteosynthesis is done on the basis of coinminution of patellar fracture.

Secure fixation and accurate reduction is aim on top if preservation of patellar function is obtained[13]. If there is too much comminution for secure open reduction and internal fixation, but a major (usually superior) fragment with a substantial amount of normal articular cartilage is present, partial patellectomy is considered appropriate approach.

Marya K.S. (1987)[14] assessed the relative merits of patellectomy and osteosynthesis with tension band wire, reported although only half the patients achieved excellent results (while 80% of osteosynthesis group), majority of patients after patellectomy had good to excellent results and only a negotiable number of patients had poor results. He said, when needed patellectomy should be performed without hesitation.

Bostman D. (1981)[15-16] have suggested, even comminuted fracture, should be treated by internal fixation; but most surgeons prefer patellectomy for more comminuted fracture.

We treated one case by modified TBW[17-19], in this case we could not achieve secure fixation as needed. Despite of this, near to excellent result we achieved in this case after prolonged continous physiotherapy.

So, it is universally accepted that good to excellent results are more due to physiotherapy after any modality of treatment.

Soft tissue overlying the patella is often injured from[20-21] –

- Direct compression or abrasion at time of fracture.
- A large fracture, soft tissue hematoma compromise the soft tissue.
- Tight bandage in an effect to reduce and prevent the haemarthrosis of knee.
- Tense haemarthrosis stretching the overlying skin.

Care is taken to minimized additional injury by -

- Avoiding compressive splints.
- Avoiding excessive knee flexion.
- Avoiding direct contact with ice.
- Aspiration of joint effusion that is stretching the anterior skin.

INCISIONS

In this series we prefer transverse incision and all operative cases were approached through transverse incision[22-23]. Once the fracture has been exposed, a defect in the extensor mechanism extending several centimeters medially or laterally can be repaired easily by this approach. Transverse incision has following advantages:

a) Better cosmetic results. (Better healing and less tendency to form thick Hypertrophic Scar).
b) Cutaneous branch of saphenous nerve is escaped from trauma.
c) Better exposure to Retinaculae medially and Laterally.

REPAIR OF EXTENSOR APPARATUS

In the present series, repair of extensor apparatus were done transversely in 7 cases of total patellectomy[24]. Vertical or Purse string fashion of repair was not used. There is no convincing evidence to recommend one method or another. During partial patellectomy we preserved superior pole in all 6 cases[25-26]. It was tried to preserve as much of the length of the patellar fragment. Two holes through the fracture surface were made near the articular surface. So, that there is minimum step off between tendon and remaining intact cartilage.

H.C. Duthie (1958)[27-29] suggested this concept to prevent the tilting of the patellar remnant.

RESULT

At the end of followup excellent results were obtained in Table 2 ...9 cases (3 2%), Good results were obtained in 12 cases (42%), fair results were obtained in 5 cases (17%) and poor results were (after partial patellectomy) in 2 cases (7%).

CONCLUSION

DEPENDING ON FINDINGS OF TABLE 1&2

1. A clear male predominance of fracture patella was recorded over female because of their nature of work.
2. In present series predominance of right patella to left (Ratio 2:1). No particular reason could be traced out for this predominance.
3. In this series fall on ground is commonest mode of trauma (this mode may cause direct, indirect or combination injury to patella) fall from height is rarest cause of injury.
4. Patellar fracture usually occurs from distraction and three - point bending of the patella as well as from direct blows.
5. Equal number of transverse (14) and comminuted fracture (14) were recorded in this study. Displaced fracture were more than undisplaced.
6. When undisplaced fracture patella (criteria recommended by BIRGITTA) with intact extensor mechanism were chosen for conservative treatment. Uniform excellent to good results (85%) were obtained. So conservative treatment definitely has a place in treatment of such fracture.
7. Interval between trauma and surgery is not fixed universally it depends on condition of skin. Time interval should be given for compromised skin, so that post operative wound healing should not be at risk.
8. To approach patella and retinaculum, Transverse incision has many advantage over longitudinal

a. Better exposure of Retinaculum for repair.
b. Better cosmetic results.
c. Cutaneous br. Of Saphanous Nerve is escaped from Trauma.

9. During repair of Extensor apparatus

a. Transverse repair of Quad. Tendon and patellar ligament is simple easy after total patellectomy.
b. In partial patellectomy, preservation of superior pole fragment should be tried, length of patellar ligament should be maintained and patellar ligament should be sutured near to articular surface of remaining fragment to prevent the tilt of fragment.

10. Technically well performed total patellectomy had also provided majority of excellent and good results (72%), 28% cases with fair results and no poor results- following displaced comminuted fracture patella.
11. Some loss of quad. Strength and bulk of thigh circumference after total patellectomy is rule. Majority of patient had loss of quadriceps strength <30% and wastening <2cm.
12. For patients with a severly comminuted fracture with displaced fragments and no major articular fragment remaining intact. This treatment was found to be better than no treatment.
13. Partial patellectomy gave poorest result as compared to other modalities. So it is better to go for total patellectomy if fracture is old (more than 2 months).
14. Tension Band wiring or Lag screw fixation are definitely excellent for fractures where pattern of fracture can allow anatomical

reduction and secure fixation. There should not be too much comminution for secure internal fixation.

15. Early range of motion exercises in unloaded state of patella is main stay of treatment after any modalities. Resistive (strengthening). Exercises of quadriceps and Hamistrmgs were delayed until there is evidence of fracture healing or sound healing between quadriceps tendone - patellar ligament or upper pole of patella - patellar ligament.

Isometric quadriceps, Hamistring and stiff leg exercises during immobilization period help to reduce the loss of Quadriceps and Hamistrings Atrophy and promote healing.

Case 1 : Trans. Midline fracture patella displaced, this case was treated by open reduction and Lag screw fixation

Case 1 : Showing excellent union of fracture patella without articular surface incongruity after lag screw fixation

This patient has excellent result

Case 2 : Trans. Lower Pole fracture patella with distal segment comm.. This case was treated by partial patellectomy

Case 2 : After partial patellectomy patient have full range of movement of knee joint without extensor lag.

Case 2 : Same case having full knee flexion. He had only Quad. Atrophy of 1cm.

Case 3 : Another case after partial patellectomy showing extensor lag of 20° on left side (operated limb.)

Case 3 : Showing full range of knee flexion

Case 4: Displaced comm.. fracture patella was treated by total patellectomy. Patient achieved good result

Case 5 : Undisplaced midline fracture patella involving only anterior cortex. Treated conservatively with excellent result.

Case 6 : Simple transverse midline fracture but when it was opened, both upper and distal poles have multiple small fragments so TP was done and good results obtained.

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