

Original Article

Transverse patellar fracture fixation with tape cerclage in a patient with a history of complicated contralateral patellar fracture fixation with metallic hardware

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Abstract: Patellar fractures are relatively uncommon; transverse displaced patellar fractures need surgical treatment, and the most widely used technique requires the use of metallic hardware. Despite good clinical outcomes, there are some possible complications related to the hardware. In this paper, we report a case of a 61 years-old woman that presented in 2001 with a fracture of the right patella that was treated with metallic hardware in another Hospital. After two months, the patient reported an infection of the hardware that became osteomyelitis, requiring several surgeries before achieving complete healing. The infection was eradicated, and the patient reached a good functionality of the right knee after two years from the first surgery. In 2019, she presented in our hospital with a displaced transverse fracture of the left patella. After a careful evaluation of the case, considering all the patient's comorbidities, allergies and the complications related to the previous treatment of the right patellar fracture, we decided to treat this fracture with non-metallic hardware (FiberTape Cerclage, Arthrex Inc., Naples, FL, USA). After surgery, the patient did not report any complications; the fracture was healed at the last x-ray follow-up (6 months), and the patient reached a good functional outcome of the left knee. Based on this case report, in this particular patient, the use of non-metallic hardware for patellar fracture fixation allowed us to obtain good results with no complications. However, this is only a case report, so the reliability of the proposed treatment cannot be directly concluded. Moreover, on the base of this case report, it is not possible to extrapolate the result in the routine treatment of patellar fractures.

Keywords: Patellar fractures, metallic hardware, symptomatic hardware, allergy, infection, suture tape

Introduction

Patellar fractures represent approximately 1% of all skeletal injuries, and the most common pattern is a transverse fracture, classified according to the *Arbeitsgemeinschaft für Osteosynthesefragen* (AO) guidelines as AO/OTA 34-C1/34-C2 [1]. Although fracture with minimal displacement and intact extensor mechanism can be treated conservatively, displaced fracture and an injured extensor mechanism required surgical treatment [2, 3]. Over the years, several different surgical techniques have been proposed for patellar fractures with different outcomes. According to the AO guidelines, the most frequently used technique for transverse and comminute patellar fractures is the modified tension band wiring, and also the

circumferential cerclage is widely used [1, 2]. All of these techniques involve metallic wires and, despite good clinical outcomes, can lead to symptomatic hardware, infection, hypersensitivity reactions, hardware migration or breakage that result in a second surgery to remove the hardware, in a percentage ranging between 0 and 60% [3-6]. Moreover, the rate of infection after open reduction and internal fixation (ORIF) of patellar fractures ranges from 2 to 10% [4].

Several studies have evaluated the risk factors of infection after internal fixation demonstrating that, while many of these are patient-related such as diabetes mellitus, tobacco smoking, history of stroke, heart failure and multiple previous operations, other are modifiable factors like antibiotic prophylaxis, and the number or

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Figure 1. Pre-operative x ray showing displaced transverse fracture (AO/OTA 34C1.3) of the left patella. A. AP view. B. Lateral view.

the size of the hardware used [3, 7-9]. Moreover, risk factors for cutaneous metal hypersensitivity are female sex, piercings (ears), history of hand eczema, metal allergy in a first-degree relative, history of smoking, and previous arthroplasty surgery [10]. This report is based on a patient who sustained a displaced fracture of the right patella in 2001 treated with modified tension band fixation that required, over time, several surgeries for osteomyelitis and hardware discomfort. Subsequently, the patient had a displaced fracture of the left patella in 2019, treated in our hospital. After evaluating the patient's medical history and comorbidities, showing an increased risk of infection or allergy, the fracture was treated with a suture tape cerclage instead of a metal device.

Case report

The patient was a 61-years-old woman who came to the emergency department of our hospital in September 2019 after direct trauma to the left knee occurring in a car accident. The clinical presentation consisted of pain and swelling of the left knee, loss of functionality of the extensor mechanism and palpable defect on the patella. An arthrocentesis was performed and revealed the presence of a hemarthrosis (50 ccs).

The X-rays showed a displaced transverse fracture (AO/OTA 34C1.3) of the left patella (**Figure 1A, 1B**).

The patient was immobilised with a splint, began therapy with nonsteroidal anti-inflammatory drugs (NSAIDs) and Enoxaparin sodium 4000 I.U. once a day and was admitted in our department for surgical treatment.

Medical history

The patient had a medical history of several pathologies like arterial hypertension, diabetes mellitus type II, chronic obstructive pulmonary disease, asthma, rectum sigmoiditis, cirrhosis and two herniated discs (L1-L2 and L5-S1). She had undergone numerous surgeries: appendectomy, hysteroannexiectomy, abdominal aortic aneurism treated with endoprosthesis, thromboendarterectomy of the left carotid artery, a stent of the common carotid artery and saphenectomy.

She was a poly-allergic patient with a referred allergy to levofloxacin, nylon, povidone-iodine, synthetic glues, NSAIDs, thiocolchicoside and tramadol.

She also reported a comminuted fracture of the right patella and a fracture of the right acetabulum both occurred after a road traffic injury in 2001. The fracture of the right patella occurred in June 2001 and was treated in another Hospital with a modified tension band wiring. After two months from surgery, she reported a delayed infection of the knee caused by *Staphylococcus epidermidis*. She underwent antibiotic therapy, first with ceftriaxone and cephalosporins, and then with teicoplanin and ciprofloxacin, associated with magnetotherapy. Due to the persistence of osteomyelitis, the patient underwent revision surgery with removal of the metallic hardware. The patient was discharged with an extension brace with non-weight-bearing for four weeks. After this period, weight-bearing was allowed with crutches and brace; at this time, she started passive mobilisations of the knee.

Finally, after eight weeks, she removed the brace, was allowed to walk with full weight-bearing, and completed the rehabilitation programme for the recovery of range of motion (ROM). The patient referred that, subsequently,

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she suffered for a partial re-absorption of the right patella with a poor knee function and, after three months, she had another fracture of the right patella caused by low impact trauma, a fall during a walk. For this reason, the patient underwent further surgery for a soft and bone tissues curettage, a synthetic biocompatible tobramycin-laden bone graft, and a new osteosynthesis with three Kirschner wires and two metallic cerclages of the right patella. The post-operative protocol included the first period with non-weight-bearing and a brace locked in extension (four weeks). A second period in which a progressive weight-bearing was permitted and the patient started physiotherapy to recover ROM. After eight weeks, the patient reported exposure of the hardware, and for this reason, she underwent further surgery, consisting of a proximal hemipatellectomy and metallic hardware removal. She was discharged with a brace locked in extension for four weeks. She received a prolonged in-patient therapy at a rehabilitation centre to recover ROM and walk with progressive weight-bearing. Eight weeks after the operation, the patient was walking with the help of two crutches with partial weight-bearing and with active knee flexion allowed up to 70° and was discharged from the centre. Then, she started an outpatient rehabilitation programme with the progressive recovery of the knee joint ROM, and she could return to total autonomy at about four months postoperatively. Moreover, during this period, the patient underwent 12 months of hyperbaric oxygen therapy for the residual infection. The infection was declared eradicated two years after first surgery on the right patella, and at this time, the patient was able to walk without crutches, and the ROM of the right knee was 0-100°.

Treatment

After an overall assessment of the case, the patient's comorbidities and the many complications following the use of metallic hardware for the treatment of the fracture of the right patella, we decided to treat the fracture of the left patella with the FiberTape cerclage (Arthrex, Naples, FL, USA), that is a suture tape cerclage constituted by multi-ultra-high molecular weight polyethylene (UHMWPE) and polyester.

The patient also showed some of the risk factors for metal hypersensitivity [6]: female sex,

piercing (ears), history of smoking. Informed consent was obtained before the surgery and study enrolment.

Surgical technique

A transverse skin incision of 10 cm on the knee was made to expose the fracture. The fracture site was cleared using curettage and irrigation. A temporary reduction of the fracture was obtained using the clamps and checked under fluoroscopy. A 2.4 mm eyelet Kirschner wire (K-wire) was passed with a conventional drill into the upper pole of the patellar bone from lateral to medial. A straight blunt Deschamps needle was passed under the patellar tendon from medial to lateral, to obtain a circumferential loop, and the FiberTape was passed deeply through the patellar tendon. Once the patella was surrounded, the pretied knot of the cerclage was tensioned by the tensioner applying a force up to 80 pounds. The obtained reduction was checked under fluoroscopy; when satisfactory, three alternating half-hitches were tied with the aid of the tensioner, always applying a force up to 80 pounds to each one. The remaining suture tape was then cut. At the end of the surgery, standardised anteroposterior (AP) and lateral radiographs of the knee (in full extension) were obtained in the operating room.

After the surgery, the knee was immobilised in full extension for 30 days with a cast. The patient received, two weeks after surgery, medication and the removal of skin stitches. The skin was completely healed, and a new cast in extension was applied; a progressive weight-bearing was allowed using the crutches. After four weeks, the patient removed the cast, and an unlocked knee brace was applied. At this time, she began the rehabilitation protocol to reach full ROM and walking without crutches. At eight weeks, she was able to walk without crutches, she recovered full ROM, and she removed the knee immobiliser. Subsequent follow-ups consisted of radiographic evaluation at three months (**Figure 2A, 2B**) and six months (**Figure 3A, 3B**). At the final follow-up at six months, the patient underwent subjective evaluation using the Knee Society Score (KSS) and Knee injury and Osteoarthritis Outcome Score (KOOS) questionnaires. She reported a KSS subjective score of 100 and at KOOS a total of 84.8 points distributed as follows: symptoms

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Figure 2. Immediate post-operative X-rays. A. AP view. B. Lateral view.



Figure 3. Post-operative X-ray at 3 months of follow-up. A. AP view. B. Lateral view.



Figure 4. Surgical scars appearance at six months follow-up of both knees of the patient.

and stiffness 82.14%, pain 88.9%, function and daily living 91.2%, function, sports and recreational activities 40% and quality of life 87.5%. At this time, she achieved a range of motion of 0-120°, and she could walk without pain and had no discomfort of the left knee. The surgical scar was completely healed with no complications (**Figure 4**).

Discussion

Surgical treatment of displaced patellar fractures usually involves the use of metallic hardware. This treatment can lead to complications related to the metal, such as symptomatic hardware discomfort, hardware migration or breakage, infection or allergy [2].

The infection associated with internal fixation can occur preoperatively, intraoperatively, or postoperatively during disturbed wound healing [11, 12] and are classified as early with a typical onset less than two weeks, delayed infection between 2 and 10 weeks and late infection for more than ten weeks [13]. Several studies have analysed risk factors for infection, demonstrating that the most important are patient-related, such as tobacco smoking, diabetes mellitus,

history of stroke, heart failure, multiple previous operations; also the use of a drain is correlated with a possibility to develop an infection of the surgical site [3, 7-9, 13]. The infection rate subsequent ORIF of patellar fractures ranges from 2 to 10% [4]. The main goals in the treatment of the infections after internal fixation are the eradication or suppression of the infection until achieving fracture consolidation. Several factors play a role in the recovery from a hardware infection: the time interval between fixation and infection, the implant type, the timing of hardware removal, the presence of collections, non-viable bone, graft or substitute,

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Table 1. Studies included with outcomes

Reference	No. Of Fractures	Tension Band group			Metallic hardware group		
		Re-Operation n, (%)	Nonunion n, (%)	Infections n, (%)	Re-Operation n, (%)	Nonunion n, (%)	Infections n, (%)
Shea et al. [19]	87	2/13 (15)	1/13 (1)	0/13 (0)	32/74 (43)	14/74 (19)	0/74 (0)
Gosal et al. [5]	37	1/16 (6)	0/16 (0)	0/16 (0)	8/21 (38)	1/21 (%)	4/21 (19)
Camarda et al. [20]	123	4/123 (3)	2/123 (2)	0/123 (0)	Nr	Nr	Nr

Nr, Not Reported.

soft tissue and bone defect, joint involvement, host status and response to treatment [14, 15].

Moreover, it is essential to know if the patient had previous allergic or hypersensitivity reactions to metallic devices to plan the surgical intervention adequately. The most responses to orthopaedic devices are delayed-type (type IV), or delayed-type hypersensitivity reactions and the most frequently involved allergens are nickel, cobalt and chromium [10]. Risk factors for allergic or hypersensitivity reactions are female sex, piercings, history of hand eczema, metal allergy in a first-degree relative, history of smoking, following well-functioning arthroplasty and previously failed arthroplasty [10]. Patellar fractures have been routinely treated with metallic wire technique, and the incidence of hardware discomfort or hypersensitivity/allergic reaction can lead to hardware removal in up to 60% of cases [10].

Finally, the use of metallic hardware can lead to hardware breakage and migration, that is uncommon but can lead to severe consequences. Sharma et al. [16] reported a case of intra-articular migration of a metallic wire, Tamaki et al. [17] reported migration into the posterior septum of the knee and most extraordinarily, Biddau et al. [18] reported migration of a broken cerclage wire from the patella into the right ventricle of the heart.

Considering all the complications mentioned above related to the use of metallic wires for the treatment of patellar fracture in the last year different non-metallic internal fixation systems have been developed to decrease the complication rate associated with the use of metallic hardware. Several studies have been done about the potential advantages of using non-metallic hardware for the treatment of patellar fractures (**Table 1**). Shea et al. [19] con-

ducted a study in which eighty-seven patients underwent patella fracture fixation with suture fixation (transosseous sutures and figure-of-eight tension banding with FiberWire), hybrid fixation (transosseous FiberWire sutures and metal tension banding), or metal fixation. They compared the three groups and found that the reoperation rate was highest for metal fixation and hybrid fixation and lowest for suture fixation. Their findings showed that suture fixation results in the least amount of soft tissue irritation and lowest reoperation rate. Still, these advantages were negated with the addition of a metal tension band wire. Similarly, Gosal et al. [5] compared two different groups of patients who underwent surgery for patellar fractures: group 1 involved 21 patients treated with metallic hardware, group 2 included 16 patients treated with nonabsorbable polyester (5 Ethibond-Ethicon Ltd., Edinburgh, UK). During the follow-up were found 3 cases of infection in group 1 and no cases in group 2. The reoperation rate was 38% in group 1 and 6% in group 2. Recently Camarda et al. [20] retrospectively evaluated a case series of seventeen patients with displaced patellar fractures treated by open reduction and internal fixation with a modified tension band using FiberWires sutures showing satisfactory clinical results, with a low incidence of complications and reoperations. They concluded that FiberWire tension bands could be used in place of metal-wire tension bands to treat a patellar fracture, reducing the rate of symptomatic hardware.

More recently, Peeters et al. [21] conducted a review evaluating the differences between metallic and non-metallic cerclage techniques, looking at biomechanical, technical, and biological aspects. Their findings suggest that in the upper limb, a non-metallic cerclage technique might become the gold standard. In the lower limb, both metallic and non-metallic cer-

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clage techniques are paired and reliant on the indication.

This case report is based on a patient with several allergies and comorbidities who had a fracture of the right patella treated with tension band wiring and subsequently had several local complications requiring four additional surgeries including hardware removal, debridement, patellectomy, revision osteosynthesis and final hardware removal. The complete healing has been reached after two years from the first surgery. The patient came to our hospital in 2019 with contralateral patella fracture. After a careful evaluation of the patient's medical history, including comorbidities, allergies and risk factors for infections and hypersensitivity to metallic hardware, we decided to treat the fracture with a non-metallic device, the FiberTape cerclage.

At the last follow-up six months after the treatment of the right patella, the fracture was completely healed at X-ray evaluation, and the patient was declared completely recovered. The results of the clinical scores showed that patient had achieved satisfactory results based on her age, gender and BMI. She falls within the 8 points of difference compared to the standard of the healthy population and to the scores of the subscales, which denotes a clinically considerable difference compared to the healthy population [22]. The only exception is for the sports and recreational activities category, where the patient reported a significantly lower score. Still, we should consider that the patient was 61 years old, and she did not perform any sports activities even prior the surgical treatment.

Conclusions

Even if this is a case report and we cannot extrapolate this results to the routine treatment of patellar fractures, the use of non-metallic cerclage for patellar fracture fixation, as proposed in this case report, seems to show some possible advantages, such as a lower risk of hypersensitivity and local infections, more moderate hardware discomfort, possibly reducing the rate of hardware removal.

In this particular patient, the use of non-metallic hardware for patellar fracture fixation allowed us to obtain good results with no compli-

cations. However, this is only a case report, so the reliability of the proposed treatment cannot be directly concluded.

Disclosure of conflict of interest

None.

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