MINI EXTERNAL FIXATOR ASSISTED METACARPAL LENGTHENING WITH THE DISTRACTION METHOD

Bekir Eray Kilinc, Adnan Kara, Ramazan Erden Ertürer, Yunus Oc
Igdir State Hospital Igdir, Turkey

MALI SPOLJNI FIKSATOR KAO POMOĆNO SREDSTVO PRI METAKARPALNOM PRODUŽENJU DISTRAKCIONOM METODOM

Bekir Eray Kilinc, Adnan Kara, Ramazan Erden Ertürer, Yunus Oc
Igdir Državna Bolnica, Igdir, Turska

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ABSTRACT

Phalangeal brachydactyly, which is caused by the abnormal development of the metacarpal, is characterized by shortness that can be seen in a single finger or in all fingers of the hands. Although brachydactyly is usually thought of as congenital, it can occur due to metabolic disorders or trauma. A twelve-year-old girl was admitted to our clinic with complaints of shortness in the fourth finger of the left hand. Osteotomy was applied with the drilling-osteotomy technique. The screws holding the upper and lower segments were adapted to the external fixator. Lengthening began one week after the osteotomy. The lengthening rate was organized as 0.25x2 mm/day. The amount of elongation was planned not to exceed 40% of the original bone length. Distraction was terminated after the planned elongation amount was reached, and the bone was allowed to heal. In patients under twenty years of age, the results from progressive distraction without bone grafting are close to perfect. Although the technique of successfully lengthening metacarpal fractures in children is simple, strict rules should not be ignored. Primarily, the external fixator and the distraction system should be sufficiently stable, lightweight, and should be appropriate for the size of a child's hand.

Keywords: brachydactyly, osteotomy, elongation

SAŽETAK

Falangealna brahidaktilija, koja nastaje usled abnormalnog razvoja metakarpalnih kostiju, se karakteriše skraćanjem koje može da se javi na pojedinačnom ili svim prstima. Iako je brahidaktilija obično kongenitalnog porekla, može da bude posledica metaboličkih poremećaja i trauma. Dvanaestogodišnja devojčica je primljena na kliniku žaleći se na skraćanje četvrtog prsta leve ruke. Urađena je osteotomija tehnikom bušenja. Šrafovi koji drže gornje i donje segmente su pričvršćeni za spoljni fiksator. Sa produženjem je započeto četiri nedelje nakon osteotomije. Step produženja je iznosio 0.25x2 mm/dan. Produženje ne bi trebalo da pređe 40% od početne dužine kosti. Distrakcija je završena nakon produženja i kost je ostavljena da se zaleći. Ukoliko se primeni pre dvadesete godine života distrakcija (bez zamene kostiju) daje gotovo savršene rezultate. Mada je ova tehnika jednostavna, striktna pravila ne bi trebalo da se ignorišu. Pre svega, spoljni fiksator i distrakcioni sistem bi trebalo da budu dovoljno stabilni, laki i veličine koja je prilagođena dečijoj ruci.

Ključne reči: brahidaktilija, osteotomija, produženje

INTRODUCTION

Phalangeal brachydactyly, which is caused by the abnormal development of the metacarpal, is characterized by shortness that can be seen in a single finger or in all fingers of the hands. Although brachydactyly is usually seen as congenital, it can also be due to metabolic disorders or trauma (1,2).

The exact reason for congenital shortening of the metacarpals is unknown; the deformity is generally thought to be caused by premature closure of the epiphyseal plate.

The incidence of congenital metacarpal shortening alone is approximately 0.02% to 0.05% (3). The metacarpal

extension technique was first reported as a case report by Mansoor (4). In our case, we applied the callus distraction method with a mini-Orthofix type fixator for lengthening.

CASE REPORT

A twelve-year-old girl was admitted to our clinic with complaints of shortness in the fourth finger of left hand in September 2011 (Figure 1). We evaluated our patient for brachydactyly type E. She had an isolated feature and had

Figure 1. Short fourth metacarpal of the left hand via X-ray

no complex syndromes. The patient complained of poor cosmetic appearance and fatigue during work using her left hand. The fourth finger of the left hand was 1.4 cm shorter than the fourth finger of the right hand upon examination. There was no limitation of motion in the short finger.

An upper extremity tourniquet was applied and the osteotomy site was exposed through a one cm dorsal longitudinal incision on the dorsum of the short metacarpal under general anaesthesia. After extensor tendon exploration, the periosteum was stripped without damage and osteotomy was applied with the drilling-osteotomy technique. We used a standard dorsopalmar radiographic projection of the hand; the X-ray beam was inclined 15° from the vertical at a distance of 100 cm. After confirming by

fluoroscopy that the osteotomy was complete, two pieces of 3 mm self-tapping screws were placed to the proximal and the distal segment of metacarpal along the long axis and placed on the dorsal surface; they were then adapted to the main fixator by clamps. We applied the mini-Orthofix type fixator for lengthening. Fluoroscopy was used to confirm the position of the screws and fixator. A bone graft was not used (Figure 2,3).

Lengthening began one week after the osteotomy. The amount of lengthening was determined according to the formula specified by Aydınlioğlu (5). The lengthening rate was organized as 0.25x2 mm/day. The amount of elongation was planned not to exceed 40% of the original bone length. The time for healing and consolidation was determined based on postoperative radiographs taken once a week for 4 weeks. Sufficient length was achieved using 0.5 mm/ day elongation in four weeks. Lengthening reached 1.4 cm. The degree of lengthening ranged from 100% of the right hand fourth metacarpal length. Active finger movements began in the early period of post-operative movement. The distraction procedure was taught to family and every week the family was called for control of effective growth and to control the fixator. Pin-care with antiseptics was recommended. The parents were taught to care and dress the pin tract. Distraction was terminated after the planned elongation amount was reached and the bone was allowed to heal. The consolidation time was the time between the end of distraction osteotomy and the total consolidation or removal of the fixator. After a one month waiting period for bone consolidation, the external fixator was removed in the outpatient clinic after maturation of

Figure 2. Post-operative X-ray

Figure 3. Post-operative picture

Figure 4. Fixator extracted X-ray

the callus. Any infection during treatment, delayed union or non-union were not found (Figure 4,5).

Considering the functional results, the patient was satisfied with the cosmetic appearance after surgery. The metacarpophalangeal range of motion was measured using a goniometer, preoperatively and 6 months postoperatively. There was no evidence of metacarpophalangeal joint stiffness. Her Quick Dash Score was eleven.

During the follow-up period, there was no re-fracture, subluxation/dislocation in the metacarpophalangeal joint, degenerative changes or neurovascular injury in the patient.

DISCUSSION

Brachymetacarpia is the congenital shortening of the metacarpals and usually affects the third, fourth, and fifth digits. Though its exact aetiology is unknown, premature closure of the epiphysis is thought to be involved. The condition may occur sporadically or occur as part of a syndrome. Brachydactyly (BD) refers to the shortening of the hands, feet or both. There are different types of BD; among them, type E (BDE) is a rare type that can present as an isolated feature or as part of more complex syndromes such as pseudohypoparathyroidism, hypertension with BD, and BD with mental retardation. Each syndrome has characteristic patterns of skeletal involvement. However, brachydactyly is not a constant feature and shows a high degree of phenotypic variability. In addition, there are other syndromes that can be misdiagnosed as brachydactyly type E. Variable shortening of the metacarpals with more or less normal length of phalanges occurs in BDE. Occasionally, the metatarsals are also short. This results from hypoplastic and partially fused metacarpal epiphyses, which are visible on radiographs.

Various osteotomy and intercalary bone grafting techniques are indicated in the treatment of broken short metacarpals. It is hard to provide sufficient lengthening with these techniques, and acute lengthening increases the risk of neurovascular damage (6). The callotasis method, also known as distraction osteogenesis in metacarpal and

Figure 5. Fixator extracted picture

metatarsal lengthening, is now more preferred and used by many surgeons (3,7,8,9,10,11,12,13). A gap of approximately 3 cm can be achieved within 2 to 3 months without the need for a bone graft in patients aged between 10 and 14 years. Whereas a bone graft is required in approximately 50% of patients aged between 26 and 30 years, it is still generally advised for persons older than 25 years who require metacarpal lengthening of more than 3 cm (14-15). Similarly, a bone graft is recommended in patients who need lengthening of more than 20 mm (16). We achieved a mean lengthening of 14 mm without the use of a bone graft. Limited corticotomy has been advocated when there is a compromised endosteal blood supply, but endosteal blood supply and bone marrow have no effect on consolidation and healing. The proximal metaphysis is the site with the best blood supply, and this reduces the time needed for healing and consolidation (17). The significant advantages of this method can be stated as follows: obtains further lengthening, does not require a bone graft, absence of donor site morbidity, multiple bone implementation, allows early loadings, has fewer neurovascular complications, has reduced loss of joint motion because of the better adaptation of the soft tissues to gradual lengthening and the lack of plaster (3,7,9,10,17,18). However, some disadvantages must be noted: longer consolidation time, frequent occurrence of pin tract infections, significant loss of motion and stiffness of the MP joint, MP joint subluxation/dislocation, angulation defects and delayed union or pseudoarthrosis development (3,10,19,20). In a study comparing the two methods, the functional outcome and length were not very significant, but it was clear that the consolidation time of the callotasis method was longer (10). Determining which technique should be preferred depends on the surgeon's experience. Distraction osteogenesis is an alternative method that can be used in patients who desire great lengthening with a reduced risk of complications. In patients under twenty years of age, the progressive distraction results without bone grafting are close to perfect. Although the technique of successfully lengthening metacarpal fractures in children is simple, strict rules should not be

ignored. Primarily, the external fixator and the distraction system should be sufficiently stable, lightweight, and appropriate for the size of a child's hand.

RESULTS

Bone remodelling is an excellent technique for children. For the treatment of childhood brachydactyly, one session of the metacarpal lengthening technique with mini-Orthofix type external fixator distraction osteogenesis is a good alternative to complex and technically demanding procedures. Metacarpal lengthening by callus distraction is an appropriate method that achieves adequate lengthening. Healing is faster in younger patients and, if tolerated, surgery can be performed in early childhood. It can also be performed satisfactorily in adults following traumatic amputations. To avoid additional lengthening of normal metacarpals prior to epiphyseal closure, adolescence is the most appropriate time to perform distraction lengthening in congenitally short metacarpals. Careful preoperative planning, secure intraoperative mounting of the external fixator, and sufficient postoperative patient and parental cooperation are essential to avoid complications.

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