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Case report

Double femoral osteotomy fixed with a Puddu plate and a retrograde intramedullary nail to treat biapical deformity of the femur☆

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ABSTRACT

Biapical femoral deformities are challenging to treat. In order to correct concomitant metaphyseal and diaphyseal deformities of the femur, the authors propose a double femoral controlled osteotomy with combined internal fixation, consisting of a Puddu plate and an intramedullary nail. The method was described in two patients. Results were analyzed using a visual analog scale (VAS), the Lysholm score, and SF-36. No complications were found. Complete consolidation of the osteotomies and radiographic alignment correction were achieved. Results were obtained with a minimum follow-up of 66 months. Both patients had improved for pain (VAS from 60 to 40 and from 50 to 20 at reassessment), function (Lysholm score from 78 to 93 and from 55 to 73) and quality of life (SF-36, both mental – from 40.7 to 57.1 in case one and from 24.7 to 59.7 in case two – and physical – from 27.7 to 45.6 and from 28.2 to 46.8). The authors have found that this technique is a reliable, accurate, and reproducible solution for biapical deformities of the femur.

Osteotomia femoral dupla fixada com placa Puddu e haste intramedular retrógrada para tratamento de deformidade femoral biapical

Palavras-chave:
Osteotomia
Deformidades articulares adquiridas

RESUMO

O tratamento das deformidades femorais biapicais é desafiador. Para a correção das deformidades metafisárias e diafisárias concomitantes do fêmur, os autores propõem uma osteotomia dupla femoral controlada com uma fixação interna combinada com uma placa de Puddu e uma haste intramedular. O método foi demonstrado em dois pacientes. Os

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Pinos ortopédicos
Fixadores externos
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resultados foram analisados com escala visual analógica (EVA) e os escores Lysholm e SF-36. Não foram encontradas complicações. A consolidação total das osteotomias e a correção do alinhamento radiográfico foram alcançadas. Os resultados foram obtidos com um seguimento mínimo de 66 meses. Ambos os pacientes apresentaram melhoria na dor (EVA de 60 a 40 e de 50 para 20), função (Lysholm de 78 a 93 e 55 a 73) e qualidade de vida (SF36, ambos mentais – de 40,7 a 57,1 no caso um e 24,7 a 59,7 no caso dois – e físico – de 27,7 para 45,6 e de 28,2 para 46,8). Os autores concluíram que essa técnica é uma solução confiável, precisa e reprodutível para deformidades biapicais do fêmur.

Introduction

Biapical femoral deformities (BFD) are difficult to treat, especially when considering the difficulties of internal fixation of multiple bone fragments after osteotomies or the complications of external fixation (EF),[1–3] such as soft tissue adhesion, range of motion (ROM) restriction, and pin-tract infection.[3] For faster functional recovery, minimally invasive internal fixation associated with controlled femoral osteotomy is an attractive alternative.

For the correction of concomitant metaphyseal and diaphyseal deformities of the femur, the authors report a controlled femoral double osteotomy with internal fixation, combined with a Puddu plate (PP) and a retrograde intramedullary nail (IMN).

Clinical cases

Patient 1

Male, 27 years, with hypophosphatemic rickets and bilateral valgus knee. Radiograph of the left femur indicated DFB with two angulation rotation centers (ARCs) – one metaphyseal and one diaphyseal. The diaphyseal deformity was in an oblique plane, projected in the frontal view as a 24°valgus angulation and, in the lateral view, as a 36° antecurvate deformity. The distal (metaphyseal) deformity presented a 12°valgus deformity (Fig. 1A–C), calculated by the angle at which the distal anatomical axis reaches the joint orientation line; the anatomical femoral lateral distal angle (aFLDA) was 69° (normal aFLDA = 81°). If this correction angle is projected into the distal metaphysis, the length of the opening wedge can be calculated; in this case, it was 1.8 cm. The clinical examination disclosed retroversion of the left femur. The patient also presented other deformities: recurvate and externally rotated right femur, treated with IMN; right and left tibias in valgus deformities, treated with EF.

Patient 2

Female, 26 years, with congenital pseudoarthrosis of the right tibia. The tibia was treated with a vascularized fibular graft in childhood, and residual leg deformities were corrected with circular EF. During growth, the patient developed a compensatory deformity of the right femur (Fig. 2A and B). The femur had a pre-curvature of 23° and a valgus deformity of 4° (Fig. 3A) on the diaphysis. The aFLDA was 61°, representing a 20°-valgus deformity (Fig. 3B), which corresponds to an opening wedge of 2.0 cm. This patient did not present rotational deformity. Following the recommendation of the microsurgery team, the patient is currently using an orthesis on the right leg to protect the graft.

Surgical technique

The patient was placed in the supine position, and a sterile tourniquet was placed on the proximal thigh. A 15 cm lateral incision was made on the distal portion of the thigh, and a blunt dissection was made posteriorly to the vastus lateralis. Under fluoroscopic vision, a guidewire was positioned from lateral to medial in the distal femur to mark the osteotomy site. The guidewire was placed inclined, so that the osteotomy would begin at the lateral metaphysis, but would be distally and medially directed. The osteotomy was performed under fluoroscopy, using an osteotome and following the guidewire to preserve the medial cortex. The opening wedge was obtained with a dilator to the predefined extent; PP fixation was used. Ideally, a locking plate and unicortical screws should be used, as they are locked, stable, and do not interfere with the IMN entry (Patient 1). Alternatively, non-locking screws may be inserted away from the center of the canal (Patient 2). The closure in deep and superficial layers is very important to contain the bone graft obtained from the drilling of the femoral canal.

The tourniquet was removed and a transpatellar incision was made. A guidewire was inserted into the femoral canal. The canal was milled, avoiding the plate screws. The bone graft obtained from the milling was maintained inside the femur to fill the metaphyseal focus. A retrograde IMN was in-serted until the femoral deformity level. Percutaneous osteotomy was performed using the multiple-hole technique and completed with an osteotome. The IMN was introduced and secured proximally and distally.

Weight-bearing was not authorized for three weeks; thereafter, partial load was authorized as tolerated. Physical therapy (for ROM gain) was initiated in the second postoperative week.

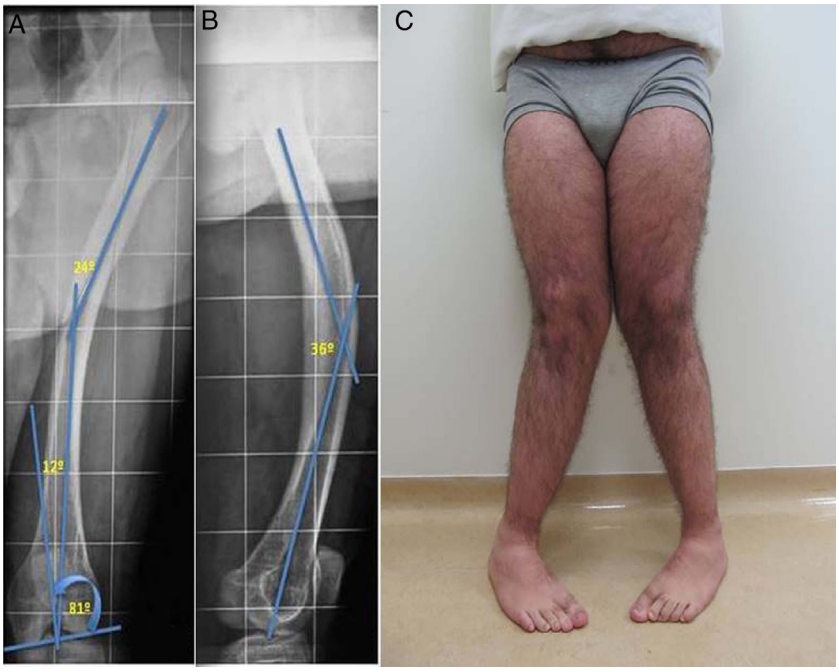

Fig. 1 – Clinical case 1: preoperative radiographs showing deformities on frontal (A) and lateral (B) views; clinical image (C).

Fig. 2 – Clinical case 2: clinical image (A) and orthostatic radiograph (B).

Fig. 3 – Clinical case 2: radiographs showing deformities in the frontal (A) and lateral (B) views.

Results

No complications were observed. Both patients regained complete ROM after the procedure.

Patient 1

The aFLDA was corrected from 69° to 81°. A retrograde IMN corrected the angular deformities (antecurvate and valgus), as well as retroversion (Figs. 4A and B and 5C), with internal rotation of the femur. The pre and postoperative scores were as follows: visual analog scale (VAS), 60–40; Lysholm, 78–93; SF-36 mental, 40.7–57.1; SF-36 physical, 27.7–45.6.

Patient 2

The aFLDA was corrected from 61° to 81°. A retrograde IMN corrected the diaphyseal angular deformity (Fig. 5A–C). The pre

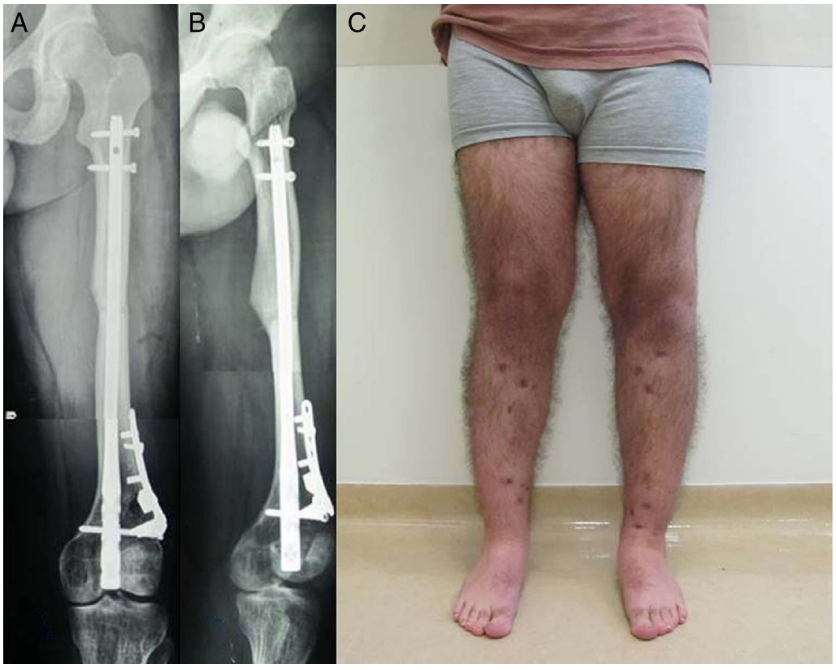

Fig. 4 – Clinical case 1: postoperative radiographs showing deformities on frontal (A) and lateral (B) views; clinical picture (C).

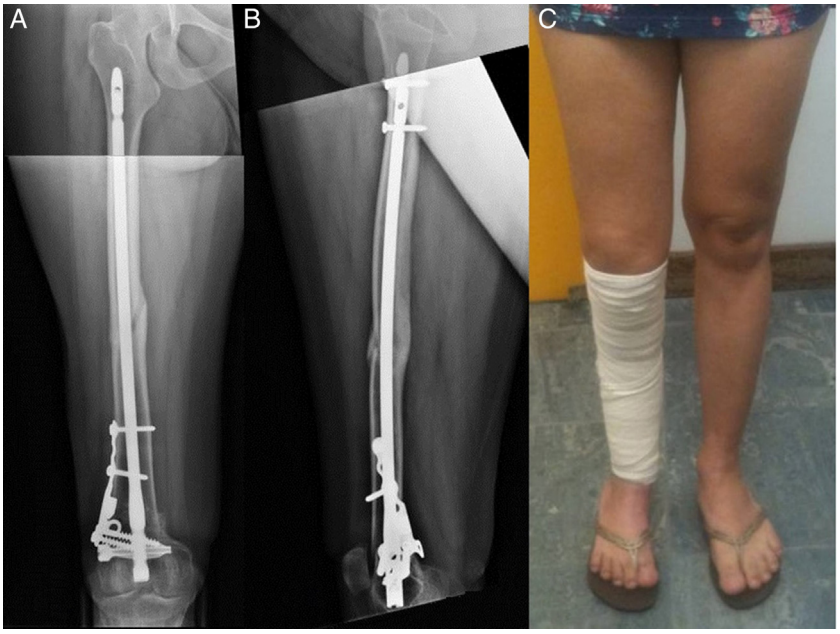

Fig. 5 – Clinical case 2: radiographs on frontal (A) and lateral (B) views; clinical image (C) demonstrating the correction of the femoral deformity.

and postoperative scores were as follows: VAS, 50–20; Lysholm, 55–73; SF-36 mental, 24.7–59.7; SF-36 physical, 28.2–46.8.

Discussion

Combined diaphyseal and metaphyseal deformities of the femur are not common in the general population, but their incidence is higher in patients with metabolic diseases.[1,4,5] These deformities should be corrected,[6] as they can lead to joint overload and cause early osteoarthritis. The treatment of BFDs with osteotomies is complex, due to the difficulty to perform internal fixation of the multiple bone fragments, as well as to the greater morbidity caused by soft tissue injury. The use of circular EFs is possibly the most versatile method for treating these types of deformities; it presents very good results, but has some disadvantages. In the femur, the pins pass through the muscle tissue; they can cause pain, discomfort, infection, and fibrosis in their path. This can lead to loss of ROM. Difficulties in coping with the EF may also be a problem.[2,4,5,7] Patient 2 refused EF; therefore improvement of her quality of life was significantly more mental than physical.

Both patients had all deformities corrected and presented a significant clinical improvement, especially in quality of life. The use of PP associated with retrograde IMN was an effective technique to correct BFD with good radiographic results and a quick functional recovery.

Conclusion

The described technique is a reliable, accurate, and reproducible alternative for combined metaphyseal and diaphyseal deformities of the femur.

Conflicts of interest

The authors declare no conflicts of interest.

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