

=Abstract=

Lengthening of the Short Tubular Bone by Gradual Distraction without Bone Grafting

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From 1994 to 1997, we performed 14 metatarsals lengthening and 3 metacarpals lengthening in 13 adolescent patients by metaphyseal osteotomy followed gradual distraction of callus (callotaxis) using an external fixators. Congenital and acquired shortness of metacarpal and metatarsal may cause not only cosmetic problem but also pain adjacent metatarsals. Excellent clinical results were obtained. The average lengthening and percent original lengthening were 12.9mm (range from 6.4mm to 20.0mm) and 33.9% (range from 15% to 50%). The average lengthening days were 60.6 days. No one required bone grafting after the lengthening and there was no severe complication (stops the lengthening and course of treatment). We used a rigid, unilateral external fixator designed for use in the hand and foot and one Ilizarov external fixator (60mm half ring x 2). At the time of last follow-up, from 12 months and 4 years later, healing had been achieved in all with an average healing index 85 days/cm, an average healing time 112 days and the corrections of the length of the metatarsals and metacarpals were done.

We concluded that the osteotomy with gradual distraction without bone grafting was one of the effect methods for the treatment of lengthening of short tubular bone.

Key Words : Lengthening, Osteotomy, Distraction, Metatarsal, Metacarpal

가 1 : 25 . 72%
 가 가 ²⁰⁾ .
 , , , Freiberg
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 , 가
 , 가가 ²²⁾ .
 Lelievre
 9)

가
 (1=2>3>4>5).
 가
 .
 6)
 ,
 12)
 ,
 10, 23, 24)

1983
 Skirving Newman
 .
 1994 1 1997 9
 14 3
 13
 19.5 13 27

16
 가 1 , 1 ,
 1 . 9 ,
 6 2
 .
 14 4
 3 1, 3, 5 가 1 .
 : 12 : 5 .
 2
 (DKM mini-lengthener 16 , mini-
 Ilizarov 1)
 . 7 1 0.25 mm
 3 (0.75mm/d)
 . 51 (7 120)

가
 .
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 6
 ,
 .

Table 1
 Caton ²⁾ Table 2
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 , ,
 6 4 2
 3 . 가
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Table 1. Details of patients and lengthening techniques

Case	Age (yr)	Sex	Segment	Side	Etiology	Location	Lengthening technique
1	27	F	4	R	Congenital	MT*	Callotasis
2	15	F	4	R	Congenital	MT	Callotasis
3	25	F	4	R	Congenital	MT	Callotasis with tendon lengthening
4	14	F	4	R	Congenital	MT	Callotasis with tendon lengthening
5	14	F	4	L	Congenital	MT	Callotasis with tendon lengthening
6	13	F	4	R	Congenital	MC**	Callotasis with tendon lengthening
7	14	F	5	L	Congenital	MC	Callotasis with tendon lengthening
8	17	F	4	R	Congenital	MT	Callotasis with tendon lengthening
9	17	F	4	L	Congenital	MT	Callotasis with tendon lengthening
10	19	F	4	R	Congenital	MT	Callotasis
11	19	F	4	R	Congenital	MT	Callotasis with tendon lengthening
12	19	F	4	L	Congenital	MT	Callotasis with tendon lengthening
13	15	F	4	R	Congenital	MT	Callotasis
14	22	F	4	L	Congenital	MT	Callotasis
15	27	F	4	R	Congenital	MT	Callotasis with tendon lengthening
16	27	F	4	L	Congenital	MT	Callotasis with tendon lengthening
17	27	M	1	R	Trauma	MC	Callotasis with mini-Ilizarov

* : metatarsal

** : metacarpal

Table 2. Classification of complications during lengthening

Complication	(consolidation)
Benign	Does not jeopardize result Does not increase HI Treated without anesthesia
	12.9mm 6.4mm 20.0mm 33.9%
Serious	Does not jeopardize result or course of treatment may delay HI Treated under anesthesia
	15% 50% (Healing Time) 112 80 186 (Healing index) 53 85 days/cm
Severe	Jeopardize result Stops lengthening Stops course of treatment
	6 days/cm 156 days/cm (Table 3). Table 4

Table 3. Length achieved, healing time and healing index (HI) in 17 cases

Case	Age (yr)	Segment	Lengthening (mm)	% Original length	Healing time (days)	HI* (days/cm)
1	27	4	12	26	106	88
2	15	4	13	27	88	68
3	25	4	8	15	80	100
4	14	4	6.4	33	91	142
5	14	4	6.5	35	91	140
6	13	3	20	49	108	54
7	14	5	15	50	112	75
8	17	4	19	41	100	53
9	17	4	18	38	100	56
10	19	4	10	19	156	156
11	19	4	17	37	120	71
12	19	4	17	37	157	92
13	15	4	13	35	186	143
14	22	4	14	33	80	62
15	27	4	12	34	78	60
16	27	4	13	34	101	78
17	27	1	13	34	110	85

* : healing index

Table 4. Details of complications

Case	Complications			1	2	3
	Benign	Serious	Severe			
1	Superficial pin-track infection	—	—	(5°, 4°, 4°), (5°)	1 (7°), 1 (3°)가	1
3	—	Deep pin-track infection	—	가	.	
4	—	Deep pin-track infection	—			
5	—	Deep pin-track infection	—	1		
7	Superficial pin-track infection	—	—	3, 5	4, 5	
10	mild extension contracture	—	—	DKD mini-lenthrner	(Fig. 1-B),	6
12	Superficial pin-track infection	—	—	0.5mm		1
15	Metatarsalgia	—	—	1 0.5mm	1.0mm	3
16	Metatarsalgia	—	—		41mm	가 61mm 20mm

Fig. 1. 13 years old female patient.

- A.** Initial plain film in A-P projection of Rt. hand shows shortness of third metacarpal and fifth metacarpal bone.
- B.** Immediate Postoperative plain film in A-P projection of Rt. hand demonstrates the osteotomy site and applied state of DKM mini-lengthener.
- C.** 1 month after operation the plain film shows distracted state with callus formation.
- D.** 3 months after operation the plain film shows more distracted state with good callus formation.
- E.** 5 months after operation the plain film shows removed state of DKM mini-lengthener with good consolidation and axis.

49% 48 lengthening)

108 54 days/cm

6 3 가

0°, 64° 14 21

21)

(Fig. 1-C, D, E). 13

2 Magnan¹⁰⁾ 1983 1990 7

9 가

17 3 10

4 4 2 4 1mm/day

(Fig. 2-A). 4 24% 83% 가

DKM mini-lenthner 50 days/cm 가

(Fig. 2-B), 7 1 2 0.25mm/ 4 가 1

20 30 2

4 1 3 7 1 2 가 50% 가

4 0.25mm 6 65%

46mm 가 65mm 19mm 2

41% 39 Seitz¹⁸⁾ 8 14

100 53 5 7 가

days/cm 7 1 0.25mm 25

mm 35mm 가

1 3 가 1

(Fig. 2-C, D, E). 1 가 1

Mori shima⁷⁾ 3 4 Kawa-

1 0.35mm 가

74 141 37% 66%

12)

1 2 50%

(one stage

Fig. 2. 19 years old female patient.

- A.** Initial plain film in A-P projection of Rt. foot shows shortness of forth metatarsal bone.
- B.** Immediate Postoperative plain film in A-P projection of Rt. foot demonstrates the osteotomy site and applied state of DKM mini-lengthener.
- C.** 1 month after operation the plain film shows distracted state with callus formation.
- D.** 3 months after operation the plain film shows more distracted state with good callus formation.
- E.** 7 months after operation the plain film shows removed state of DKM mini-lengthener with good consolidation and axis.

가 (callotasis) . DKM mini-lengthner .

Catalosis , 가

가

Kirschener

1994 1 1997 9 13

11 17

가
(neo-osteogenesis)

가^{1,3)} 12.9mm

1 33.9%, 112 (80

2 186), 85 days/cm(53 days/

3 cm 156 days/cm)

1

(microfilm) 2

가 4

가¹⁾

Ilizarov⁵⁾

가

5-7 , 1

1.0mm (distraction rate),

(0.24mm

6),

(slow rate)

가

(high rate)

4)

Callotasis

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