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Journal of Orthopaedics, Trauma and Rehabilitation 19 (2015) 39–43

Contents lists available at ScienceDirect

Journal of Orthopaedics, Trauma and Rehabilitation

Journal homepages: www.e-jotr.com & www.ejotr.org

Original Article

Use of Universal Mini External Fixator in the Management of Postosteomyelitic Defects in Short Tubular Bones in the Paediatric Population

使用通用迷你外固定支架(Universal Mini External Fixator, UMEX)在兒科病人中治理因骨髓炎造成在短管狀骨的缺陷

Kawoosa Altaf A. [a,*], Wani Iftikhar H. [a], Shah Shaika F. [b], Baasit Syed [a]

[a] Postgraduate Department of Orthopaedics, Hospital For Bone and Joint Surgery, Government Medical College Srinagar, Kashmir, India
[b] Department of Microbiology, Government Medical College Srinagar, Kashmir, India

ARTICLE INFO

Article history:
Received 2 January 2014
Received in revised form
28 March 2014
Accepted 15 May 2014

Keywords:
osteomyelitis
short tubular defects
UMEX (Universal Mini external fixator)

ABSTRACT

Background/Purpose: The purpose of this study was to evaluate the results of reconstruction of post-osteomyelitic defects in short tubular bones in a paediatric population using a universal mini external fixator (UMEX).
Methods: This was a prospective case series based on 10 consecutive cases who were followed-up for an average period of 3.5 years. Ten patients (mean age: 10.2 years) with an average shortening of 4 cm of the corresponding digit were operated upon using soft tissue distraction by UMEX followed by interposition bone grafting from the iliac crest. The second metacarpal was involved in five patients, the first metacarpal in three patients, and the proximal phalanx of the right big toe was involved in two patients.
Results: All of the patients achieved union at the graft host site at an average of 12 weeks and an average of 3.8 cm lengthening of the digit was achieved. All patients had improved digit length, and function and appearance of the hand and toe. Apart from a minor pin tract infection and stiffness, there were no major complications. Final average follow-up at 3.5 years did not show any recurrence of infection or loss of correction.
Conclusion: We believe that UMEX is a versatile method of managing postosteomyelitic defects in short tubular bones, with fewer complications and a high union rate, even in situations in which bone fragments are small and difficult to handle with other methods.

中 文 摘 要

目的: 本研究的目的是評估使用通用迷你外固定支架(universal mini external fixator, UMEX)來重建在兒童因骨髓炎造成在短管狀骨的缺陷。
設計: 十個病人的前瞻性病例報告，平均隨訪期為3.5年。
方法和材料: 10例患者（平均年齡10.2年），患有平均4厘米的指骨縮短，接受了利用UMEX配合從髂骨提取的中間骨移植。有5例涉及第二掌骨，3例涉及第一掌骨和2例涉及右腳大腳趾的近節指骨。
結果: 所有植骨都成功愈合，平均時間為12週，平均指骨加長3.8厘米。所有患者的指骨長度，功能和外觀都改善。除了一例有針道感染和僵硬，沒有嚴重併發症。 在最終平均隨訪3.5年中，沒有任何感染復發或失去校正。
結論: 我們認為UMEX是治理因骨髓炎造成在短管狀骨的缺陷的方法。即使在骨碎片都非常小，和其他方法失敗的情況下，UMEX仍能有併發症少，癒合率高的效果。

* Corresponding author. *E-mail:* draltafk@yahoo.com.

http://dx.doi.org/10.1016/j.jotr.2014.05.001
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Introduction

Osteomyelitis of the metacarpals, metatarsals and phalanges is uncommon after the age of 5 years. During childhood, these short tubular bones have an extensive blood supply through a large nutrient artery entering almost in the middle of the bone. The first infective inoculum lodges at the centre of the marrow cavity, and the diaphysis is often involved predominantly in this age group.[1]

Pyogenic osteomyelitis sometimes results in sequestration of the diaphysis with healing resulting only after extrusion of this sequestrum. The resultant defect often leads to shortening of the affected digit, interfering with the normal prehensile function. Metacarpal reconstruction is vital to maintain the function of digits and hand as a whole. Stability takes precedence as mobility is marginal even in the normal hand.[2]

We report a series of 10 cases in which we were able to overcome the soft tissue shortening with the help of a universal mini external fixator (UMEX). This was followed by interposition bone grafting. All the patients united uneventfully, regaining the lost length of the digit with improvement in the range of motion at the final follow-up.

Patients and methods

Ten patients (8 female; 2 male) with a mean age of 10.2 years were operated upon for metacarpal and phalangeal defects resulting from chronic osteomyelitis and diaphyseal sequestration from 2005 to 2011. The second metacarpal was involved in five patients, with the involvement of dominant hand in four patients and the nondominant hand in one patient (Table 1). In the dominant hand, the first metacarpal was involved in three patients and the proximal phalanx of the big toe of the right foot was involved in two patients, resulting in shortening and cosmetic disfigurement of the corresponding digit. All patients with involvement of the first and second metacarpals presented with shortening of the corresponding finger, impairing the functions of pinch and grasp of the affected hand (Figure 1). Two patients with shortening of the great toe had difficulty in push off movements during walking (Figure 2). The diaphyseal sequestration and extrusion in these patients had left only the metaphyseal portion intact, and were not amenable to bone transport (Figures 3 and 4). The mean shortening of the affected digit was 4 cm. Surgery was performed in two stages. The first stage involved distraction of the soft tissue to achieve lengthening of the affected metacarpal joint and to create a gap for future bone grafting. At this stage, the UMEX was applied to the remnants of the metacarpals under local anaesthesia without opening the defect site. The UMEX comprised small dimension clamping elements connected by a threaded rod. Rotation of the rod in a clockwise or counterclockwise manner created distraction or compression, respectively, across the fixation clamps. Distraction was started on the 1st postoperative day at the rate of 1 mm/d. We preferred gradual distraction to avoid pain and problems of any vascular compromise associated with acute distraction. Once the distraction was completed (Figure 5), that is, when the original length of the metacarpal and phalanx was achieved, the second stage of surgery was performed. This stage was performed under general anaesthesia. The defect site was approached dorsally and cleared of any scar tissue and cultures were performed to assess any recurrence of infection. Any tethered tendons at this stage were released from the surrounding scar tissue, however, no tendon lengthening was deemed necessary due to initial gradual distraction. The remnants of the affected metacarpal and phalanx were gently freshened to receive the bone graft. A corticocancellous strut graft from the iliac crest of appropriate size was harvested and locked in the gap created in the metacarpal and phalanx using the UMEX in the compression mode. During healing, compression was maintained to enhance the union between graft and host site (Figure 6).

Table 1
Patient's details

Serial no.	Age (y)	Sex	Involved digit and side	Degree of shortness of affected digit	Patient complaint	Complications
1	13	F	Index finger (R)	44 mm	Cosmetic, functional impairment,	Pin tract infection
2	10	M	Index finger (R)	45 mm	Impaired pinch function, cosmetic	Mild stiffness
3	12	F	Thumb (R)	42 mm	Impaired pinch function, cosmetic	Nil
4	14	F	Great toe (R)	32 mm	Cosmetic, difficult push off	Pin tract infection
5	11	F	Index finger (L)	44 mm	Impaired pinch function, cosmetic	Nil
6	12	F	Thumb (R)	30 mm	Impaired pinch function, cosmetic	Nil
7	15	F	Index finger (R)	43 mm	Impaired pinch function, cosmetic	Nil
8	11	F	Index finger (R)	46 mm	Impaired pinch function, cosmetic	Mild stiffness, loss of length (8 mm)
9	13	M	Thumb (R)	38 mm	Functional impairment	Nil
10	10	F	Great toe (R)	36 mm	Cosmetic, impaired push off	Mild pin tract infection

F = female; L = left; M = male; R = right.

Figure 1. Preoperative clinical photograph of the right hand showing shortening of the index finger secondary to the second metacarpal defect.

Figure 3. Preoperative X-ray showing diaphyseal defect.

Figure 2. Clinical photograph of the foot showing great toe shortening due to the proximal phalangeal defect.

Figure 4. Preoperative X-ray showing proximal phalangeal defect of the great toe.

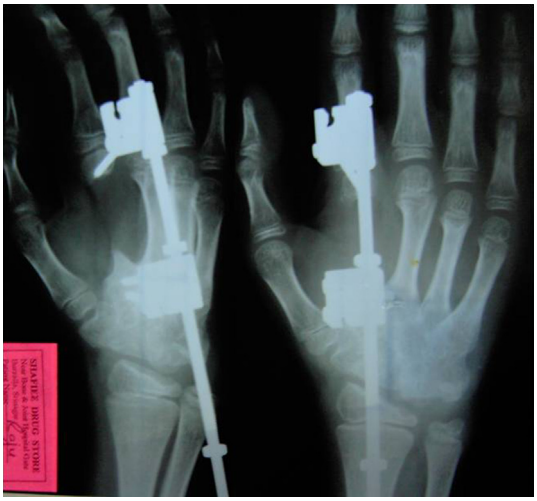

Figure 5. Postoperative X-ray after distraction showing attainment of length of the metacarpal.

Figure 6. X-ray showing consolidation of bone graft with UMEX *in situ*.

Results

The patients were followed-up regularly at 1 week intervals initially and later at 3-weekly intervals. All the patients achieved union at host graft sites at an average of 12 weeks (Figures 7 and 8). An average lengthening of 3.8 cm was achieved. However, in one patient, there was a loss of length of 8 mm due to compression at the union site. All the patients had improvement in the length, function and appearance of the affected digit (Figures 9A and 9B). Mild stiffness at the metacarpophalangeal (MCP) joint in two patients was managed with physiotherapy. There was mild pin tract infection in three patients that recovered after treatment with oral antibiotics.

Figure 7. X-ray at final follow-up at 2 years showing reconstruction of the metacarpal.

Figure 8. X-ray at final follow-up showing reconstruction of proximal phalanx.

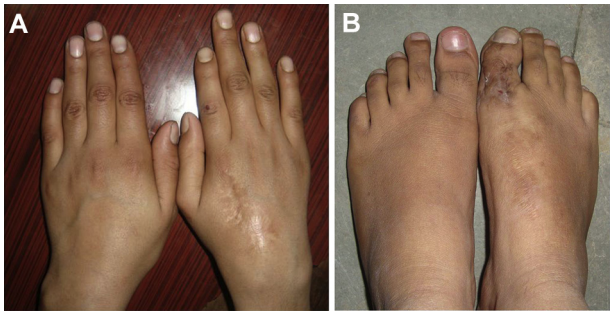

Figure 9. (A) Clinical appearance of the right hand after reconstruction of the second metacarpal. (B) Clinical appearance of the right foot after reconstruction of the proximal phalanx of the big toe.

At an average 3.5 years of final follow-up, none of our patients showed recurrence of infection or loss of function of the affected digit.

Discussion

Bone defects can result from a destructive injury as the sequel of tumour resection, osteomyelitis, pseudoarthrosis, or avascular necrosis. Osteomyelitis of the wrist and hand is uncommon.[3] In children, short tubular bones end up with diaphyseal sequestration. In the case of osteomyelitis or septic arthritis, radical debridement of all infected tissue and bone is indicated. Antibiotic coverage is recommended both locally and systemically, and in case any doubt persists about elimination of the infection, reconstruction is postponed.[2] In such situations, vascularised bone transfers are the method of choice because they provide a good blood supply with antibiotic delivery. However, according to Hierner et al,[4] loss of muscle function with a possible functional and aesthetic defect in the donor site, has to be accepted. Even though Barth[5] believes that conventional bone grafts lack initial perfusion and undergo resorption, Bishop[6] recommends nonvascularised grafts in the face of otherwise ideal conditions only for defects up to 6 cm.

External fixators have been used for management of bone loss in the metacarpals. This is to maintain length and alignment that are quintessential for later intervention and ultimate hand function.[7,8]

Our patients required soft tissue distraction in view of their late presentation. Application of the UMEX distractor under local anaesthesia helped us avoid general anaesthesia in the first setting.

According to Seitz and Fromson,[9] staged lengthening by relatively rapid stretching of the soft tissues and interposition bone grafting often causes excessive pain. With the help of the UMEX distractor, we were able to control soft tissue stretching until the metacarpal and phalangeal length was regained. In the second stage, an iliac crest bone graft was placed with the same fixator acting as a neutralising implant, with the possibility of applying compression if required. The problems of loss of length due to any graft resorption or compression at the union site could be eliminated by initial over lengthening to leave room for any collapse and compression. Thus, coupled with our previous experience with the UMEX distractor, makes it a versatile instrument for conducting pertinent procedures in tubular bones.[10–12]

In conclusion, we believe that UMEX is a versatile method of managing postosteomyelitic defects in short tubular bones, with fewer complications and a high union rate, even in situations in which bone fragments are small and difficult to handle with other methods.

Conflicts of interest

The authors declare that there are no potential conflicts of interest.

References

1. Tuli SM. *Tuberculosis of the skeletal system*. New Delhi: Jaypee Brothers; 2000.
2. McFadden JA. Vascularized partial first metatarsal transfer for the treatment of phalyngeal osteomyelitis. *J Reconst Microsurg* 1998;**14**:309–12.
3. Hayes TG, Gill EP, Swarna U. Osteomyelits of the wrist in a patient with Hodgkin's disease. *J intern Med* 1991;**229**:467–9.
4. Hierner R, Giunta R, Wilhelm K, et al. Local muscle flap of the second and third interosseous space for the treatment of osteomyelitis in the central metacarpal region. *Ann Chir Main Memb Super* 1996;**15**:61–9.
5. Barth H. Histologishe Untersuchungen uber Knochen Transplantation. *Beitr Pathol Anat Allg Pathol* 1895;**17**:65–142.
6. Bishop A. Vascularised bone grafting. In: Green DT, Hotchkiss RN, Pederson WC, editors. *Gren's operative hand surgery*. 4th ed. Philadelphia: Churchill Livingstone; 1999. p. 221–5.
7. Penning D, Gausepohl T, Madu K, et al. The use of minimally invasive fixation in fractures of the hand; the minifixation concept. *Injury* 2006;**31**:102–12.
8. Peimer CA, Smith R, Leffert R. Distraction fixation in the primary treatment of metacarpal bone loss. *J Hand Surg (Am)* 1981;**6**:111–24.
9. Seitz Jr WH, Fromson AI. Digital lengthening using callotasis technique. *Orthopaedics* 1995;**18**:129–38.
10. Kawoosa AA, Dhar SA, Mir MR, et al. Distraction osteogenesis for ulnar lengthening in Kienbock's disease. *Int Orthop* 2007;**31**:339–44.
11. Kawoosa AA, Mir GR. Congenital bilateral brachymetatarsia – lengthening by distraction osteogenesis. *JK Practitioner* 2003;**10**:289–91.
12. Kawoosa AA, Mir NA, Badoo AR, et al. Metacarpal lengthening by distraction osteogenesis. *JK Practitioner* 2004;**11**:32–4.