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Case Series

Orthopaedics Section

Comminuted Patella Fracture and its Non-union Treated with Modified Cerclage Wiring (Wire Mesh Technique): A Case Series

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ABSTRACT

Non-union of the patella is relatively rare, occurring in 2.4-12.5% of cases, yet it frequently requires surgical treatment due to discomfort and functional impairment. The proximal fracture fragment is usually displaced by the quadriceps, resulting in a gap that hinders recovery. Managing non-union in comminuted patella fractures is extremely challenging due to the presence of numerous tiny pieces and difficulties in attaining stable fixation. The present case series presents an innovative cerclage wiring procedure, referred to as the "Wire Mesh Technique," employed for patients with comminuted patellar fractures and non-union. The present case series included three male patients aged 35, 42, and 66 years, each exhibiting non-union of comminuted patella fractures subsequent to trauma. All patients experienced difficulty bearing weight and extending the affected knee, characterised by extensor lag and limited range of motion. Radiographic assessments confirmed non-union of the patella in every case. After clinical and radiographic evaluation, the wire mesh procedure was utilised to address insufficient healing and the complex arrangement of fragments. Postoperative rehabilitation included early in-bed mobilisation and quadriceps exercises starting on day zero, walker-assisted non-weight bearing on day two, and gradual range of motion exercises initiated on day ten. Full weight-bearing began at two months. Postoperative imaging showed optimal implant placement and medullary healing. Patients successfully regained weight-bearing capacity and experienced enhanced knee flexibility and motion. This approach reduces circular tension and improves stability, facilitating rapid mobilisation and positive outcomes in complicated patellar fracture non-unions.

Keywords: Extensor mechanism reconstruction, Internal fixation, Orthopaedic surgical technique, Postoperative rehabilitation

INTRODUCTION

Patella fractures constitute 1% of all skeletal fractures and are common around the knee joint [1]. While non-union of the patella is relatively uncommon, occurring in only 2.4-12.5% of cases, it typically warrants early surgical intervention [2]. A gap at the fracture site arises due to the quadriceps anchoring to the proximal part of the fracture, displacing the fragment proximally; if this gap is too large, it can lead to failure of fibrous union and extensor lag [3]. In rare cases, the femoral condyles may be discernible beneath the skin at the fracture location.

While non-union of the patella may be acceptable for patients with low functional demands, surgical intervention is necessary for active patients with high functional demands. The aim of surgery is to restore the quadriceps mechanism, allowing for knee extension without compromising the full range of motion. However, surgical options are limited and often yield unpredictable outcomes. Various treatment modalities include Open Reduction and Internal Fixation (ORIF) with Tension Band Wiring (TBW), cancellous screws, cerclage with or without bone grafting, and partial patellectomy, all of which produce variable results [4].

Fixing patella fractures continues to pose challenges despite advancements in techniques. This case series advocates the use of a Modified Cerclage wiring (Wire Mesh) technique as an effective and optimal alternative to TBW in cases of non-union of comminuted patella fractures.

CASE SERIES

Case 1

A 35-year-old male presented with a history of a road traffic accident four months prior, where he sustained injuries to his right hip and right knee. He was diagnosed with an acetabular fracture of the right hip and a comminuted patella fracture of the right knee at the previous hospital where he was treated. The patient underwent acetabular fracture fixation with plating via the posterior approach and TBW for the patella fracture. He later presented with complaints of inability to bear weight on his right lower limb and difficulty extending his knee.

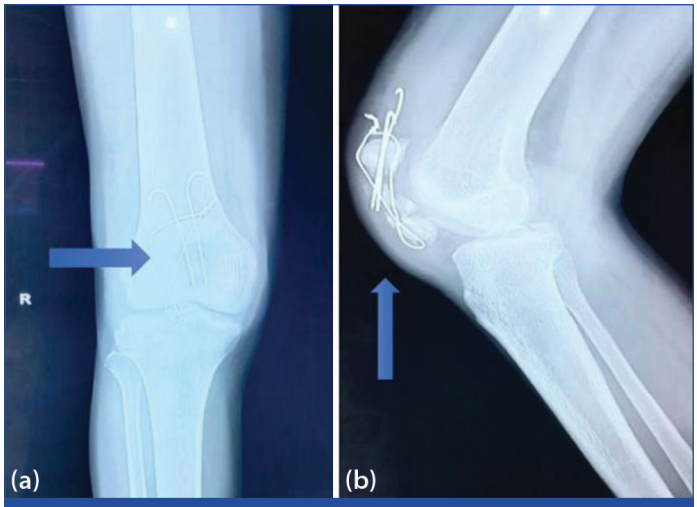
On examination, a previous surgical scar was noted. Extensor lag was present at 30 degrees, with further active range of motion from 30 to 160 degrees. He was unable to perform straight leg raises with the right lower limb. There were no distal neurovascular deficits.

Preoperative radiographs of the right knee (anteroposterior and lateral views) showed non-union of the comminuted patellar fracture with tension band wire in situ [Table/Fig-1a,b]. The patient was taken for removal of the implants, freshening of the fracture ends, and fixation of the fragments with the Modified Cerclage wiring technique (mesh wire technique) [5].

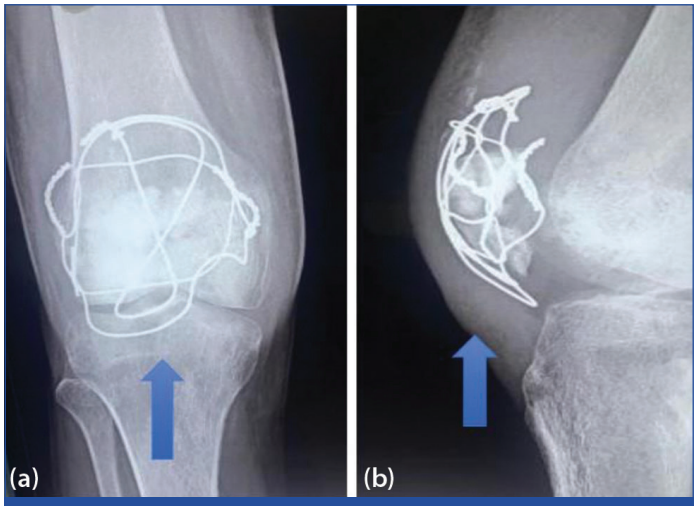
Four months postoperatively, the patient could perform straight leg lifts without extensor lag and achieved complete knee range of motion (0-160°). The surgical site had healed adequately, with no ongoing discomfort. Postoperative radiographs demonstrated proper implant placement and fracture healing [Table/Fig-2a,b]. Functional recovery is illustrated in [Table/Fig-3a,b].

Case 2

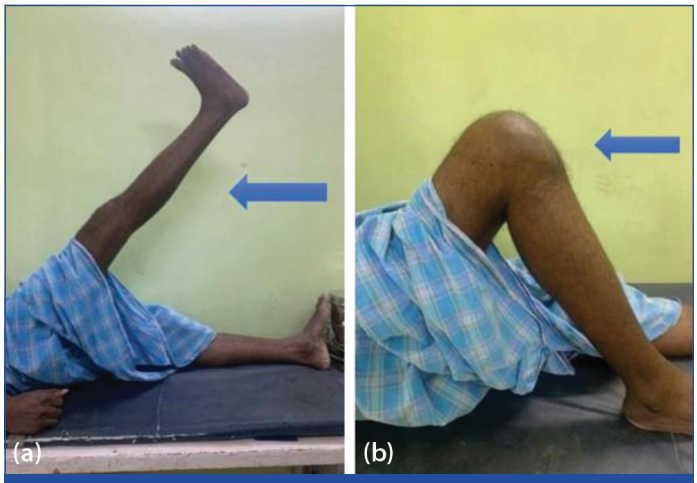
A 42-year-old male presented with a history of a road traffic accident seven weeks prior to his visit, during which he sustained an injury to his right knee. The patient was unable to bear weight on his right lower limb.



[Table/Fig-1]: a) Anteroposterior view and b) Lateral view of the right knee illustrating the Modified Cerclage (Wire Mesh) arrangement employed for fixation. The blue arrows denote the location of the cerclage wires stabilising the comminuted patellar fragments.

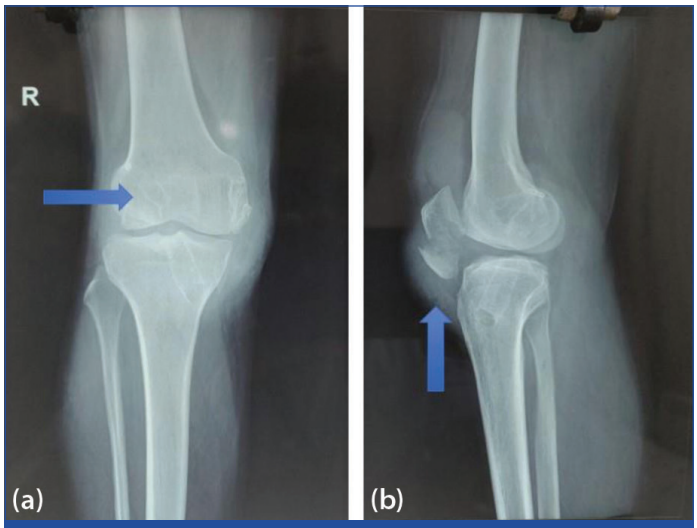


[Table/Fig-2]: Radiographs four months postoperatively a) Anteroposterior view and b) Lateral view of the right knee illustrating the Modified Cerclage (mesh wire) fixation technique. The implant is appropriately positioned, exhibiting signs of osseous union. The blue arrows denote the cerclage construct that stabilises the comminuted patellar fragments.



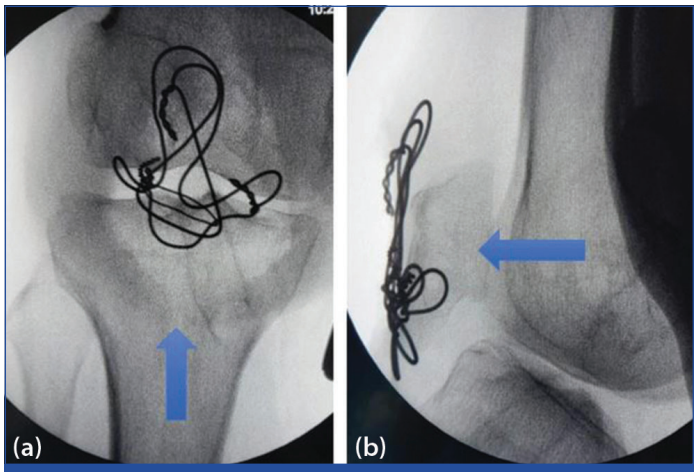
[Table/Fig-3]: Clinical image of patient after follow up period 4-month: a) Patient able to perform Straight right leg raising; b) Showing knee flexion being performed by patient. The blue arrow indicates the leg raising and knee flexion by patient.

Upon examination, he exhibited diffuse swelling and tenderness over the knee joint, with a restricted range of movement (flexion 0-60 degrees). He was unable to perform the straight leg raising test, and there was no distal neurovascular deficit. Preoperative radiographs of the right knee (anteroposterior and lateral views) revealed non-union of a comminuted transverse patella fracture with an implant over the posterior aspect of the femoral condyle [Table/Fig-4a,b]. The patient underwent ORIF using Modified Cerclage wiring.



[Table/Fig-4]: Preoperative radiographs of the right knee: a) Anteroposterior view; and b) Lateral view showing non-union of a comminuted patellar fracture. The blue arrows indicate the fracture fragments and the posteriorly displaced implant over the femoral condyle.

Four months postoperation, the patient exhibited no extensor lag, successfully performed straight leg raises, and attained full knee range of motion (0-160°). He was able to bear weight without any support. Postoperative radiographs confirmed the position of the implant and the union of the fracture. Intraoperative fluoroscopic images of the right knee (anteroposterior and lateral views) showed the implant in a satisfactory position with adequate reduction [Table/Fig-5a,b]. Unfortunately, postoperative functional photographs were unavailable for this case.

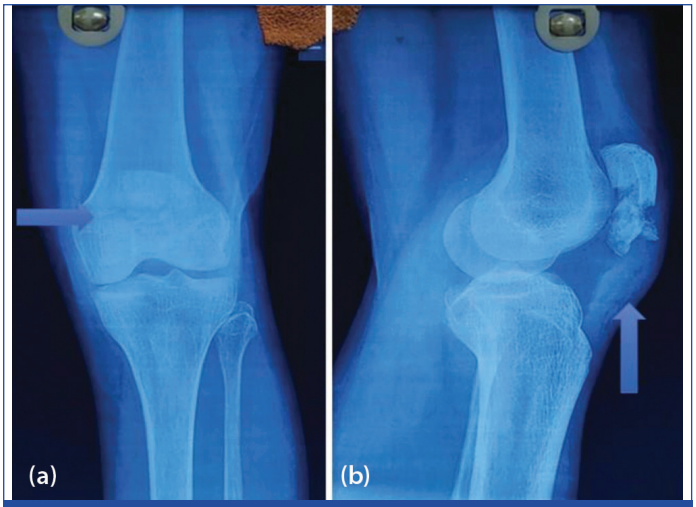


[Table/Fig-5]: Intraoperative fluoroscopic images: a) Anteroposterior and b) Lateral views showing satisfactory implant position with anatomical reduction of the comminuted patellar fracture. The blue arrows indicate the site of fracture reduction achieved with the wire mesh construct.

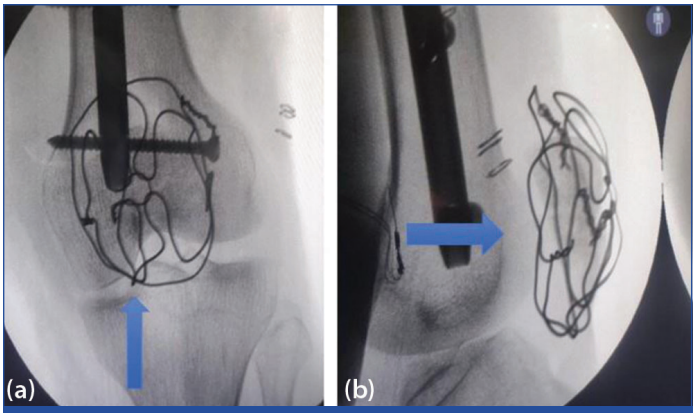
Case 3

A 66-year-old male presented with a history of a slip and fall at his residence, resulting in an injury to his left knee. The patient was unable to move his left lower limb and could not bear weight on it. Upon examination, he had swelling over his left knee with tenderness localised to the patella, and flexion was restricted from 0-50 degrees. He was unable to perform the straight leg raising test but had no distal neurovascular deficit. Radiographs of the left knee (anteroposterior and lateral views) revealed a comminuted patella fracture [Table/Fig-6a,b]. ORIF using the Modified Cerclage wiring technique were performed. Intraoperative fluoroscopy images are presented in [Table/Fig-7a,b].

At four months post-surgery, the patient was able to move around independently, execute straight leg raises, and exhibited full knee range of motion (0-160°) without extensor lag. The surgical incision

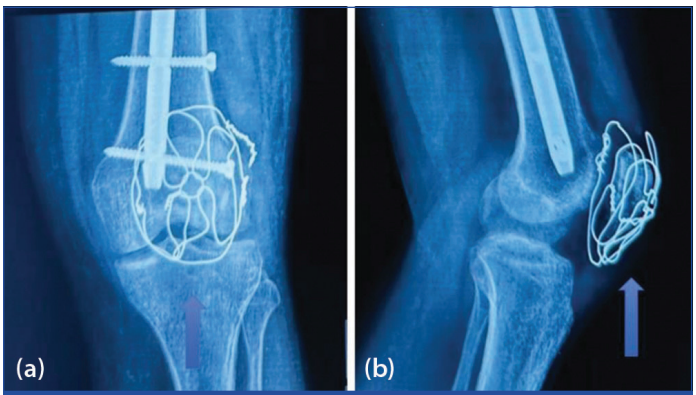


[Table/Fig-6]: Preoperative radiographs of the left knee showing: a) Anteroposterior and b) Lateral views. The blue arrows indicate a comminuted fracture of the patella, with significant displacement and fragmentation visualised on the lateral view.



[Table/Fig-7]: Intraoperative fluoroscopic images showing: a) Anteroposterior and b) Lateral views of the left knee. The blue arrows indicate the comminuted patellar fragments stabilised using the Modified Cerclage (wire mesh) technique. The implant is seen in satisfactory position with adequate anatomical reduction.

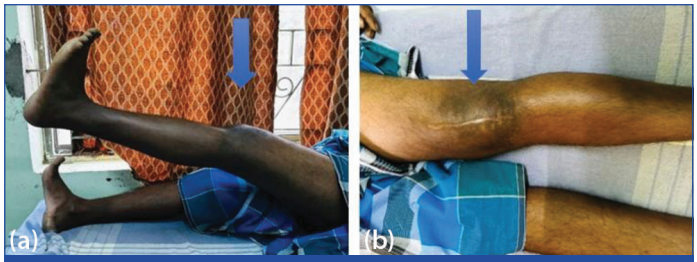
healed without complications [Table/Fig-8a,b]. Postoperative radiographs confirmed union and stability of the implant. The postoperative clinical assessment demonstrated functional recovery, with no extensor lag and a properly healed incision [Table/Fig-9a,b].



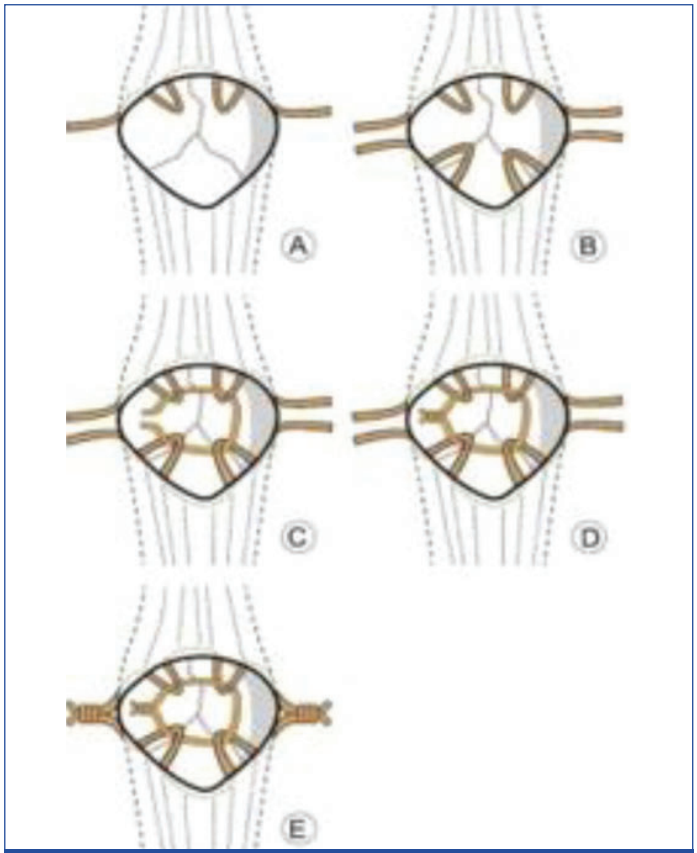
[Table/Fig-8]: Four-month postoperative radiographs of the left knee showing: a) Anteroposterior and b) Lateral views. The blue arrows highlight the fracture site with evidence of bony union. The implant remains in satisfactory position, and no signs of hardware failure or displacement are noted.

Surgical Technique: The surgical procedure performed in all cases was ORIF via Modified Cerclage wiring (the Wire Mesh Method) [Table/Fig-10] [6]. All surgeries were conducted under spinal anesthesia, with the patient in the supine position and the affected knee in complete extension.

A midline anterior incision was made over the prior surgical scar in Case 1. The superficial layer of fascia was incised, exposing the fractured patella, which displayed non-united fragments. The



[Table/Fig-9]: Postoperative clinical images showing functional recovery. a) Patient performing straight leg raise without extensor lag, indicating good quadriceps strength and functional extensor mechanism; b) Healed midline surgical scar over the anterior knee with no signs of infection or gapping. Blue arrows indicate the surgical site.



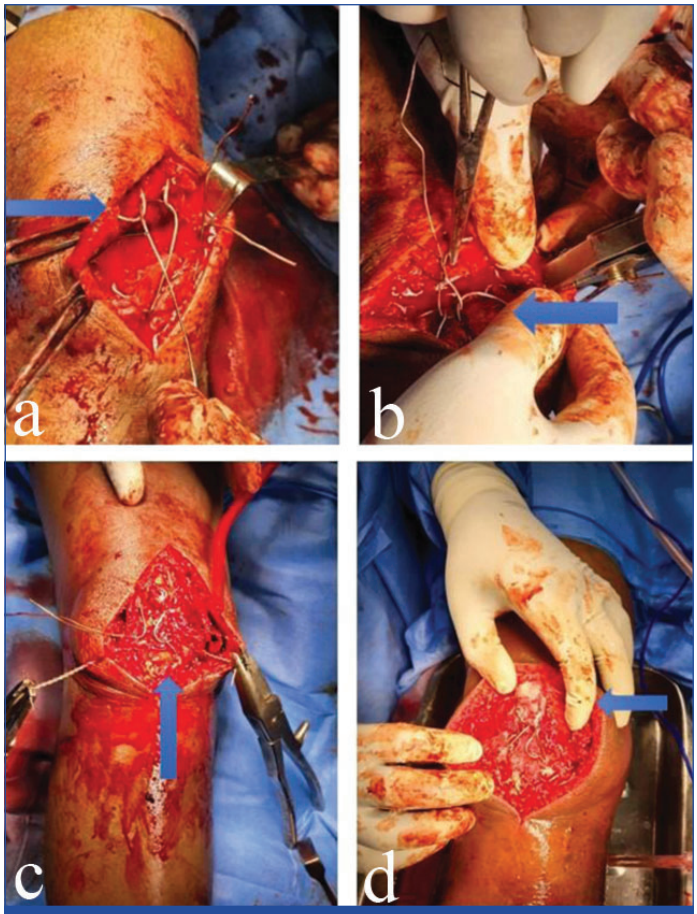
[Table/Fig-10]: Showing the steps of Modified Cerclage wiring (Mesh wire) technique: a) Suturing of half of the patella intermittently; b) Suturing of other half of patella intermittently; c) Third wire introduced through reserved loops; d) Tightening of third wire; e) Tightening of remaining ends of first and second wires used simultaneously without overtightening [6].

previous implant was excised, and the fracture edges were debrided. The fragments were anatomically realigned and temporarily secured with Kirschner wires. Intraoperative fluoroscopy was employed to verify the congruity of the articular surface.

The first wire was sutured intermittently around the upper half of the patella, leaving loops. The second wire was placed around the lower half in a similar fashion [Table/Fig-11a,b]. A third wire was passed through these loops across the anterior patellar surface and tightened. Two surgeons concurrently adjusted the first and second wires to optimal tension [Table/Fig-11c,d]. Final congruity was reverified with fluoroscopy. The wire terminals were buried and removed to prevent postoperative irritation.

A supplementary figure-of-eight stainless steel wire was used to enhance construct stability in Case 1. With the knee in flexion, the anterior patellar retinaculum was sutured, and the wound was closed in layers.

A typical midline incision was performed in Cases 2 and 3 (not over a previous scar). These steps were performed similarly to Case 1. No prior implants were present, and no figure-of-eight wire was necessary in these cases. No other notable intraoperative variations were observed.



[Table/Fig-11]: Intraoperative steps of Modified Cerclage (wire mesh) fixation: a) Cerclage loops passed over patellar fragments; b) Third wire tightened for reinforcement; c) Sequential tightening of wires for compression; d) Wire ends cut and buried. Blue arrows indicate key steps in stabilisation of the comminuted fracture.

DISCUSSION

Conventional techniques such as tension band wiring, cerclage wiring, screws, and partial patellectomy exhibit limitations in managing compressed patellar fractures due to instability, hardware issues, or impaired knee function. The capitalise M cerclage wiring (Wire Mesh) approach [7] offers consistent compression, while an anterior third wire counteracts flexion forces, ensuring improved stability and facilitating early movement.

Outcomes frequently vary based on fracture type, the patient's overall health, and the treatment method employed [7]. Nonsurgical management is generally used for low-demand patients with higher morbidity. The union rate and return to functional activity are often inadequate when management is delayed or disorganised. In contrast, patients treated with well-structured strategies-such as prompt surgical fixation, early conservative management with immobilisation, or elective surgical intervention following initial stabilisation-generally experience enhanced functional results.

Sun Y et al., (2019) managed 38 comminuted patella fractures using the mesh wire approach, reporting exceptional results with minimal complication rates [6]. Additional research conducted by Harna B et al., (2021) corroborates the efficacy of Modified Cerclage techniques for increasing stability, promoting prompt mobilisation, and enhancing functionality in complex patellar fractures and non-unions [8].

Each proposed treatment method has its reasons for failure, such as circumferential cerclage wire fixation lacking a fixed and stable fracture site, leading to complications like wire loosening. Cerclage wiring is frequently used to complement other fixation measures. This technique provides additional stability and support during the healing process [9].

The TBW using the Association for the Study of Internal Fixation (AO) technique may not be suitable alone for comminuted patellar fractures. When multiple wires and tension bands are used, complications such as wire migration and broken K-wires are common [10]. The major disadvantage of TBW is symptomatic hardware, which has compelled many surgeons to avoid this technique. Reports indicate that symptomatic hardware removal occurred in up to 36.8% of these cases [11].

Partial patellectomy has several drawbacks, such as delayed rehabilitation, reduced range of motion, persistent pain during extension, and overloading of the knee joint. This procedure decreases the lever arm of the quadriceps mechanism, resulting in an eccentrically loaded knee joint, which can lead to early degenerative changes [7].

The Modified Cerclage technique, also known as the "Wire Mesh" technique, minimises circumferential tension over the fracture fragments and transforms it into compression with one wire. An additional wire positioned anterior to the patella helps neutralise the tensile forces produced during knee flexion. This provides a robust and secure construct, allowing patients to begin exercises promptly and yielding positive clinical outcomes [12]. Therefore, the present study proposes a modified wire mesh technique, similar to that reported by Sun Y et al., for treating acute comminuted patella fractures and their non-union [6].

CONCLUSION(S)

Non-unions of comminuted patella fractures present a formidable challenge for management using traditional fixation techniques due to the intricacies of reducing many small fragments and the resultant instability. The Modified Cerclage wiring method (Wire Mesh Method) demonstrated in this case series provides a promising alternative. It offers a strong and sturdy framework that promotes early mobilisation, aids functional recovery, and shows adequate radiological union with few complications. This method is valuable for managing complex patellar non-unions and could be a significant addition to the surgical repertoire for orthopedic surgeons tackling these challenging situations.

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