 Acta Chir Orthop Traumatol Cech. 88, 2021, No. 4
p. 260–265

ORIGINAL PAPER
PŮVODNÍ PRÁCE

Use of an Intramedullary Locking Nail for the Treatment of Patella Fractures

Nitrodřeňový zajištěný hřeb v léčbě zlomenin patelly

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ABSTRACT

PURPOSE OF THE STUDY
Treatment of patella fractures has always been difficult; especially in older patients. The aim of this study was to investigate the XS nail in the treatment of patella fractures.

MATERIAL AND METHODS
49 fractures could be registered and reevaluated with a standardized questionnaire.

RESULTS
Mean follow-up time was 38.67 months, mean age 71.48 years. The mean OKS was 16.26 points, the Kujala Score was 81.56 points. No wound healing or revision could be detected.

CONCLUSIONS
The XS nail is a good treatment option with a low risk of complications also for the age-related trauma patient and for more complex patella fractures.

Key words: patella, patella fracture, XS nail, locking nail, intramedullary nail, nail osteosynthesis.

INTRODUCTION

Fractures of the patella represent about 0.5–1.5% of all skeletal injuries. Younger people in particular are affected, with a peak frequency of injuries between the ages of 30 and 60, with the injury affecting men twice as often as women. The patella is of high importance for the function of the knee joint and serves as a force transmitter and intensifier by up to 30% (3, 10). A fracture of the patella is a fracture that often leads to problems such as restricted movement or wound healing disorders. According to the current guidelines, only about 70% of patients can expect a good or very good result, while about 30% of patients treated have complaints or even pension entitlements (15). Despite the low incidence of patella fractures, it is particularly important in the field of occupational health and safety, as many pension claims are made because of isolated patella fractures (3).

To allow the fracture to heal and prevent dehiscence of the fragments, the tensile forces must be removed (6).

Treatment options depend on the fracture morphology, the age of the patient and possible concomitant injuries.

The treatment methods are still part of professional discussions. The standard therapy for patella fractures is tension band osetosynthesis (6). However, this often leads to unsatisfactory results with poor results in 5–36% (6, 12, 18, 19).

Another, more recent treatment option is the locking plate osteosynthesis, which was developed for the treatment of multi-fragment and comminuted fractures. One advantage is the possibility of multiple fixation of the fragments with angle-stable screws. The decisive disadvantage, however, is that compression of the fragments via the plate is not possible. In addition, injuries with weeping wounds or lack of soft tissue coverage are contraindications to plate osteosynthesis due to the risk of infection (13).

Due to the poor results and the high complication rate of the tension band osteosynthesis, which is still the standard treatment for patella fractures, a small fragment retraction compression nail (XS nail) was developed. The central position of the implant allows uniform compression of the fracture surfaces. It is independent of the soft tissue anchoring of the compression elements. The nail can also be used to treat tensile fractures such as patella or olecranon fractures and the problems of eccentric tension band slings do not occur (6).

The goal of any therapy should the anatomical restoration of the functionality in the knee joint and the fastest possible mobilization in order to avoid increasing immobility and a rising risk of further diseases.

The aim of this study was to investigate the extent to which an intramedullary locking implant has proven itself in the treatment of patella fractures and which complications can be expected.

MATERIAL AND METHODS

Between 2014 and 2016, we were able to record a collective of 47 patients with 49 fractures in our trauma centre, in which an isolated patella fracture was treated with an intramedullary force carrier (XS nail). In our retrospective study with re-evaluation in 2019, we were able to include a total of 27 patients. Patients with an inserted knee endoprosthesis or with concomitant fractures near the knee joint were excluded. Patients with multiple injuries were also included.

Of the recorded participants, 19 were female and 8 male. Three of the 47 patients had died, 2 patients came from abroad and could not be contacted. The remaining patients were lost of follow-up.

The data evaluation was based on the collected patient data with anamnesis sheet, findings of the imaging diagnostics, anaesthesia protocols, operation reports, ward reports, physiotherapy protocols and the corresponding physician's letters. The patients were also contacted again by telephone and to complete a standardised questionnaire. Data on the Visual Analogue Scale of Pain (VAS), the Oxford Knee Score (OKS), the Kujala Anterior Knee Pain Scale and the SF-12 on general health perception were collected.

The OKS consist of twelve questions about the function and symptoms of the knee joint, each with five possible answers. One point stands for a very good result, no or few symptoms, whereas five points for a poor diagnosis or many symptoms. Scores between twelve and 60 points can be achieved, with twelve being the best score to be achieved (14).

The Kujala Anterior Knee Pain Scale questionnaire consists 13 multiple-choice questions and is a questionnaire specially developed for the assessment of anterior knee pain (11). In total, a maximum of 100 points can be achieved. A lower score means a greater functional impairment or more pain.

The SF-12 questionnaire deals with health-related quality of life and is a shorter version of SF-36. It comprises 8 subscales from which the two sum scales (mental and physical sum scale) can be calculated. The summation scales are calculated to give an average score of 50 points with a standard deviation of ±10 in the average US population. A higher score means a better state of health (17).

The flexion deficit in comparison to the opposite side was subjectively evaluated by the patients. A strong flexion deficit meant a clear restriction in comparison to the opposite side, a flexion of at least 90° was asked, below 90° would be evaluated as a strong flexion deficit.

Implants and surgical technique

The used implant was the XS nail by Intercus (Intercus GmbH, Bad Blankenberg, Germany), which is used in our trauma centre for patella fractures, fractures of the ankle and olecranon fractures and with which we have already had very good results and very good experiences in the past (2, 4, 5).

The XS nail was already introduced to the market in 1999 for patella fractures (2); it lies largely intraosseous, so that implantation is possible even with only little soft tissue coverage. It is gentle on soft tissue and increases the load-bearing capacity (2).

The nail has a round profile with a diameter of 4.5 mm. A smaller variant, the XXS nail has a diameter of 3.5 mm.

There are nails in the execution of 4–11 locking holes with a distance of 9 mm. The two holes closest to the insertion handle are longitudinal oval (2).

After reduction, the XS nail is implanted using a 2 mm guide wire, which is overdrilled with 4.5 mm. The nail is clamped into the insertion handle and then inserted. It is important that the insertion should be perpendicular to the main fracture plane, depending on its orientation. Cross-locking is then performed with threaded wires with a diameter of 2.0 mm or angular sta-

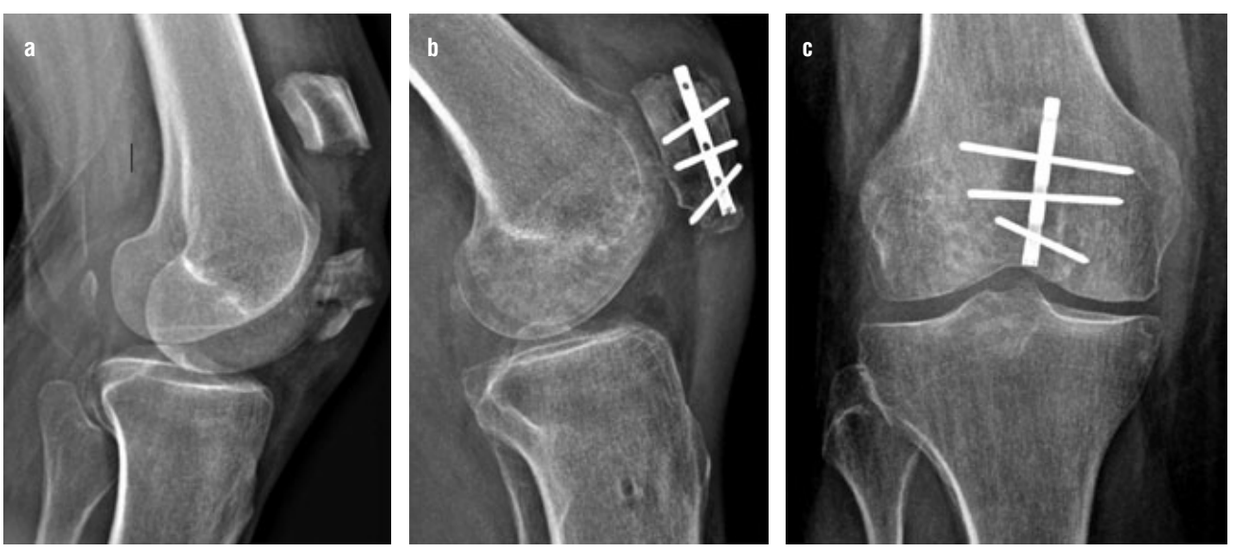

Fig. 1. Pre- (A) and postoperative X-ray (B, C) after XSN treatment of a patella fracture (source: own).

ble with 2.4 mm wires. Usually a central nail is used, whereby a double nail system is possible. Compression of the fracture is achieved by insertion of a grub screw. This moves the proximal threaded wire towards the fracture. Cerclages (e.g. wire, FiberWire, etc.) can also be placed over the threaded wires in order to grasp fragments that have been blasted out frontally or fragments that have been blasted out far medially or laterally. In distal fractures, a McLaughlin loop should be inserted additionally due to the tension of the patellar tendon (2).

Aftercare is carried out by means of an electronic splint and physiotherapy up to 90° starting from the first day up to six weeks after operation. Walking on a flat floor with full weight-bearing can also be done without an orthosis. Only in the case of very complex mobilization (2).

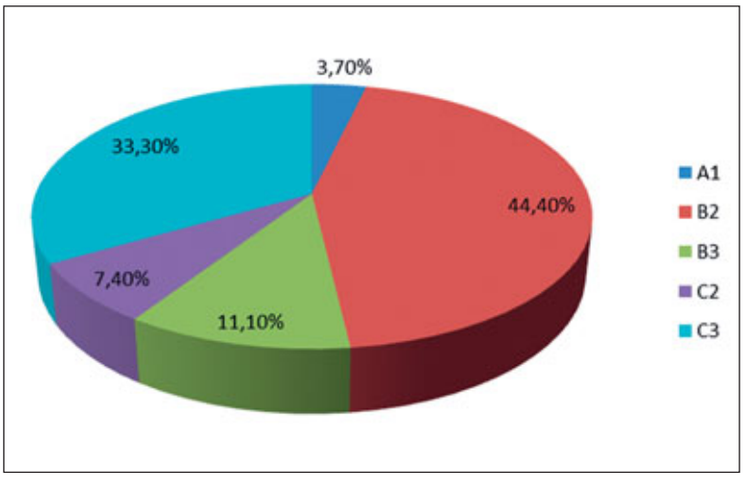

Fig. 2. Fracture classification recording to Speck und Regazzoni. (15, 16)

Radiological examination

For primary diagnostics, X-ray diagnostics (a.p., lateral, tangential beam path) is used. For more complex fractures, computer tomographic diagnostics can be performed. An MRI scan is only performed if there is a suspicion of concomitant internal damage to the knee joint (3).

In our examination, the available radiological images were evaluated independently by two trauma surgeons in addition to the already existing radiological reports. In the evaluation of the imaging, attention was paid to artefacts that might impair a possible answer to any question (Figure 1).

Ethics vote and evaluation of the data

Because of the retrospective aspect of the study and the completely anonymous processing of the data, a complete consultation and review by an ethics committee is not necessary according to the specifications of the ethics committee of the local Medical Association. The study design as well as the inclusion of patients and their data follows the Declaration of Helsinki in its current form. Data analysis was conducted using IBM SPSS Statistics® 24 2016.

RESULTS

Unless otherwise stated, the data of the results refer to the 27 patients included.

The mean follow-up time was 38.67 months (minimum 24, maximum 56, standard deviation (SD) = 10.82). The mean age of the patients at the time of treatment was 71.48 years (minimum 43, maximum: 91, SD = 10.99).

The average time between accident and surgery was 2.52 days (minimum 0, maximum 12 days, SD = 3.27), with 37% of the patients being treated directly on the day of the accident and 74.1% of the patients within the first three days.

Classification

According to the 1994 Speck and Regazzoni classification (15, 16) 3.7% of the cases had an A1 fracture, 44.4% had a B2 fracture, 11.1% had a B3 fracture, 7.4% had a C2 fracture and 33.3% had a C3 fracture (Fig. 2). The classification was based on the available imaging (X-ray and CT).

Functional outcome – flexion deficit

74.1% (20 persons) of the participants stated that they had no deficit in flexion, 25.9% (7 persones) stated that they had a slight flexion deficit in comparison to the opposite side, no patient had a strong flexion deficit in comparison to the opposite side.

Assistants

81.5% of the patients do not need any walking aid, 3.7% use a cane and 14.8% a walker. All patients stated that there was no change from before the injury.

Complications

Major complications defined by us, are severe complications such as deep infections, sepsis, implant failure and periosteosynthetic fractures.

There were no major complications in the entire group.

We defined minor complications as those that did not significantly impair the patient's healing process.

Overall, four out of 49 patients (8.2%) had a minor complication. In one case metal removal was not completely possible, in one case a drill wire dislocation occurred in the course of the operation, which was removed under local anaesthesia, superficial skin necrosis was treated conservatively and in one case postoperative joint stiffness occurred, which could be treated by anaesthetic mobilisation. Within the 27 patients examined, the complication rate with one patient (incomplete metal removal, 3.7%) was even lower.

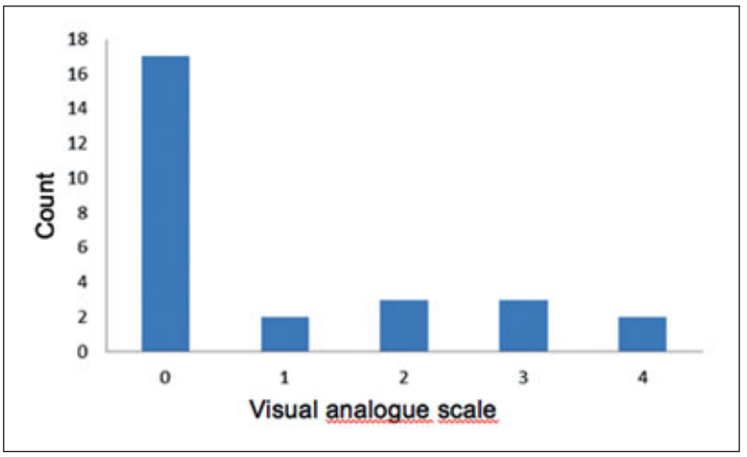

Fig. 3. Visual analogue scale of pain.

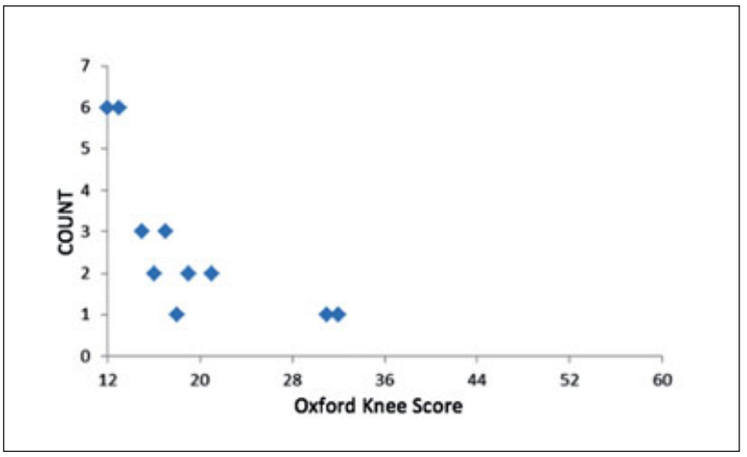

Fig. 4. Oxford Knee Score. (14)

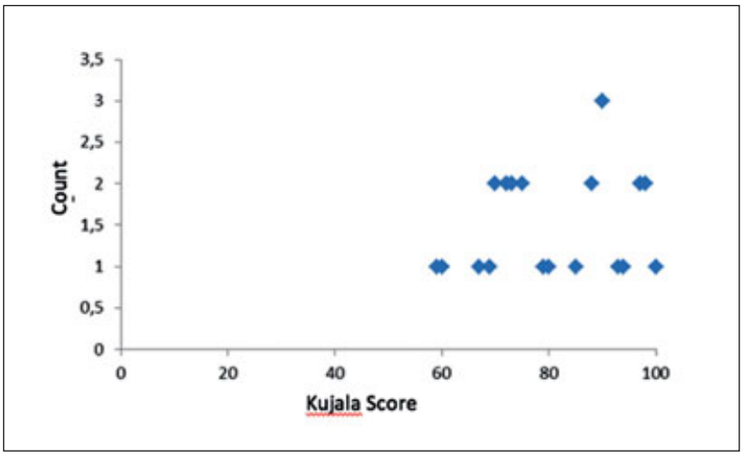

Fig. 5. Kujala Score. (11)

Evaluation of the scores

Pain – VAS

The mean value in the visual analogue scale pain (VAS) was 0.93 points with a minimum of 0 and a maximum of 4 and a standard deviation of 1.39.

At the time of postoperative follow-up 17 patients were completely pain-free (VAS 0), five patients reported having mild pain (2 times VAS 1 and 3 times VAS 2). Five other patients reported moderate pain (3 times VAS 3 and 2 times VAS 4) (Fig. 3).

Oxford Knee Score (OKS)

In the Oxford Knee Score the patients achieved an average score of 16.26 points with a minimum of 12 and a maximum of 32 and a standard deviation of 5.22 (Fig. 4).

Kujala Score or Anterior Knee Pain Scale

The average score was 81.56 points with a minimum of 59 points and a maximum of 100 points and a standard deviation of 12.38 (Fig. 5).

SF-12

The average score was 45.49 points on the physical cumulative scale (PCS), with a minimum of 13.31 points and a maximum of 60.47 points and a standard deviation of 11.67. On the mental cumulative scale (MCS), the average score was 48.1 points, with a minimum of 33.6 and a maximum of 59.53 with a standard deviation of 6.11 (Fig. 6).

Two patients (one patient is a resident of a nursing home) with particularly bad results stated that the limitation was not caused by the operated knee, but that their general state of health was poor and they were in bad mental condition.

DISCUSSION

The care and follow-up treatment of patella fractures has always been difficult, especially in elderly patients. The aim of this study was to evaluate the extent to which an intramedullary, locking implant has proven itself in the treatment of patellar fractures and what complications can be expected.

The patella supports the quadriceps femoris muscle in the extension of the leg by guiding the force of the muscle around the distal end of the femur (7, 8). During flexion of the knee joint, the patella causes a braking of the condylar advance, so that the Lig. cruciatum posterius is relieved (9). The patella has a braking effect when going downhill, as it converts tensile forces into compression forces (8).

A patella fracture is usually caused by a direct impact trauma; indirect traumas such as the sudden flexion of the knee joint with a contracted quadriceps femoris mus-

cle or postoperative fractures after knee endoprosthesis or after patella tendon transplantation for cruciate ligament plastic surgery are less frequent (3).

The current standard therapy is tension band osteosynthesis, but this often leads to poor results (6, 12, 18).

A more recent method is the angle-stable plate osteosynthesis. Studies show first acceptable results, although long-term studies and studies with high case numbers are still pending (13). However, this is also an eccentric force carrier which does not allow sufficient compression of the fragments.

With an intraosseous force carrier such as the XS nail, which is inserted centrally into the bone, a compression of the fracture surfaces and good soft tissue protection can be achieved (2).

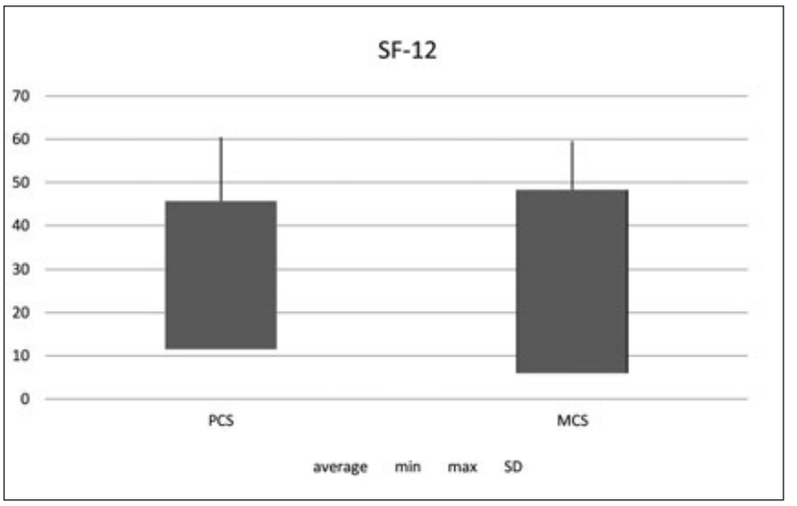

Fig. 6. SF-12. (17)

Overall, we achieved good results in the Oxford Knee Score and the Kujala Score in our patient collective with an average follow-up period of 38.67 months. The recorded pain symptoms were also very low with an average value of 0.93 points on the visual analogue scale of pain. The physical and mental cumulative scale of the SF-12 is similar to the average values of an age-appropriate standard collective found in the literature (17) (Fig. 6).

No major complication could be detected in the observed period. The four minor complications refer to the total collective of 49 patella operations and were small at 8.2%. Only one of the four patients was among the 27 patients examined.

The first results after implantation of an XS nail for patella fractures by Friedl (2004) showed a very good result after 6 months with an excellent result in 69% and good results in 20.7% of the cases. Wire dislocation occurred in 6% of cases, with initially unthreaded wires. In the course of time these were replaced by threaded wires. There was no pseudarthrosis, dehiscence or nail breakage (2).

The retrospective follow-up study by Gehr and Friedl (2001) showed persistent subjective complaints such as pain when kneeling, running uphill and recurrent swelling after treatment of a patella fracture with tension band osteosynthesis in 66.7% of patients. 39% showed a flexion deficit greater than 30°. Overall, 12.4% of patients had poor results with pseudarthosis and femoropatellar arthrosis. There was a high complication rate with 11.1% early and 12.5% late complications requiring follow-up surgery (6).

In 2008, Wild et al. showed a high complication rate in the treatment with tension band osteosynthesis. Only 20% of the patients showed no radiological or infectious complications, whereby the majority were minor complications and joint steps <2 mm were already considered minor complications. In 10% of the patients a revision surgery was necessary. Overall, this group of patients showed good mobility with an average of 120°. The VAS score was good with a result between 1.4-1.6 points on average. In the subjective evaluation 67% of the patients showed a very good or good result, 32% of the patients showed a satisfying (24%) or bad result (8%). Additionally, the Lysholm score and Tegner score were determined in this study (19).

During treatment with plate osteosynthesis, Wurm et al. (2015) showed load-dependent pain in 10.5% of patients and a final limitation of movement in 10.5% with demonstrated flexion >100°. A total of 6 complications were observed (1x premature ME in case of renewed infection, 2x renewed fracture in case of fall, 1x change of a too long screw and 2x secondary dislocation). In the treated group, 11 of 65 restorations were revision procedures (20). Müller and Frosch (2017) found no implant-specific complications in 39 patients examined after plate osteosynthesis. In one case there was a secondary dislocation of the proximal pole with inadequate refixation, two cases were secondarily revised with insufficient reduction, in four cases metal removal was performed with soft tissue irritation or retropatellar pain with cartilage damage, a comminuted fracture could not be treated with plate osteosynthesis due to multiple fragments (13).

Ellwein et al. showed in their prospective study after implantation of a locking plate osteosynthesis half a year postoperatively a good result with a total of 88% subjective satisfaction and a good range of motion with an average flexion of 138°. A good result was also achieved in the Kujala Score with a score of 88 points. The pain level was good with an average of 1.8 points, with a range of 0–8 points on the VAS. In total, two patients postoperatively showed a joint level below 2 mm, one patient developed prepatellar bursitis, so that a bursectomy was performed and early metal removal was possible when the fracture was consolidated. One patient suffered from an early dislocation, so that a revision operation with a change of procedure was necessary (1).

A weakness of the study is the short follow-up period of 6 months and the small number of included patients with only 17 patients.

It is a bit difficult to compare the different studies. There are few standardised scores, the criteria for assessing whether a result is good or bad are often not comprehensible and the case numbers are small. Overall, our results in the follow-up examination of the XS nail do not seem to be inferior to the other procedures. A lower complication rate of 3.7% of our examined groups of 27 patients, or 8.2% when considering all 49 patients operated on, is shown than in a collective treated with plate osteosynthesis, which is calculated from the authors' data and ranges between 9.23% (20) and 11% and respectively 23% (1), if the low fracture dislocation is taken into account. Complications with tension band osteosynthesis have been reported in up to 80% of cases (19). In VAS, too, our patients scored very well with an average value of 0.93 points (range 0–4) (Fig. 3). We also achieved satisfactory results in our function score (OKS = 16.26 points) (Fig. 4) and the Kujala Score (Fig. 5) showed a good result despite the high average age of our patients with 81.56 points.

The strengths of the study lies in the detailed data collection and documentation.

A weakness of the study is the small size of the collective and the lack of a comparative collective.

CONCLUSIONS

In the treatment of patella fracture, the XS nail is a good treatment option with a low risk of complications and a good result in the Oxford Knee Score, VAS and Kujala Anterior Knee Pain Scale. The implant also offers a good treatment option for the age-related traumatology patient and for more complex fractures and poor soft tissue situation.

Conflict of interest

The presentation of the topic is independent and the presentation of the content is product-neutral. There is no conflict of interest.

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