Treatment of Proximal Phalanx Fractures With an Intramedullary Fixation Approach

History, Technique, Considerations, and Case Studies

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INTRODUCTION

Phalangeal fractures are one of the most common upper extremity fractures, of which the proximal phalanx is most often injured.[1] Traditionally, proximal phalanx fractures have been treated with conventional surgical techniques involving Kirschner wires (K-wires) and plates and screws, or non-operatively with splints and casts. Unfortunately, these approaches require long periods of immobilization for adequate fracture stability and are associated with complications such as stiffness, tendon adhesions, and infections.[2]

In recent years, intramedullary (IM) fixation has been advocated for treatment of proximal phalanx fractures due to the advantages of avoiding periosteal stripping and allowing for immediate range of motion (ROM).[3] With IM fixation gaining momentum among hand surgeons as one of the newest options for treating the proximal phalanx,[1] this booklet was assembled as a quick and simple resource to provide background, surgical technique, pearls, considerations, and case studies on the approach.

HISTORIC TREATMENT OF PROXIMAL PHALANX FRACTURES

Although proximal phalanx fractures are the most common phalangeal fractures, there is no consensus on an optimal treatment method at this time.[3] Fractures that are inherently stable can be treated non-operatively but usually require a splint (Figure 1) and do not achieve full active motion or complete fracture healing until approximately 6 weeks post-op.[4] Whereas surgical treatment of unstable fractures has been suboptimal with traditional procedural techniques such as percutaneous fixation with K-wires, open fixation with plates and screws, and IM fixation with headless compression screws (HCSs).

K-wire fixation (Figure 2) is frequently used to address transverse and oblique proximal phalanx fractures and comes with a recommendation of having a diameter of at least 0.9mm to achieve stability.[3]

Figure 1

Figure 2

This approach is popular due to short operating times and minimal tissue exposure, but often requires immobilization due to questionable rotational stability, causing tendon adhesions and stiffness.[5] K-wire fixation usually involves a secondary removal procedure after 3 to 4 weeks and is associated with complications such as tenolysis, non-union, pin infection, and pin loosening.[5]

Fixation with plates and screws (Figure 3) provides rigidity but entails extensive surgical exposure, leading to tendon adhesions, soft tissue injuries, and subsequent devascularization.[5,6] The procedure is both time consuming and technically difficult, with minimal margin for error.[6] This approach is associated with complication rates of up to 81%, caused by immobility due to extensor lag, stiffness, and/or joint contracture, resulting in secondary surgery rates of up to 21%.[7]

More recently, percutaneous IM fixation with HCSs (Figure 4) has grown in popularity due to the minimally invasive nature that not only reduces the risk of tendon adhesions and stiffness, but also provides stable fixation, allowing early mobilization.[8]

Figure 3

Figure 4

Unlike conventional techniques, IM fixation achieves nearly 100% maintenance of fracture reduction with low complication rates.[8] Unfortunately, HCSs may have difficulty addressing oblique or comminuted fracture patterns due to complications such as shortening and outcomes such as questionable rotational stability.

ADOPTION OF THE INTRAMEDULLARY FIXATION APPROACH

IM fixation of proximal phalanx fractures has been suggested in the past to overcome questionable outcomes and high complication rates resulting from traditional approaches. In 1992, Merle and Dautel used specially shaped large pins for IM fixation but could not avoid common issues such as extensive dissection when introducing the implant and had difficulty preparing the intramedullary canal.[5]

In 1997, the use of HCSs to minimize tissue disruption and increase the stability of IM fixation when treating phalangeal fractures was first described by Weiss.[5] He discovered that an antegrade approach into the base of the proximal phalanx produced minor damage to the articular surface of the metacarpophalangeal (MCP) joint relative to a retrograde approach into the proximal interphalangeal joint[5] and that the IM approach avoided extensive soft tissue damage. In 2001, Hornbach and Cohen used a single intramedullary 1.1mm K-wire in an antegrade fashion across the MCP joint to minimize soft tissue damage but achieved questionable rotational stability.[5]

By 2016, a study by Aita et al. found that a percutaneous IM approach with HCSs minimizes the risk of tendon adhesions and is associated with less risk of joint stiffness because the fixation is stable enough to allow early mobilization.[8]

IM FIXATION OF PROXIMAL PHALANX FRACTURES USING THE INFRAME™ INTRAMEDULLARY THREADED MICRO NAIL

Illustration of the InFrame Intramedullary Threaded Micro Nail

Figure 5 - Non-Compression, 2.0mm Diameter Micro Nail

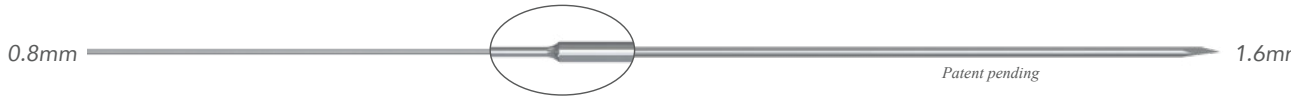


Figure 6 - Dual Diameter Guidewire

Although IM fixation has been a promising, minimally invasive surgical approach for unstable proximal phalanx fractures, a single implant may not provide adequate fixation for specific fracture patterns[1] because multiple implants in various orientations[3] may be appropriate to maintain reduction and achieve immediate mobilization.

In any configuration, the operative goals would be to minimize adhesions, disruption to the extensor and flexor tendons, and damage to the periosteum. A dual antegrade IM fixation technique may achieve these goals by eliminating any metal to bone surface contact, minimizing significant friction to the tendon mechanisms, and avoiding insult to the articular surface of the metacarpal head via an intra-articular, intramedullary approach.[1]

ExsoMed's InFrame Intramedullary Threaded Micro Nail (Figure 5) achieves these goals and sets a new standard by offering a proximal phalanx-specific design that dramatically improves surgical outcomes. There are numerous reasons that the implant and approach have captured the attention of our limited market release (LMR) surgeons and have been advocated as a "game changer." First, InFrame's non-compression construct helps avoid inadvertent shortening in oblique and comminuted fractures. Second, the 2.0mm diameter design and robust length offering allow surgeons to personalize constructs specific to each patient's fracture pattern (Figure 7, 8), achieving optimal intramedullary fit to create rigid fixation and rotational stability.

Figure 7
InFrame X Construct

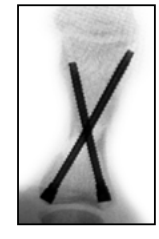


Figure 8
InFrame V Construct

Third, the unique dual diameter guidewire has a 1.6mm leading end and a 0.8mm trailing end (Figure 6) that removes the need for a dedicated reamer and provides superior rigidity relative to standard K-wires, facilitating accurate placement and reducing surgical time compared to other techniques. Finally, surgeons are noticing faster union time and return to daily activities for their patients because immobilization is not required. In addition, biomechanical testing has demonstrated the superior bending and torsion strength of InFrame compared to K-wires, plates and screws, and HCSs (Table 1).

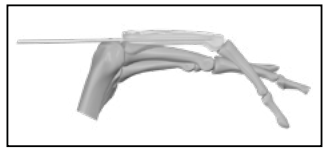
Table 1 - Apex Volar 4-Point Bending and Torsion Bench Test Data*

		K-wires (2 x 0.045)	Dorsal Plates & Screws	Lateral Plates & Screws	Headless Compression Screws
BENDING STABILITY	InFrame X Construct	+97%	+473%	+91%	+48%
	InFrame V Construct	+14%	+232%	+11%	~
ROTATIONAL STABILITY	InFrame X Construct	+341%	+166%	+98%	+1533%
	InFrame V Construct	+368%	+182%	+110%	+1633%

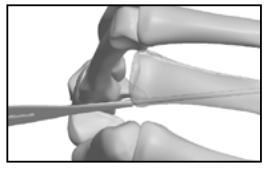
* Data on file

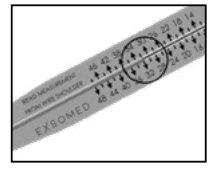
SURGICAL TECHNIQUE

Step 1: Anatomically reduce the fracture and insert the dual diameter guidewire percutaneously, via antegrade or retrograde approach, into the proximal phalanx until the trocar tip passes the far side cortical wall and then retract until the trocar tip reaches the desired final implant position.

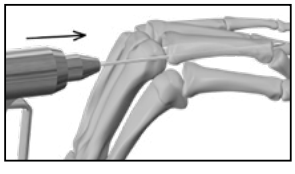


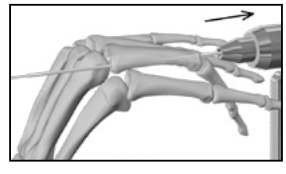
Step 2: Create a stab incision adjacent to the guidewire entry site and insert the depth gauge. Align the guidewire within the center groove of the depth gauge and read the length marking at the diameter transition of the guidewire to obtain the appropriate implant length.



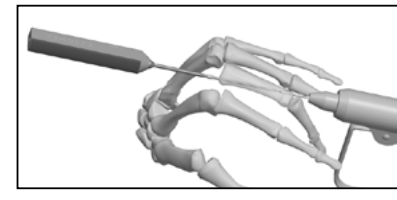


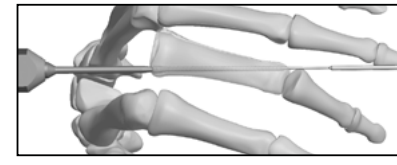
Step 3: After measurement, drive the guidewire farther through the bone until it is exiting and can be clamped on the leading end. Reposition the wire driver and clamp the guidewire at the exiting end to position the guidewire so that the small diameter spans the fracture.





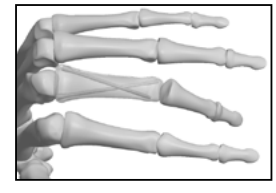
Step 4: Slide the selected implant over the smaller diameter of the pre-positioned guidewire and use the driver to advance the implant to the desired depth. Verify placement and proper reduction with fluoroscopic imaging. Both ends of the implant should be below the articular surface. Once confirmed, remove the guidewire via the trocar end and ensure articular function is not inhibited.



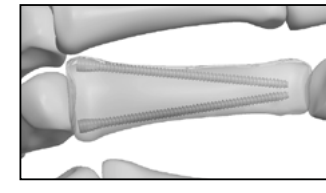


Step 5: If additional implants are desired to be inserted into the same phalanx, repeat steps 1-4, verifying under fluoroscopic imaging that the previously placed implant and newly placed guidewire are in different planes. Some examples of possible InFrame constructs include: X or V patterns.

X pattern



V pattern



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SURGICAL PEARLS

Based on a survey of surgeons who have extensive experience addressing proximal phalanx fractures via an intramedullary approach with InFrame and other implants, the following surgical pearls were compiled: 1) Prior to implanting InFrame, it is of utmost importance to achieve anatomic reduction for both open and closed surgical techniques. 2) When advancing or retracting the dual diameter guidewire, always ensure that the wire driver collet clamps on only the larger diameter of the wire to avoid excessive torsional stress. 3) Once reduction has been achieved, avoid penetrating the articular surface whenever possible and advance the guidewire past the far side of the cortical wall to aid its removal after implant placement. 4) After using the InFrame Depth Gauge for pre-operative templating to determine the appropriate size of the micro nail, it may be appropriate to downsize by 2mm or more to account for any tissue between the depth gauge and bone, as well as for the subosseous placement of the implant leading and trailing ends. 5) When advancing the nail, ream sequentially and refrain from overexertion against resistance. If met with excessive torque, cycle between advancement and retraction to allow the cutting flutes of the micro nail to cut the bone (InFrame's self-tapping feature) and ensure the implant is buried below the outer surface of the bone at both ends. 6) Once the first implant placement has been confirmed, verify under fluoroscopic imaging that the second implant is in a different plane from the first implant. 7) Make final rotational adjustments and encourage early range of motion, permissible due to the rigid fixation and rotational stability achieved with InFrame.

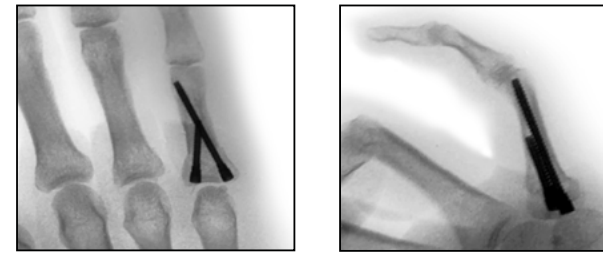
PATIENT SELECTION

Before using the intramedullary approach, ensure the patients are candidates for InFrame by verifying that they are skeletally mature and do not have osteoporotic bones. For patients in whom the intramedullary canal is too narrow, a single implant may achieve adequate purchase of the micro nail threads. An ideal first patient is one who sustained a transverse fracture within 7 days. These are the most straightforward case types, when considering reduction, guidewire placement, and gaining a good understanding of how InFrame works.

CONSIDERATIONS OF IM FIXATION

One area of concern with an antegrade intramedullary fixation approach is insult to the articular surface of the metacarpal head. Regardless of fracture pattern, an intra-articular method is recommended because it is not critical for the first micro nail to orient exactly parallel to the long axis of the proximal phalanx if a secondary micro nail is placed, providing an additional plane of fixation (Figure 9).[1] An additional advantage to this approach is that concomitant metacarpal fractures of the affected proximal phalanx may be treated with an implant, such as INnate™, in a retrograde intramedullary technique through the same incision.[1]

Figure 9
InFrame Y Construct



SOME ADDITIONAL THOUGHTS

InFrame provides surgeons with a simple and efficient intramedullary fixation approach that can be performed in a minimally invasive fashion for all fracture patterns and locations in the proximal phalanx. The 2.0mm diameter design allows a multitude of constructs to achieve canal-fill, resulting in rigid fixation and rotational stability. The percutaneous approach minimizes soft tissue and tendon damage while the innovative dual diameter guidewire simplifies the placement while providing accuracy and reduced surgical time. This efficiency is critical due to the statistically significant association between extended operative time and surgical site infections.[9] The immediate mobilization achieved with InFrame prevents stiffness that often occurs with other techniques and offers patients the ability to return to their daily activities faster. The next section of case studies will provide additional background.

Use of the InFrame™ Intramedullary Threaded Micro Nail for an Oblique, Comminuted Fracture of the 3rd Proximal Phalanx

Nathan Lesley, MD
The Hand to Shoulder Center of Fort Worth, Fort Worth, TX

CASE PRESENTATION

Patient was a 33-year-old male who suffered a midshaft oblique fracture with comminution to his 3rd proximal phalanx from a crush injury. An operative solution that achieved rotational stability and early range of motion (ROM) was desired due to the unstable fracture pattern and need to return to work quickly.

PRE-OP PLAN

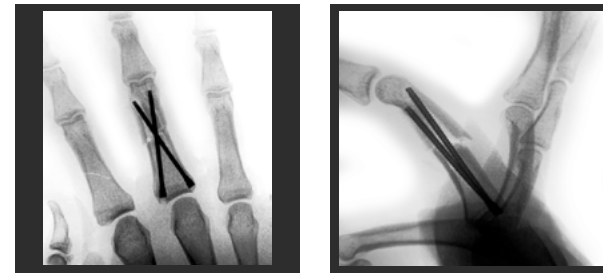
Dr. Lesley typically considers lag screw fixation for oblique fracture patterns but wanted to achieve early ROM without complications such as stiffness. A minimally invasive approach using K-wires was an option but too often results in poor fixation, requires a long period of immobilization, and has a high infection rate. Dr. Lesley chose InFrame because the cannulated, fully threaded micro nail has a 2.0mm diameter design that allows cross implantation constructs to achieve rigid fixation, rotational stability, and early ROM. The innovative guidewire removes the need for reaming and simplifies implant placement, resulting in accuracy and reduced surgical time. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to other modalities.

Pre-op

OPERATIVE FINDINGS AND APPROACH

The patient suffered a very unstable crush injury to the distal half of his proximal phalanx. Upon reduction, Dr. Lesley inserted the dual diameter guidewire across the fracture site from the ulnar proximal cortex to the radial distal cortex under fluoroscope to stabilize the fracture and accurately align the desired final implant position. Next, he used the depth gauge to determine that a 40mm micro nail was needed for the 3rd proximal phalanx. The larger diameter of the guidewire was used to push the guidewire distally until the smaller diameter was across the fracture. He then threaded the InFrame micro nail until bi-cortical purchase was achieved at both the distal and proximal ends. Once he verified the final position of the first implant under fluoroscope, Dr. Lesley used the same methodology to place the second micro nail but in a different plane from the first implant. He then inserted the second dual diameter guidewire from the radial proximal cortex to the ulnar distal cortex and used a 42mm micro nail. The intramedullary space was large enough for Dr. Lesley to create an "X" configuration with two InFrame implants in approximately 25 minutes.

Post-op



FOLLOW-UP

At two weeks, the patient did not experience any pain and had excellent ROM. He was able to return to work quickly due to the rigid fixation and rotational stability achieved with InFrame.

DISCUSSION

The 2.0mm diameter design and robust length offering allowed Dr. Lesley to create a construct that was long enough to achieve bi-cortical bone purchase, resulting in rotational control and early ROM. The delivery mechanism of InFrame was also important to the success of the operation because it simplified a more precise placement in only 25 minutes of total surgery time. The rigid fixation and rotational stability allowed his patient to minimize downtime and return to work faster than other implants and surgical approaches.

Use of the InFrame™ Intramedullary Threaded Micro Nail for an Oblique, Fracture to the 5th Proximal Phalanx

Yorell Manon-Matos, MD
Center for Neurosciences, Orthopaedics & Spine, Dakota Dunes, AZ

CASE PRESENTATION

Patient was a 17-year-old female who suffered an extra-articular oblique fracture to her 5th proximal phalanx while playing volleyball. A minimally invasive approach, resulting in early mobilization, immediate range of motion (ROM), and minimal stiffness was desired.

PRE-OP PLAN

Dr. Manon-Matos normally considers dorsal plate fixation complemented with lag screws to address oblique fracture patterns, but wanted to minimize any soft tissue disruption to achieve early mobilization. He also considered K-wires due to the percutaneous approach, but wanted to avoid extramedullary hardware and complications such as stiffness and infections.

Pre-op

Dr. Manon-Matos decided to proceed with InFrame because the cannulated, fully threaded micro nail allowed for an intramedullary (IM) approach that achieved rigid fixation and early mobilization. The innovative dual diameter guidewire facilitated precise and efficient placement by removing the need for reaming and allowing InFrame to be inserted over the trailing end of the guidewire with ease. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to K-wires and plates and screws, allowing earlier active ROM and reduced recovery time.

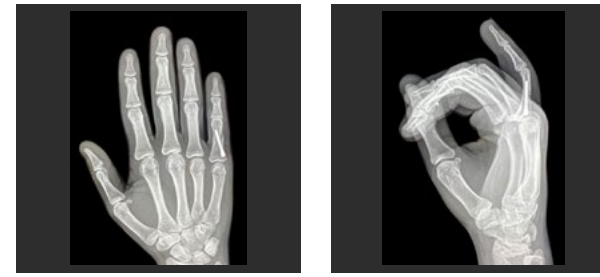
OPERATIVE FINDINGS AND APPROACH

Once anatomic reduction was achieved, Dr. Manon-Matos inserted the dual diameter guidewire across the fracture site from the ulnar proximal cortex to the radial distal cortex under fluoroscope to stabilize the fracture and accurately align the desired final implant position. Next, he used the depth gauge to determine that a 20mm micro nail was needed for the 5th proximal phalanx. The larger diameter of the guidewire was used to drive the guidewire distally until the smaller diameter was across the fracture. He then implanted the cannulated InFrame micro nail until bi-cortical purchase was achieved at both the distal and proximal ends. Due to the narrow IM canal, Dr. Manon-Matos was not able to utilize a secondary micro nail, but was satisfied with the rigid construct stability of only one InFrame implant. Total surgery time was approximately 25 minutes.

FOLLOW-UP

At 1 week post-op, the patient demonstrated early range of motion with no complications and was expected to achieve full ROM without any restrictions in another 1 to 2 weeks.

Post-op



DISCUSSION

InFrame allowed Dr. Manon-Matos to achieve his operative goal of stable fixation, early mobilization, and minimal to no soft tissue damage. The straightforward and reproducible placement of the InFrame micro nail allowed surgery to be completed in 25 minutes. The 2.0mm diameter design enabled Dr. Manon-Matos to create a singular InFrame construct that was perpendicular to the fracture pattern, achieving canal-fill and rotational stability. The unique delivery mechanism for InFrame is also important because it simplifies a more precise and efficient implant placement. His patient experienced anatomic and functional restoration of her proximal phalanx, thereby returning to her daily activities faster than other implants and surgical approaches.

Use of the InFrame™ Intramedullary Threaded Micro Nail for Oblique Fractures to the 4th and 5th Proximal Phalanges

Derek Masden, MD, FACS
Anne Arundel Medical Center, Annapolis, MD

CASE PRESENTATION

Patient was a 61-year-old male who suffered a proximal, oblique fracture to his 4th and 5th proximal phalanx from a fall. An operationally efficient and minimally invasive approach, resulting in rotational stability and immediate range of motion (ROM) was desired.

PRE-OP PLAN

Dr. Masden considered K-wires due to the minimally invasive approach, but wanted to avoid poor fixation, high infection rates, and immobilization. Plates and screws would provide rigid fixation but could result in soft tissue damage, stiffness, and tendon adhesions. Dr. Masden also considered headless compression screws (HCSs) as an intramedullary (IM) approach to avoid damage to the periosteum, but was concerned that the compression could cause angular deformities upon insertion.

Dr. Masden chose InFrame for IM fixation because the 2.0mm diameter design allowed specific constructs for each fracture to achieve rotational stability and bi-cortical purchase. The unique dual diameter guidewire facilitated precise and efficient placement by removing the need for reaming and allowing InFrame to be inserted over the guidewire with ease. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to other surgical approaches, allowing immediate ROM and reduced recovery time.

Pre-op

OPERATIVE FINDINGS AND APPROACH

The patient suffered oblique base fractures that needed stable fixation upon anatomic reduction. Once reduction was achieved, Dr. Masden inserted the dual diameter guidewire across the fracture site from the ulnar proximal cortex to the radial distal cortex under fluoroscope to stabilize the fracture and accurately align the desired final implant position. Next, he used the depth gauge to determine that a 32mm micro nail was needed for the 5th proximal phalanx and threaded the InFrame micro nail until bi-cortical purchase was achieved at both the distal and proximal ends. Once he verified the final position of the first implant under fluoroscope, Dr. Masden used the same methodology to place the second InFrame micro nail but in a different plane from the first implant. He then inserted the second dual diameter guidewire from the radial proximal cortex to ulnar distal cortex under fluoroscope and used a 30mm micro nail to create an "X" configuration. Dr. Masden utilized the same technique to implant two InFrame micro nails in the 4th proximal phalanx but used a 36mm and 34mm micro nail to create a "V" construct. Total surgery time was approximately 1 hour.

Post-op

FOLLOW-UP

The patient achieved full ROM immediately after surgery, which would have been difficult to replicate with other fixation techniques or implants. At 2 weeks post-op, he did not have any physical restrictions and did not miss a single day of work.

DISCUSSION

By using InFrame in an IM approach, Dr. Masden accomplished his operative goal of minimizing his operative time and soft tissue disruption. The diameter and length offering enabled Dr. Masden to create "X" and "V" constructs specific to each fracture, resulting in immediate ROM due to rotational stability. The innovative delivery mechanism for InFrame is also important because it simplified a more precise implant placement. Follow-ups are easy because patients do not require formal therapy, allowing patients to return to their daily activities faster than other approaches.

Use of the InFrame™ Intramedullary Threaded Micro Nail for an Oblique Fracture of the 5th Proximal Phalanx

Marissa Matarrese, MD
University of Vermont Health Network Champlain Valley Physicians Hospital, Plattsburgh, NY

CASE PRESENTATION

Patient was a 59-year-old male who suffered a proximal, oblique fracture to the base of his 5th proximal phalanx when his power drill spun around and twisted his finger. A percutaneous approach providing stable fixation to allow for early mobilization was desired.

PRE-OP PLAN

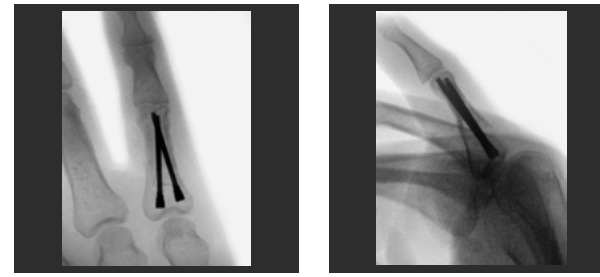
Dr. Matarrese considered headless compression screws (HCSs) due to the minimally invasive approach and early mobilization but was concerned that compression would cause angulation or shortening across the fracture site. She also considered lag screws but did not want to leave any extramedullary hardware behind. Dr. Matarrese proceeded with InFrame because the fully threaded micro nail allowed for an efficient, intramedullary placement without any hardware exposure. The InFrame implant has a 2.0mm diameter design with a robust length offering of 12mm-48mm, allowing various construct patterns to achieve rigid fixation and rotational stability. The unique dual diameter guidewire facilitated precise placement by removing the need for reaming and allowing InFrame to be inserted over the trailing end of the guidewire with ease. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to K-wires, HCSs, and plates and screws, allowing earlier active range of motion (ROM) and reduced recovery time.

Pre-op

OPERATIVE FINDINGS AND APPROACH

The patient suffered an oblique base fracture to his 5th proximal phalanx. Once anatomic reduction was achieved, Dr. Matarrese used a closed, percutaneous approach with InFrame. She inserted the dual diameter guidewire across the fracture site from the ulnar proximal cortex to the radial distal cortex using mini fluoroscopy to stabilize the fracture and accurately align the desired final implant position. Next, Dr. Matarrese used the depth gauge to determine that a 28mm micro nail was needed for the 5th proximal phalanx and threaded the micro nail until it was seated in the subchondral bone. Once she verified the final position of the first implant under fluoroscope, Dr. Matarrese used the same methodology to place the second InFrame micro nail but in a different plane from the first implant. She then inserted the second dual diameter guidewire from the radial proximal cortex to the ulnar distal cortex under fluoroscope and used another 28mm micro nail to create a "V" configuration with slight crossing at the distal end, resulting in stable fixation with no rotational deformity. Total surgery time was approximately 10 minutes.

Post-op



FOLLOW-UP

At 1 week post-op, the patient demonstrated nearly full ROM with no complications and was expected to reach full ROM without any restrictions in 1-2 months.

DISCUSSION

InFrame enabled Dr. Matarrese to achieve her operative goal of stable fixation, rotational stability, and minimal to no soft tissue damage. The simple and straightforward placement of the InFrame micro nail allowed the surgery to be completed in only 10 minutes and under local anesthesia. The 2.0mm diameter design and robust length offering allowed Dr. Matarrese to create a "V" frame construct with no extramedullary hardware and zero complications. The innovative delivery mechanism for InFrame is also important because it simplified the implant placement by removing the need for a dedicated reamer. Her patient was satisfied with the results and experienced anatomic and functional restoration of his proximal phalanx.

Use of the InFrame™ Intramedullary Threaded Micro Nail for an Oblique, Distal Neck Fracture of the 3rd Proximal Phalanx

David Shenassa, MD
Sports Medicine Associates of South Florida, Weston, FL

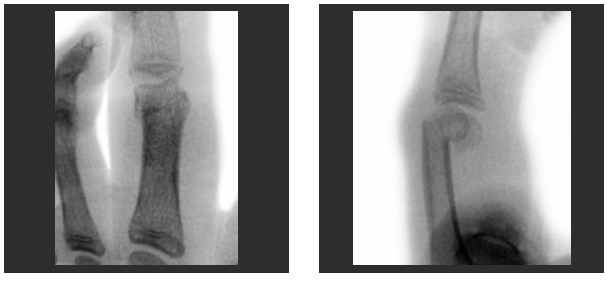
CASE PRESENTATION

Patient was a 16-year-old male who suffered an oblique, distal neck fracture to his 3rd proximal phalanx from a high impact injury while playing football. A minimally invasive approach that achieved rotational stability was desired to allow immediate range of motion (ROM) so that he could get back to practice as soon as possible.

PRE-OP PLAN

Dr. Shenassa typically considers extra-articular K-wire pinning for oblique fracture patterns but wanted to achieve active and passive ROM as quickly as possible, without complications such as infection and stiffness. Dr. Shenassa chose InFrame intramedullary (IM) fixation because the cannulated, fully threaded micro nail comes in a 2.0mm diameter design with a robust length offering, allowing various construct patterns that would achieve rigid fixation and rotational stability. The unique dual diameter guidewire simplifies implant placement by removing the need for a dedicated reamer, resulting in a more accurate and efficient placement compared to other implants and surgical approaches. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to K-wires, headless compression screws, and plates and screws, allowing immediate active ROM and reduced recovery time.

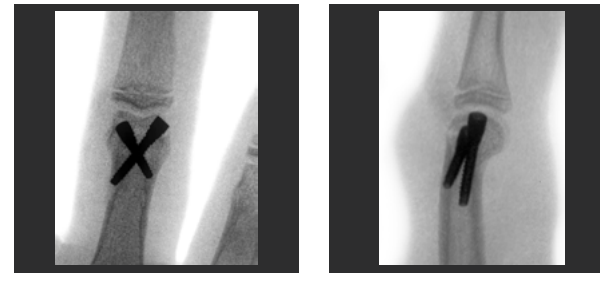
Pre-op



OPERATIVE FINDINGS AND APPROACH

Dr. Shenassa anatomically reduced the fracture using a closed, percutaneous approach with InFrame. He normally uses an antegrade approach but went retrograde because the fracture was located near the neck of the proximal phalanx. First, he inserted the dual diameter guidewire across the fracture site from the radial distal cortex to the ulnar midshaft cortex under fluoroscope to stabilize the fracture and accurately align the desired final implant position. Next, he used the depth gauge to determine that a 16mm micro nail was needed for the 3rd proximal phalanx. The larger diameter of the guidewire was used to push the guidewire distally until the smaller diameter was across the fracture. He then threaded the cannulated InFrame micro nail until bi-cortical purchase was achieved at both the distal and midshaft ends. Once he verified the final position of the first implant under fluoroscope, Dr. Shenassa used the same methodology to place the second InFrame micro nail but in a different plane from the first implant. He then inserted the second dual diameter guidewire from the ulnar distal cortex to the radial midshaft cortex under fluoroscope and used a 12mm micro nail. The IM space was large enough for Dr. Shenassa to create an "X" configuration with two InFrame implants, creating rotational stability. Total surgery time was approximately 20 minutes.

Post-op



FOLLOW-UP

At two weeks, the patient experienced minimal pain and achieved full active and passive ROM. He resumed full, unrestricted activities during football practice, which would not have been possible to replicate if K-wires or other modalities were used.

DISCUSSION

The diameter and length offering of InFrame allowed Dr. Shenassa to create an "X" frame construct that fit the narrow IM canal, achieving distal to midshaft cortex stability with rotational control. The delivery mechanism for InFrame was also vital to an efficient operative time because it simplified a more precise implant placement, taking only 20 minutes of total surgery time. The strong fixation and earlier ROM enabled his patient to return to practice faster than other implants and surgical approaches.

Use of the InFrame™ Intramedullary Threaded Micro Nail for a Transverse, Comminuted Fracture of the 5th Proximal Phalanx

W. Brad Stephens, MD
Tallahassee Orthopedic Clinic, Tallahassee, FL

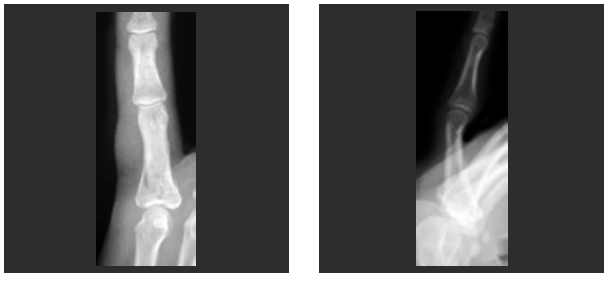
CASE PRESENTATION

Patient was a 22-year-old female who suffered a proximal, transverse fracture with comminution to her 5th proximal phalanx from a high impact injury while playing sports. A minimally invasive approach resulting in rotational stability and immediate range of motion (ROM) was desired.

PRE-OP PLAN

Dr. Stephens typically addresses transverse fracture patterns with extra-articular K-wire pinning but wanted immediate mobility to avoid stiffness. He considered lag screws but the canal was too small for more than one implant and ROM recovery usually takes approximately 3-4 weeks. Dr. Stephens chose InFrame because the 2.0mm diameter design allowed him to use two InFrame micro nails in the narrow intramedullary canal, achieving rigid fixation and rotational stability. The unique dual diameter guidewire facilitates the accurate and efficient placement of the fully threaded micro nail by removing the need for reaming and allowing InFrame to be inserted over the trailing end of the guidewire with ease. Biomechanical testing has demonstrated the superior rigidity with InFrame compared to other techniques, allowing immediate ROM and reduced recovery time.

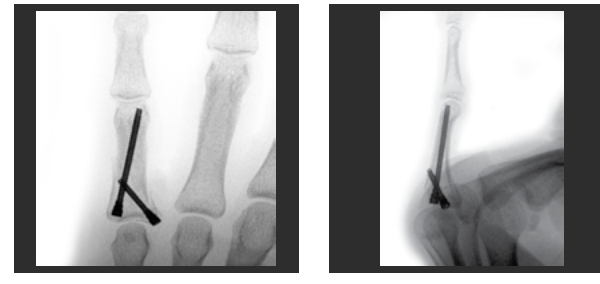
Pre-op



OPERATIVE FINDINGS AND APPROACH

The patient suffered an ulnar deviation and extension deformity with an intra-articular fracture fragment at the metacarpophalangeal (MCP) joint to her 5th proximal phalanx that needed to be addressed upon anatomic reduction. Once reduction was achieved, Dr. Stephens inserted the dual diameter guidewire across the fracture site from the ulnar proximal cortex to the radial distal cortex under fluoroscope to stabilize the fracture and accurately align the desired final implant position. Next, he used the depth gauge to determine that a 30mm micro nail was needed for the 5th proximal phalanx and threaded the InFrame micro nail until bi-cortical purchase was achieved, correcting the ulnar deviation and extension deformity. Once he verified the final position of the first implant under fluoroscope, Dr. Stephens used the same methodology to place the second InFrame micro nail but in a different plane from the first implant. He then inserted the second dual diameter guidewire from the radial proximal cortex to ulnar midshaft cortex under fluoroscope and used a 16mm micro nail. Although the initial micro nail provided stable fixation, Dr. Stephens created a "Y" configuration with the second, shorter implant to capture the radial base fracture fragment at the MCP joint. Total surgery time was approximately 10 minutes.

Post-op



FOLLOW-UP

At 2 weeks, the patient did not experience any pain but suffered from slight stiffness. She was very close to regaining full ROM and everything else looked great.

DISCUSSION

With InFrame, Dr. Stephens was able to not only achieve rigid fixation with rotational stability from a "Y" frame construct, but also complete the surgery in only 10 minutes. The purpose built design allowed Dr. Stephens to create an optimal construct to achieve rotational stability and immediate ROM. For InFrame, the delivery mechanism is also vital because it simplifies the placement while improving accuracy. The strong fixation and earlier ROM enabled his patient to return to her daily activities faster than other implants and surgical approaches.

For more information on the InFrame™ Intramedullary Threaded Micro Nail, please visit www.acumed.net or call 888 627 9957

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