

Early Breakage of All Proximal Locking Compression Screws under Non-weight-bearing Conditions after Derotational Femoral Osteotomy in a Child with Cerebral Palsy: A Case Report

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Learning Point of the Article:

Surgeons need to consider the spasticity of the limbs as a cause of implant failure.

Abstract

Introduction: The locking compression plate (LCP) system for pediatric hips has improved fixation and angular stability. Herein, we report a rare case in which all proximal locking compression screws were broken before weight bearing in the early post-operative period after derotational femoral osteotomy in a child with spastic cerebral palsy (CP).

Case Report: Derotational femoral osteotomy was performed using a LCP system for a 9-year-old boy with spastic CP to correct excessive femoral anteversion, causing unstable toe-in gait. Proximal screw breakage was found 2 weeks postoperatively during hip-spica casting under non-weight-bearing conditions. Implant breakage was considered a result of the excessive spasticity of the lower limb. At the time of reoperation, shortening and varus correction of the femur and muscle tendon release were performed in addition to the re-fixation of the osteotomy. Intensive pain control was ensured, and anti-spastic medication and botulinum toxin injection were administered. Complete bone healing was successfully achieved 6 months after the second surgery.

Conclusion: Surgeons need to consider the spasticity of the lower limb as a cause of implant failure. Management to reduce spasticity and mechanical load to the implant is important for preventing implant failures in patients with spastic CP.

Keywords: Cerebral palsy, femur, osteotomy, weight-bearing.

Introduction

Patients with cerebral palsy (CP) often have hip problems. Common pathological hip conditions include excessive anteversion and valgus deformity of the femur, which may result in unstable toe-in gait and hip instability. If conservative treatments (rehabilitation, orthosis, and oral or injective medications for spasticity) fail, surgical treatment is considered. Proximal femoral osteotomy is one of the most established surgical procedures for such hip conditions and is used to correct femoral deformities and to stabilize the hip joint.

In corrective femoral osteotomy in children with spastic CP,

achieving firm fixation is crucial. Lower limb spasticity can cause mechanical stress on the implant. Moreover, patients with CP commonly have osteoporosis [1, 2]. Conventional blade plates are reported to have a high incidence of fixation loss [3].

The locking compression plate (LCP) system for pediatric hips [4] has improved fixation and angular stability. In selected cases, a shorter period of casting and early weight bearing can be allowed, and some studies report decreased rates of loosening, even in osteoporotic bones.[3] Favorable clinical outcomes have been reported in children with CP who underwent proximal femoral osteotomy [5]. Only a few studies reported failure to implant the LCP system for femoral osteotomy. The loosening of

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Author's Photo Gallery



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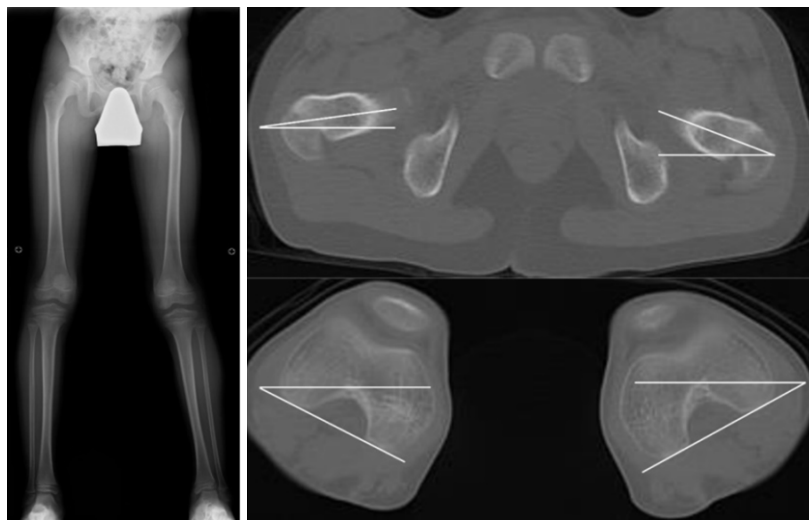


Figure 1: Radiographic images of the lower extremities. (a) Bilateral patellar medialization and high femoral neck-shaft angle in a leg radiograph in standing anterior-posterior position, indicating an excessive femoral internal rotation and high anteversion. (b) Computed tomography images of the femur; femoral anteversion angles are 55° (right) and 58° (left).

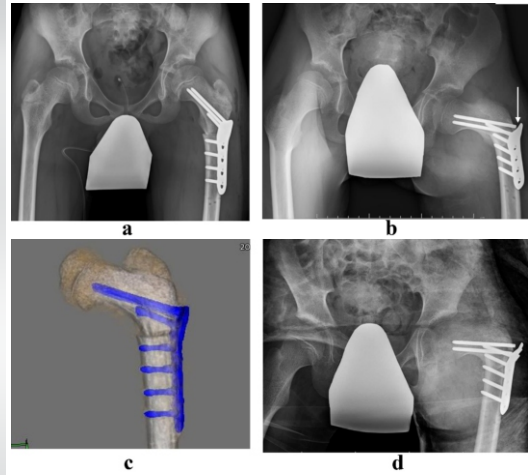


Figure 2: Post-operative radiographic images of the left femur. (a) A post-operative radiograph immediately after left femoral derotational osteotomy. (b) A radiograph 2 weeks after the first surgery showing correction loss; white arrow indicates a proximal screw breakage. (c) Three-dimensional image of the proximal femur 2 weeks after the first surgery showing minimal correction loss. (d) A radiograph 3 weeks after the first surgery; the progression of correction loss and breakage of all proximal screws are observed.

screw, loss of correction, and infection are the most common failures in the early post-operative period [3, 4].

However, there are no reports of implant breakage in the aforementioned period after femoral osteotomy in patients with CP during hip-spica casting under non-weight-bearing conditions. Therefore, we report a rare case of LCP screw breakage that occurred just 2 weeks after derotational femoral osteotomy in a child with spastic CP.

Case Report

A 9-year-old boy with CP was born at 38 weeks of gestation with

a birth weight of 2772 g. Developmental delay and spastic diplegia were observed and the patient started walking at 4 years of age. He was followed up by a pediatric neurologist, but no medication was prescribed for his lower leg spasticity because it was considered necessary for walking. He and his parents visited our clinic when he was 9-years-old, with complaints of frequent falls due to a toe-in gait that causes instability during ambulation. The patient could walk short distances without assistance at home but required a wheelchair to travel long distances.

In supine position, the patient’s leg alignment was neutral. On ambulation, internal rotation of the hips and right and left foot

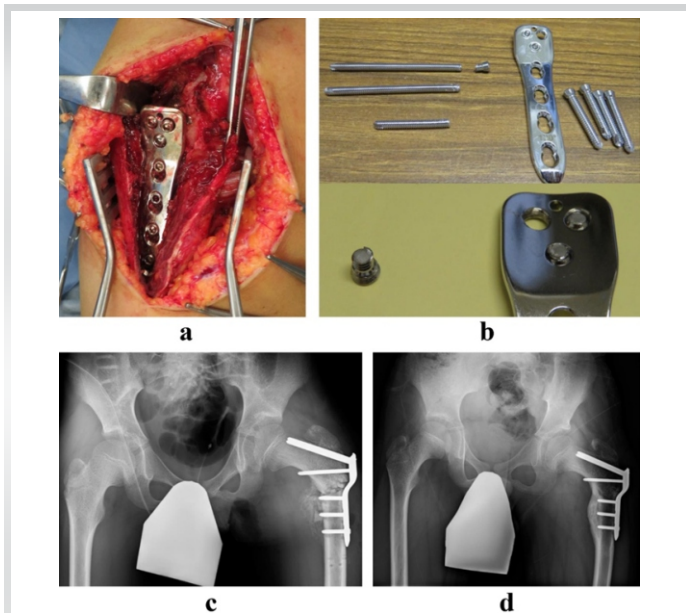


Figure 3: Intraoperative findings and radiographic images after reoperation. (a) An intraoperative photograph showing no screw loosening or metal debris. (b) The explanted implants are shown; all proximal screws are broken just under the locking thread. (c) A radiograph immediately after reoperation. (d) A radiograph 6 months after reoperation; complete bone healing is achieved.

Table 1: Pre-operative physical and radiographic findings.

	Right side	Left side
Physical findings		
Hip ROM		
Flexion (°)	130	130
Extension (°)	0	0
Abduction (°)	30	30
Adduction (°)	20	20
Internal rotation (°)	100	100
External rotation (°)	30	20
Knee ROM		
Flexion (°)	150	150
Extension (°)	-5	-10
Popliteal angle (°)	120	90
Ankle ROM		
Dorsiflexion (KE/KF) (°)	10/10	0/0
Plantar flexion (°)	30	30
Foot progression angle (°)	90	100
Ashworth scale (hip)	3	3
Radiographic findings		
Femoral neck shaft angle (°)	153	154
Femoral anteversion angle (°)	55	58
Tibial torsion (°)	27	11

ROM: Range of motion, KE: Knee extension, KF: Knee flexion



progression angles of 90° and 100°, respectively, were observed. Physical examination findings are summarized in Table 1. At admission, the patient's height and weight were 130 cm and 24 kg, respectively.

A standing anteroposterior full-length leg radiograph showed bilateral patellar medialization and high neck-shaft angle of the femur, indicating excessive femoral internal rotation and high femoral anteversion (Fig. 1a). Computed tomography (CT) of the patient's lower extremities revealed right and left femoral anteversion angles of 55° and 58°, respectively (Fig. 1b) (Table 1). A single-event multilevel surgery, including bilateral femoral derotational osteotomy, distal hamstring lengthening, and soft tissue and bony procedures of the feet were proposed by a surgeon to correct the rotational deformation of the lower limbs, thereby improving gait. However, the patient and his parents requested minimal hospital stay. Therefore, the surgeon decided to treat the left knee contracture and to correct only the left femoral deformity as it is more pronounced than the right.

Left femoral osteotomy at the subtrochanteric level and correction of toe-in gait by decreasing the femoral anteversion by 40° were planned. First, we performed fractional lengthening of the left distal hamstrings to improve the flexion contracture of the left knee. Subsequently, osteotomy of the proximal femur was performed by a standard lateral approach. The Pediatric Hip Plate 3.5 (Depuy-Synthes, Oberdorf, Switzerland) LCP with a screw angle of 120° was used. The bone was sufficiently solid, and the plate fixation was stable. All three proximal and four distal holes were fixed with locking screws with a 3.5 mm diameter (Fig. 2a). Unilateral hip-spica casting above the ankle without weight-bearing was performed for post-operative therapy. Post-operative pain was managed with intravenous acetaminophen, opioids, and oral ibuprofen. Opioids were discontinued on post-operative day 2. After recovery from general anesthesia, the patient showed an increased left foot spasticity. The on-demand use of oral tizanidine and suppository diazepam was indicated to be necessary by a pediatric neurologist.

At 2 weeks postoperatively, radiographic examination was performed after removing the hip-spica casting; breakage of one proximal locking screw and varus deformity were found on radiography and CT images (Fig. 2b, 2c). The surgeon considered the displacement acceptable, and the hip-spica casting was applied under general anesthesia. An additional daily oral dose of 10 mg baclofen was introduced.

At 3 weeks postoperatively, breakage of all proximal screws and progression of the varus displacement were observed on radiographic examination (Fig. 2d). A reoperation was performed, and intraoperative findings were as follows: the breakage of the proximal screws occurred just under the locking

thread, no screw loosening or metal debris was observed, and one of the three locking threads was detached from the plate (Fig. 3a, 3b). Refixation was performed using a locking plate with a screw angle of 110°. We performed a 12 mm femoral shortening to reduce the stress at the osteotomy site simultaneously with a bilateral hip adductor tenotomy and a botulinum toxin injection into the bilateral hip adductor and left rectus femoris muscles (Fig. 3c). A bilateral one-and-a-half hip-spica casting including the left foot was applied for 6 weeks. Post-operative pain management included epidural anesthesia for 1 week, and a conventional daily dose of 10 mg baclofen and 3 mg tizanidine. The clinical course after reoperation was good. Partial weight-bearing was allowed at 9 weeks postoperatively, and full weight-bearing was allowed at 12 weeks postoperatively. At 6 months after reoperation, the osteotomy was completely healed without any signs of implant breakage or displacement as confirmed by radiography (Fig. 3d), and the patient showed increase stability on ambulation with a remarkable reduction in falls at 1 year postoperatively compared to his pre-operative condition.

Discussion

This is a rare case of LCP screw breakage at only 2 weeks after derotational femoral osteotomy in a child with CP during hip-spica casting immobilization under non-weight-bearing conditions. LCP breakage rate has been reported to be 0–7.1% [6, 7], and in cases of femoral osteotomy in children with CP, the reported rate is 0–3.3% [4, 5, 8, 9]. Only one case of LCP breakage has been reported, which was detected at implant removal, thereby having no clinical relevance [4]. Implant loosening and loss of correction are the most common failures in femoral osteotomy in patients with CP. This is mainly because the majority of patients with CP have osteoporosis [1]. In the present case, osteoporosis was minimal because the patient was able to move, and no medications that may cause osteoporosis were prescribed. As proximal screws were firmly fixed to the proximal femur, the instability at the osteotomy site caused micromotion not only between the screws and the bone but also between the screws and the plate. This could be the possible reason of implant breakage in this case.

All previously reported locking screw breakages occurred under weight-bearing conditions. However, in our case, breakage occurred during hip-spica cast immobilization under non-weight-bearing conditions. We proposed that the main cause of locking screw breakage was the excessive spasticity of the lower limbs. In patients with CP, muscle tone can increase postoperatively because of post-operative pain and discomfort. This case suggests that the increased muscle tone of spasticity leads to a tremendous mechanical load on the implant. We

speculate that the continuous and repetitive stress on the implant caused metal fatigue, resulting in screw breakage. Surgeons should recognize that the mechanical load due to increased spasticity can be comparable to weight-bearing conditions when considering implant failure.

Another reason for screw breakage may be insufficient casting. We applied hip-spica cast immobilization above the ankle after the first surgery. However, the above-ankle hip spica cast cannot control the rotation of the hip, thereby allowing rotation at the osteotomy site. Both axial stress by weight-bearing and rotational stress by spasticity may cause implant failure.

In the second surgery, additional treatments were indicated to prevent implant failure. We considered that the management of spasticity is one of the most important factors for a successful osteotomy in patients with CP. To reduce the mechanical load on the implant, we additionally performed intensive pain control, anti-spastic medication, botulinum toxin injection, hip adductor tenotomy, and femoral shortening. We believe that these additional treatments led to a successful bone union after the second surgery.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for patient images and other clinical information to be reported in the journal. The patient's parents understand that his names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

Conclusion

We report a rare case of LCP screw breakage in the early post-operative period after derotational femoral osteotomy in a child with spastic CP during hip-spica cast immobilization in non-weight-bearing conditions. Surgeons should remember that screw breakage can occur even under non-weight-bearing conditions. Therefore, the management of spasticity to reduce muscle tone and mechanical load to the implant is important to prevent implant failures in patients with CP.

Clinical Message

This is quite a rare case of LCP screw breakage at only 2 weeks after derotational femoral osteotomy in a child with spastic CP during hip-spica cast immobilization in non-weight-bearing conditions. The aim of this report is to give surgeons the idea that screw breakage can occur even under non-weight-bearing conditions and that it is necessary to manage spasticity to reduce the muscle tone and mechanical load to the implant to prevent implant failures in patients with CP.

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