

Judet's Quadricepsplasty Procedure during Total Knee Arthroplasty in a Patient with Osteoarthritis and Irreducible Congenital Permanent Dislocation of the Patella

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Abstract

Surgical management by total knee arthroplasty (TKA) in patients with osteoarthritis (OA) and congenital, permanent dislocation of the patella is a real challenge and the most important issues are the shortening, contracture and malrotation of the quadriceps muscle. The result is that during the child's growth a genu valgum and an external tibial rotation is developed. These torque forces are the main reason for knee osteoarthritis in elderly people and they have to be removed in order to achieve long-term outcomes of the prosthesis. In such a situation, we performed a knee prosthesis by lateral approach and Judet's quadricepsplasty. This procedure allowed to correct the retraction and malrotation of the quadriceps muscle and to reduce patellar dislocation as well as to have a correct patellar tracking. To our knowledge no case has been reported in the literature using lateral approach Judet quadricepsplasty for a CR TKA in an adult patient with congenital permanent dislocation of the patella.

Keywords: Quadricepsplasty; Permanent Congenital Patella Dislocation; TKA; Knee

Abbreviations

TKA: Total knee Arthroplasty; OA: Osteoarthritis

Introduction

Permanent dislocations of the patella are the most severe dysplasias of the knee extensor system and they are defined as follows [1] at birth, patella's are permanently dislocated and fixed on the lateral aspect of the lateral condyle of the knee, both in extension and in flexion, and they are irreducible by external closed manipulation. These were first identified by Singer [2] in 1856, but the first description of their surgical treatment is credited to Goldthwaith [3] and Conn [4]. The pathogenesis is caused by the failure of internal rotation of the myotome containing the quadriceps femoris within the first trimester of intrauterine life, and by the patella that remains dislocated in a lateral position [1]. This produces a retraction and shortening of the fibers of that specific muscle, which represents the "primum movens" of the pathological alterations found in this dysmorphism [1,5-7]. Such dislocations are frequently associated with other malformations and are undiagnosed

at birth, due to the late appearance of the ossification nucleus of the patella, which occurs between the 3rd and 5th year of life, and to the many subcutaneous fat layers that in early childhood can conceal the patellar profile [1]. In this group of congenital dysplasia of the knee extensor mechanism, habitual or recurrent dislocation of the patella is found. They differ from the first for the lesser gravity of the pathological findings and the distinct manifestation of the patellar dislocation, which only takes place during the knee flexion. In these patients' similar surgical characteristics were found [5,8]. The main common anatomical feature is the shortening and contracture of the vastus lateralis fibers and, less frequently, of rectus femoris of the quadriceps muscle, which conditions the external rotation of the extensor mechanism and the resulting fibrosis of iliotibial band, lateral patellofemoral ligaments and lateral retinaculum, which leads to an abnormal attachment of patella and iliotibial tract to the lateral retinaculum and intermuscular septum. Other peculiar features are the atrophy and the laxity of the VMO, whose proximal insertions are sometimes slack; the increased Q angle, due to the lateralization of the tibial tubercle; the increase of the ex-

ternal rotation and external tibial torsion with valgus deformity as a result of the constant pull of the quadriceps on the lateral aspect of the knee; the fibrosis of the lateral retinaculum and the flattening of the anterior femoral groove and patellar surfaces; the extension lag of the knee and the possible hamstring retraction [1,5]. In paediatric population surgery indications must be given as soon as possible and subsequently to the diagnosis [9]. This is due to the fact that an early repositioning of the patella helps the modelling of the patello-femoral articular surfaces, ensuing in better long-term results. In such cases, it is necessary to correct those primitive anomalies that conditioned the emergence of this deformity and it is necessary to avoid isolated practices, such as patellar tendon or tibial tuberosity transfers, which proved to be the reason for subsequent degenerative arthritis in the patello-femoral compartment [10]. Amongst the possible combinations of the clinical pictures of these dysplasias, some individuals with permanent dislocation of patella do not present flexion contractures, valgus angular deviations or extra-rotatory deformities at a young age. In such patients, it is possible to note lower-grade limitations of daily activities and good quadriceps strength with lack of extensor muscles deficits. In such cases, patients can have a good social life and patellar dislocation can be associated with patellectomy; yet, it may be acceptable to leave the patella dislocated in older patients [11-13].

Osteoarthritis progression and surgical indications

In subjects diagnosed with patellar dislocation at a later stage, for example in post pubertal age or adulthood, non-prosthetic surgical indications need to be investigated also keeping in mind the importance of the surgical procedure and hard physiotherapy required. Often times, it is difficult for a surgeon to decide which surgical technique is the most suitable for each individual case [7,14]. Even in those cases with very positive results, in fact, although it was possible to obtain adequate patellar stability and a consequent functional advantage, it is unlikely that the surgeon will manage to restore an adequate patellofemoral congruity so as to reduce pain and prevent arthritis progression of that knee. However, surgical abstention does not modify the potential instability and, if it can prevent patellofemoral arthritis due to the absence of the patella in the femoral trochlea, it will lead to a valgus gonarthrosis as a result of the abnormal functional stress on the knee induced by external rotation of the extensor mechanism. This will be characterized by the presence of the aforementioned flexion contracture of the knee and valgus, external rotator and torsional deformities of tibia in different combinations. As far as knee OA is concerned, for a durable total knee arthroplasty to be carried out it is necessary to deal with issues related to the patellofemoral joint and to the pathogenesis of the patellar dislocation. Against the backdrop, we believe that the most appropriate surgical solution consists in a knee arthroplasty associated with an "a la carte" rebalanc-

ing of the extensor apparatus treatment [14] by using the most suitable techniques for each case and modifying the procedure according to the anatomical variations detected during the operation ([7,8,11,13,15-18]. Furthermore, quadricepsplasty as Judet's procedures [8]) or other modalities ([5,18]), must be carried out. Eventually, this will be associated with a proximal [8,15] and distal realignment [19], which was already used for conservative surgery in young adults, together with a trochleoplasty [20,21] for a lateral constraint to the patella. Similar positive results were achieved for medial patellofemoral ligament reconstruction. In knee prosthesis, patellofemoral prosthetic designs have an obvious natural congruence and a small amount of these modalities has been used in TKA [16,22]. Different surgery procedures were performed for TKA in subjects with congenital patellar dislocation: without realignment of the extensor mechanism [11,12] with medial parapatellar arthotomy [15,18] or subvastus approach [17]; with vastus medialis transfer and concomitant variety of different lateral release procedures; with lateral parapatellar approach that is, in our opinion, more appropriate on dealing with this specific group of patients [5,16,22]. Less used is the distal realignment with Elmslie-Trillat technique and it is preferred the external rotation of the femoral and tibial prosthetic components [18,23]. In the post-op, there is a number of different guidelines, such as bracing post-operatively [8], post-op mobility or active extension exercises with limitation [15] or without limitation. All of these different operative techniques were aimed to realign the patella and often acceptable or satisfactory results were achieved with infrequent patellar tilting [17], patella alta, flexion contracture [16] or extension lag [18].

Clinical Case

We talk about a 74-year-old woman affected by congenital permanent irreducible dislocation of the patella (Figure 1 and 2), untreated and well-tolerated, formerly had infrequent episodes of instability and few problems in her everyday living. Neglected chronic patellar dislocation produced genu valgum with external rotation and torsion deformity of tibia and subsequent osteoarthritis, which became painful and debilitating. On planning TKA for such patients, special attention must be given to restoring the correct extensor mechanism alignment with quadricepsplasty and a careful soft tissue balancing to avoid the perpetuation of the same functional stress on the new prosthetic implant. The patient provided consent for data concerning this case to be submitted for publication.

Surgical treatment

A PCL-retaining Press-Fit Condylar (PFC) Sigma (De Puy, Johnson and Johnson, Raynham, USA) (CR) with rotating platform was used as a prosthetic implant. The preparation of the surgical operative field was extended to the hip and a sterile ischemic ring tour-

Figure 1 and 2: Preoperative lateral and skyline radiographs: the patella is dislocated on the lateral gutter (laterally on the edge of the lateral femoral condyle).

niquet was used in the first stage surgery to limit blood loss due to the lateral distal quadricepsplasty and TKA.

A lateral para-patellar skin incision extended to the proximal thigh with tibial tubercle detachment and posterolateral femoral access was performed. This allowed the wide release of distal insertions of the iliotibial tract from the tibia and of the vastus lateralis from the external intermuscular septum. After the tibial tubercle detachment, when the knee was flexed, and the patella reduced into the trochlea, the tibial tubercle was always proximally dislocated (Figure 3) and the knee flexion was limited to 60° if fixed in his previous position.

Figure 3: Intraoperative photography: with patella reduced in the trochlea tibial tuberosity is dislocated proximally.

After performing knee arthroplasty with the usual technique and patella resurfaced, the ring tourniquet was removed from the thigh as well. Then, the Judet's quadricepsplasty was completed with an additional proximal release of the vastus lateralis along with the section of its proximal insertions from the trochanteric region. The anterior rectum insertion usually was preserved since it did not seem to be retracted.

After this release quadriceps derotation and the tibial tuberosity reinsertion with a medial offset of 7-8 mm, an intra-operative knee flexion to 125°-130° with patellar prosthesis stable in its anatomical position became possible (Figure 4 and 5). In this patient no, proximal realignment (according to Insall procedure) or medial parapatellar approach was associated with preservation of the medial blood supply of the patella [17].

The closure of the big gap on the lateral aspect of the knee joint and thigh was possible, as it is usually in our lateral approach, with the mobilization of synovial tissue [24] lateral meniscus and Hoffa's fat pad, which must be preserved when we are approaching to the knee in prevision of the joint coverage (Figure 6).

The suture of the several plans was performed with the knee flexed to control the correct patella tracking and tension from the lateral structures. As usually a post op x-ray was performed (Figure 7-9).

Figure 4 and 5: CR TKA with reduced patella, medial tibial tubercle transfer and Judet quadricepsplasty; large defect remains in the released lateral retinaculum.

Post-operative Treatment

Standard physical therapy consisting of continuous passive motion, weight bearing as tolerated, ambulation and isometric quadriceps strengthening was implemented after surgery with no brace and without limiting active extension exercises.

In order to reduce the stress acting on the reinserted tibial tuberosity and to limit skin tension, considering the large subcutaneous delamination’s, on the 2nd day the limb was positioned on a

Figure 6: Lateral break closure was possible by mobilization of synovial tissue, lateral meniscus and Hoffa’s fat pad.

Figure 7, 8 and 9: Post-operative A-P, lateral and skyline radiographs: CR TKA with patella centrally placed in the trochlea, correct height of the patella and medial tibial tuberosity transfer.

motorized frame, with a ROM between 0° and 70° for the first 2-3 days and between 0° and 90° for three weeks. After this first period, an increasing knee flexion was permitted. At this stage, particular attention was given to the full recovery of knee extension. The results with the final ROM of 0°-115°-120° were definitely positive.

It is worth mentioning that the loss of about 10°-15° of the obtained intra-operatively flexion was due to the emergence of an anterolateral para-patellar superficial skin necrosis. Such complication led to avoid the maximum knee flexion and to a non-optimal involvement of the patient in the kinesiotherapy, for a period of time.

Results and Discussion

In the presence of knee OA associated with permanent congenital dislocation of the patella, it is fundamental to reflect and find solutions to solve such issues also taking into consideration the high invasiveness due to the association of Judet's quadricepsplasty and TKA.

In continental Europe, Judet's quadricepsplasty is the main surgical technique used for the treatment of this condition in adolescents and young adults [6,7]. Alternatively, in elderly patients it may well be acceptable to leave the patella dislocated in the lateral gutter or to remove it by performing a patellectomy [11-13]. In case of obliged extensive release of the lateral retinaculum, other possible solutions are: a different lengthening of the rectus femoris or of the quadriceps tendon [13,18] that was necessary to achieve full flexion; release of the distal portion of the vastus lateralis that was detached from the rest of the quadriceps [5] with an usually vastus medialis advancement or Install technique [8,15]. Less common are other associated or isolated procedures, such as medial and proximal transposition of the tibial tubercle with, eventually, reconstruction of the medial patellofemoral ligament [16,22].

If a more conservative surgical approach is adopted and the patella dislocation is not treated, the valgus and external rotation stress will persist, exerted by the persistent external rotation of the quadriceps muscle. A failure to correct an abnormal biomechanical stress on the knee prosthesis could lead, over years, to a bone-prosthesis interface stress and/or polyethylene wear, which might produce an early implant mobilization.

The other possible option, i.e. a different quadricepsplasty in association with proximal and/or distal alignment, could be the

reason for a knee active extension lag as well as for the flexion limitation due to insufficient recovery of quadriceps length. However, the aforementioned method can be used to address this issue, even though it requires a lot of caution in the post-operative period for the flexion recovery.

Conclusion

In the light of the above considerations, we believe that if a TKA in a patient with permanent congenital dislocation of the patella must be performed our surgical procedure should be considered as the "gold-standard". Not only it allows to treat the causes of patellar dislocation, but also it restores physiological patello-femoral tracking and ensure a prompt flexion recovery. Moreover, in relation to the multiplicity of actions required to correct this condition in adolescents and in young adults, the procedure is much easier in case of knee arthroplasty. This is due to the fact that articular surfaces of the patellofemoral joint are congruent, and we can expect better results on pain reduction and stability rather than in "conservative" surgery, also by associating corrective actions on the bone and cartilage structure of patella and trochlear groove.

Lateral parapatellar approach [24] is more appropriate in dealing with this specific group of patients because preserve a good vascular blood supply of the patella. Judet quadricepsplasty, even if is a very invasive technique, can restore adequate quadriceps lengthening and avoid extension lag that often we can observe with other different quadricepsplasty techniques.

To our knowledge no case has been reported in the literature using lateral approach Judet quadricepsplasty for a CR TKA in an adult patient with congenital permanent dislocation of the patella.

Conflict of Interest

No benefits or funds were received in support of this study. Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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