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ORIGINAL ARTICLE • HIP - PATELLA

Surgical treatment of congenital patellar dislocation in skeletally mature patients: surgical technique and case series

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Abstract
Background Congenital patellar dislocation is a rarely encountered condition and is readily treated in childhood to prevent lasting disability, knee pain, decreased range of motion and ambulation problems. This condition is very rarely seen in skeletally mature patients, and the treatment of the condition represents a challenge to the orthopedic surgeon.
Surgical technique and methods Patients were treated with soft tissue reconstruction and tibial tubercle transfer with or without a prior medial close-wedge distal femoral osteotomy, depending on the degree of valgus deformity. We, then, searched the database of our orthopedics center for cases of congenital patellar dislocation in skeletally mature patients who were surgically treated. We collected a total of five knees and analyzed the cases according to the type of surgery performed and difference between pre- and postoperative functions.
Results Five knees with congenital patellar dislocation were treated. The mean age of the patients was 29.6 years, and mean follow-up time was 4.3 years. Mean preoperative range of motion was 65°, and it increased to a mean of 105.5° after surgical treatment. The mean preoperative Kujala score was 29.2 and increased to 67.2 after surgical treatment.
Discussion Congenital patellar dislocations that are allowed to proceed to adulthood are difficult to treat, and surgical treatment depends on the degree of deformity of the patella and of the knee joint. This study shows that surgical treatment is able to correct the deformity and provide better knee function.

Keywords Congenital patellar dislocation · Surgical treatment · Adults

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Introduction

Patellar dislocation is a commonly encountered condition in the orthopedic emergency setting and occurs mainly as a result of trauma. In most cases, it is easily treated and the treatment protocol is well documented. Congenital patellar dislocation (CPD) is on the other hand described as a laterally dislocated patella which is discovered at birth or in during the early days or weeks of life and cannot be reduced, using conservative methods, inside the trochlear groove on either flexion or extension. These cases are very rare and can be associated with lower limb malformations or congenital syndromes such as nail–patella syndrome, epiphyseal dysplasia or Down's syndrome. In most cases, the patients are treated in childhood and cases of neglected CPD in skeletally mature patients are an even rarer condition [1–3]. Congenital patellar dislocation in adults can

be a disabling condition that restricts the range of motion and can severely affect knee function. This is because the patella rests against the lateral side of the femoral condyle on both flexion and extension which causes a valgus deformity of the knee joint and decrease in joint space of the lateral compartment. Furthermore, other associated problems include a dysplastic femoral trochlear groove and malalignment of the extensor mechanism.

Several different types of treatments, both conservative and surgical, have been set forth for the treatment of patellar dislocation [4–7]. Unlike traumatic patellar dislocation, which can be treated through both conservative and operative measures, CPD surgery is the only option to attain a working knee joint with a fully functional patellar tracking [8]. Attaining satisfying postsurgical results is difficult due to the altered morphology of the knee joint. Due to the fact that this condition is very rarely encountered, surgical treatment of CPD in adults is controversial and treatment choices include observation, patellectomy and patellar realignment [9]. Total knee arthroplasty (TKA) is also a treatment option in cases of severe valgus deformity evolving as a result of a congenitally dislocated patella. There are reports of TKA being undertaken in or after middle age to resolve the problem of arthritis in the lateral compartment of the knee joint and at the patello-femoral articular junction [5, 9]. Patellar realignment can be achieved through soft tissue reconstruction and tibial tubercle transposition. Soft tissue reconstruction includes lateral ligament release, medial patello-femoral ligament (MPFL) reconstruction and reinforcement of medial soft tissue [10]. Even though these two steps can partially make up for improper patellar tracking and extensor mechanism malalignment, the valgus deformity is left untreated. Surgical reconstruction of the knee joint for realignment of the patella in skeletally mature patients is not well documented in the medical literature, with most published works being case reports on the subject [6]. In this paper, we give a detailed explanation of the surgical technique we used and then present a case series of patients who were treated with this method for CPD (Fig. 1).

Surgical technique

Based on preoperative assessments, patients presenting with a valgus deformity of the knee (>6°) were treated with a medial close-wedge distal femoral osteotomy to correct the valgus deformity along with soft tissue reconstruction and tibial tubercle transfer. Patients who did not have a valgus deformity were treated with soft tissue reconstruction and tibial tubercle transfer only. All surgeries were done in one stage.

Distal femoral osteotomy

We chose to perform a medial close-wedge osteotomy of the distal femur. The patient was placed supine on the operation table with the knee fully extended. After induction of anesthesia, a medial longitudinal incision, of about 15 cm, to the knee joint was made to allow for proper soft tissue dissection. We proceeded to incising the superficial soft tissue layers and dissecting the vastus medialis which was retracted superiorly with the help of a homan retractor. We stripped the soft tissue from the posterior part of the femur using a periosteal stripper and used a homan retractor to hold back and protect soft tissues posterior to the femur. Special care was taken to ensure that the profunda femoris artery is not damaged during the procedure. Starting at a few millimeters (2–3 mm) from the superior edge of the medial femoral condyle, the femur was osteotomized horizontally until reaching the superior edge of the lateral femoral condyle. We then used fluoroscopy and a guide pin to estimate the amount of bone to be removed so as to be able to realign the knee joint. We performed the proximal osteotomy that started in the medial supracondylar region (about 1 cm proximal to the distal osteotomy) and finished at the same point as the distal osteotomy at the superior edge of the lateral femoral condyle, thus preserving part of the lateral cortex. The triangular osteotomized bone wedge was removed, and the osteotomy was closed by applying pressure. After fluoroscopic examination of the knee joint and of the distal femur to check whether the FTA angle was within normal range, the osteotomy was stabilized using distal femoral condylar plates (L-shaped plates, Pu Jiang Orthopedics Plates, Shanghai, China). We then proceeded to soft tissue reconstruction and tibial tubercle osteotomy (Fig. 2).

Soft tissue reconstruction and tibial tubercle osteotomy

Soft tissue reconstruction consisted of a three-step surgical technique to reposition the patella in the trochlear groove. The first step which is also an obligatory step is the release of the lateral retinaculum of the knee, to liberate the patella. It is important that the surgeon considers the availability of soft tissue for wound closure after the patella has been repositioned in the trochlear groove. This can be ensured by using a V–Y plasty or Z-plasty which increases the availability of soft tissue for closure. After this first step, the surgeon can try to reduce the patella but this would most likely not succeed if the patella is completely dislocated and was preoperatively irreducible. The second step is to do a tibial tubercle osteotomy. The osteotomized

Fig. 1 Congenital patellar dislocation in a skeletally mature female. The patella can be seen dislocated outside of the femoral trochlear groove both on extension and on flexion. The different positions of the patella are shown with *red* on *blue* ink in the photograph. On standing view photograph, patient can be seen to have bilateral valgus knee deformity with the *left side* more severe (color figure online)

bone fragment was about 5 cm in length and was realigned with the intracondylar notch in such a way that the patella would reduce into the trochlear groove; the tibial tubercle is temporarily fixed with Kirschner wires until a satisfactory position for the tibial tubercle is attained. If the patella is still irreducible, the tibial tubercle should not be repositioned in a more medial position because over-medialization of the tibial tubercle will not provide optimal patellar tracking. We therefore proceeded to a third step which consisted of bringing the quadriceps tendon more medially from its lateral position. Hamstring tendon, about 15 cm in length, was collected from the pes anserinus. One extremity of the collected tendon tissue was sutured to the lateral side of the quadriceps tendon and pulled to a more medial position by suturing the other extremity of the collected tendon tissue to the lower extremity of the vastus medialis which caused the proximal part extensor mechanism to be pulled medially, thus nullifying the initial pull of the quadriceps tendon on the patella and allowing us to reduce the patella in the trochlear groove, both in flexion and in extension. The tension in the hamstring tendon was cautiously estimated by trial reduction of the patella until we obtained the appropriate tension in both flexion and extension. An important part of this procedure is being able to estimate the tension in the quadriceps tendon and the position of the tibial tubercle when it is refixed. Quadriceps patellar tendon biomechanics is a relatively fragile system with the smallest inconsistency leading to pain on ambulation, which eventually results in patello-femoral arthritis. After the patella is satisfactorily reduced inside the trochlear groove in both flexion and extension, the osteotomized tibial tubercle is fixed with two hollow cannulated cortical screws (Pu Jiang Orthopedics, Shanghai, China). The surgeon then proceeds to wound closure (Fig. 3).

Postoperative rehabilitation

Proper postoperative rehabilitation is primordial to the success of the surgery. After the drainage tube was removed, the patient's knee was placed in a knee brace and restricted from motion. This is an especially important step because motion too early could cause failure of the reimplanted tibial tubercle or distal femoral internal fixation. Three months postoperatively, around the time when the

Fig. 2 CPD knee joint preoperatively. On skyline view of the knee, bilateral CPD is shown very clearly: The patella is outside the groove of the patella (*arrows*). The standing anterior–posterior view shows that the patella is found on the lateral side of the knee and there is bilateral valgus deformity of the knee

fracture healing was considered adequate, the patient was allowed to start motion in his left knee and was allowed to weight-bear. By re-adjusting the knee brace, the patient's motion was then restricted to 0° in extension to 60° in flexion which was gradually increased at each follow-up visit, until the patient was able to fully extend and flex his knee (Fig. 4).

Case series

Materials and methods

We searched our database for skeletally mature patients who were treated for CPD. The inclusion factors for this study were as follows: (1) a diagnosis of CPD, (2) patients who were skeletally mature (18 years old or older and roentgenograms showing epiphyseal closure) and (3) patients who were surgically treated and followed up for more than 2 years postoperatively. Exclusion factors included: (1) patients who had received prior conservative or surgical treatment. The cases were collected between January 2000 and December 2011; a total of five knees were treated at our center. All the cases were treated by the same group of surgeons, and the surgical treatment was done using the same surgical technique. Two patients presented with bilateral congenital dislocation of the patella (two females, aged 38 years and 34 years), while one patient presented with unilateral CPD (one male aged 18 years). We used the Kujala score to assess operative results.

Results

The mean age of the patients was 30 years. The mean time for follow-up was 4.3 years, with a range of 24 months–6 years. Of the five CPD knees that underwent surgical treatment at our center, four knees underwent repositioning of the tibial tubercle, soft tissue reconstruction and distal femoral close-wedge osteotomy. The remaining one knee (the youngest patient) underwent tibial tubercle translocation and soft tissue reconstruction only. After the surgery, all patients were followed up at the outpatient department. The follow-ups were scheduled at 6 weeks after the surgery, then 3 months postoperatively and then every 3 months until the 1 year mark, after which they had to come every year. There were no complications reported after the patients were discharged from the hospital, and none of the patella operated on suffered a dislocation. Most patients were able to achieve full extension and flexion 1 year after the surgery. There was no re-dislocation of the patella or failure of the internal fixation reported. The youngest patient who was diagnosed with a unilateral CPD was re-admitted to our center 1 year after the first surgery for removal of the tibial tubercle screws.

Preoperative and postoperative knee scoring and function

The mean preoperative range of motion was 65°, and it increased to a mean of 105.5° after surgical treatment. The mean preoperative Kujala score was 29.2 with a range of 24–44 and increased to 67.2 after surgical treatment. The range of the postoperative Kujala score was from 56 to 81.

Preoperative and postoperative radiological findings

When examining the preoperative roentgenograms, we found one knee had a normal valgus deviation of approximately 3° and four knees had a valgus deformity of

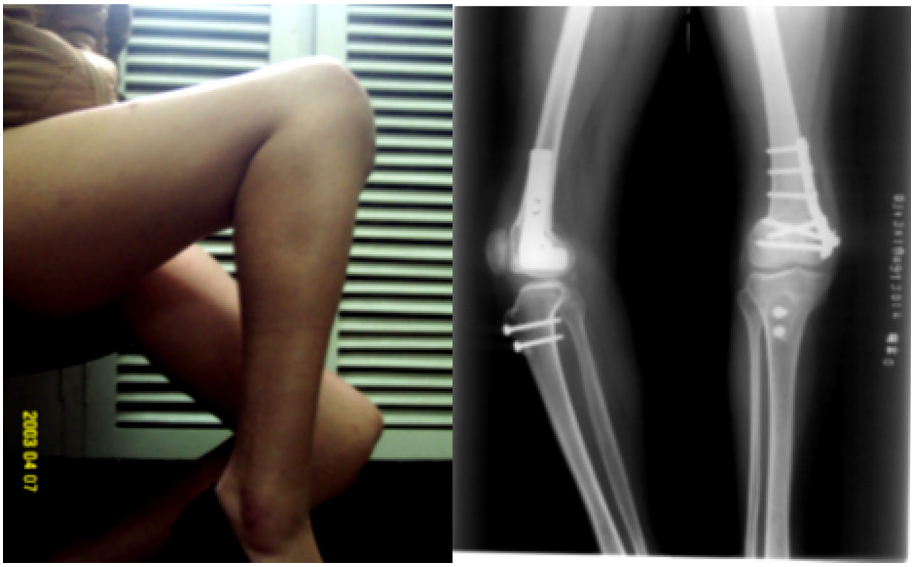

Fig. 3 Knee of one of the patient undergoing tibial tubercle translocation, soft tissue reconstruction and distal femoral osteotomy postoperatively. The knee can be flexed more than 90°. The roentgenograms show a lateral and anterior–posterior view of the operated knee joint. An L-shaped plate can be seen on the medial side of the femur along with screws placed for fixation of the tibial tubercle. The valgus deformity has also been corrected

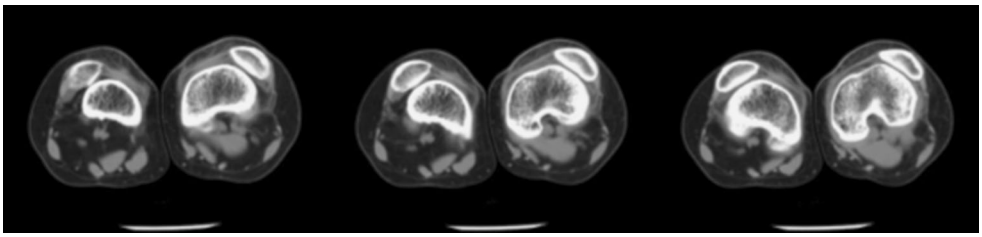

Fig. 4 Patella of a patient lying outside of the femoral trochlear groove at three different levels on a CT scan. The articular side of the patella is flat, and the trochlear groove is dysplastic

more than 6°. Postoperatively, all knees with a valgus deformity of more than 6° were corrected to a normal valgus deviation of approximately 3°.

Discussion

Congenital dislocation of the patella presents with altered knee morphology. The patella, the trochlear groove, the extensor mechanism, the lateral retinaculum and the MPFL all present with some degree of deformity. Such knees also tend to have abnormal lower extremity biomechanics caused by excessive femoral anteversion and tibial external rotation, which can further lead to lower limb length discrepancy, osteoarthritis of the lateral compartment of the knee and severe valgus deformity of the knee joint [11–13]. All these morphological changes should be taken into consideration intra-operatively and require correction to be able to reposition the patella in the trochlear groove and prevent re-dislocation. Treatment protocol for neglected congenital dislocation of the patella is very different to treatment for traumatic dislocation of the patella. The latter may be treated conservatively with success, while surgery is a sine qua non condition to regain satisfactory functional capacities for the former. The literature on the subject is very sparse with most papers reporting cases of surgical treatment of CPD in children and rare case reports of surgical treatment of CPD in skeletally mature patients [6, 7, 10]. Dislocated patella in pediatric cases can be treated with relative ease with techniques such as extensive quadriceps release or derotation [1, 3].

In contrast to traumatic patellar dislocation in adults where factors such as injury to the medial patello-femoral ligament are responsible for lateral patellar dislocation, in the congenital form of the problem, medial ligament injury is not the source of the problem. In CPD knees, the MPFL which is normally the main responsible structure in preventing lateral dislocation is over-stretched over the trochlear groove. Repair to the MPFL is a required step in repositioning of the patella to prevent subsequent dislocations, but performing this step only is by no means enough for patellar relocation; however, a lax MPFL can negatively affect the surgical result and can result in postoperative re-dislocation of the patella. Intra-operative evaluation of the structure is therefore a necessity. Tibial tubercle osteotomy and translocation is another important step to the success of this procedure. The surgeon must be able to analyze the Q

angle intra-operatively so as to be able to reposition the tibial tubercle. If tibial tubercle transfer is found to be insufficient for relocation of the patella, the surgeon must pull the proximal end of the extensor mechanism medially instead of transferring tibial tubercle in an overly medial position which would negatively affect patellar tracking. However, even with the patella reduced in the trochlear groove which provides better tracking ability to the patella, it is difficult to know whether this procedure is only a stop-gap with the patient eventually developing patello-femoral arthritis due to poor patello-trochlear relationship.

Open-wedge varus osteotomy which was performed on four knees is also an important step in treating CPD. The lateral position of the patella causes undue pressure on the lateral femoral condyle which eventually results in valgus deformity of the knee and therefore osteoarthritic degradation of the lateral compartment. Varus osteotomy is therefore important in patients presenting with valgus deformity because it helps to prevent osteoarthritis and it also decreases the lateral vector acting upon the patella in the valgus knee and increases the stability of the knee [8, 14]. Although the usefulness of close-wedge varus osteotomy in the treatment of lateral compartment osteoarthritis in CPD is still unproven, this course of action has shown its merits in the treatment of primary osteoarthritis of the lateral compartment of the knee joint, especially for younger active patients [15]. There is another mention of this type of procedure performed for congenital patella dislocation. Noda et al. [6] treated a 34-year-old female in a two-stage surgery, whereby the first stage was used to correct the valgus deformity and to shorten the limb using an Ilizarov external fixator. The second surgery was performed to relocate the patella inside the femoral trochlear groove. It must be noted that Noda et al. also underlined the fact that if the patient did not require limb-shortening surgery, they would not have resorted to a two-stage surgical treatment. They also reported excellent postoperative results. Kwon et al. [7] also reported one patient treated in a similar manner, but the patient presented with congenital habitual patellar dislocation and not CPD. The other main treatment given to patients with CPD is TKA. Due to the fact that CPD patients present with both patello-femoral and lateral compartment osteoarthritis, TKA is a valid treatment. However, use of prosthesis is best reserved for elderly patients who will not require several revision surgeries. Marmor et al. reported the case of a 63-year-old CPD patient who presented with serious disability and was treated with a TKA.

Postsurgical management is a very important part of the treatment protocol for congenital dislocation of the patella. Use of a restrictive knee brace in these types of patients is important so as to provide ample time for soft tissue and osteotomy healing and to prevent re-dislocation of the patella. Use of brace is particularly important in patients who have undergone a distal femoral osteotomy to give the fracture enough time to heal and prevent the patient from putting undue stress onto the plates.

Conclusion

Patients with CPD can experience severe pain and knee function problems in their daily life. Surgical correction of the deformity of the knee is primordial to allow the patient to regain proper motion in his knee. We discussed a three-step approach to treating patients with CPD. All patients were successfully treated and achieved satisfactory range of motion in their knees following surgery.

Conflict of interest None.

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