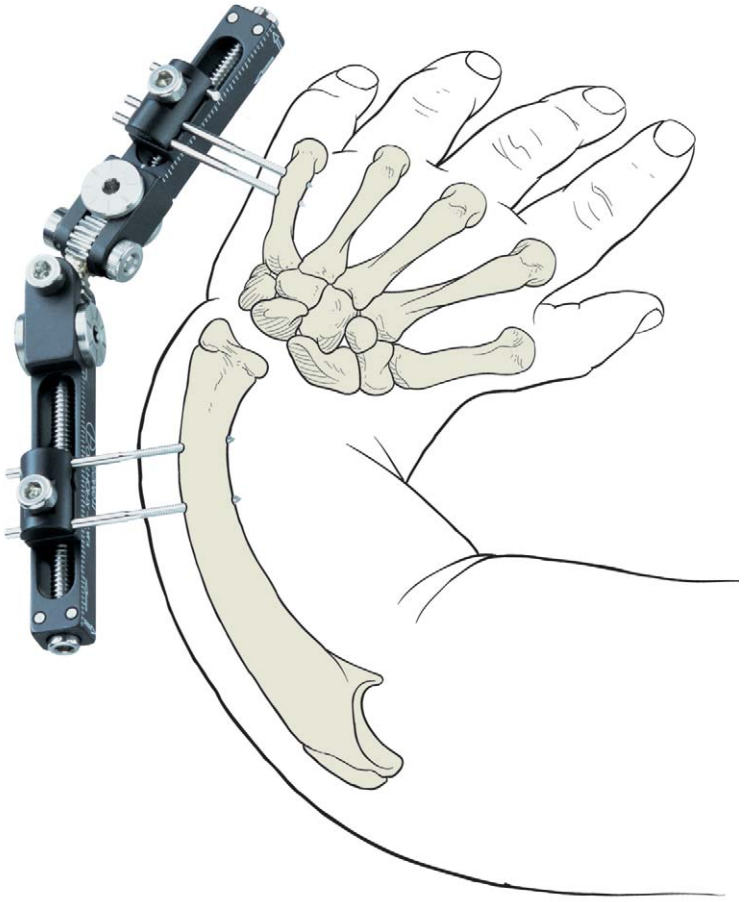
MultiPlanar MiniRail™



14

Correction of Upper Extremity Contractures

MiniRail System
Part C: M2 MultiPlanar MiniRail

By Dr. L. Andrew Koman

ORTHOFIX®
ALWAYS INNOVATING

CONTENTS

GENERAL INFORMATION:

The M2 is provided as a non-sterile single use device.

There are a variety of screws available for this device, as listed on the back cover of this guide.

Note: In this technique we use the term screw instead of wire. Screws have 3mm diameter shafts with various threaded tips and wires are 2mm diameter shafts. The threaded wires are more applicable for use in the Radial Club Hand procedures, as the majority of patients are age three years or less and have very small bones.

The largest selected diameter screw should be compatible with the patient's bone diameter. The hole in the bone should not be larger than 30% of the bone diameter, and should be in the center of the bone axis. This is particularly important for stability when lengthening.

All implants are self-drilling. The wires can be inserted directly percutaneously; or for optimal placement the screws can be inserted through a small incision.

All the screws have tapered threads. Care should be taken not to insert too far. They should **not** be backed out, as loosening will occur.

The 1.6 and 2.0 mm wires have cylindrical threads, and can be backed out if necessary.

In the diaphysis, screw or wire insertion should be in the center of the bone axis, to avoid excessive stress.

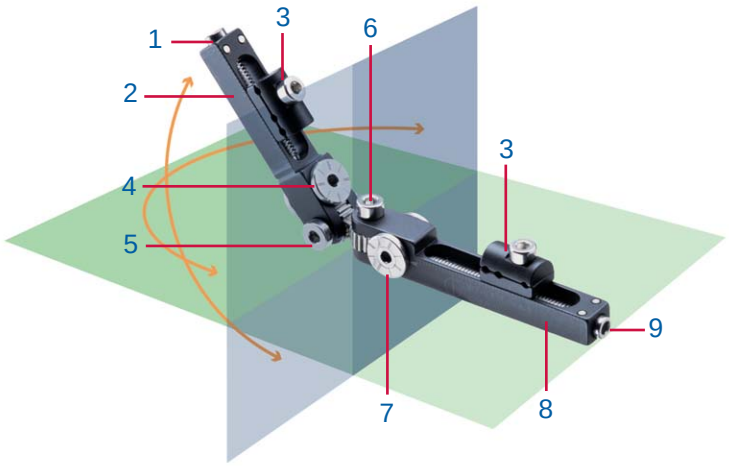
Note: If 2.5 –2.0 mm threaded screws are used and backed out; a screw with a larger thread can be inserted.

The MultiPlanar Geared MiniRail M2 permits staged correction of complex joint deformities and nonsurgical lengthening of musculotendinous contractures. The device consists of 2 linked monorails connected by paired gears. It is constructed to allow positioning of radio-ulnar or dorso-palmar gears over the center of rotation of the deformity and permits distraction and/or compression by either railed segment.

With complex upper extremity deformities, there is no standard center of rotation or arc of motion for the wrist deformity. Careful monitoring is required by the surgeon for a successful outcome. The center of rotation will change with compression/distraction, dorso-palmar or radio-ulnar correction. Proper correction and adjustments will be dependent on the age and size of the patient in addition to the specific deformity.

The Indications for the M2 are:

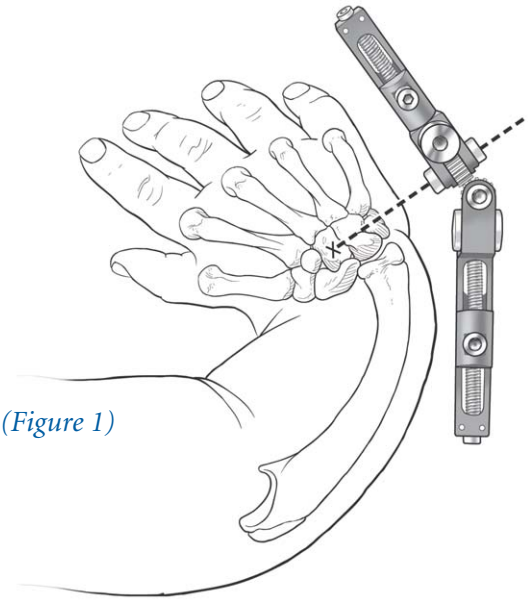
- Complex Upper Extremity Deformities
- Hand Contractures
- Wrist Contractures
- Indicated for Pediatrics through Adult



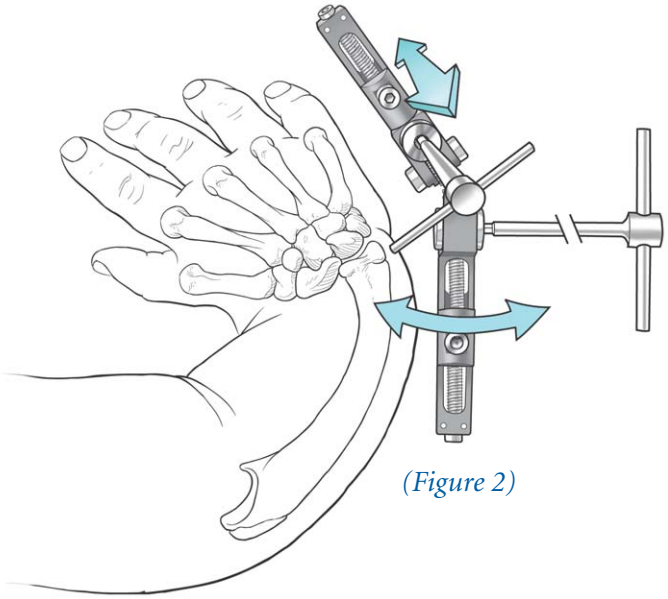
1. dorso-palmar compression/distraction screw
2. dorso-palmar rail
3. screw clamp
4. dorso-palmar flange & socket
5. dorso-palmar locking screw
6. radio-ulnar locking screw
7. radio-ulnar flange & socket
8. radio-ulnar rail
9. radio-ulnar compression/distraction screw

SOFT TISSUE CORRECTION PRIOR TO CENTRALIZATION OR RADIALIZATION

1. Determine the center of rotation of the deformity. Align the M2 dorso-palmar center of rotation at the level of the capitate to serve as a visual reference for determining the first distal screw insertion point. *(Figure 1)*



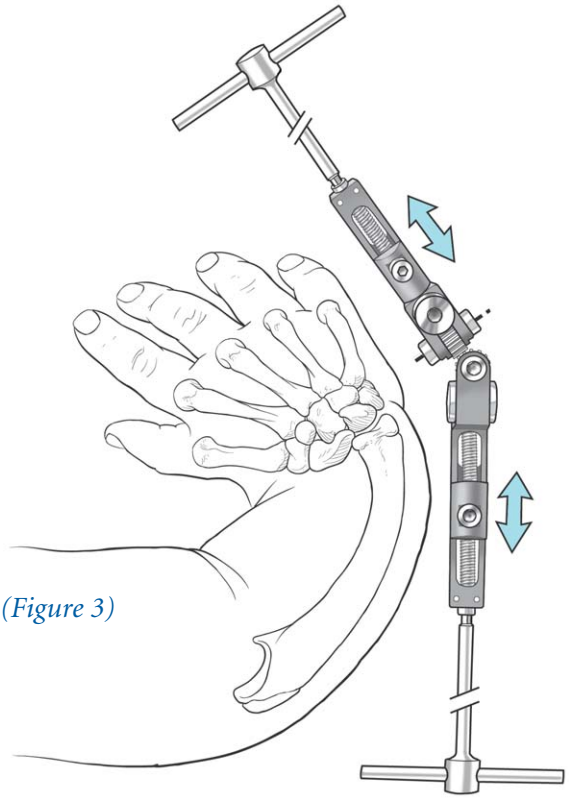
(Figure 1)



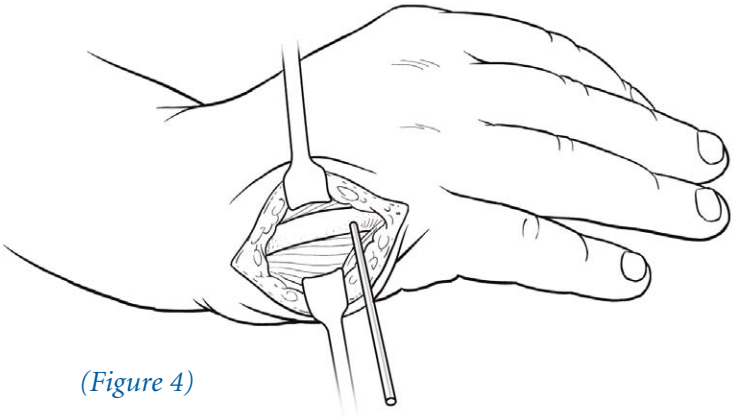
(Figure 2)

2. Position the monorails parallel to the deformity by using a 3 mm wrench to adjust the dorso-palmar and the radio-ulnar links. The adjustment can be refined once the rail is applied to the screws. *(Figure 2)*

3. Ideally, allow space on either side of the screw clamps for subsequent compression and/or distraction. Compression/distraction should be equal in both rails. To move the screw clamps, turn the screw at the end of the rail with a 3 mm wrench (clockwise = distraction, counterclockwise = compression) in the end of the rail segments. In small children it may be necessary to maximize compression (ie: position the clamp as proximal to the gears as possible on the distal rail to align the radio-ulnar axis with the gear). Although not ideal, if the 5th metacarpal is too short, placing a screw in the 4th will allow more room for the distal rail. *(Figure 3)*



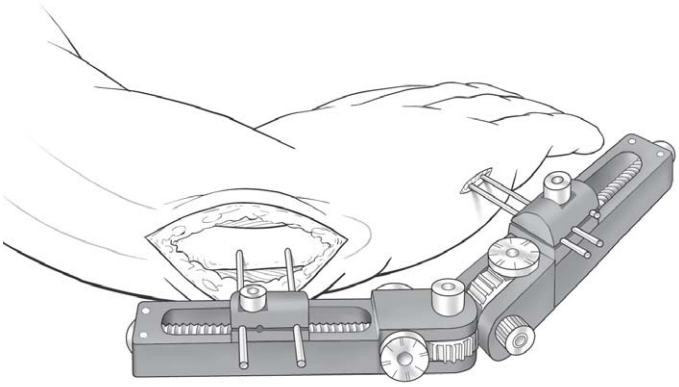
(Figure 3)



(Figure 4)

5. Apply the M2 MiniRail over the screw in the outermost seat of the clamp. Insert the second screw, using the clamp as a guide to ensure the screw is properly spaced and parallel to the first. Only 1-2 mm of the screw tip should penetrate the second cortex in order to avoid the risk of damage to the soft tissues. Due to the tapered design, conical screws should not be advanced too far, as they will become loose if they are backed out. Once both screws are inserted, tighten the screw clamp with a 3mm wrench. *(Figure 5)*

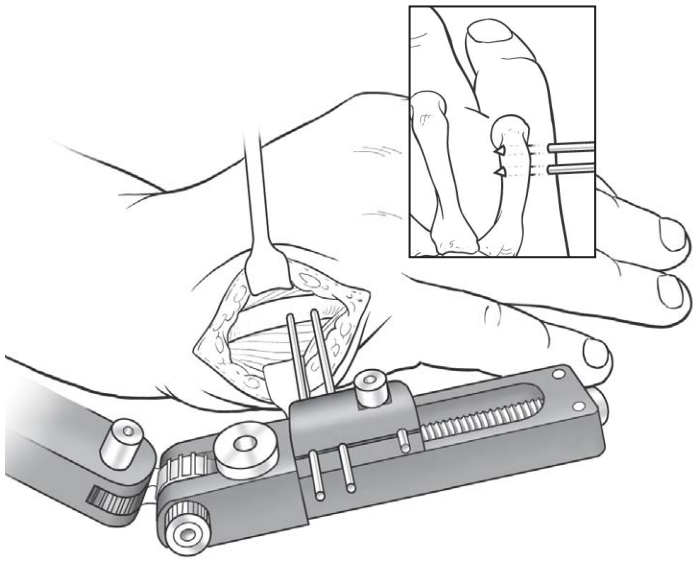
Note: In small children it may be necessary to insert the screws in the two screw seats closest to the gears. A blank screw in the outermost seat is then required to ensure that the screws are all secured evenly.



(Figure 6)

4. Make a longitudinal incision over the 5th metacarpal at the proposed position of the screws, to expose the bone subperiostially, thereby protecting neurovascular structures. Insert the first 2 mm threaded screw in the frontal plane of the metacarpal, at 90º to the long axis of the bone. *(Figure 4)*

Note: The screws will be dependent on patient size. See General Comments for more information.



(Figure 5)

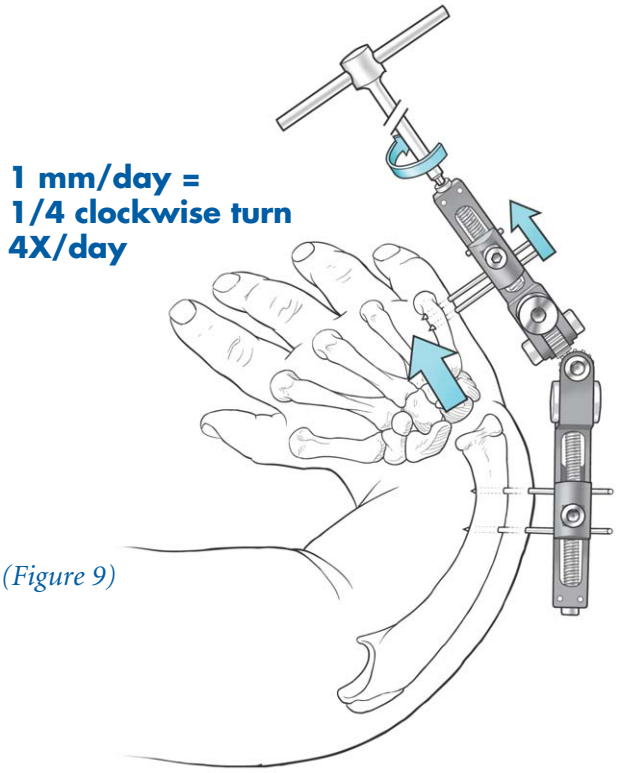
6. Using the M2 as a guide, determine the position of the proximal screw clamp over the ulna. Make a longitudinal incision over the ulnar border to expose the ulna subperiosteally. Insert the two proximal screws with the same procedure as for the distal screws using the outermost clamp seats, parallel to each other and in the frontal plane at 90º to the axis of the long bone. Once both screws are inserted, tighten the screw clamp with a 3mm wrench. *(Figure 6)*

7. Confirm accurate position of the screws with a C Arm. Ensure that all screws engage both bone cortices.

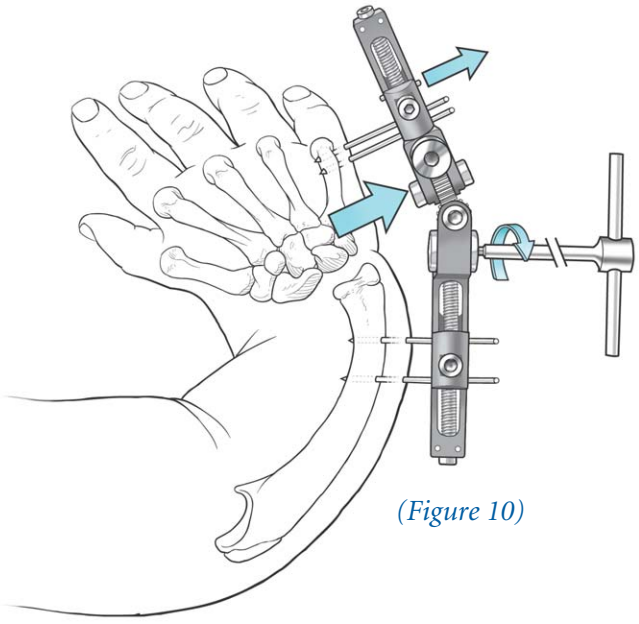
POST OPERATIVE MANAGEMENT

8. The patient should be seen in the office on the first post-operative day. Distraction of the hand begins the first day after surgery. The family will be instructed on where and how to turn the gears on the M2 for compression/distraction, dorso-palmar and radio-ulnar corrections. The patient will be seen in the surgeon's office once or twice a week for the clinician to monitor the corrections and make adjustments where appropriate.

9. Distract at a rate of 1 mm per day, which is accomplished using the distal rail, with one quarter clockwise turn of the compression/distraction screw, four times a day. Approximately 2-5 mm of total distraction should be sufficient. *(Figure 9)*

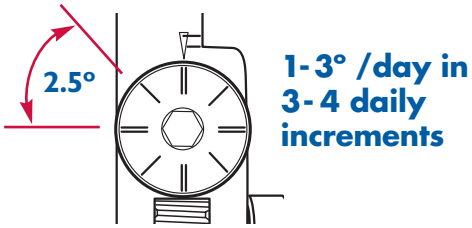


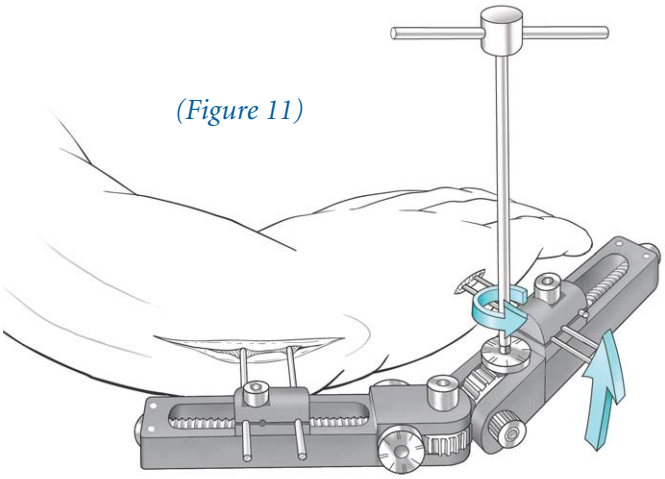
(Figure 9)



(Figure 10)

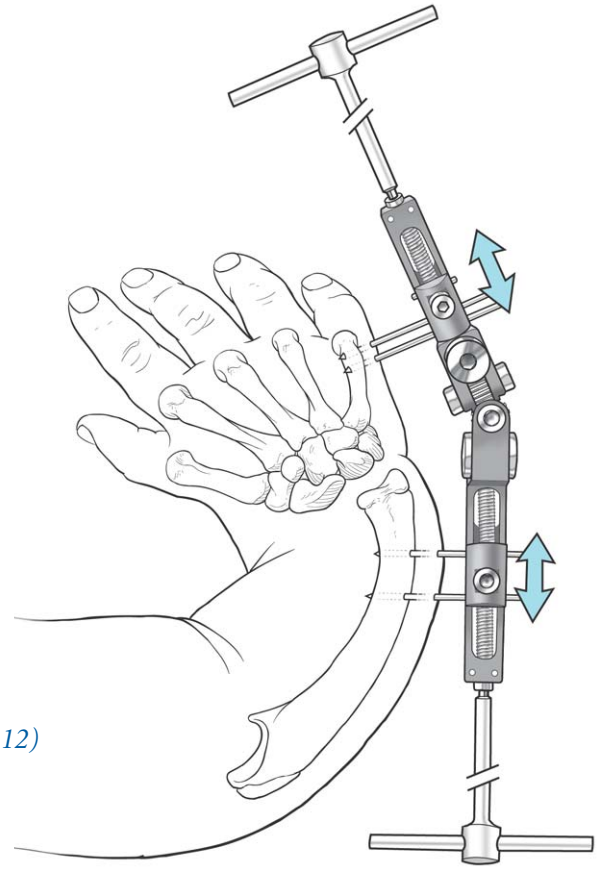
10. Correction in an ulnar direction at 1-3º per day in 3 or 4 increments daily, using the radio-ulnar flange. Each mark of the flange represents 2.5º. Speed of correction depends upon "stiffness" of the tissue and should be patient specific. During the ulnar correction, additional joint distraction of 2-4 mm or more may be required to avoid impingement. Following distraction, compression of 1-2 or more mm may be required. The axis of rotation may change as ulnar correction takes place, and lengthening may occur. It will be necessary to use compression and/or distraction to maintain the correct center of rotation. *(Figure 10)*





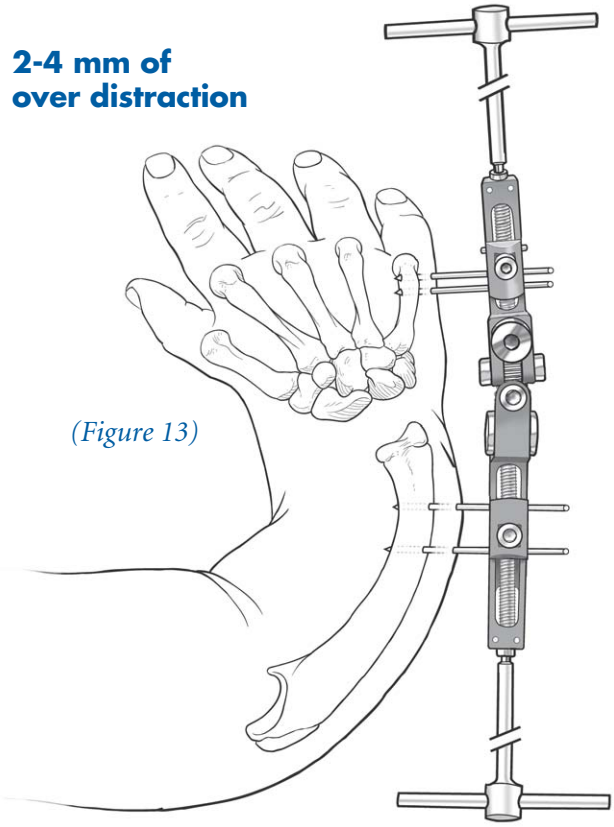
(Figure 11)

11. Dorso-palmar correction can be accomplished, if necessary, at 1º-3º per day, incrementally, using the dorso-palmar flange. *(Figure 11)*



(Figure 12)

12. The fixator is applied in radial deviation to compensate for the deformity. As the lengthening process continues toward ulnar deviation the space between the distal ulna and proximal carpal bones depends on the center of rotation of the fixator relative to the ulna. If the center of rotation requires re-alignment during the lengthening process, adjust one rail distally and one proximally. *(Figure 12)*



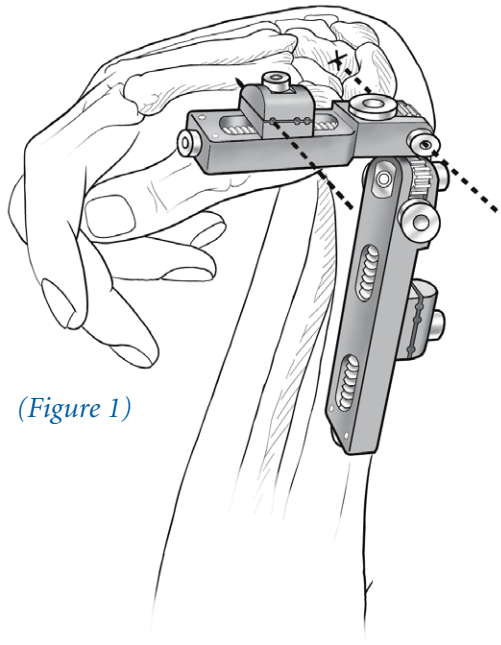
(Figure 13)

13. Continue the post-operative correction process until there is 2 - 4 mm of over-distraction and radio-ulnar alignment is appropriate. *(Figure 13)*

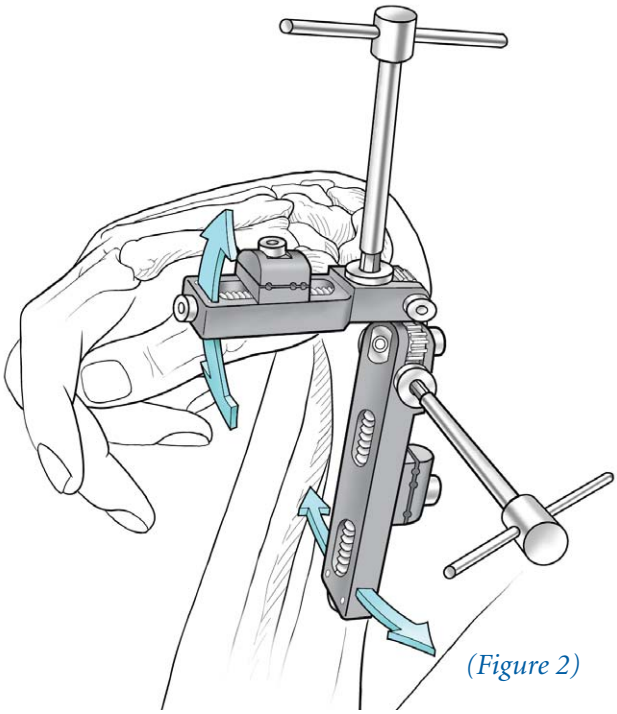
14. Follow with Radialization or Centralization by loosening the distal clamp and translating the hand as required. Ulnar osteotomy may also need to be considered.

CORRECTION OF WRIST CONTRACTURE SECONDARY TO SPASTICITY

1. Determine the center of rotation of the deformity. Align the M2 dorso-palmar center of rotation at the level of the radial styloid to serve as a visual reference to determine the first distal screw insertion point. *(Figure 1)*



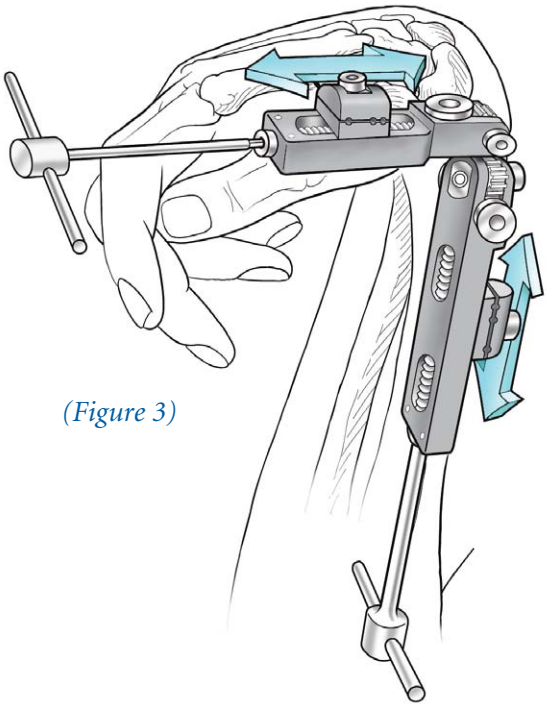
(Figure 1)



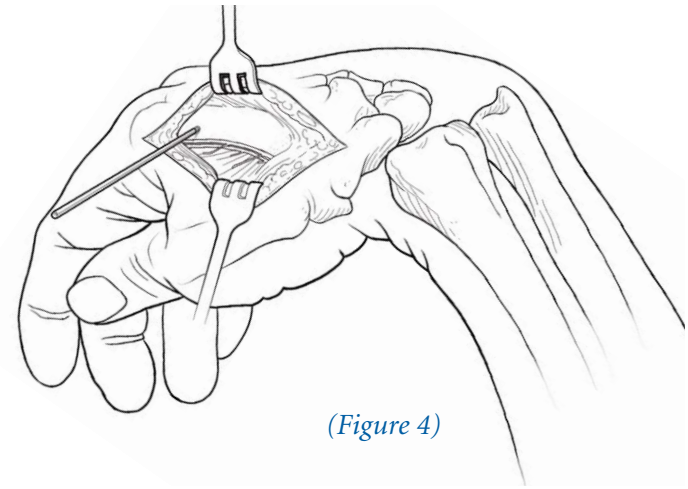
(Figure 2)

2. Manipulate the rails to match the required position of correction, using a 3 mm wrench to adjust the dorso-palmar and the radio-ulnar links. The gross adjustment can be refined after the fixator is mounted. *(Figure 2)*

3. Ideally, allow space on either side of the screw clamps for subsequent compression and/or distraction. Equal availability of compression/distraction in both rails is optimal. To move the screw clamps, use a 3 mm wrench in the compression/distraction screw at the end of the rail segments. *(Figure 3)*



(Figure 3)

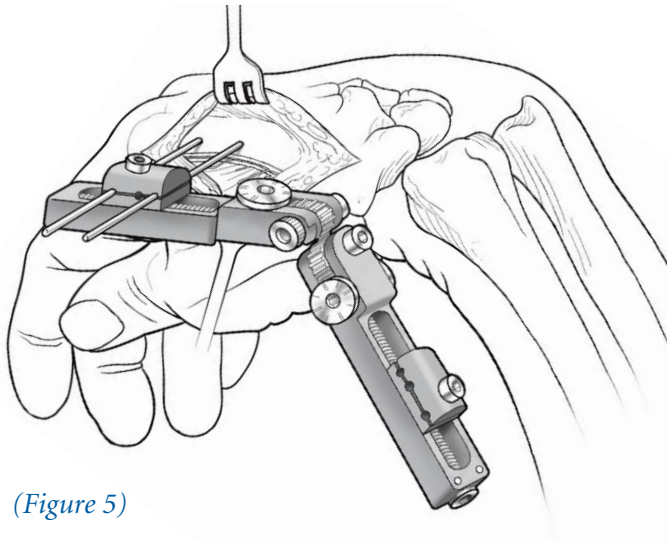


(Figure 4)

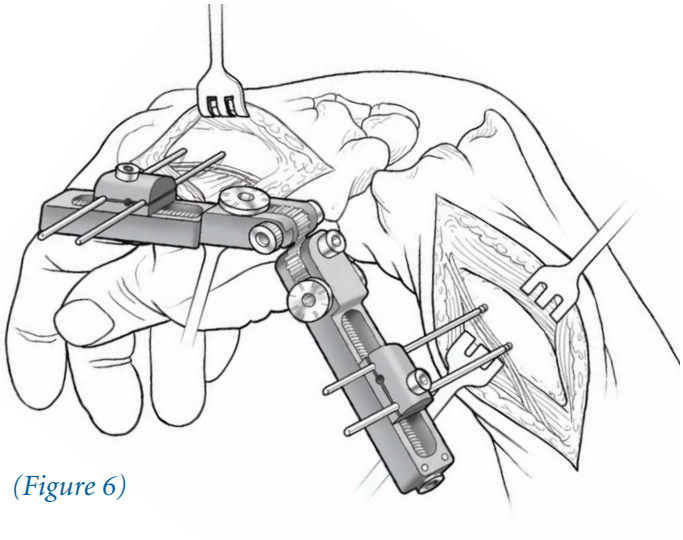
4. Make a mid-lateral longitudinal incision over the 2nd metacarpal at the proposed position of the screw, to expose the metacarpal subperiosteally. Insert the first 3mm screw in the frontal plane of the metacarpal, at 90º to the long axis of the bone. *(Figure 4)*

Note: The wires/screws will be dependent on size of patient. See General Comments for more information.

5. Apply the M2 MiniRail over the screw in the outermost seat of the clamp. Insert the second screw, using the clamp as a guide the screw is properly spaced and parallel to the first. The screw is positioned either in the base of the 2nd metacarpal or the base of the 2nd and 3rd metacarpals, capturing 3 or 4 cortices as necessary to obtain good bone purchase. Only 1-2 mm of the screw tip should protrude through the second cortex to avoid the risk of damage to the soft tissues. Due to the tapered design, conical screws should not be advanced too far, as they will become loose if they are backed out. Once both screws are inserted, tighten the screw clamp with a 3mm wrench. *(Figure 5)*



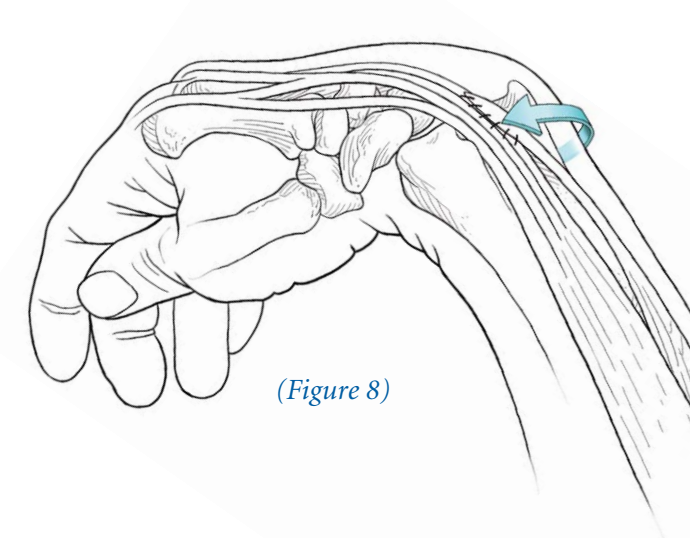
(Figure 5)



(Figure 6)

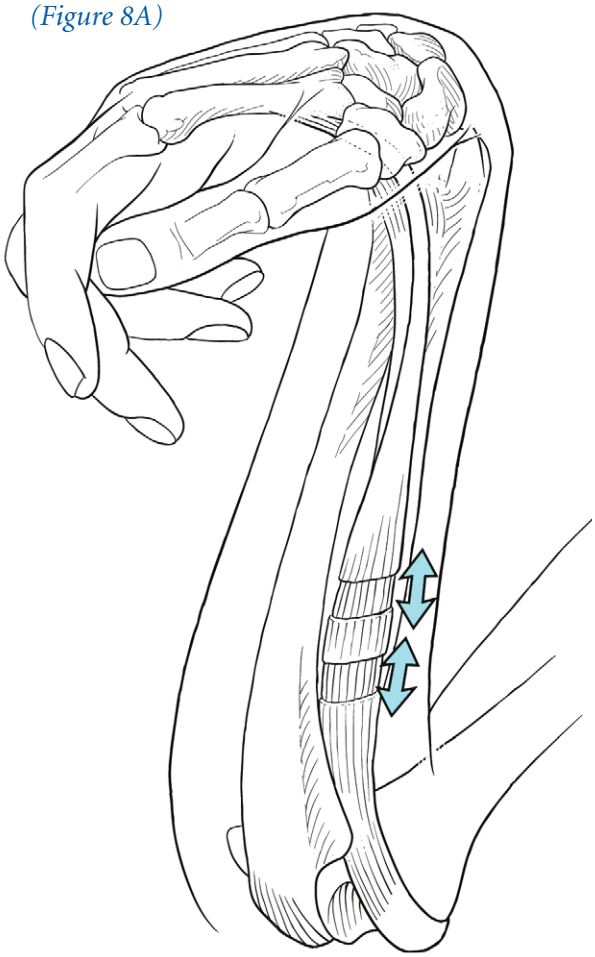
6. Using the M2 as a guide, determine the position of the proximal screw clamp over the radius. Prior to proximal screw placement, it is recommended to identify and protect the superficial radial nerve. This may be accomplished either by blunt dissection and insertion of pin guides or by open incision, retraction of the nerve and insertion of the screw under direct vision. Insert the two proximal screws with the same procedure as for the distal screws, using the outermost clamp seats, parallel to each other, and in the frontal plane at 90° to the axis of the long bone. Once both screws are inserted, tighten the screw clamp with a 3mm wrench. *(Figure 6)*

7. Confirm with a C Arm that the screws are positioned accurately and that they all engage both cortices.



(Figure 8)

(Figure 8A)



8. Perform tendon release as necessary. Prior to tendon release the M2 body may be removed, leaving the screws in place. Options for tendon release include:

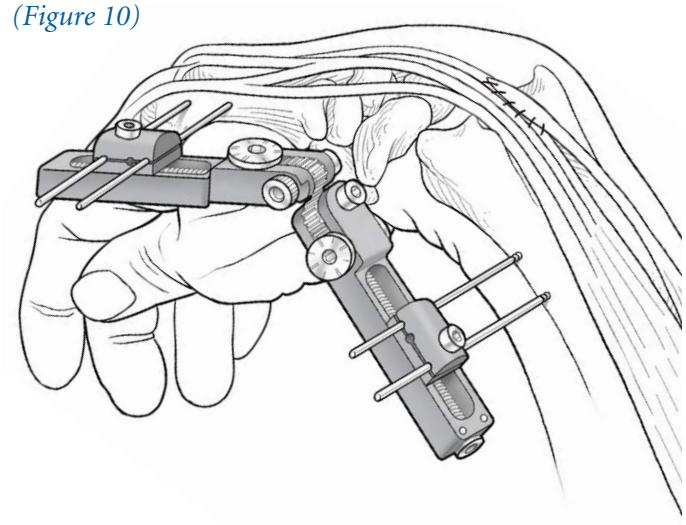
- The flexor carpi ulnaris (FCU) is lengthened or transferred to the extensor digitorum communis (EDC) or extensor carpi radialis brevis (ECRB). *(Figure 8)*
- The flexor carpi radialis (FCR) is fractionally lengthened. *(Figure 8A)*
- Chemical denervation may be preformed on flexor carpi radialis (FCR), flexor digitorum superficialis (FDS), flexor digitorum profundus (FDP), and flexor pollicis longus (FPL) to aid in correction and decrease muscle pain.

Additional staged tendon release procedures are usually required in the correction phase. The description of these procedures is beyond the scope of this manual. They should be carried out according to best practice as defined in the medical literature.

9. Proximal row carpectomy may be necessary to correct severe fixed deformity.

10. Replace the M2 over the four previously inserted screws as necessary, and tighten the clamps with a 3 mm wrench. *(Figure 10)*

(Figure 10)

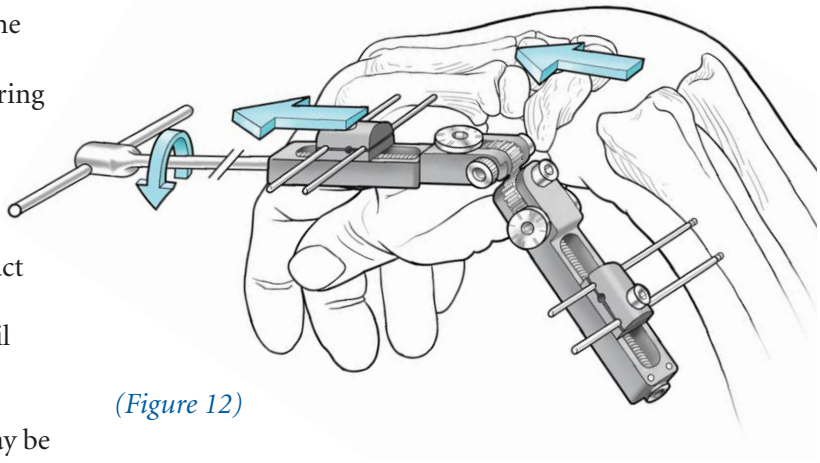


POST OPERATIVE MANAGEMENT

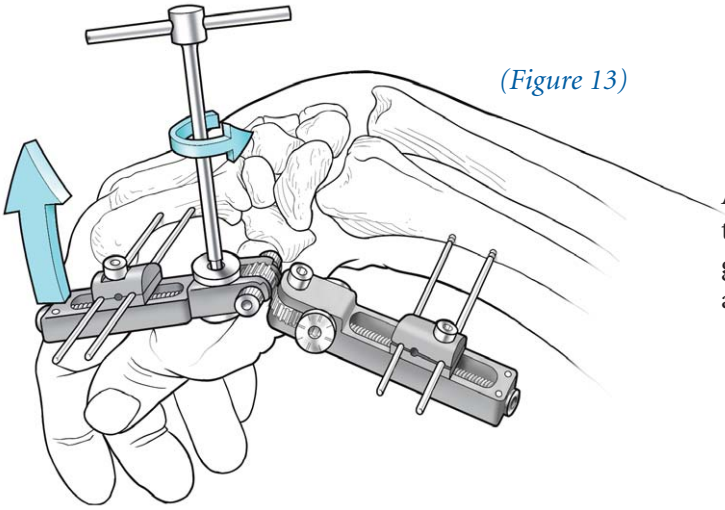
11. The patient is discharged and is seen in the clinician's office on the first post-operative day. The family will be instructed on where and how to turn the gears on the M2 for compression/distraction, dorso-palmar and radio-ulnar corrections. The patient will be seen in the surgeon's office once or twice a week for the clinician to monitor the corrections and make adjustments where appropriate. Careful monitoring is crucial. Fixator adjustments are specific to the patient and the severity of the deformity.

12. Longitudinal distraction may be required. Distract at a rate of 1 mm per day, which is accomplished with a one quarter clockwise turn of the distal rail compression/distraction screw, four times a day, producing in all 4-5 mm of total distraction. Depending on the stiffness of the soft tissue it may be necessary to alternate distraction and then compression for the comfort of the patient. *(Figure 12)*

1 mm/day =
1/4 clockwise turn



(Figure 12)



(Figure 13)

1-3° /day in 3-4 increments daily

13. Patient should gradually dorsiflex at 1 -3º per day using the dorso-palmar flange, in 3 to 4 increments daily. Passive range of motion of the digits through therapy with active motion is encouraged. *(Figure 13)*

Although additional staged surgeries may be required, the outcome should be improved range of dorsiflexion, grasp capabilities, release and ability to assist in daily activities.

ORDERING INFORMATION

M 190	Sterilization Tray, Empty: can be ordered separately and used for sterilizing the MultiPlanar MiniRail
M 210	T-Wrench for Bone Screws
M 211	Quick Connect Unit for the Drill
13570	T-Wrench for Clamp Screws
10012	Allen Wrench 3 mm
M 300	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 2.5-2 mm total length 40 mm, and thread length 15 mm
M 301	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 2.5-2 mm total length 45 mm, thread length 20 mm
M 310	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 50 mm, thread length 18 mm
M 311	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 60 mm, thread length 20 mm
M 312	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 60 mm, thread length 25 mm
M 313	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 60 mm, thread length 30 mm
M 314	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 70 mm, thread length 20 mm
M 315	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 70 mm, thread length 25 mm
M 316	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0 - 2.5 mm total length 70 mm, thread length 30 mm
M 317	Self-Drilling Cortical Screws shaft ø 3 mm, thread ø 3.0-2.5 mm total length 100 mm, thread length 30 mm
M 420	Threaded Wires 1.6 mm (pack of 4), total length 70 mm, thread length 15 mm
M 426	Threaded Wires 2.0 mm (pack of 4), total length 100 mm, thread length 15 mm
M 511	M2 MultiPlanar MiniRail Fixator

Quick Reference Screw Ordering Guide
3.0 - 2.5 mm Thread Diameter / Shaft Diameter 3 mm

Total Length (mm)		18	20	25	30
Thread Length (mm)	50	M 310			
	60		M 311	M 312	M 313
	70		M 314	M 315	M 316
	100				M 317

Quick Reference Screw Ordering Guide
2.5 - 2.0 mm Thread Diameter / Shaft Diameter 3 mm

Total Length (mm)		15	20
Thread Length (mm)	40	M 300	
	50		M 301

ORTHOFIX®
ALWAYS INNOVATING

www.orthofix.com

1720 Bray Central Drive
McKinney, Texas 75069
800.266.3349
customersevice@orthofix.com