ORIGINAL RESEARCH PAPER

Orthopaedics

COMPARISION OF HORIZONTAL & VERTICAL FIGURE OF 8 TENSION BAND WIRING IN TRANSVERSE AND DISPLACED FRACTURE PATELLA

KEY WORDS: Tbw, Figure Of 8, Inter-fragmentary Compression

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ABSTRACT

INTRODUCTION : Fractures of the patella constitute almost 1% of all skeletal injuries, resulting from either direct or indirect trauma. Patellar fractures are classified as- transverse, longitudinal, polar or comminuted). However, 30 % of patella fractures require surgical intervention. Most commonly, tension band wiring utilizes two K wires and a vertically or horizontally oriented Figure of 8 construct using Stainless steel wire.

AIMS : To compare the results of vertically oriented figure of 8 tension band wiring versus horizontally oriented figure of 8 tension band wiring for displaced transverse fracture of patella in adults.

MATERIAL & METHODS : 32 patients coming at OPD & emergency of Department of Orthopaedics with displaced transverse fracture patella with in age group of 18 – 60 years treated with Tension Band Wiring (TBW)- Vertical & Horizontally orientation.

RESULTS: In our study, 32 adult patients with displaced transverse fracture of patella were randomly allocated into two group i.e. Vertical group (treated with vertically oriented figure of 8 TBW) and Horizontal group (treated with horizontally oriented figure of 8 TBW). Patients from both groups reported mild pain at two weeks. Pain, which was subsided by 4 weeks. All fractures of both group united satisfactorily 4-5 weeks after surgery. Maximum mean knee flexion for Vertical group at 4 weeks, 8 weeks and 12 weeks post operatively was 105 degrees, 134 degrees and 137 degrees respectively. Maximum mean knee flexion for Horizontal group at , 4 weeks, 8 weeks and 12 weeks post operatively was 115 degrees, 134 degrees and 136 degrees respectively. Slippage of SS wire was a fairly common complication, occurring in 37.5 % in Vertical group and 25 % in Horizontal group & the complications had no negative impact on knee ROM.

CONCLUSION : Transverse fracture of patella in adults is best treated by open reduction and internal fixation using tension band wiring. Using a horizontal figure of 8 construct is theoretically superior to the more common vertical figure of 8 construct achieving better inter-fragmentary compression. But our study reveals the clinical & radiological outcomes of horizontal and vertical constructs to be almost identical.

INTRODUCTION

Patella fractures constitute almost 1% of all skeletal injuries, can occur due to both direct and indirect trauma.(1) Patellar fractures can be transverse, l ongitudinal, polar or comminuted. Any of these may be undisplaced or displaced.(2) Closed fractures with minimal displacement, minimal articular incongruity and an intact extensor mechanism can be successfully treated nonoperatively.(3) However, 30 % of patella fractures require surgical intervention.(4) Opinion differ as to the optimal treatment of displaced patellar fractures. Accepted methods include a variety of wiring techniques, screw fixation, partial patellectomy, and total patellectomy. (5) Tension band wiring for displaced transverse fracture of patella is a simple, inexpensive technique of fixing the fracture with good patient compliance and advantage of early mobilization of the joint. However, the technique has some disadvantages as second procedure is required for removal of the metallic implant t and risk of K wire sliding and causing skin problems.(6) Most commonly, tension band wiring utilizes two K wires and a vertically oriented Figure of 8 construct using Stainless steel wire. In theory, a horizontally oriented Figure of 8 construct using Stainless steel wire should cover more area of the patella and provide greater inter fragmentary compression and better functional outcomes and less complications as compared to the conventional horizontal figure of 8 construct.

AIMS AND OBJECTIVES

AIMS

To compare the results of vertically oriented figure of 8 tension band wiring versus horizontally oriented figure of 8 tension band wiring for displaced transverse fracture of patella in adults.

OBJECTIVES

To obtain satisfactory union of fracture.
To achieve full functional recovery of knee joint.
To minimize post operative complications.

MATERIALS AND METHODS.

1. **STUDY AREA:** The proposed study was an institution based, conducted at the Orthopaedics department of I.P.G.M.E.R.& S.S.K.M. Hospital, Kolkata, a tertiary health care center catering to people of West Bengal and adjacent states of Eastern India.
2. **STUDY POPULATION:** The patients coming to orthopaedics- OPD and emergency with displaced transverse fracture of patella.
3. **STUDY PERIOD:** From Jan 2017 to December 2019 (24 months duration)
4. **SAMPLE SIZE:** 32 (Thirty two)
5. (**STUDY AREA:** Department of Orthopaedics, Institute Of Post Graduate Medical Education & Research, Kolkata

INCLUSION CRITERIA:

1. Adult Age group (18-70 year)
2. Type of fracture: displaced transverse patella fracture
3. Fracture of duration <3 weeks
4. Those willing to participate in the study through signing of consent form

EXCLUSION CRITERIA:

1. Patients with comorbid conditions not fit for surgery
2. Undisplaced fracture
3, Polytrauma injury of ipsilateral limb
4. Unsalvageable distal limb due to vascular injury or any other reason
5. Comminuted fracture of patella
6. Old and neglected fractures (>3weeks)

6. **STUDY DESIGN:** This is an institution based, prospective longitudinal study
7. **PARAMETERS TO BE STUDIED:**

PRE OPERATIVELY :

Age, Sex , Side affected, Time interval between injury and surgery

POST OPERATIVELY :

Time taken for complete union of fracture, Knee range of movement, Complications such as post operative infection, soft tissue giveaway, displacement of fracture fragments, non union, slippage of SS wire, breakage of SS wire.

SURGICAL TECHNIQUE :

All surgeries were performed under spinal anaesthesia. After proper anaesthesia, patient was positioned supine, limb was scrubbed with antiseptic solution and draped maintaining asepsis. The patella was exposed via a midline longitudinal incision. After dissection of subcutaneous tissue, the fracture site was exposed and any defect in the extensor mechanism was noted. The defects in retinaculum usually extends several cm medially or laterally, or both. Reduction of fracture done by using two large towel clips. Two parallel 2.0-millimeter smooth K wires were inserted by ante grade (0 from inferior to superior direction, or alternatively by retrograde through the fracture site, which assures that the wires will be inserted slightly anterior to the mid-point. A 18-gauge SS wire is then passed across the anterior surface of the patella (either cross or not crossed) and passed directly behind the K wires. A figure of 8 pattern was then made either horizontally oriented or vertically oriented using the SS wire, keeping it flush with the patellar surface. To tighten the SS wires, the two ends are pulled away from the patella as the wires are twisted using a plier at the superolateral aspect of the patella. Simultaneously, another knot is given at the superomedial aspect using a K wire. Superiorly the K wire ends ware cut and twisted 180 degrees, and impacted into the quadriceps tendon. The inferior protruding ends of the K wire were cut short . Wound was irrigated with normal saline and the extensor retinaculum were repaired. After closure of wounds, sterile dressing done and compression bandage was applied from mid calf to mid thigh region.

Reduction held with towel clips & K- wires inserted from below upwards

Articular surface reduction confirmed radio logically

Vertical figure of 8 construct

Horizontal figure of 8 construct

POST OPERATIVE PROTOCOL, REHABILITATION & FOLLOW UP

- The knee was immobilized in a long knee brace immediately after surgery.
- Intravenous antibiotics & analgesia were given twice daily for 3 days.
- After 48 hours, dressing was changed taking sterile measures.
- Foot and ankle mobilizing exercises and static quadriceps exercises were encouraged from 1st post operative day
- Weight bearing allowed on the affected limb as per pain tolerance keeping long knee brace on.
- Patients were encouraged to do knee bending passively as per pain tolerance from the 2nd post operative day.
- After two weeks, sutures were removed, active ROM exercises of the affected knee was started along with increased static and dynamic quadriceps strengthening exercises.
- ambulation without long knee brace was encouraged from 2-3 weeks onwards.
- AP and lateral radiographs of the affected knee were obtained immediately after surgery, at 2 weeks, 4 weeks, 8 weeks and 12 weeks and thereafter at 6 months.

RESULTS

In our study, 32 adult patients with displaced transverse fracture of patella were randomly allocated into two group i.e. Vertical group (treated with vertically oriented figure of 8 TBW) and Horizontal group (treated with horizontally oriented figure of 8 TBW).

Mean age in Vertical & Horizontal group was 43.7 years & 45.6 years respectively.

Male : female sex ratio in Vertical group was 1.2 : 1 & Horizontal Group was 1.6 : 1.

In both Horizontal and Vertical groups, 62.5% of patients had a fracture in left patella, while remaining 37.5 % had fractured right patella.

The mean interval between date of injury and date of surgery was 9.4 days for Vertical group & 7.1 days in Horizontal group.

Patients from both groups reported mild pain at two weeks.

Pain, however, was not reported at 4 weeks by both groups.

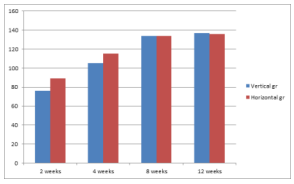
Knee radiographs of both groups showed signs of union by 4-5 weeks after surgery.

Maximum mean knee flexion for Vertical group at 2 weeks, 4 weeks, 8 weeks and 12 weeks post operatively was 76 degrees, 105 degrees, 134 degrees and 137 degrees respectively.

Maximum mean knee flexion for Horizontal group at 2 weeks, 4 weeks, 8 weeks and 12 weeks post operatively was 89 degrees, 115 degrees, 134 degrees and 136 degrees respectively.

Slippage of SS wire was a fairly common complication, occurring in 37.5 % in Vertical group and 25 % in Horizontal group. No other complication was noted. SS wire slippage was unrelated to the age, gender, side affected or delay in surgery. In both groups, the complications had no negative impact on knee ROM.

COMPARISON OF ROM KNEE IN BOTH GROUP



DISCUSSION

Fractures of the patella constitute almost 1% of all skeletal injuries, resulting from either direct or indirect trauma. Patellar fractures are classified as- transverse, longitudinal, polar or comminuted. (7) Any of these may be undisplaced or displaced. Most fractures in reported case series are transverse. Closed fractures with minimal displacement, minimal articular incongruity and an intact extensor retinaculum can be successfully treated non-operatively using cylinder cast for 4-6 weeks. However, 30 % of patella fractures require surgical intervention.(7,8)

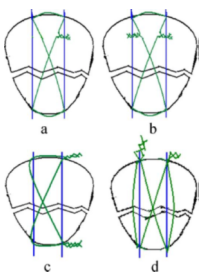
Fractures associated with retinacular tears leading to incompetent extensor mechanism, >3mm of fragment displacement or >2mm of articular incongruity and open fractures are best treated operatively. (5,9)

The goals of surgical intervention are :

- Maximal preservation of the patella to maintain its role in knee joint articulation and movement
- Restoration of the articular congruity of the patella
- Preservation of the functional integrity and strength of the extensor mechanism

Opinion differ as to the optimal treatment of displaced patellar fractures. Accepted methods include a variety of wiring techniques, screw fixation, partial patellectomy, and total patellectomy.

Tension band wiring for displaced transverse fracture of patella is a simple, inexpensive technique of fixing the fracture with good patient compliance and advantage of early mobilization of the joint.



a. Vertical figure of 8 with single superolateral knot
b. Vertical figure of 8 construct with two knots, superolateral and superomedial
c. Vertical figure of 8 construct with two knots, superolateral and inferolateral
d. Horizontal figure of 8 construct with two knots, superolateral and superomedial

THE PRINCIPLE OF TENSION BAND WIRING IS:

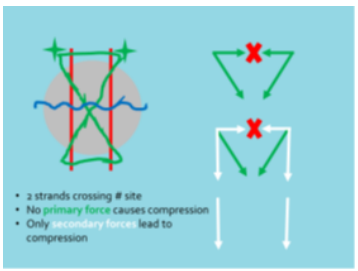
1) Conversion of the tensile forces generated from the quadriceps complex at the anterior cortical surface of the patella into compressive forces at the articular surface.
2) With progressive knee flexion, the passive tensile forces in the extensor mechanism increase inter-fragmentary compression at the articular surface.

It would be understandable to most surgeons that, in order to reduce the risk of displacement or failure, a construct that produces the greatest inter-fragmentary compression and has the maximum stiffness to resist cyclic loads should be used. It was also noted that tightening of the wire by twisting at two different sites compared to a single site has been shown to provide greater inter-fragmentary compression.

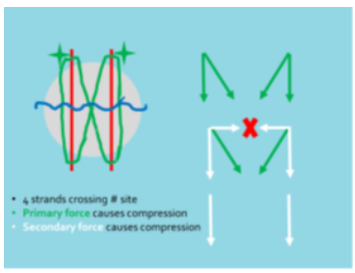
John et al. demonstrated improved stability if the wire twists were placed at the corners of the figure of 8 loop & also found that utilizing a horizontal figure of 8 with four strands crossing the fracture rather than the more common vertical tension band improved interfragmentary compression .(10)

In theory, a horizontally oriented Figure of 8 construct using Stainless steel wire should cover more area of the patella and provide greater inter fragmentary compression and better functional outcomes and less complications as compared to the former construct.

In many study, it was found that placement of the figure of 8 in a horizontal orientation with two wire twists at the corner improved interfragmentary compression by 63%. Permanent fracture displacement was 67% lower with horizontal figure of eight constructs ($p<0.05$; t test) (9,10)



Biomechanics of Vertical figure of 8 construct



Biomechanics of Horizontal figure of 8 construct

Keeping these principle and ideas in our mind, we conducted this study in our institute comparing the results of Vertically oriented figure of 8 tension band wiring vs Horizontally oriented figure of 8 tension band wiring in displaced transverse fracture of patella in adults.

CONCLUSION

Transverse fracture of patella in adults is best treated by open reduction and internal fixation using tension band wiring.

Using a horizontal figure of 8 construct is theoretically superior to the more common vertical figure of 8 construct achieving better interfragmentary compression as reported by biomechanical studies.

Our study also reveals the clinical outcomes of horizontal and vertical constructs to be almost identical.

LIMITATION OF OUR STUDY

This study was not without limitations. Sample size was small and evaluation of only short term outcomes was done. As this was not a multi-centric and multi-observer study, biasness may be there for the chosen surgical methods.

ACKNOLODGEMENT :

we would like to thank all of our patients for their co-operation

DECLERATION

FUNDING : None

CONFLICTS OF INTEREST : None

ETHICAL APPROVAL :

Institutionat Ethical comettee Approval taken

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