Displaced patella fractures: percutaneous cerclage wiring and second arthroscopic look

Summary

Introduction. The patella has an important role in the knee joint extension mechanism and that it’s why it is of the most importance to restore the continuity of the articular surface during surgery. In patella fractures, in addition to the bone’s damage, there is an injury of soft tissues and surrounding structures that make the knee extension possible. For the purpose of their repairing we use percutaneous cerclage wiring. After bone consolidation, we perform an arthroscopic revision in order to check it as prove of the effectiveness of the technique and the post-traumatic chondral lesions.

Methods. In this study we treated 20 patients with patella fractures. All cases were closed fractures, and the AO classification was 34-C1 in 6 cases, 34-C2 in 5, 34-C3 in 9. The mean follow-up was 23 months (18-31). In all cases we performed a radiographic control at the end of the synthesis and in each following clinic control. We also evaluated them with an arthroscopic control.

Results. No limitation of extension was noted in any patient and the mean flexion was 143° (120-160). In all 20 cases we had evidence of radiographic consolidation at 6 months. We didn’t have any non-union cases or failures of the fixation devices.

Conclusions. To perform a percutaneous patella fixation has the same results as the tension band technique with less damage to the soft tissues.

Level of evidence. Prospective case series. Therapeutic, Level IV.

KEY WORDS: patellar fractures; percutaneous cerclage wiring; arthroscopic control; post-operative displacement.

Introduction

Surgical treatment is indicated in displaced patellar fractures to restore the extension mechanism of the knee and to reduce the risk of early femoro-patellar osteoarthritis. Tension band wiring and screw fixation are the most commonly accepted osteosynthesis methods for this kind of fractures (1, 2).

We should always keep in mind the role of peripatellar soft tissues in patellar stability. As well as the reduction and fixation of the fracture itself, the repairing of these tissues is more important to the stabilization of the patella during the extension mechanism of the knee joint (1-6). In accordance with this principle, we use percutaneous cerclage wiring with the purpose of helping the soft tissues to heal. After consolidation, we arthroscopically check the knee in order to confirm the right reduction of the fracture, hence, the effectiveness of the technique and the possible post-traumatic chondral lesions.

Patients and methods

There were twelve male and eight female patients, all of them with displaced patellar fractures. The mean age was 56.7 years (45-70 years). All underwent surgery at same hospital, “Hospital Santa Maria Della Misericordia” in Perugia from January 2013 to December 2015 and were followed-up for a minimum of 18 months. All patients were informed of the conduction of the study and agreed to be included in it by signing the informed consent – previously accepted by the Ethics Committee of our hospital. The cause of injury in all fractures treated was a blunt trauma and they were all closed fractures. The AO classification was type C1 in 6, type C2 in 5 and type C3 in 9. Patients of group underwent the same follow-up, conducted by clinical evaluations, a standard radiologic study, and the administration of Knee Osteoarthritis Outcome Score (KOOS) and activity daily living (ADL) (1-9).
**Surgical technique**

Surgery was performed under a peripheral neural blocking of femoral and sciatic nerves, in supine position and with the knee slightly flexed. Four skin incisions were made at superior-inferior and medial-lateral margins of patella (7-9). We used a bent cannula to pass the wire around the patella including soft tissues (Figure 1).

Firstly, the cannula was passed through the quadriceps femoris tendon proximally and then passed along the superior margin of the patella. Secondly, the cannula was passed through the patellar tendon and around all margins of the patella and all soft tissues. The whole procedure was supervised under X-ray controls. In the end, the tension was applied using a cable tensioner to lock the sleeve. The femoro-patellar joint congruency was confirmed reproducing the

![Figure 1 A-I - Surgical technique. A) Pre-operative plan in which we draw the fracture and its surrounding structures on the skin. B, C) Rx images of patella fractures before the operation. D, E, F) Rx images of the result of the percutaneous cerclage wiring. G, H) Post-operative results in A-P view (G) and in lateral view (H). Dedicate instruments have been used for the surgery (I).](image-url)
knee flexion-extension mechanism manually. The wire was tightened during the gliding of the patella to the trochlea trailing. For the final check X-ray control was used (7-10). The first day after surgery all patients started their physiotherapy. They walked with partial weight bearing with the aid of two crutches and when in bed, they worked with a continuous passive motion device i.e. arthromotor (Figure 1). This device is a support for passive mobilization which increases the flexion of the knee 10° degrees week by week. Isometric exercises also started immediately and patients didn’t need an extension tutor (10). The range of motion was monitored during all clinical follow-ups. After 6 months, when the fracture was allegedly healed, we checked our results arthroscopically. We introduced a 30° degree arthroscope in the femoro-patellar aspect of the knee joint by the same entry points used for the osteosynthesis. We checked the articular cartilage surfaces of the trochlea and patella during flexion and extension movements (1).

Results

The mean duration of follow-up was 23 months (18-31 months). No limitation of extension was noted in any patient and the mean flexion was 143°, range 120° to 160°. In all 20 cases we had evidence of radiographic consolidation at 6 months. We had no pseudoarthrosis or failures of the fixation devices. Through the arthroscopy inspection there was evidence of good articular congruency with no gaps or misalignments and it presented a good joint slip. There were a few inflammatory tissues that were removed (Figure 2). One case of superficial wound infection was detected. It presented at the infero-medial incision site, and it resolved after a month after surgery with just oral antibiotics. According to ICRRS Classification for Chondral Injuries, no osteoarthritis of the patella-femoral joint occurred throughout the follow-up period. Results of the KOOS score were divided in base of symptoms and stiffness; pain; activity daily living (ADL) and quality of life. In Symptoms and Stiffness score we had a mean 75% (71.43%-82.14%); in Pain score we had a mean 82.35% (69.44%-97.22%); in ADL score we had a mean 87.06% (72.06%-100%) and in Quality of life we had a mean 73.75% (50%-100%). Mean operative skin to skin time was 35’ (range 20’ - 52’). In two cases the removal of the fixation device was necessary do to swelling of the overlying knee skin (Figure 3).

Discussion

The percutaneous synthesis of patella fractures can be performed through four mini incisions without dissecting the fractured region and surrounding soft tissues. Post-operatively, all patients immediately start working with a continuous passive motion device and walking with the aid of a couple of crutches, partially weight-bearing (11-14). Bone union was achieved in all our patients. In only two of them we observed a non-perfect alignment of the patellar articular surface. We measured it in the X-rays images and there was a gap of 1,6 mm in the first case and of 1,8 mm in the second one. These results are in according with the literature in which the alignment is acceptable if it is less than 2,00 mm (15-20).

The main advantage of not dissecting the surrounding soft tissues is early acquisition of a favourable range of motion after surgery (21-23). Wu et al. applied the tension band wiring and measured a mean knee joint flexion angle of 138.9° (110-140) (3). Chang et al. also applied the tension band wiring through cannulated screws and had a mean knee joint flexion angle of 123° (100-140) (4). Camarda et al. applied the Fiberwire tension band and had a mean knee joint flexion angle of 131.1° (120-140) (5). Matsuo et al. applied the percutaneous cerclage wiring like us, and had a mean knee joint flexion angle of 141° (120-160) (6). Our patients had a knee joint flexion angle of 143° (120-160), suggesting there is a similar range of motion in patients treated with open and percutaneous reduction. Complications of open reduction and internal fixation (ORIF) apart from being more painful, include infection, osteosynthesis failure and refraction, loss of articular range of motion, nonunion, post-traumatic osteoarthritis and a knee joint contracture especially in extension mechanism. Using percutaneous cerclage wiring, there is not dissection of soft tissues and as a result, post-operative adhesions are unlikely to occur. In our study we don’t have any major complication and only one patient complains of a discomfort in a point in which the wire was pulled and closed (20-24).

All patients were followed-up in the Outpatients Clinic monthly, with clinical evaluation using the Knee Injury and Osteoarthritis Outcome score (KOOS) and radiographic evaluation using X-ray images. During the follow-up we also checked the results arthroscopically in order to evaluate the bone union of the fracture from inside the knee and to ascertain any damage of the articular cartilages of femoral trochlea and patella as well as the estate of the intrarticular soft tissues.
New percutaneous technique to reduce the patellar fractures

The patella is contained in a strong fascia formed by the patellar tendon, the fascia lata and the distal iliotibial ligament. These structures form the medialis retinaculum and lateralis retinaculum. The set of these soft tissues with patella form the extension apparatus of the knee joint.

The main function of this apparatus is to counteract the gravity force allowing the stand up position. The main activities of the daily living are walking, getting up from the chair and going upstairs and downstairs.

The patella increases the lever arm of the quadriceps tendon broadcasting the traction forces to patellar tendon. The others functions are to protect the femoral condyles from any trauma and to contribute to feeding the articular cartilage of the distal femur (2).

The patella moves like a pulley into femoral sulcus by the force of quadriceps and patellar tendon with the support of medial and lateral soft tissues. In the medial support we can observe the medial patellofemoral ligament (MPFL- the most important role of medial stabilization of the patella), the medial patellomeniscal ligament (MPML) and the medial patellotibial ligament (MPTL). In the lateral support we can observe a complex system divided into two layers: a superficial layer comprising of fibrous tissue extending from the anterior vastus lateralis muscle and posterior oblique retinaculum, and deeper layer comprising the patellar epicondylar ligament, deep transverse retinaculum, patellotibial ligament and iliotibial ligament.

Lastly, it is important to take into account the vascular supply of the patella. The vascularization comes from the genicular anastomotic tract and creates an arterial vascular ring around the patella. We shouldn’t forget that during percutaneous cerclage wiring the superior vascularization crosses in front of quadriceps tendon, while the inferior vascularization crosses behind the patellar tendon.

**Conclusion**

We performed patellar osteosynthesis employing a percutaneous cerclage wiring in 20 patients. This surgical technique is particularly useful especially in C3 fractures because it allows a good approximation of the fragments together with the soft tissue so as to restore the extensor mechanism. This procedure is not simple and it is necessary to study a larger sample of fractures to ensure better results. Nonetheless, it’s been possible for us to obtain in this study the same results of the classic fixation with less damage of soft tissues and with a better rehabilitation.

**Limitations in investigational methodology**

The limits of the current study are the limited number of patients, the non-probability sample of convenience, due to small sample, Level 1 Trauma Center.

Another limit is the retrospective design of this study. Disadvantages of retrospective studies: inferior level of evidence compared with prospective studies; subject to confounding (other risk factors may be present and not measured); cannot determine cause-effect correlation, just association; some key statistics cannot be measured.
Selection of patients may be biased, making generalization of the results difficult. It may be unclear whether the confluence of findings is merely a chance occurrence or is truly characteristic of a new disease or syndrome. Another limitation was that the measurements and interventions were made without randomization of the researcher to the experimental groups, which makes it potentially biased. Finally other limiting factors of the study acknowledged by the Authors can be the potential for regression to the mean, the presence of temporal confounders and the mention of subjective score.

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Conflict of interest statement

All Authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

Human and animal rights

For this type of study is not required any statement relating to studies on humans and animals. All patients gave the informed consent prior being included into the study. All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

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