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CASE REPORT

TREATMENT OF RECURVATUM KNEE IN A PATIENT WITH CEREBRAL PALSY BY POSTERIOR DISTAL FEMORAL HEMIEPIPHYSIODESIS. A CASE REPORT.

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SUMMARY

Genu recurvatum is characterized as an hyperextension deformity of the knee in the sagittal plane, with impacts on walking, pelvis tilting and also on ankle's and foot's biomechanics. Amongst its causes are conditions like cerebral palsy, poliomyelitis, arthrogyrosis, tibial tuberosity arrest and syndromes with generalized ligamentous hyperlaxity. Specially in cerebral palsy, factories like hamstrings lengthening and equinus deformity of the foot can produce this knee condition. The treatment methods to correct this deformity are more aggressive to date, such as quadricepsplasty, hamstring tenomyoplasty and femur or tibia osteotomies.

We describe here the treatment of a patient with mild hemiparetic hypertonic cerebral palsy GMSCF I, with unilateral genu recurvatum, using a safe and minimally invasive technique with posterior hemiepiphyodesis of the distal femur, performed with two transphyseal cannulated screws for correction. This technique has great potential for correcting the recurvatum knee in the immature skeleton during growth and can be a good alternative to the more aggressive methods currently used for the treatment of this deformity.

Keywords: bone retroversion (c05.116.214.750) / orthopedic procedures (e02.718) / minimally invasive surgical procedures (e04.502) / knee joint (a02.835.585.475)/ growth and development (q000254) / growth plate (a02.835.232.251.352)/ cerebral palsy

Introduction

Recurvatum knee is characterized as the deformity in hyperextension of this joint in the sagittal plane and, when untreated, is associated with short- and long-term complications, such as joint pain, limping, pelvis tilting and precocious gonarthrosis. At the extreme of the deformity, there may even be anterior dislocation of the knee^{1,2,3}

Recurvatum is a less usual deformity of the knee at immature skeleton, and among its causes we can find conditions such as cerebral palsy^{4,5,6,7}, arthrogryposis⁸, poliomyelitis, bone infection sequelae, some syndromes with ligament hyperlaxity generalized joint hypermobility⁹, anterior femoral distal physis arrest and tibial tuberosity fracture sequelae^{10,11,12} and iatrogenic complication following eight-Plate epiphyodesis¹³.

It is important to emphasize that the treatment of the knee in hyperextension is challenger. When the deformity is significant and there is indication of correction surgery, soft tissue procedures can be used, such as quadricepsplasty¹⁴ and hamstring tenomyoplasty¹⁵. Surgical treatment like osteotomies of the distal femur and proximal tibia with internal¹⁶ or external fixation¹⁷ for correction of bone alignment are also indicated. The aforementioned surgical procedures are aggressive and require a long recovery time, in addition to risks such as neurovascular injury, compartment syndrome and infection.

Searching for less aggressive correction surgical treatment to this sagittal knee deformity, we have used a guided growth posterior hemiepiphyodesis of the distal femur to the recurvatum correction. In this article, we present the surgical technique performed with

two transphyseal cannulated screws inserted in the posterior part of the distal femoral physis and the clinical and radiographic results of one mild cerebral palsy GMSCF I patient, hemiparetic, with unilateral left genu recurvatum, treated with this method.

SURGICAL TECHNIQUE

The patient was placed in horizontal dorsal decubitus. Two 1 cm longitudinal incisions were made on the anterior aspect of the distal thigh and the blunt dissection through the quadriceps muscle was done to the anterior aspect of the femur distally, in a proximal area to the epiphysal disc.

Percutaneously, with the fluoroscopy aid, using images in the coronal and sagittal planes, two guide wires were passed (one for each incision) from anterior to posterior and proximal to distal, crossing the femoral distal physis at its posterior third, close to the subcortical limit of the medial and lateral femoral condyles.

Two cannulated screws 4.5 mm in diameter were then inserted through two guide wires, with the screws tips fully located in the distal femoral epiphysis (Figures 1A and 1B). Then, suture of the subcutaneous tissue and the skin was performed.



Figure 1 A

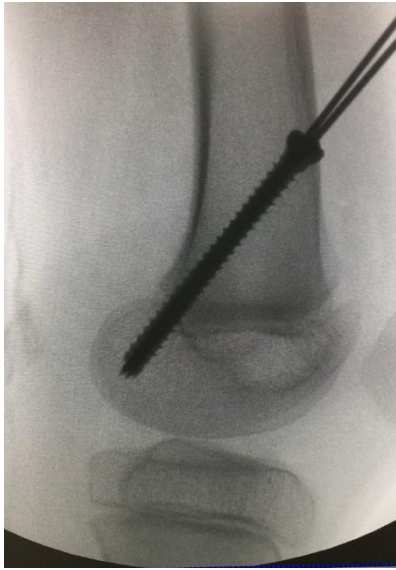


Figure 1 B

Figures 1 A e B – Intraoperative control of posterior hemiepiphyodesis of the femur, with two cannulated screws guided by metallic wires (1 A -profile view; 1 B – AP view) for treatment of deformity in recurvation of the knee due to cerebral palsy, in a 9-year-old patient.

The patient was released for knee mobilization and load the ipsilateral limb immediately after surgery.

Every four months, the deformity angle was evaluated clinically and radiographically until its complete correction, when the screws were then removed.

CASUISTIC

One 9 years old patient, male, with unilateral genu recurvatum at the left knee, caused by mild hemiparetic hypertonic cerebral palsy GMSCF I, (figures 2, 3 and 4) was treated to correct surgically the described deformity. He was also operated before recurvatum knee treatment do to an ipsilateral foot deformity.

All legal guardians of the patients signed a consent form (TCLE) before surgical treatment and the procedures followed the rules of the

Ethical Committee on Human Experiences of the institutions, with protocol having been approved by the Research Ethics Committee of the Hospital das Clínicas of the Faculty of Medicine at the University of São Paulo, under number 4,334,540.

RESULTS

Surgical treatment was performed and followed clinically and radiographically until the deformity is corrected. The time to correct the deformity was 25 months.

There were no perioperative or postoperative complications or recurrence of the deformity. The correction of the femorotibial angle in the sagittal plane was 26 degrees (figures 2, 3 and 4).



Figure 2 A



Figure 2 B



Figure 2 D



Figure 2 C



Figure 2 D

Figures 2 A – Panoramic radiograph of the left lower limb in profile, male patient, 9 years old, demonstrating recurvatum deformity knee of 32 degrees, due to cerebral palsy. 2 B – Panoramic profile X-ray of the left lower limb in profile, 25 months after surgical treatment for distal posterior epiphysiodesis of the femur with 2 cannulated 4.5 mm screws, showing correction of recurvatum knee deformity. 2 C – Panoramic profile radiography two years after the two screws removal from distal femoral physis, showing correction maintenance of the left knee recurvatum deformity. 2 D and 2 E – Pre- and post-operative clinical photographs of the left lower limbs in profile, showing correction of the recurvatum deformity by posterior epiphysiodesis of the distal femur in a patient with cerebral palsy.

Surgical treatment was performed and followed clinically and radiographically until correction of the deformity. The time taken to correct the deformity was 25 months, and a present follow-up is about 2 years.

No perioperative or postoperative complications occurred, neither recurrence of the knee deformity.

The correction of the femora-tibial angle in the sagittal plane was 26 degrees.

DISCUSSION

The recurvatum knee, or hyperextension, can be caused by cerebral palsy⁴, bone deformities affecting the distal femur or proximal tibia, traumatic anterior tibial epiphysiodesis, infections, iatrogenies after leg length treatment¹¹, capsuloligamentous malformations due to arthrogryposis^{8,18} and syndromes with joint hypermobility.

The clinic is characteristic, with posterior angulation of the knee, either unilateral or bilateral depending on the pathogenesis. The patient walks with a limp, especially when unilateral or asymmetrical. The orthostatic radiograph analysis with knees in maximum extension defines the origin of the deformity (bone, joint or mixed) and allows the calculation of the angle deformity by goniometry. The indication for surgical correction depends on this analysis.

Non-surgical treatment modalities for the recurvate knee include physiotherapy, serial casting and bracing^{2,6,19}. Surgery is indicated for situations in which the deformity is more resistant and as part of the overall treatment plan that may include correction of deformities in the foot⁷ and in the hip⁴. Among the available surgical options, quadriceps tenotomies, quadricepsplasty¹⁴, tenomyoplasty²¹ and osteotomies with distal femur shortening²⁰ or proximal tibia opening wedge, with addition of bone graft^{16,17}.

When bone deformities are present, performing supracondylar osteotomies of the femur with removal of a posterior wedge, aiming keeping the angle between the femoral diaphysis and the intercondylar groove regular, is a described surgical option²⁰.

Another treatment option used is the tibial wedge osteotomy with insertion of bone graft. anterior opening, above tibial tuberosity^{16,17}. it is important to avoid distal displacement of the patella by tibial tuberosity, reinserting the patellar tendon proximally. The osteotomies can be combined with posterior capsular repair¹⁷, mainly indicated in cases in which there was premature closure of the anterior portion of the epiphysial disc¹¹.

Among the causes of this deformity treated by the method here described, cerebral palsy is a neurologic condition observed in different diseases and causes, with multiple development joint deformities, according to tonus cerebral palsy type and athetoid movements' presence. Surgical treatment for recurvatum knee in cerebral palsy can be currently performed with soft-tissue operation or osteotomies of the distal femur or proximal tibia¹⁸. However, such procedures have higher morbidity and risk of complications, demanding a search for less invasive methods, safer and more effective.

Surgical treatment of the recurvatum knee is described in this study by guided growth through posterior hemiepiphysiodesis of the distal posterior femur using two screws, in the treatment of a patient with mild hypertonic cerebral palsy. This treatment is not indicated for situations in which there was early closure of the anterior femoral or tibial physal plate, due to any etiology^{10,11}. Occasionally, in these situations, posterior epiphysiodesis of the distal femur could only be indicated with in order to reduce the progression of the deformity during the residual growth.

Based on reports by Metaizeau^{23,24} techniques on the guided growth described for correction of coronal plane deformities (varus and valgus), we used two transphysal cannulated screws in the sagittal plane to allow distal femur anterior growth.

The patients were released to immediate loading. Clinical and radiographic evaluations were done every 4 months and the knee deformity were monitored until the recurvatum achieved full correction. At this time, the screws were removed so as to release the linear growth of the distal femur.

The posterior femoral hemiepiphysiodesis presented in this study is undoubtedly a less aggressive surgical alternative, minimally invasive, reversible method with a low rate of complications, does not require post-operative immobilization, and the patient is able to walk after the procedure and return to their normal activities. It is important to emphasize the need for follow-up at short intervals, to define the exact moment when the screws should be removed, avoiding overcorrection with inversion of the deformity.

Guided growth is used as a treatment method for lower limb deformities in the sagittal plane by Jorneau²⁴ and Klatt and Stevens²⁶, described to correction of the knee in flexion with guided growth by anterior hemiepiphysiodesis of the distal femur with two Eight-Plates, a possible treatment in mild flexion deformity in cerebral palsy.

In 2021, Stevens et al²⁶ et al also described guided growth of the tibial recurvatum by posterior epiphysiodesis of the proximal tibia using the Eight-Plate to leg length discrepancy, with excellent results moving the plates posteriorly. Kievit et al²⁷ reported a case of knee recurvatum as a complication of treatment of lower limb length discrepancy with temporary epiphysiodesis of the distal femur and proximal tibia using Eight-Plate. The hypothesis is that the recurvate was caused by a very anterior positioning of the plates, and then the correction of the recurved deformity was obtained with the surgical reapproach and posterior replacement of the plates in the distal femur.

Among the causes of this deformity, which can be treated by the method described in this article, arthrogryposis is a condition that

is present from birth and is seen in different diseases, all of which have in common the presence of stiffness and multiple joint deformities. The clinical presentation is diverse and the functional prognosis depends on the etiology, which differentiates the therapeutic options from case to case. In arthrogryposis, knee involvement is very common (38-90% of patients with amyoplasia), ranging from soft tissue contractures (in flexion or hyperextension) to instability, subluxation, or femorotibial dislocation. Flexion contractures are more common and disabling, with significant resistance to treatment and a high recurrence rate¹⁸. The prognosis for ambulation is better with recurvatum deformities. According to the literature, nonoperative treatment of knee recurvatum in arthrogryposis with passive mobilization and orthoses fails in about one third of cases. Patients who present knee recurvation due to laxity ligaments have few physical therapy or surgical treatment options with soft tissue correction, with osteotomies being reserved for patients with major gait repercussions. The posterior hemiepiphyodesis of the femur is undoubtedly a less aggressive surgical alternative, with lower risks, presenting progressive and perennial correction after removing the screws.

No studies have been found on treatment of genu recurvatum using posterior hemiepiphyodesis of the distal femur with transphyseal screws, as described in this study.

CONCLUSION

Posterior hemiepiphyodesis of the distal femur with transphyseal screws proved to be a safe and very useful method for recurvato deformities of the knee in cerebral palsy. This

technique has great potential for knee correction.

Recurvato in the immature skeleton, being an excellent alternative to more aggressive methods currently used for the treatment of this deformity.

Author Contribution Statement:

The author contributed individually to the development of this article. NBM (0000-0002-0705-1623)*: intellectual concept, performing surgeries, writing and revising the article; ARJ (0000-0003-4267-4567)*: intellectual concept, performing surgeries, writing and revising the article; TOG (000-0001-9277-7746)*: writing and revision of the article; BLCS (0000-0002-2552-7138)*: wording and article review. *ORCID (Open Researcher and Contributor ID)

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