Evaluation of Functional Outcome of Patients with Transverse Fracture of Patella Treated with Tension Band Wiring - A Prospective Study Conducted at Trichur, Kerala

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ABSTRACT

BACKGROUND

Patella is the largest sesamoid bone in the human body, which plays important role in biomechanics of the knee. It is one of the few bones without periosteal surrounding. Fracture of patella constitute almost 1 % of all skeletal injuries with high prevalence in age group of 20 - 50 years. Fracture of patella may be due to direct/indirect force. Direct force often results in displaced or comminuted fractures. Fracture caused by indirect mechanisms result from a violent contraction of quadriceps muscle with knee flexion. Most of the patella fractures are combination of direct and indirect forces. Most significant effects of fracture patella are loss of continuity of the extensor mechanism of the knee and potential incongruity of the patellofemoral articulation. Treatment option includes reconstruction of entire patella or partial patellectomy and tendon repair or total patellectomy with extensor mechanism repair. Advancement in surgical techniques treatment option being shifted from patellectomy to reconstruction, preservation, and restoration of extensor mechanism. The purpose of this study was to evaluate the functional outcome of transverse fracture of patella treated with tension band wiring.

METHODS

This prospective study was done among 35 patients, who sustained transverse patellar fractures and were admitted in Department of Orthopaedics, Government Medical College, Thrissur from 01 October 2019 to 01 October 2020. Functional and clinical outcome was assessed at 2 weeks, 4 weeks, 3 months, and 6 months using Goodfellow's scoring system.

RESULTS

The mean age was found to be 43 years, males were predominant. In 62.86 % of study population, right side was involved. In 63 % of study population, fracture occurred due to road traffic accidents (RTA). Average union was achieved in 11 - 13 weeks. Functional outcome was excellent to good in 85.71 % of study population.

CONCLUSIONS

Transverse fracture of patella can be treated with modified tension band wiring without much complications and early weight bearing is possible with good functional outcome.

KEYWORDS

Transverse Fracture Patella, Prospective Study, Tension Band Wiring, Good Fellows Score

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BACKGROUND

Patella is the largest sesamoid bone in the human body and lies within the quadriceps tendon. It plays an important role in biomechanics of the knee. It is one of the few bones without periosteal surrounding. It is a very hard and triangular shaped bone. Patella ossifies between 3 - 7 years of age and ossification completes in puberty.[1] During development, the patella originates from a single ossification centre in most cases. Approximately 23 % of the population possess up to three ossification centers which do not merge in 2 % of the cases. This results in either bipartite or tripartite patella.

Fracture of patella constitute almost 1 % of all skeletal injuries[1] with high prevalence in age group of 20 - 50 years. Fracture patella may be due to direct/indirect force. Direct force often results in displaced or comminuted fractures. Fracture caused by indirect mechanisms result from a violent contraction of quadriceps muscle with knee flexion. Most of the patella fractures are combination of direct and indirect forces. Most significant effects of fracture patella are loss of continuity of the extensor mechanism of the knee and potential incongruity of the patellofemoral articulation.

Treatment option includes reconstruction of entire patella or partial patellectomy and tendon repair or total patellectomy with extensor mechanism repair. Advancement in surgical techniques treatment option being shifted from patellectomy to reconstruction, preservation, and restoration of extensor mechanism.

Objective

To evaluate the functional outcome of transverse fracture of patella treated with tension band wiring in Government Medical College, Thrissur.

METHODS

This prospective observational study was done among 35 patients, who sustained transverse patellar fractures and were admitted in Department Of Orthopaedics, Government Medical College, Thrissur from 01 October 2019 to 01 October 2020. Informed written consent was taken from all willing patients. The clearance from IEC / IRB was obtained (IEC no: B6 -155 / 2019 / MCTCR (20) 27.9.2019)

Sample Size Calculation

Confidence Interval: 95 % (Z)
Alpha error: 5 %
Formula: $4pq/d2$
P- Proportion of patients with good to excellent results in the study by Hanumanthraya GH (75 %)
q – 1 - P
d - Maximum allowed error = 20 % of p
d = 20 % of .75 = 0.15
Sample size = 4 x 0.75 x 0.75 / 0.15 x 0.15
Minimum sample size = 25

Inclusion Criteria

- All closed and type 1 open displaced transverse patellar fractures (> 3 mm)
- All patients medically fit for surgery
- Age group between > 20 years and < 60 years

Exclusion Criteria

- Patients with neurovascular injuries
- Grossly comminuted fractures
- Vertical or marginal fractures

Statistical Analysis

Data was entered in MS Excel and analysed using EPIFLO software. Quantitative variables were expressed using mean +/- SD. Qualitative variables were expressed in percentages.

Operative Procedure

Mid line longitudinal incision over patella, fracture fragments were exposed. Blood clots and small fragments were removed and fracture surface was cleaned. Proximal and distal fragments reduced and held firmly with clamp/pointed clamps. Fracture is reduced with two parallel Kirschner wire drilled from inferior to superior through each fragment. Wires were parallel to each other and protruding beyond the patella and quadriceps tendon to the inferior and superior fragments. An 18-gauge SS wire was passed deep to quadriceps tendon as close to the bone and deep to the K-wires, then over the anterior surface of the reduced patella then transversely through the patellar tendon attachment on the inferior fragment and deep to the protruding K-wire, then back over the anterior surface of patella and tightened at the upper end in figure of eight pattern. Articular surface of patella checked by palpation in extended knee position. Both upper end of K-wire bended acutely and anteriorly and cut them short and rotated 180. Extensor expansion tear repaired with interrupted suture. Wound closed and cylinder slab applied.

Post-Operative Care

- In stable fixation of simple transverse fracture, early rehabilitation of knee joint with partial weight bearing should be started as patient becomes pain free.
- Static quadriceps and hamstring strengthening exercises were started immediate post operatively.
- Active extension was started on 4th week and active flexion was started on 2nd week. In cases with associated extensor, expansion tear flexion was started after 3 weeks and without extensor expansion tear after 2 weeks.
- Non weight bearing with knee brace or cylinder cast was applied for 2 weeks and in associated injuries at 8th or 10th week respectively. Partial weight bearing was continued till 2nd week and in associated injury till 8th and 10th week. Full weight bearing was started after 4th week.
- After discharge patients were followed up on 2nd week, 4th week, 3nd month, and 6th month.

- X-rays were repeated on 4th week, 3rd month, and 6th month. At every follow up movements of knee, quadriceps strength assessment done**.**

Good Fellows Grading of Range of Motion

Functional and clinical outcome was assessed using good fellows scoring system.

Grading	Range of Motion
Excellent	Painless full movement and able to squat
Good	Full flexion and extension, painful squat
Fair	Painless movement with 10 - 20 degrees limitation of flexion
Satisfactory	Painless movement with limitation of 20 - 40 degrees of flexion
Poor	Limitation of > 40 degrees flexion

Good Fellows Grading of Range of Motion

RESULTS

35 cases of transverse fracture of patella treated with tension band wiring were followed and following results were obtained. In this study, among 35 cases, age of patient ranges from 20 - 60 years with mean age of 43 years. Maximum patients were in the age group of 50 - 60 years (40 %). Youngest patient was of 21 years and oldest was 60 years. In this study out of 35 patients, 25 (71.43 %) were males and 10 (28.57 %) were females. Out of 35 patients, 22 had right side involvement and 13 had left side involvement. The main cause of injury, 22 out of 35 (62.85 %) were road traffic accidents. The majority of fractures in this study consists of closed type of fracture (74.28 %).

Duration between Injury and Surgery

Out of 35 patients in our study, 10 (28.58 %) patients were operated within 24 hours of injury, 16 (45.72 %) patients were operated between 25 - 72 hours, 8 (22.85 %) patients were operated between 73 hours to 1 week. Only 1 (2.85 %) patient was operated after 1 week.

Ambulation of Limb

In this study, ambulation was started with in one week in 88.57 % (31) of patients who underwent surgery within a week.

Weight Bearing

Partial weight bearing in 31 patients was started in 2 - 4 weeks and full weight bearing in 4 - 8 weeks. 4 patients partial weight bearing was started in 4 - 6 weeks and full weight bearing in 8 - 12 weeks-time.

Complications

In this study 2 (5.71 %) patients had post-operative infection, 7 (20 %) had pain on squatting, 3 (8.57 %) had limitation of flexion, 2 (5.71 %) had extension lag and 1 (2.85 %) had loss of fixation in the post-operative follow up period.

Fracture Union Time

Out of the 35 patients, in 33 (94.28 %) patients, fracture union was noted within 11 - 13 weeks and in 2 (5.72 %) patients fracture union took more than 13 weeks. In this study, out of 35 patients, 2 patients had post-operative superficial skin infection, 7 patients had pain on squatting, 3 patients had limitation of flexion, 2 patients had extension lag and 1 patient had loss of fixation in the postoperative follow up period.

Age	No. of Patients	Result
20 - 30	7	Excellent - 6 Good -1
30 - 40	6	Excellent - 5 Fair - 1
40 - 50	7	Excellent - 5 Good - 3
50 - 60	10	Excellent - 5 Good - 4 Fair - 4

Table 1. Age vs Result

Grading	No. of Patients	Percentage
Excellent	22	62.85 %
Good	8	22.85 %
Fair	5	14.28 %
Satisfactory	0	0 %
Poor	0	0 %
Total	**35**	**100 %**

Table 2. Functional Outcome and Clinical Outcome - Good Fellows Grading[19]

DISCUSSION

Dudani and Sancheti[2] in his study of patella fracture treated with tension band wiring shows, 73 % of cases had more than 120º of flexion. Weber et al. matched different type of fixation for patella fractures and found that modified tension band wiring technique gives most secure fixation. Levack B et al.[3] in his study on patellar fracture witnessed 49 years was average age for patellar fracture in his study of 30 cases, 21 fractures were seen in men & 9 fractures were seen in females. In his study, males were more susceptible to trauma due the apparent added outdoor activities. Curtis M J et al.[4] assessed results of modified AO tension band wiring, blending cerclage wiring & tension band. The blend of cerclage & tension band wiring proved to be considerably stronger & is preferred. In the study done by Boatman and Chen et al. on treatment of patellar fracture by anterior tension band method, good to excellent results were obtained in 50 - 80 %. Srinivasulu et al.[1] In his study of transverse patella fracture treated with tension band wiring, stated 10.5 % cases had restricted movements greater than 20 degrees, though the physiotherapy protocol & quick mobilization with weight bearing were followed. In his study, fair range of motion and better results were seen in patients with early functional rehabilitation. In the study done by Benjamin et al.[5] on properties of different types of fixations in transverse patella fractures observed that, the modified tension band wiring had stronger fixation compared to other methods. Smith et al.[6] studied outcome of patella fracture in 51 patients out of which 49 patients were managed with modified tension band wiring & 2 patients were managed with tension band wires threaded through cannulated cancellous screws & showed excellent results in almost 90

% of patients. Burvant et al.[7] studied the strength of fracture fixation done by circular wire around the bone and by tension band wiring. On comparison, he concluded that stronger fixation & superior stability is seen in cases treated with tension band wiring. Ndiaye et al.[8] conducted study on 26 cases of patella fracture among which 18 cases were treated with modified tension band wiring, and other cases with circular wire. The outcome of results concluded that first approach has been associated with better results for transverse fractures or crushing injuries on middle part of patella. Schimitsch et al.[9] in his study of patella fracture treated with tension band wiring reported 25 (52 %) of their 50 patients presented with associated injuries. Berg E E et[10] al. in his study concluded that mean time taken for radiological union of transverse patella fracture was 13 weeks. Good results were observed in transverse fractures of patella treated by tension band wiring. It is less expensive and is a simple procedure with a short period of learning curve. Chatakondu SC et al.[11] in his study of tension band wiring in patella fractures using stainless steel wire concluded that patients whose fractures were fixed with stainless steel achieved union with good re-establishment of knee function. Mehdi et al.[12] studied the outcomes in 203 patients with patella fractures operated by tension band wiring technique and were followed up for 6 years.

The mean age of study group was 36 years. 83 % showed excellent to good outcome and 17 % had fair to poor outcome. Commonest side effects were pins loosening (10 %), non-union (4 %) & osteoarthritis (5.8 %.) Chen A et al. studied and followed up 38 patients of transverse patellar fracture for 2 years and observed that the metallic tension band fixation can be used in treating patella fracture with no need for another surgery for implant removal when bone union has achieved. Gosal HS, Singh P et al.[13] in his study of use of metal wire & non absorbable polyester for tension band wiring in patellar fractures concluded that out of 37 cases, excellent results were seen in 34 cases. Ozdemire et al.[14] conducted a study with 20 patients on fracture of patella treated with modified tension band wiring and concluded good & fair results 55 % & 35 % patients respectively. Gumula et al.[15] observed 45 patients with patella fracture out of which 20 patients were treated with tension band wiring, 14 patients treated with partial patellectomy & 11 patients treated by total patellectomy. The final outcome concluded that most of good and excellent results were reported in patients treated with tension band wiring. Maini Ps et al.[16] in his study concluded that 70 % of patella fractures were transverse type in their study. One patient had superficial infection due to stitch abscess which resolved after suture removal and antibiotic treatment. Out of 30 patients, 8 patients had extensor lag. Yang Kh, Byun et al.[17] clinically assessed comminuted fractures involving inferior pole of the patella treated with distinct vertical wiring technique. All the fractures united at a mean of seven weeks (6 to 10). No post-operative infection or breakage of wire was seen. This technique preserved length of patella and also helped in allowing early mobilization of knee. Gardner Michael J et al.[18] stated that tension band fixation done anteriorly was the definitive treatment of patella fractures & gives most reliable results in simple transverse fracture patterns. Kin J Y et al.[19] stated that tension band wiring done using stainless steel wire gives excellent clinical & radiologic results in transverse patella fracture.

Hoshino et al.[20] in his retrospectively studied surgically treated patellar fracture patients concluded that implant was removed electively in 37 % & 23 % of patients treated correspondingly with K-wires & cannulated screws. Della Rocca G J[21] concluded that displaced patella fractures effects disturbance to the extensor mechanism of the knee. Prerequisite for unassisted gait is an undamaged extensor mechanism. Therefore, operative treatment of the displaced patella fracture is largely recommended. Tarek et al.[22] in his study of patella fracture among 30 patients treated with tension band wiring showed knee society score excellent in 75 %, good in 20 % patients and fair in 5 % of patients. Sudheendra P et al.[23] in his study of transverse patella fracture treated with tension band wiring shows, in nearly 84 % of cases, radiological union was seen by 16 weeks in almost all cases. Mean union time was 15 weeks. More than 75 % patients had no pain or only mild pain. Only 10 (23.3 %) patients had noteworthy extensor lag. Quadriceps strength was normal in almost 2/3 of the patients. In his study, 97.7 % patients had full range of knee flexion. Excellent results were achieved in 58 % (25 cases), good in 16 % (7 cases) fair in 18.6 (8 cases) & poor in 4.7 % (2 cases). Hanumantharaya et al.[24] study on tension band wiring technique in patellar fracture had excellent results in 75 % cases and good results in 18 % cases.

The treatment of patella fracture may be either operative or non-operative. Conservative treatment has been limited to fracture with less than 2 mm articular displacement or fracture displacement less than 3 mm Patella fracture with rupture of quadriceps mechanism and displacement of patellar fragments > 3 mm should be internally fixed. There are many surgical techniques for open reduction and internal fixation of transverse fracture of patella but at the degree of 90° of flexion of knee joint articular surface was distracted by posterior angulation of fracture fragment (Weber et al.). In this prospective study, 35 transverse fracture patellae were treated with modified tension band wiring and the following results were obtained.

Comparison of Age Distribution

In this study, among 35 cases, age of patient ranges from 20 - 60 years with mean age of 43 years. Maximum patients were in the age group of 50 - 60 years (40 %). Youngest patient was of 21 years and oldest was 60 years.

Comparison of Gender Distribution

In this study, a predominance of male patients was seen, accounting for 25 (71.42 %) and females were 10 (28.58 %).

Comparison of Side of Injury

Among 35 cases, 22 (62.86 %) were on right side and 13 (37.14 %) were on left side.

Comparison of Causes of Injury

Out of 35 cases, 22 (62.86 %) were due to road traffic accidents and 13 (37.14 %) were due to direct injury from fall.

Type of Fracture

Majority of cases in this study were closed type (74.28 %) and rest were open type (25.71 %).

Complications

In this study, following complications were observed in the follow up period. Out of 35 patients, 7 (20 %) had pain on squatting, 3 (8.57 %) had limitation of flexion, extensor lag was seen in 2 (5.71 %), superficial skin infection was seen in 2 (5.71 %). One patient had loss of fixation in the post-operative period. None of the patients had refracture. The observations are comparable with the following studies.

Study	Percentage
Srinivasulu et al.[1]	10 %
Maini et al.[16]	26.6 %
Sudheendra.P R et al.[23]	23 %
Hanumantharaya G H et al.[24]	0 %
Bostman et al.[25]	20 %
This study	5.71 %

Table 3. Comparison of Extensor Lag

Study	Percentage
Smith et al.[6]	12.64 %
Sudheendra et al.[23]	13.7 %
Nummi et al.[26]	11 %
Gangadhera Reddy et al.[27]	1.7 %
Muraleedhar et al.[28]	5 %
This study	2.85 %

Table 4. Comparison of Infection Rate

Study	Percentage
Smith et al.[6]	4 %
Maini et al.[16]	3.3 %
Gangadhera Reddy et al.[27]	3.3 %
Muraleedhar et al.[28]	5 %
Sreenivas et al.[29]	0 %
This study	5.71 %

Table 5. Comparison of Loss of Fixation

Study	Time for Union
Hung L.K et al.[30]	12 weeks
Smith et al.[6]	16 weeks
Hanumantharaya GH[24]	12 weeks
Berg E E et al.[10]	13 weeks
Sreenivaslu et al.[1]	12 - 16 weeks
This study	11 - 13 weeks

Table 6. Comparison of Fracture Union Time

The union period in this study was observed as 11 - 13 weeks in 94.28 % of patients while 2 (5.71 %) showed union in more than 13 weeks.

The final outcome was measured by good fellows grading. According to this study, 85.71 % had excellent to good functional outcome and remaining 14.28 % patients had fair outcome.

Study	Excellent	Good	Fair	Satisfactory	Poor
Sudheendra et al.[23]	58 %	16 %	18.6 %	7.4 %	0
Maini at al.[16]	73.4 %	16.6 %	10 %	0	0
Sanchetti et al.[2]	73 %	13 %	9.5 %	0	0
Ozdemir et al.[14]	55 %	25 %	20 %	0	0
Hanumantharaya GH[24]	75 %	18.8 %	6.2 %	0	0
This study	62.85 %	22.85 %	14.28 %	0	0

Table 7. Comparison of Outcome

Summary

This is a prospective study for finding out the functional outcome of transverse patella fracture treated by tension band wiring technique over a period of 6 months in Department of Orthopaedics, Government Medical College, Thrissur.

In our study, 35 cases were followed up for 6 months. As per our study, treatment of patella fracture with tension band wiring is a definitive treatment with minimal complications and good functional outcome. It also helps for early mobilization in the post-operative period. The results of our study are comparable with other studies in the literature review.

CONCLUSIONS

50 - 60 years age accounted for maximum number of patients. Incidence is more common in males. Right sided injury is the more common than left side. Road traffic accidents were found to be the major cause. Most of the fractures were of closed type. About 74 % of cases were operated within 3 days. Only few complications occurred, with major share belonging to pain on squatting. Majority of patient treated with tension band wiring for patella fracture had excellent to good outcome

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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