Anatomical Safe Zones for Pins & Wires

Bonus Tips & Tricks

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PRINCIPLES OF WIRE AND HALF PIN PLACEMENT WITHIN ANATOMICALLY SAFE ZONES

• Author dependent

Ilizarov, Solomin, Bianchi, Naygam

• Text and Atlas Descriptions
ATLAS
FOR THE INSERTION
OF TRANSOSSEOUS WIRES
AND HALF-PINS
ILIZAROV METHOD
GENERAL CONSIDERATIONS

• Cool wire/pins in large tray w/COLD NS (Saw Blades)
• Push wire thru skin, through muscle to engage bone
• Pulse drill w even pressure through bone
• Stop at distal cortex
• Tap wire thru soft tissue-prevents twisting of tissue, toggle drill
All of the above to prevent thermal damage

• To bone

• To soft tissue
SKINNY WIRES: SMOOTH AND OLIVE

- Tibia, Fibula, Calcaneous
- 1.8-2.0 mm
- (.062 K wire = 1.6mm)
SCHANZ HALF PINS

- Tibia 4-6mm diameter
- Calcaneous 4-6mm
- Metatarsals 3-4 mm
LOWER EXTREMITY SURFACE ANATOMY

- Palpate and mark w/surgical scribe
- Knee Joint
- Tibial Tubercle
- Fibula Head
- Anterior Tibial Crest
- Medial Tibial Wall
SURFACE ANATOMY...CONTINUED

• Medial and Lateral Malleolus
• Talar Neck
• Navicular and Cuneiform
• Base first met and base fifth met
ATLAS
FOR THE INSERTION OF TRANSOSSEOUS WIRES AND HALF-PINS
ILIZAROV METHOD
Levels of the anatomical cuts of the lower extremity

TIBIA and FIBULA left

1. The diagram demonstrates the wide medial and lateral access to the tibia that is available for pin insertion. A reference wire is usually first inserted for fine wire fixation. This is inserted in the transcondylar transverse plane anterior to the fibula. Optimum fixation is then obtained using two half pins placed anteriorly. The medial one can be used to also fix the fibula head, if this is the case a drill guide and trochar should be used. Alternatively a 2-3mm smooth pin can be used to transfix the proximal tibio-fibular joint, for example in tibial lengthening. This is inserted by palpating and protecting the common peroneal N. with the thumb and holding the soft tissues posteriorly, while the knee is flexed and the pin is driven through the fibular head. The pin is directed anteriorly, medially and slightly distally toward the closest available ring. The wire is cut off flush with skin, and pulled through to be flush with bone.

2. The half pin is inserted perpendicular to the subcutaneous border of the tibia on the medial aspect. The fine wire is inserted slightly obliquely to the transverse plane of the tibia to engage it in its widest portion.

3. Tibial fixation is with a medial-oblique wire and a half pin inserted into the medial aspect of the tibia perpendicular to the medial aspect.

4. The insertion of the wire and half pin at this level is similar to that described for Cut Two and Three.

5. The wire at this level is placed almost parallel to the frontal plane of the tibia. The half pin is inserted again on the medial aspect, slightly obliquely to the wire as shown in the diagram.

6. A distal tibial reference wire is the initial fixation used, with a direct medial to lateral wire. The fibular stabilization takes place through a lateral oblique wire directed from posterolateral to anteromedial. Additional stabilization can be achieved with a wire directed from antero lateral to posteromedial, anterior to the neurovascular bundle. Alternatively a stabilizing half pin can be inserted anteriorly, lateral to the tibialis anterior tendon. This should be done with care using a limited open technique through a small incision, which is dilated with an artery forceps. The forceps is used to displace the soft tissues and therefore protect the anterior neurovascular bundle, allowing safe pre-drilling and insertion of a 5 or 6mm half pin.
The first cut crosses the medial and lateral tibial plateau just below the level of the knee joint. The tibia is palpable throughout the anterior two thirds, but not posteriorly. Other superficial landmarks include the lateral collateral ligament attaching to the fibular head, the patella tendon and the patellar tubercle inferiorly. The tibia is approximately 80% cancellous at this level. The fibula is also becoming predominantly cancellous in composition on the posterolateral side. The medial tibial surface provides attachment for the sartorius, gracilis and semitendinosus, making up the pes anserinus. The saphenous N. and V. run between these muscles with the inferior geniculate A., and the infrapatellar N. emerges superficially. The major neurovascular structures are posterior and slightly lateral, except for the common peroneal N. situated laterally along the posterior border of biceps femoris, and the saphenous N. and V. medially, about a hand’s breadth medial to the medial border of the patella.

The diagram demonstrates the wide medial and lateral access to the tibia that is available for pin insertion. A reference wire is usually placed for fine wire fixation. This is inserted in the transcondylar transverse plane anterior to the fibula. Optimum fixation is then obtained using two half pins placed anteriorly. The medial one can be used to also fix the fibula head, if this is the ease a drill guide and trochar should be used. Alternatively a 2-3 mm smooth pin can be used to transfix the proximal tibia-fibular joint, for example in tibial lengthening. This is inserted by palpating and protecting the common peroneal N. with the thumb and holding the soft tissues posteriorly, while the knee is flexed and the pin is driven through the fibular head. The pin is directed anteriorly, medially and slightly distally toward the closest available ring. The wire is cut off flush with skin, and pulled through to be flush with bone. Note: do not place the wire through the capsule. Begin 13-15 mm distal to the articular surface.
This section is taken about 7-8 cm distal to the knee joint. At this level the whole of the anteromedial border of the tibia is palpable, which provides a useful guide to the relative cross-sectional diameter of the bone. The cortical component at this level is approximately 40% of the tibial diameter. The neurovascular bundle takes a more central position in the leg here, with the anterior bundle lying in close proximity to the interosseous membrane in the sagittal axis. Posteriorly the neurovascular bundle runs just posterior to the tibialis posterior muscle, again in the sagittal axis. The gastrocnemius has divided into its lateral and medial heads in the calf.

The half pin is inserted perpendicular to the subcutaneous border of the tibia on the medial aspect. The fine wire is inserted slightly obliquely to the transverse plane of the tibia to engage it in its widest portion.
This section is taken about 12 cm distal to the knee joint. The medial border of the tibia is still located in a subcutaneous position. The cortical component of the bone is gradually increasing. At this level the fibula is more triangular in cross section, and here has its smallest diameter. Again the neurovascular bundles are relatively central, between the tibia and fibula. The anterior tibial A. and V. and the deep peroneal N. are centred on top of the interosseous membrane, in the sagittal plane.

Tibial fixation is with a medial-oblique wire and a half pin inserted into the medial aspect of the tibia perpendicular to the medial aspect.
This section is taken just inferior to the midpoint between the knee and ankle joints. The tibia maintains its dense cortex, now comprising up to 80% of the cross section, with a medial subcutaneous position. The fibular now takes on a more quadrangular cross section. The major neurovascular bundle is very close to the geometric centre of the leg. The anterior bundle is anterior to the interosseous membrane. The posterior tibial A. and V. with the tibial N. runs posterior and lateral to the tibia at the confluence of the soleus, tibialis posterior and flexor digitorum longus muscles. The peroneal vessels remain medial in relation to the fibula. The muscular contributions remain similar with the one significant difference being the increasing mass of gastro-soleus.

The insertion of the wire and half pin at this level is similar to that described for Cut Two and Three.
This section is taken at about 12 cm from the ankle joint, where the tibia remains palpable along its medial surface, but is relatively anterior because of the increasing posterior musculature. The fibula is not usually palpable due to the peroneal muscle mass. Both bones at this level consist primarily of cortical bone. The anterior tibial A. and V. with the deep peroneal N. run in a more posterior position, now lying adjacent to the interosseus membrane. The tibialis anterior and the extensor hallucis longus muscles cover these structures. The posterior tibial A. and V. with the tibial N. are located centrally between the soleus muscle and the deep posterior compartment, descending on the tibialis posterior muscle.

The wire at this level is placed almost parallel to the frontal plane of the tibia. The half pin is inserted again on the medial aspect, slightly obliquely to the wire as shown in the diagram.
The last section of the leg is taken just proximal to the ankle joint, 2 cm proximal to joint. At this level both malleoli are well-defined, palpable landmarks. The epiphyses of both the tibia and fibula are quadrangular in cross section at this level. The major tendons are also usually readily palpable in their subcutaneous positions. The anterior tibial A. and V. with the deep peroneal N. lie between the tendons of tibialis anterior and extensor hallucis longus. The posterior tibial A. and V. with the tibial N. are located in the posteromedial quadrant, between the flexor digitorum longus and the flexor hallucis longus tendons.

A distal tibial reference wire is the initial fixation used, with a direct medial to lateral wire. The fibular stabilization takes place through a lateral oblique wire directed from posterolateral to anteromedial. Additional stabilization can be achieved with a wire directed form anterolateral to posteromedial, anterior to the neurovascular bundle. Alternatively a stabilizing half pin can be inserted anteriorly, lateral to the tibialis anterior tendon. This should be done with care using a limited open technique through a small incision, which is dilated with an artery forceps. The forceps is used to displace the soft tissues and therefore protect the anterior neurovascular bundle, allowing safe pre-drilling and insertion of a 5 or 6mm half pin.
FOOT WIRES

Through base of first metatarsal engaging second metatarsal.

Through base of fifth metatarsal engaging fourth and third metatarsal.
FOOT left

clinical examples
This section is taken through the metatarsal bases, about 1cm distal to the tarsometatarsal joints. At this level the metatarsals have reasonably thick cortices with a medullary core. The first metatarsal in particular has a considerable cancellous centre with thick cortices. The bases of the bones fit together in cross section like keystones in an archway, creating a stable bony arch with the highest point being around the third metatarsal. The dorsal surface is quite superficial, covered only by skin and fascia, extensor tendons and laterally by extensor digitorum brevis. The extensor retinaculum ends distally at the level of the tarso-metatarsal joints. The tendon of extensor hallucis longus lies over the first metatarsal, the dorsalis pedis A, and deep peroneal N. over the second, the extensor digitorum longus with the brevis tendons over the third and fourth. The extensor digitorum tendon to the little toe, with that of abductor digiti minimi lies over the dorsum, base and shaft of the fifth metatarsal.

Fixation at this level is initially achieved by crossed wires. The first from the medial side, obliquely and dorsally through the bases of first, second and third metatarsals. The second wire enters from the lateral side, again obliquely and dorsally, but this one fixes the fifth, fourth and third metatarsals as shown. This fixation can be supplemented for stability using 2-3mm Steinmann pins, or in the case of the first metatarsal base using a threaded half pin. These can be inserted into the centre of the metatarsal base from the dorsal aspect of the foot. If a first metatarsal pin is used care must be taken to spread the soft tissues with an artery to protect the dorsal neurovascular structures. Alternatively, especially in the smaller foot, the navicular or cuneiforms can be used as insertion points medially, and the cuboid can be used laterally as insertion points.

Note: it is possible to use 1st to 5th metatarsal wire.
TIPS & PEARLS

Best positioning of wires 90’ to each other

Sweet Spot of Wires 60’

If angle of wire application less the 60’, use Olive wire to prevent translation and shifting
TIPS & PEARLS

If angle <30’ then tension will decrease on other wires

Decrease in tension results in irritation of skin and resultant pin tract infection or granuloma

Incidence of Osteomyelitis with pin tract infection <4%
TIPS & PEARLS

Can use fixation bolt as guide when aiming wires

Immerse Skinny Wires and Half Pins in Cold NS

Use Wet Sponge To Hold and Guide At Insertion Point
TIPS & PEARLS

Half Pin-use to capture and toggle bone segment

Stirrup Wire-pull or hold bone fragment

Bent Wire with Tension-compression principle
TIPS & PEARLS

Latency period for distraction 7-10 days

Distraction of bone segments $\frac{1}{2}$ to 1mm/day

Pain with distraction due to “traction” on Neurovascular Structures
TIPS & PEARLS

Cleaning of wires and ex fx frame

Spray Bottle – Baby Shampoo 1/3
- Alcohol 1/3
- Normal Saline 1/3
qs to Spray Bottle

Rx-for HH/Wound Care RN
GOAL OF SURGERY

Correct Deformity

Single vs Staged Procedure

Promote Stability Of Bone Segments

Resultant functioning plantar grade foot
GOAL OF SURGEON

RTF / RTW / RTL

“Manage your patients Expectations”
TIPS & TRICKS & PEARLS

COORDINATE/REPS/GAME PLAN

BLOCK TIME/2 ROOMS

DON’T BACKLOAD YOUR DAY
Baylor Surgical Hospital at Fort Worth, 
1800 Park Pl Ave, Fort Worth, TX 76110, 
USA

Description

Procedure

Remove Comminuted Navicular Fracture Fragments
Left Foot
Prepare Talus - All Cuneiform Surfaces
Implant 4 Web Custom Cage-Fill w Biologics
Secure w Wright Me 3.5 mm Cortical Screws
Arrowhead Mini Rail External Fixator

Instruments

Arthrex BMA
Drill Bit 2.0
Foot & Ankle Instrument Tray
Hall Zimmer Pneumatic Sagittal Saw/Drill/K-wire
Driver
Jaryga Large Osteotomes
Jaryga/Downey Large Bone Set
Karlin Small & Large Curettes
Large and Small Geipi
Large and Small Weitlaner

Midas Rex 4mm Burr
Orthofix Trinity Elite
Orthofix Versashield
Stryker System 5 or 7
Wright Med 3.5mm screw set
Wright Med Augment Injectable
4Web Custom Navicular Osteogenic Titanium Cage

Jaryga Gloves 8.0 Biogel
Downey Gloves 7.5 under/8.0 over Latex and Free
Radiation (Radiaxon)

2.0 Vicryl
3.0 Monocryl
2.0 Nylon

TLS # 10 French Drains (2)

.5% Marcaine 9cc + 1cc Decadron 4mg/ml = 10cc 
Injection (2)

Xeroform/4x4 flats/Korlix Rolls/Gin Ace

My Notes
1. Subtal AR
   - 0.7 x 70 Arthrex partially threaded cannula screw
   - 0.7 x 60 Arthrex partially threaded cannula screw
2. TAL
3. 4WEB utility cage 22 x 18 mm, 14 degree, 6.5 mm, small (qty)
   - Arthrex 20 x 20 DynaNite staples (qty 2)
4. IN
   - Arthrex 20 x 20 DynaNite 20 x 20 staple (qty 1)
   - Arthrex 18 x 18 DynaNite 18 x 18 staple (qty 2)
5. 1st TMT
   - 4WEB large cotton cage 23 x 17 mm, 17 degree, 12 mm
   - Arthrex 18 x 18 DynaNite staple
   - Arthrex 18 x 18/15 DynaNite staple (qty 2)
   - Arthrex 25 x 20 DynaNite staple (qty 3)

Biologics!
3 cc Augment
3 medium Trinity elites
3 x 4 Versashield
3 x 9 Versashield

Thank you Dr. Jaryga!
DISTAL TIBIA
HINGE PLACEMENT
HINGE PLACEMENT
TEAM
Thank You

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