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Surgical technique 操作手册



胫骨髓内钉内固定系统 Tibial Nail System



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WASTON **华森**
M E D I C A L

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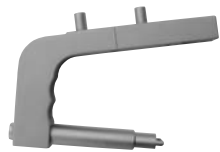
前言

INTRODUCTION

髓内钉在长骨骨折治疗方面越来越受欢迎，它适合于胫骨平台以远 7–8cm 至距离踝关节面 5.5cm 以内的骨折，干骺端须完整。Waston 髓内钉内固定系统较现有的其它髓内钉系统有更多的优点，它最大的优点是通过体外机械瞄准装置可以精确而快捷地植入近端和远端的锁钉，而无需 X 线导引。锁钉的直径 4mm，螺钉杆光滑，穿远侧骨皮质进行固定。这种结构的锁钉比同样直径的全螺纹锁钉更加坚强。主钉的交锁孔直径是 4.2mm。本系统提供可靠的近端和远端的锁紧，确保最大原稳定性及最小的断钉危险。

Intramedullary nailing has become increasingly popular as a treatment for long bone fractures, and it is suitable for all fractures extending from 7-8 cm distal to the tibial plateau, to within 5.5 cm of the distal articular surface, provided that the epiphyses are closed. The WASTON Intramedullary Fixation System is a set of intramedullary nails which offers several advantages over existing systems. A major advantage of the system is the ability to insert both proximal and distal locking screws accurately and quickly without the use of X-rays, using an external mechanical targeting device. The locking screw has a smooth shank 4 mm in diameter which penetrates the distal cortex. A locking screw of this configuration is much stronger for a given diameter than a fully threaded screw. The locking holes in the nail are 4.2 mm wide. The system provides secure proximal and distal locking, ensuring maximal stability, with minimal risk of screw breakage.

工具
INSTRUMENTS



15043-001 瞄准器手柄 (胫骨)
Nail Support Handle (Tibial)



15043-002 近端瞄准支架 (胫骨)
Proximal Outrigger (Tibial)



15043-003 锁轮 (M12 × 1.5)
Outrigger Locking Screw (M12 × 1.5)



15043-004 导杆 (胫骨)
Guide Bar (Tibial)



15043-005
远端瞄准支架 (胫骨)
Distal Outrigger (Tibial)



15041-004
吊紧螺栓 (M6)
Locking Rod (M6)



15041-006 支架锁轮 (M8)
Outrigger Locking Screw (M8)



15041-008
T 型定位杆 (Ø5.0)
T-Handled Stabilizing Rod (Ø5.0)



15041-110
软组织分离器 (Ø8)
Soft Tissue Protector (Ø8)



15041-311/411
钻套 (Ø4.2/Ø5.2)
Drill Guide (Ø4.2 / Ø5.2)



15041-117
开孔器 (大)
Pointed Awl (large)



15041-118/218/318/418/518
髓腔绞刀 (Ø7 / Ø8 / Ø9 / Ø10 / Ø11)
Rigid Reamer (Ø7 / Ø8 / Ø9 / Ø10 / Ø11)



15041-420/520
骨钻 (Ø4.0/Ø5.0)
Drill Bit (Ø4.0 / Ø5.0)



15041-421
骨钻 & 限位器 (Ø4.0)
Drill Bit and Slide Limited Device (Ø4.0)



15041-022
T 型平底钻 (Ø5.0)
T-Drill Bit (Ø5.0)

工具
INSTRUMENTS



15041-123
套管 (Ø10 & Ø8.2)
Screw Guide (Ø10 & Ø8.2)



15041-025
直角定位杆
Stabilizing Rod



15041-026
测深器 (20 ~ 90mm)
Locking Screw Depth Gauge (20~90mm)



15041-127
丝锥 (HA6.0)
Tap (HA6.0)



15041-028
T型六角扳手 (SW3.5)
Screw T-Wrench (Hex, SW3.5)



15041-029/129
L型六角扳手 (SW2.5/SW5.0)
Screw L-Wrench (SW2.5 / SW5.0)



15041-130
打拔器手柄 (M6)
Sliding Hammer with Detachable Swing Arm (M6)



15041-131 打拔器 (大)
Adapter for Extractor (large)



15041-032
锁钉取出器 (M8 × 1 左旋)
Locking Screw Extractor (M8 × 1, Left)

植入物
IMPLANTS



胫骨髓内钉
Tibial intramedullary nail

操作技术 OPERATIVE TECHNIQUE

术前评估髓内钉和锁钉规格

PRE-OPERATIVE ESTIMATION OF NAIL AND LOCKING SCREW SIZE

通过直接测量胫骨平台至内踝的长度，医生在术前对所需髓内钉的长度应该有很好的评估，如有必要，可以测量健侧胫骨。通过放射学检查了解髓腔的宽度，并结合患者的体重和骨折的严重程度，医生将可以判断可能的髓内钉的直径，以及是扩髓或还是非扩髓。注意 X 线片有 8%~15% 的放大倍率。大直径的髓内钉适用于严重粉碎性骨干骨折和胫骨上 1/3 段骨折以增加稳定性。通常髓内钉的规格取决于骨的大小和扩髓的程度，无论哪种情况，医生都要做好准备。

The surgeon should be able to gain a good estimate of the required length pre-operatively, by direct measurement of the length of the tibia from the plateau to the medial malleolus, if necessary, using the uninjured leg. By looking at the width of the medullary canal on the radiograph, and from the knowledge of the weight of the patient and the severity of the fracture, the surgeon will be able to gauge the likely diameter of the nail, and whether to use a reamed or an unreamed nail. It should be noted that the X-ray film has magnification of 8% or 15%. A larger nail is indicated in severely comminuted diaphyseal fractures and in proximal third fractures to provide extra stability. In general, the size of nail chosen will depend on the size of the bone, and the amount of reaming, if any, that the surgeon is prepared to accept.

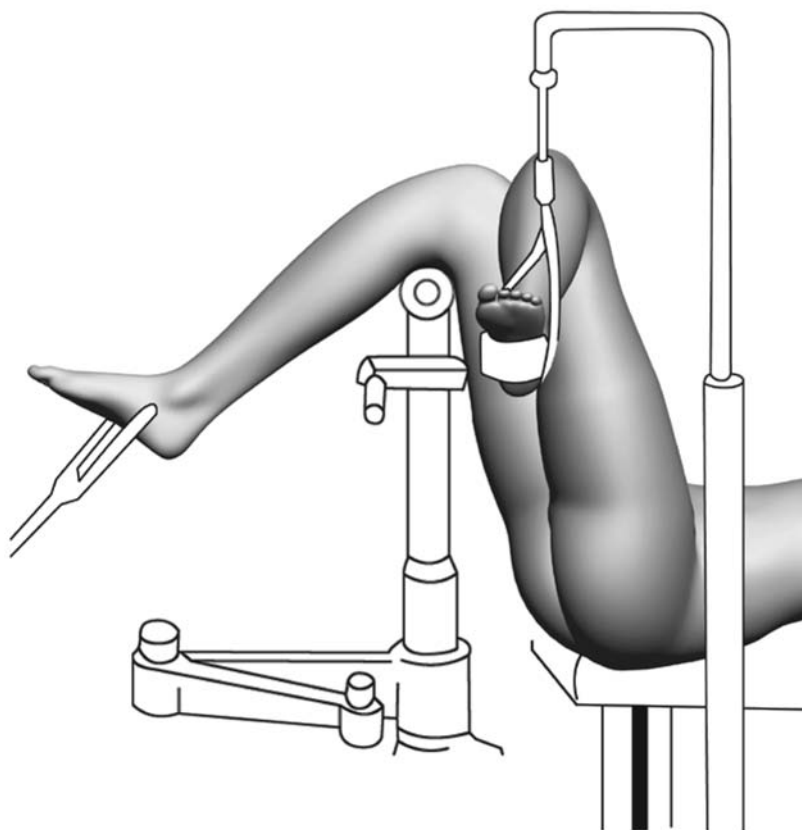


患者准备

PREPARATION OF THE PATIENT

取仰卧位将患者置于可穿透 X 线的手术床，确保患肢膝关节屈曲至少能达到 90° ，以及正侧位 X 线片均能显示完整的胫骨。可以通过徒手挤压骨折部位或者应用消毒的止血带、弹性绷带来达到临时的复位和稳定。用斯氏针插入跟骨行牵引复位也可以作为一种选择。根据医生的判断，通过骨折复位床牵引下肢也可以完成复位过程。

Position the patient supine on a radiolucent operating table. Ensure that the knee of the injured leg can be flexed at least 90° and x-ray visualization of the entire tibia is possible in both the AP and lateral views. Temporary reduction and stabilization can be accomplished by manual pressure at the fracture site, or by application of a sterile tourniquet or elastic bandage around the fracture. Alternatively, reduction can be achieved by skeletal traction with Steinmann-type pin inserted through the os calcis. At the surgeon's discretion, the procedure can be performed on a fracture table with the leg placed in traction.



进钉点

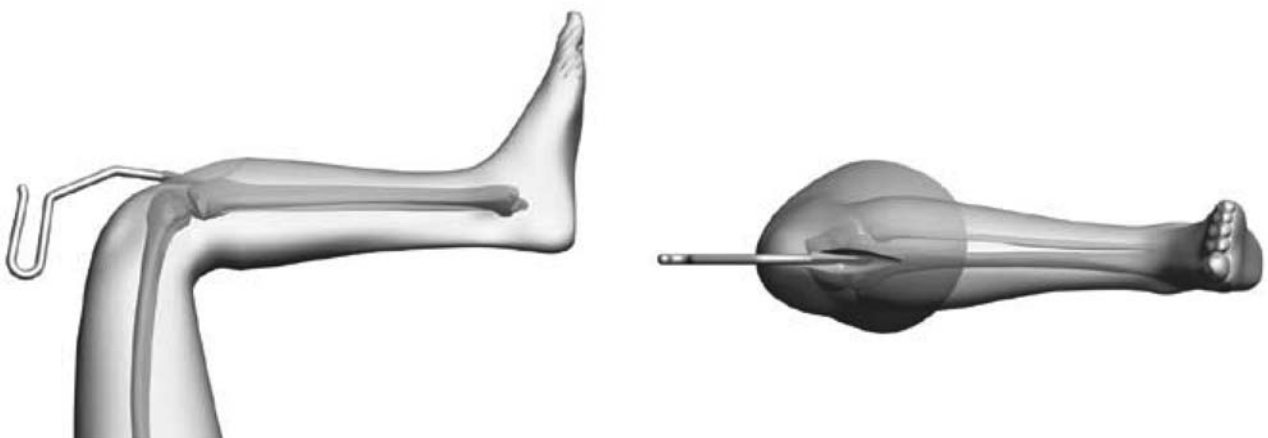
INSERTION SITE

髓内钉的入点前后位片上应和骨髓腔位于同一直线上，在胫骨平台的前缘。进钉点的位置和胫骨结节相关并随患者的解剖而异。取胫骨结节中线作纵行切口，向近端延长。根据医生的习惯和患者的解剖结构特点，来选择牵开或者切开髌韧带。

The entry point for the nail is in line with the medullary canal in the AP view, and is at the anterior edge of the tibial plateau. The location of the entry point in relation to the tibial tubercle varies with patient anatomy. Make a longitudinal incision over the midline of the tubercle, extending proximally. Retract the patellar tendon laterally, or split the tendon, depending on surgeon preference and patient anatomy.

将髓腔开孔器尖端置于入点，通过影像增强器来确定它是否位于骨髓腔中线。如果不在，调整位置到满意为止，在内、外侧面检查开孔器尖端的位置。旋转推进开孔器向髓腔钻孔，保持开孔器的直柄部分与胫骨干平行，这样开孔器的尖端就对准了胫骨轴线。

The tip of the Pointed Awl is placed at the entry point and the Image Intensifier used to confirm that this is centered over the canal. If it is not, it is adjusted until it is satisfactory, checking the position of the tip of the awl in the medial-lateral plane. The awl is then advanced with a rotational action towards the medullary cavity, keeping the straight part of the handle parallel with the tibial diaphysis, so that the tip of the awl is pointing directly down the tibial shaft.

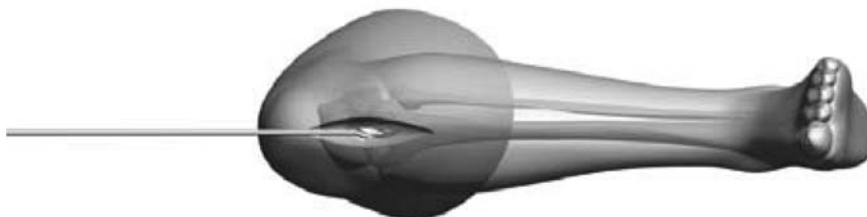


进钉点 (续)

INSERTION SITE (CONTINUED)

取出开孔器，用 7mm 硬扩髓钻轻轻推入髓腔来证实髓腔已经打开。扩髓钻插入时一旦感觉有阻力就应该停止，维持扩髓钻在原位，用影像增强器来确认在前后位和侧位上方向和髓腔的方向一致，从 7mm 扩髓钻开始，以每 1.0mm 为增量依次进行，直至比所选髓内钉直径大 1mm 就足够。通常扩髓至超过髓腔狭部就足够了，除非胫骨远端骨折时扩髓要超过骨折线。

The awl is removed, and at this point it is useful to confirm that the medullary canal has been opened, using the 7 mm Rigid Reamer, which is gently pushed down into the medullary canal. The introduction of the Rigid Reamer should be stopped as soon as resistance is felt. With the Rigid Reamer in place, the Image Intensifier should now be used to confirm alignment in both planes. starting with the 7.5mm reamer. the reaming should be continued in 1.0mm increments, up to a width 1mm greater than the nail diameter. Reaming past the isthmus is generally sufficient except in the case of a distal fracture, where reaming should be extended beyond the fracture line.



应该强调硬扩髓钻不是设计来去除皮质骨的，不要试图用他们来扩髓腔峡部。

It should be emphasized that the Rigid Reamers are not designed to ream cortical bone, and no attempt should be made to ream the isthmus with these instruments.

扩髓（续）

REAMING PROCEDURE (CONTINUED)

扩髓时须平稳施压并检查扩髓钻头是否一直在推进。如果很费劲，或者扩髓钻头没有推进，表明扩髓钻头被碎骨屑阻塞。在这种情况下拔出扩髓钻清洁钻头就很重要。在骨质较硬的年轻病人可能需要多次清洁。如果扩髓钻头清洁后，扩髓钻仍不能顺利通过，就应该拔出扩髓钻，换用先前使用的规格的钻头插入，来回扩髓两次。同样需要确认的是按照依次增加的顺序换用扩髓钻头。任何原因导致扩髓钻不能前进都可能对骨和软组织产生严重的热损伤。

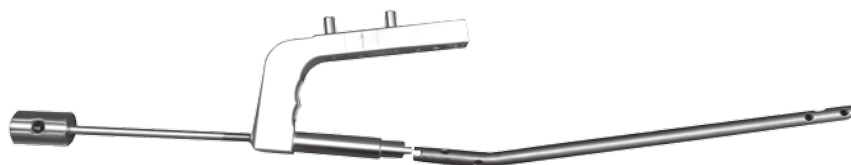
Steady pressure should be exerted while reaming and a check should be made that the reamer is advancing at all times. Excessive pressure, or a reamer that is not advancing, may indicate that the reaming head has become clogged with bone debris. It is very important in these cases to remove the reamer and clean the head. In young patients with hard bone this may be necessary more than once. If the reamer will not pass easily in spite of cleaning the head, it should be removed, and the previous size inserted, and passed slowly up and down the canal twice. A check should also be made to ensure that the reaming heads are being used in the correct order. A reamer that is not advancing for any reason may cause significant thermal damage to bone and soft tissues.

植入髓内钉 NAIL INSERTION

扩髓髓内钉 REAMED NAIL

选择合适长度和直径的髓内钉，将吊紧螺栓插入手柄，将选好的髓内钉安装在手柄上。

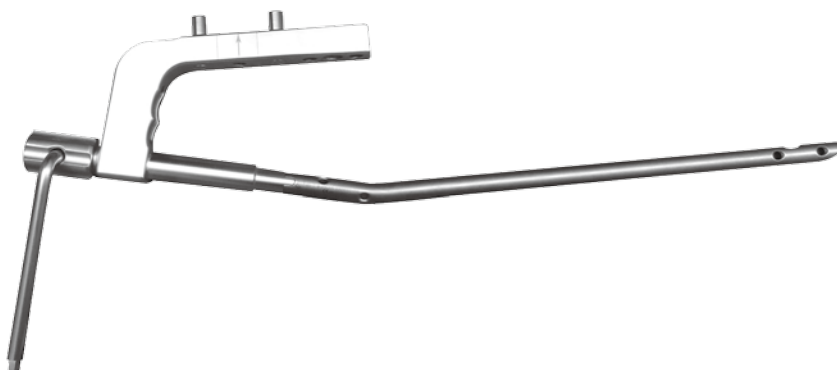
A nail of correct diameter and length is now selected. The Locking Rod is inserted into the back of the Nail Support Handle and the chosen nail into the nail support.



植入髓内钉（续） NAIL INSERTION (CONTINUED)

将髓内钉安装在正确的位置，并用 SW5 吊紧扳手旋紧吊紧螺栓来完成髓内钉的紧固。插入髓内钉之前检查髓内钉和导杆的近端和远端的孔是否对应，这点非常重要。为做到这点，需按照后述的“远端锁紧”和“近端锁紧”过程将导杆安装在手柄上。

The nail must be rotated until it seats into the correct position and the Locking Rod is then firmly tightened into the nail, completing this with the SW 5 Wrench. Before the nail is inserted, it is important to check alignment of the distal and proximal holes in the nail and the Guide Bar. In order to do this, the Guide Bar is mounted on to the handle following the procedures described below under “Distal Locking” and “Proximal Locking” pages.



植入髓内钉（续）

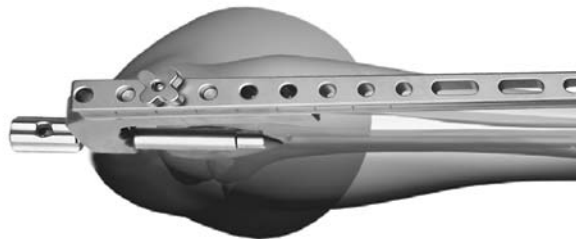
NAIL INSERTION (CONTINUED)

在影像增强器监视下，徒手将髓内钉顺导针尽可能深地插入骨髓腔。将髓内钉插入远端骨折块，直至手柄、髓内钉接口处和骨面平齐。这表明髓内钉插入至正确的深度。理想的状况下，可以徒手插入髓内钉，但轻轻敲击可能是必要的。

注意：钻孔和植入锁钉前取出导针。

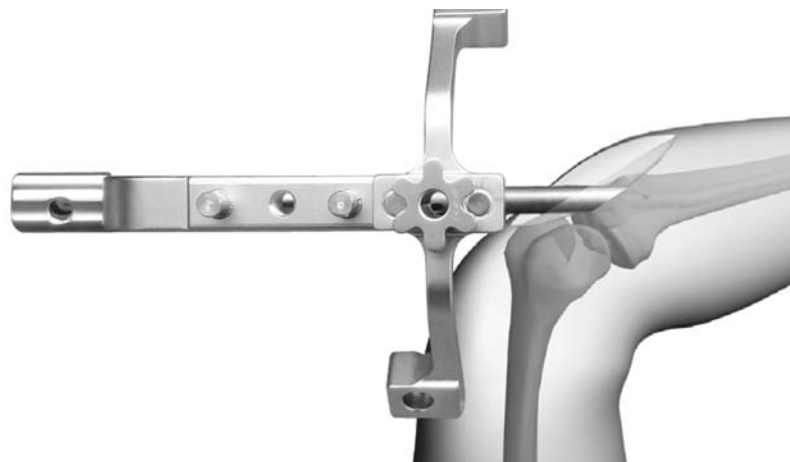
The nail is now manually inserted over the Guide Wire into the medullary canal as far as possible, under image intensification. The nail is advanced into the distal fragment until the step on the nail support is flush with the surface of the bone. This indicates that the nail has been inserted to the correct depth. Ideally, the nail should be inserted by hand, but gentle tapping may be necessary.

Note: Remove the Guide wire prior to drilling holes and insert the Locking Screws.



将打入拔出器装在吊紧螺栓的尾部，并且需要完全拧紧以避免损伤螺纹。这样可以通过轻轻的敲击将髓内钉插入正确的位置。以髓内钉的近端尾部陷入骨面 5-10mm 为宜。如果不能插入，扩髓至直径再增加 1.0mm，如果仍不适合，就应该换用直径小一号的髓内钉植入。

The Sliding Hammer maybe attached to the end of the nail Locking Rod, and it must be tightened fully to avoid damage to the thread. The nail can then be inserted into the correct position by gentle hammering. Ideally, the proximal end of the nail is recessed in the bone by 5-10mm. If the nail will not advance, the bone should be reamed an additional 1.0 mm. If this is unacceptable, a smaller diameter nail should be inserted.



注意：移除打入拔出器后，须检查确认吊紧螺栓是否紧固。

Note: After the Sliding Hammer has been removed, a check should be made to ensure that the Locking Rod is tightened firmly.

非扩髓髓内钉

Unreamed Nail

将 8mm 或 9mm 髓内钉和手柄用吊紧螺栓同扩髓髓内钉一样牢固拧紧，如果允许，通常尽可能选用直径 9mm 的髓内钉。将髓内钉通过入口插入骨髓腔，在 X 线的监控下用手将髓内钉尽可能深地插入。一般需要按照上述方法连接打入拔出器完成插入，敲击尽可能轻柔。

It is always preferable to use a 9 mm nail if possible. The 8 mm or 9 mm nail is locked firmly to the Nail Support Handle with the Locking Rod as for the reamed nail. It is then inserted through the entry portal into the medullary canal, and advanced manually as far as possible, using X-ray control. It will normally be necessary to attach the Sliding Hammer, as described above, to complete the insertion, hammering as gently as possible.

谨慎操作以确保髓内钉和胫骨轴线保持一致，以避免穿透骨皮质。如果敲击后髓内钉仍不能通过髓腔，需要通过影像增强器仔细检查其位置。有可能髓内钉的前端撞击胫骨后侧骨皮质。这种情况需要回敲拔除髓内钉，调整入口的方向。如果髓内钉仍然不能进入，而方向正确，需再次拔除，考虑更换小一号的髓内钉，或者扩髓。

Care should be taken to ensure that the nail remains parallel to the tibial diaphysis, to avoid perforation of the cortex. If the nail will not pass in spite of hammering, the situation should be carefully reviewed with the Image Intensifier. The tip of the nail may be striking the posterior cortex. In this case the nail should be removed by reverse hammering, and the direction of the entry portal adjusted. If the nail will not pass, but the direction seems to be correct, it should again be removed, and consideration given to using a smaller nail, or to reaming.

髓内钉插入后，需要通过 X 线来检查插入髓内钉是否造成骨折断端分离。无论多久的骨折断端的分离将可能导致筋膜间室综合症，因此必须避免。骨折断端的移位应尽可能地通过膝关节和脚后跟之间的加压来纠正。如果这时不能完全纠正，将会影响随后的远端锁紧，这种病例必须先锁紧远端；这时，检查矢状面和冠状面上的对线也同样很重要。

At the end of insertion, the fracture site should be checked by X-ray to see whether nail insertion has caused any distraction of the fragments. Distraction at the fracture site for any length of time may be associated with compartment syndrome, and must be avoided. If at all possible, any distraction should be corrected now by compression between heel and knee. If full correction is not achieved at this time, it can be affected following distal locking, which in this case must be done first. It is also important at this stage to check for axial reduction in the sagittal and coronal (frontal) planes.

注意：扩髓和非扩髓髓内钉都可以通过轻轻地旋转来插入，直至髓内钉的弯曲部分到达骨皮质的位置。这之后髓内钉只能通过推或敲击推进，不能旋转。

Note: Both reamed and unreamed nails can be advanced by gentle rotational movements until the bend in the nail reaches the surface of the bone. After this the nail must be advanced without rotation by pushing or hammering.

远端锁紧

DISTAL LOCKING

因为操作难度较高，所以通常推荐先完成远端锁紧。当然，如果是比较靠近胫骨近端的骨折或者非常不稳定的骨折，也可以先近端锁紧。

It is generally recommended that distal locking is performed first, because it is potentially more difficult. In very proximal or unstable fractures, however, it may be preferable to carryout proximal locking first.

将导杆放置于手柄的两个圆柱上，当导杆上和髓内钉长度对应的刻度与手柄前缘的平面一致，拧紧固定。注意导杆上对应每个规格髓内钉长度和手柄的箭头对应。远端锁钉通常在冠状面上从内侧植入。极少数情况，因内侧皮肤损伤或者是远端骨折块的形状，医生希望从外侧植入锁钉。这时，远端支架应该置于外侧，锁钉从腓骨前面植入，其他步骤和常规的内侧入路一样。

The Guide Bar is placed on between the handle, moved downwards until the number corresponding to the nail length is at the level of the front of the handle, and locked firmly into place. Note that there is on arrow for the tip of the Bar Locking Screw corresponding to each nail length. A retaining ball in the handle makes finding the correct position of the Guide Bar easily. The distal locking screws are inserted in the frontal plane, normally from the medial side. On rare occasions, because of skin damage medially, or because of the configuration of a distal fracture, the surgeon may wish to insert the screws from the lateral side. In this case the Distal Outrigger is placed on the lateral side, and the nail is rotated so that the locking screws will pass anterior to the fibula. The procedure for distal locking is then identical to that for the more usual medial approach.

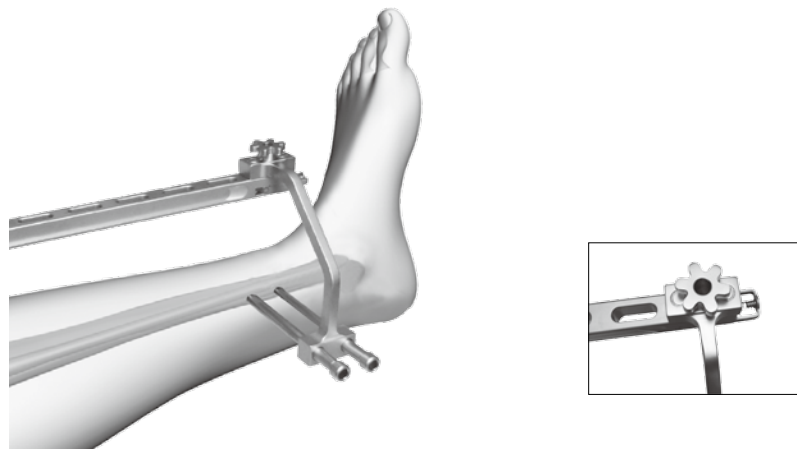


远端锁紧 (续)

DISTAL LOCKING (CONTINUED)

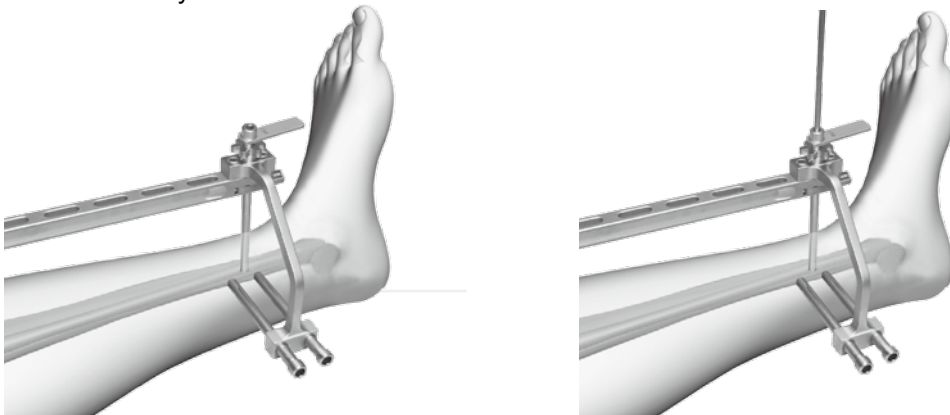
将远端支架安装在导杆上使其位于胫骨的所选入路侧，把螺钉套插入远端支架，先不做切口。通过定位杆使系统达到初步稳定和精确定位。

The Distal Outrigger is mounted on the Guide Bar so that it lies on the correct side of the tibia, and the Screw Guides are inserted into the Outrigger, but no incision is made as yet. The system is first stabilized in exact alignment, utilizing the Stabilizing Rod.



将钻套 $\phi 5$ 插入远端支架手轮中间的孔，然后在钻套正下方皮肤上作切口，显露胫骨前面的骨皮质，需谨慎操作避开胫前肌腱和血管神经束以免损伤。将钻套 $\phi 5$ 插入至前端抵到骨皮质表面，并稳定在胫骨前方的中央。用 $\phi 5$ 骨钻在前方皮质钻孔后拔除。也可以用 $\phi 5$ 的平底钻先在骨皮质上钻出平面，使骨钻不至于在骨皮质上打滑而使远端定位不准确，再用 $\phi 5$ 的骨钻打穿上层皮质骨至髓内钉平台，取出骨钻，用 $\phi 5$ 的平底钻清除孔内骨屑，直至听到或手感平底钻尖端触及髓内钉，向髓内钉轻敲平底钻，也可以帮助确定，再取出平底钻。

A Drill Guide ($\phi 5$) is inserted into the holes in the Distal Outrigger Locking Screw. An incision is made in the skin directly beneath it, and the anterior tibial cortex exposed by blunt dissection using the Obturator, taking care to deflect the tendon of Tibialis Anterior laterally to avoid damage to it or to the neurovascular bundle. The Drill Guide ($\phi 5$) is advanced until its tip is engaged in the tibia, and stabilized on the center of the tibial crest. A 4 mm Drill Bit is now used to drill the anterior cortex only. The Drill Bit is removed. A Pin($\phi 4$) can also be used to drill a recess on the tibial cortex before using Drill Bit to increase its stability.

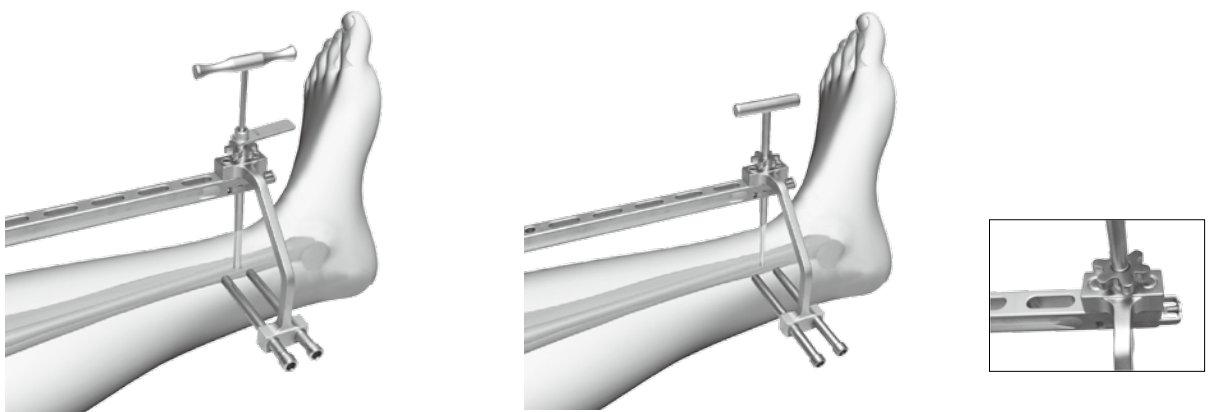


远端锁紧 (续)

DISTAL LOCKING (CONTINUED)

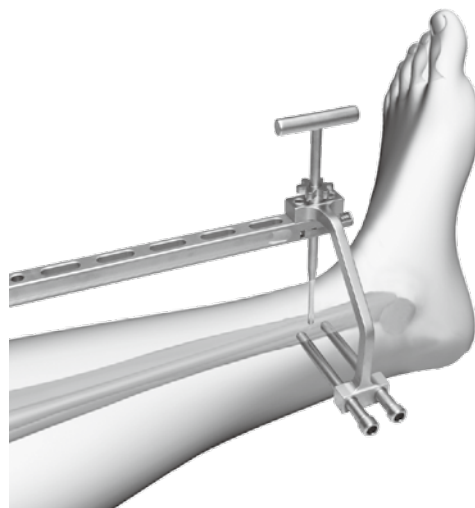
取出 $\varnothing 5$ 的钻套，用定位杆顺远端支架定位孔插入，经定位孔至髓腔内髓内钉平台，轻抬支架，使弹簧卡块卡定位杆圆型卡槽内，可以听见“叭”的卡入声。这时说明远端定位已定好。

Remove the $\varnothing 5$ drill guide and fix the stabilizing rod in an exact position according to the diameter of the nail. Clip the guide bar gently so that its forks engage the two recesses in the stabilizing rod.



于螺钉套 ($\varnothing 10/\varnothing 8$) 放入 $\varnothing 8$ 的软组织分离器对准皮肤部位作切口，钝性分离暴露骨皮质，谨慎操作以防止卷入或损伤血管神经结构。同样，如果选择外侧入路，医生亦须通过仔细地分离软组织显露骨皮质来保证锁紧过程中避免损伤肌腱和血管。将螺钉套插至骨皮质。

An incision is now made beneath each Screw Guide ($\varnothing 8/\varnothing 10$), and the cortex exposed in each incision by blunt dissection, taking care to avoid entrapment of, or damage to, the neurovascular structures. Similarly, if the approach is from the lateral side, the surgeon must ensure that the tendons and vessels are not damaged during the locking procedure, by careful soft tissue dissection down to the bone. The Screw Guides are then advanced until they are in contact with the cortex.

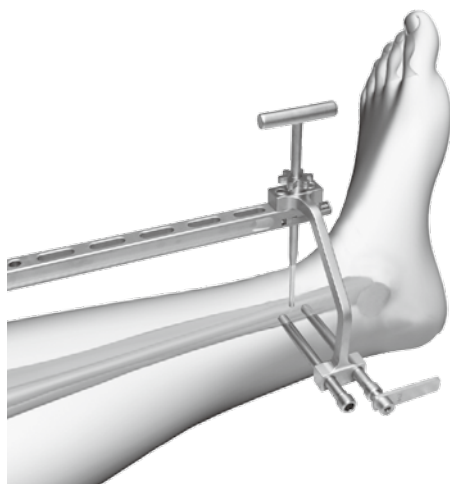


远端锁紧 (续)

DISTAL LOCKING (CONTINUED)

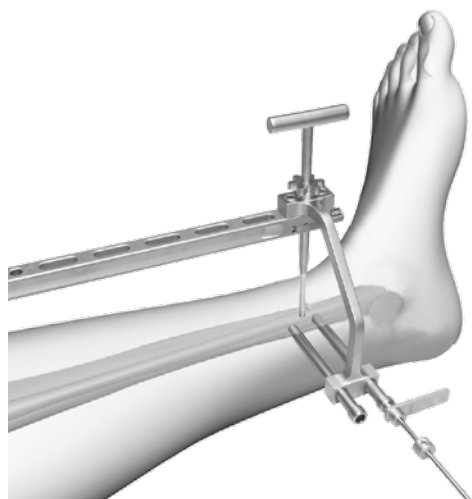
放入 $\phi 4.0$ 的内钻套，顶至皮质骨，使用 $\phi 4.0$ 的骨钻，骨钻限位套装在钻头近端。将骨钻插入 $\phi 4.2$ 钻套，抵住骨，在开始钻孔前，轻压骨钻使尖端紧压住骨皮质。

The Drill Stop is attached to the Drill Bit at the proximal end. The Drill Bit is introduced into the Drill Guide ($\phi 4.2$), down to the bone, before the drill is started, and gently pressed to engage the tip in the cortex.



医生平稳地钻穿近侧的骨皮质，在钻头抵住对侧骨皮质时停止钻孔。移动骨钻限位套至距钻套 ($\phi 4.2$) 顶部 7–10mm 处并锁紧。继续钻孔至穿透对侧骨皮质，骨钻限位套可以防止损伤对侧的软组织，也提供一种估计锁钉长度的方法。

The assistant maintains constant contact between the tip of the Stabilizing Rod and the nail throughout this procedure, if necessary, by applying gentle pressure. The Drill Guide ($\phi 4.2$) is inserted into one of the Screw Guides and gently tapped to engage the tip in the cortex. The surgeon continues to hold the the Drill Guide ($\phi 8/\phi 4$) with one hand until the first cortex has been drilled.

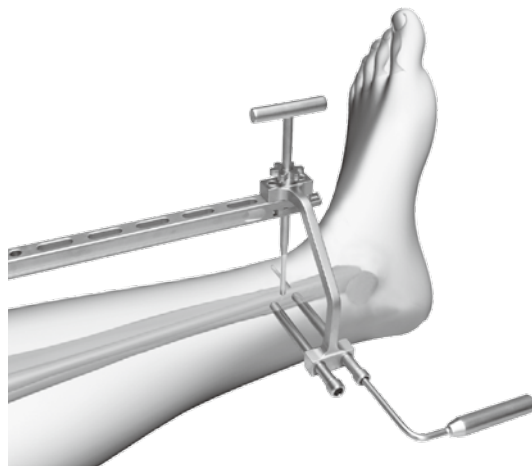


远端锁紧 (续)

DISTAL LOCKING (CONTINUED)

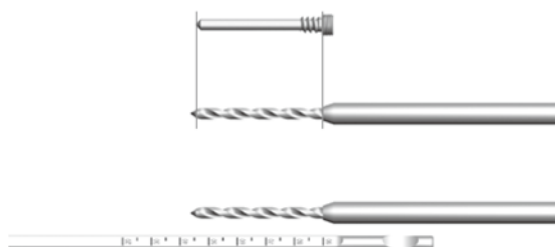
取出骨钻和钻套 (ø4.2)，将螺钉代替杆插入螺钉套，穿过髓内钉和远侧骨皮质。螺钉代替杆可以固定住导杆、远端支架以及髓内钉之间的位置，可以通过插入导针或影像增强器来证实它的位置。这样螺钉代替杆可以保证螺钉套的对位。

The Drill Bit is removed with the Drill Guide (ø4.2). The Graduated Angled Trocar is now inserted into the Screw Guide, so that it passes through the nail, and engages the far cortex. This trocar should now have stabilized the position of the Guide Bar and Outrigger in relation to the nail, and its position can be confirmed by manipulation or with the Image Intensifier. Now that Screw Guide alignment is maintained by this trocar.



正确的锁钉的长度(钉帽顶部至螺钉尖的距离)可以通过测量的穿出钻套的骨钻的长度加5mm来确定。骨钻的锥形尖端长度忽略不计。记下正确的锁钉长度。还有另外一种可供选择的方法，就是用测深器按照后述的方法来确定锁钉的长度。

The appropriate locking screw length, from the top of the screw head to its tip, is determined by measuring the amount of drill bit protruding from the Drill Guide (ø8/ø4), and then add 5mm to it. The tapered tip of the Drill Bit should be ignored in this measurement. A screw of the correct length is reserved. An alternative method of screw measurement using the Depth Gauge is described below.

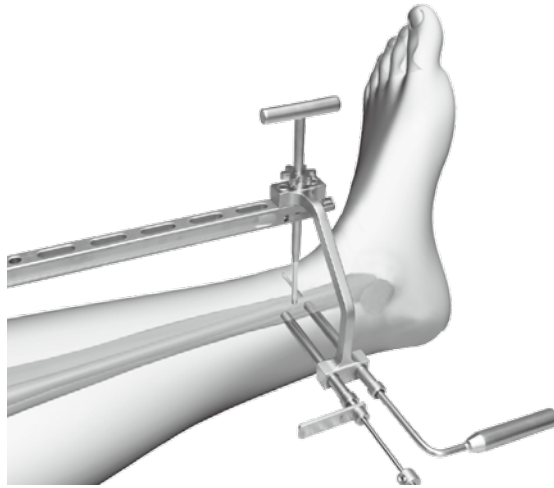


远端锁紧 (续)

DISTAL LOCKING (CONTINUED)

将骨钻限位套重新放在骨钻的近端。按照同样的技术钻好第二个锁钉孔，并测量好第二个锁钉的长度。

The Drill Stop is now replaced at the proximal end of the Drill Bit. The second locking hole is now drilled, using exactly the same technique. The length of the second locking screw is determined.

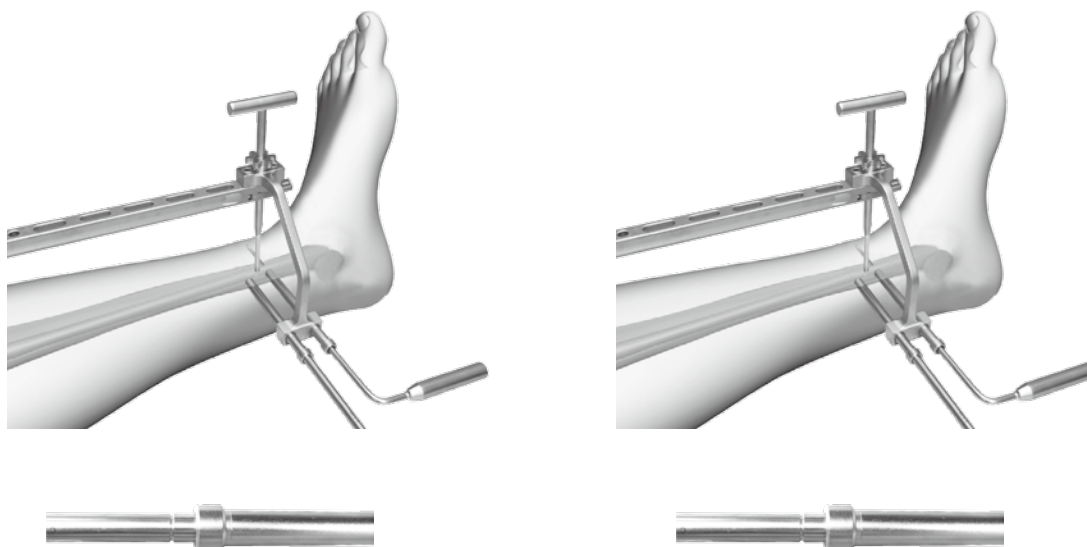


用骨螺钉丝锥插入螺钉套进行近侧骨皮质攻丝。在丝锥杆上有一个环形的标记，表明攻丝的深度已经正确对应锁钉的螺纹长度。移去骨螺钉丝锥，用骨螺钉六角扳手将合适长度的螺钉插入第二个螺钉套，径直将螺钉推入，至螺纹抵住骨皮质为止。注意六角扳手上环形标记，当锁钉推到底时这个标记高于螺钉套的顶部6-10mm。在螺钉没有推到位前不需要拧动骨螺钉六角扳手，因为此时没有螺纹嵌入骨皮质。稳定地顺时针拧动六角扳手，可以轻压手柄，直至六角扳手上的标记和螺钉套顶部齐平。再拧一圈使锁钉完全拧紧。需要注意的是不要继续拧紧以防止破坏骨皮质里的螺纹。

The Tap is inserted into the Screw Guide to tap the proximal cortex. There have one circular marks on the Screw Tap according to the length of a locking screw's thread. The Screw Tap is removed. A locking screw of correct length is now inserted into the second Screw Guide, and pushed through the bone with the Hex Screwdriver, until its thread engages the cortex. Note that there is a circular mark on the Screwdriver Shaft. This mark will be 6-10 mm above the top of the Screw Guide when the locking screw has been pushed in sufficiently. There is no point in turning the Screwdriver until this position is reached, because there will be no thread in contact with the bone. The Screwdriver is now turned steadily clockwise, exerting gentle pressure, until the mark on the shaft of the Screwdriver reaches the top of the Screw Guide. One more complete turn should then be made to tighten the screw fully. It is important not to continue turning after this position is reached, because the thread in the bone may be stripped.

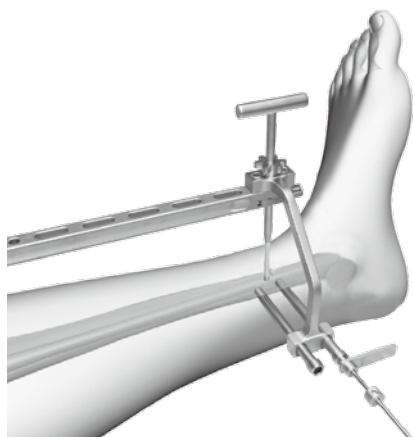
远端锁紧 (续)

DISTAL LOCKING (CONTINUED)



取出螺钉代替杆。用同样的方法拧入第二个远端锁钉。移除螺钉套后，松开锁块手轮，通过影像增强器或者 X 线片检查的方法来确定远端的两枚锁钉是否都穿过髓内钉，以及确认骨折复位没有丢失。拆除远端支架和定位杆。

Remove the Graduated Angled Trocar from the first screw Guide. The same technique is followed for insertion of the second distal locking screw, after which both Screw Guides are removed by loosening the Clamp Locking Nut. A check should now be carried out with the Image Intensifier or radiograph to confirm that both locking screws have passed through the nail and to confirm that the reduction has been maintained. The Distal Outrigger and the Stabilizing Rod are now removed.

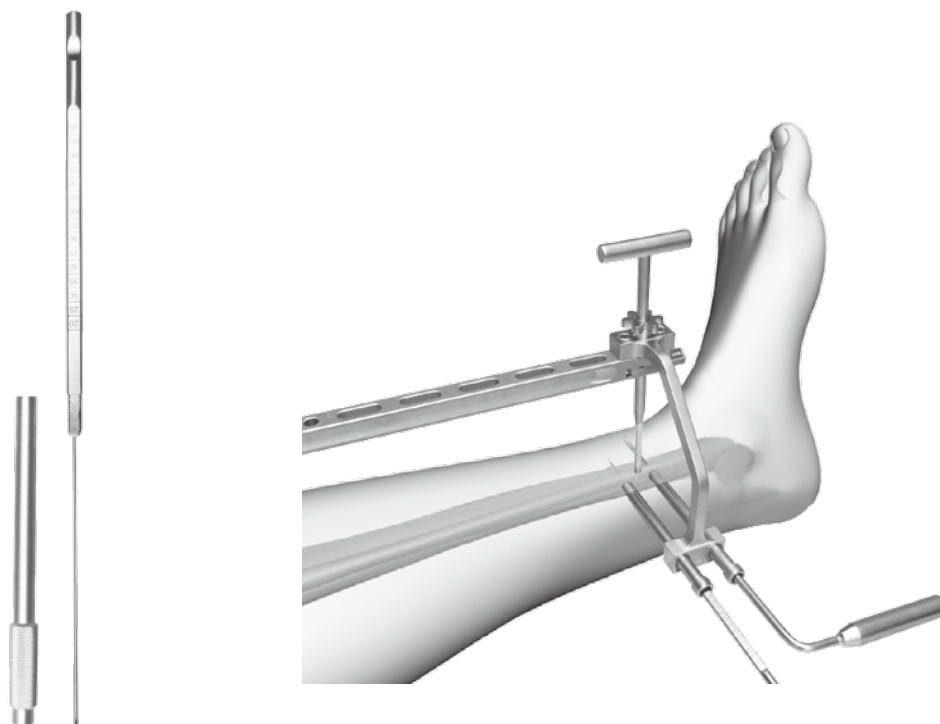


评估锁钉长度的另一种方法 – 利用测深器

ALTERNATIVE METHOD OF ESTIMATING LOCKINGSCREW LENGTH USING THE DEPTH GAUGE

如果不能确定锁钉的正确长度，无论是为验证钻孔后取得的测量值，或者因为外科医生忽略了这一步骤，可以按下述方法使用测深尺：医生首先要检查螺钉套在正确的位置，即前端抵住骨面。拧下测深器的保护套。将测深器带钩端插入螺钉套穿过对侧骨皮质，再往回拉使钩住远侧骨皮质的表面。锁定的正确长度就可以在螺钉套顶部平面读出。这种测深器只适合与 WASTON 的胫骨和股骨髓内钉，因为它的精确度依赖于螺钉套的固定长度。

If there is any doubt about the correct locking screw length, either in respect of the measurement obtained after drilling, or because the surgeon omitted this step, the locking screw Depth Gauge may be used as follows: the surgeon should first check that the screw guide is positioned so that it is touching the bone. The Depth Gauge cover is then unscrewed and removed. The hooked end is inserted down the Screw Guide and through the bone. It is then drawn back so that the hook engages the outer surface of the far cortex. The correct length of screw can now be read at the top of the Screw Guide. This Depth Gauge is only suitable for use with WASTON Tibial and Femoral Nails, since its accuracy depends on a fixed length of Screw Guide.

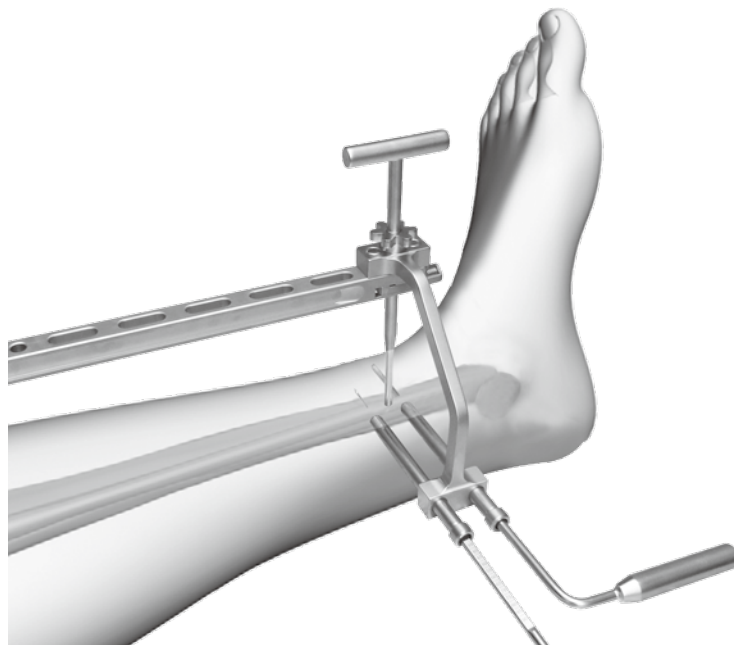


锁钉更换

LOCKING SCREW REPLACEMENT

如果在手术过程中，无论何种原因须更换锁钉，需要用骨螺钉螺纹扳手，根据手册最后章节“髓内钉取出”部分操作。

If a locking screw should need replacing for any reason during the course of the operation, the Locking Screw Extractor should be used, as described in the section on Nail Removal at the end of this manual.



检查骨折是否分离

CHECK FOR FRACTURE DISTRACTION

在近端锁紧前，必须仔细检查骨折断端的是否存在任何分离移位。如果存在，可以按照前述方法将打入拔出器和吊紧螺栓连接。通过往回轻敲而消除骨折间隙。避免出现锁定全部完成而骨折断端存在分离移位，这一点非常重要。否则可能导致筋膜间室综合症或骨折延迟愈合。

Before proximal locking is carried out, the fracture should be screened to check for any distraction. If this is present, the Sliding Hammer can be reattached to the Locking Rod as described previously. The fracture gap can then be closed by gentle reverse hammering, after which the hammer is removed. It is very important to avoid completing the locking of the nail with the fracture distracted. There is an association between fracture distraction, and delayed union or compartment syndrome.



近端锁紧

PROXIMAL LOCKING

拿掉导杆锁轮和导杆，将近端支架安装在手柄上，插入两个螺钉套并定位皮肤切口。在作切口前，医生必须切记骨折有移位可能，所以需最后一次检查骨折的复位情况。在螺钉套对准的皮肤上作切口，钝性分离软组织暴露胫骨皮质。将螺钉套前推抵住骨皮质并把手轮锁紧固定。先钻内侧的锁钉孔。

Remove the Guide Bar locking screw and the bar. The Proximal Outrigger is mounted on the handle, and two Screw Guides inserted into the guide seats to locate the sites for the incisions. Before making the incisions, the surgeon should carry out a final check for reduction of the fracture, remembering the possibility of distraction. An incision is made beneath each Screw Guide, and the tibial cortex exposed in each case by blunt dissection. The Screw Guides are advanced down to the cortex and locked in position with the Clamp Locking Nuts. The medial hole is drilled first.



近端锁紧 (续)

PROXIMAL LOCKING (CONTINUED)

把钻套 ($\phi 10/\phi 8$) 插入内侧的螺钉套, 轻敲以使钻套前端紧压骨皮质。再放入 $\phi 4.2$ 内钻套, 将骨钻插入钻套至骨, 开始钻孔前轻压使钻头尖端紧压骨皮质固定。钻孔后插入螺钉代替杆, 最终瞄准确定。再钻外侧的锁钉孔, 选取合适长度的螺钉, 近侧骨皮质攻丝, 植入锁钉。取出螺钉代替杆, 用同样的技术植入内侧的锁钉。

A Drill Guide ($\phi 8/\phi 4$) is inserted into the medial Screw Guide, and tapped gently to engage its tip in the cortex. Then, insert the $\phi 4.2$ Drill Guide. The Drill Bit is introduced down to the bone, and pressed against the cortex to fix the tip before drilling begins. The Graduated Angled Trocar is inserted after this hole is drilled, and final alignment confirmed. The lateral hole is now drilled, the screw length determined, the proximal cortex tapped and the screw inserted. The Graduated Angled Trocar is then removed, and the medial screw inserted using the same technique.



最终检查

Final Check

最后检查确认骨折复位满意, 四个锁钉正确地通过交锁孔锁紧, 螺钉头和骨皮质表面齐平, 锁钉末端刚刚穿出对侧骨皮质。

A final check is now made to confirm that fracture reduction is satisfactory, and that all four locking screws are correctly inserted through the nail, the screw heads flush with the bone, and the distal ends just protruding beyond the second cortex.

拆除装置和关闭切口

REMOVAL OF THE JIG ASSEMBLY AND CLOSURE

拆除近端支架，松开导杆锁轮，取下导杆。用 SW5 的吊紧扳手旋转几圈松开吊紧螺栓，并拆除手柄。吊紧螺栓和手柄拆除后，用骨螺钉六角扳手将封帽拧入髓内钉尾部。建议髓内钉入口处的伤口留置闭合引流装置。所有切口按常规逐层缝合。加压包扎伤口以防止血肿形成。引流装置 24-48 小时后拔除。

The Proximal Outrigger is removed, the Guide Bar Locking Screw loosened, and the Guide Bar removed. At this stage, the Handle is removed after loosening the Locking Rod a few turns with the SW 5 Wrench. Once the Locking Rod and the Handle have been removed, a Nail End Cap is placed over the end of the nail. The nail end cap is screwed tight with the Hex Screwdriver. Closed suction drainage is advised for the insertion wound. All incisions should be sutured in layers in the usual way. Firm dressings should be applied to prevent hematoma formation. The drainage is removed after 24-48 hours.



术后处理 POST-OPERATIVE MANAGEMENT

负重 WEIGHTBEARING

鼓励病人用拐杖尽早下床活动，但患肢膝关节须制动休息 1-2 天。每天更换敷料，引流装置拔除后，患肢膝关节可以自由活动。对于稳定性骨折，病人可以早期负重，逐渐增加并在第 4 周完全负重。对于不稳定性骨折，允许尽早脚趾着地，在随后 6 周部分负重，并逐渐增加负重量。完全负重要等到有连续性骨痂通过骨折线。对于严重粉碎性骨折病人，Winqvist-Hansen IV 和 V 型，必须有外固定支架保护才能开始负重，如果植入的髓内钉直径是 8mm 或者 9mm，必须要等骨折愈合后才能负重。

The patient is mobilized on crutches immediately, but the knee is rested in an immobilizer for 1-2 days. Dressings are changed daily, and, after the drain has been removed, the knee may be mobilized freely. With a stable fracture, a patient may weightbear as able, increasing to full weightbearing by 4 weeks. If the fracture is unstable, toe touch weightbearing is permitted immediately, with gradually increasing partial weightbearing over the next 6 weeks. Full weightbearing is only advised once there is some continuity of callus across the fracture site. Fractures with severe comminution, of Winqvist-Hansen types IV and V, should be supported before weightbearing with an external brace, if an 8 mm or 9 mm nail has been used, until the fracture is healed.

动力交锁

DYNAMIZATION

动力交锁，即拔除一对锁钉，不被推荐为标准操作技术的一部分。然而，如果骨折稳定而 12 周尚无骨痂形成，可以建议取出远侧的两枚锁钉。如果骨折不稳定，需要考虑更换大号的扩髓髓内钉。如果骨折延迟愈合，医生应避免继续使用 8mm 或 9mm 直径的髓内钉来固定。此时以更换大号直径的空心髓内钉为宜。如果骨折断端存在骨萎缩，可能需要进一步的促进骨折愈合的局部治疗。

Dynamization, by removal of one pair of locking screws, is not recommended as part of the standard technique. However, should there be no callus formation at 12 weeks, removal of the pair of screws furthest from the fracture site is advised, provided that the fracture is stable. If the fracture is unstable, exchange nailing with a larger reamed nail should be considered. The surgeon should try to avoid continued fixation with an 8 or 9 mm nail if delayed union is present. In this situation, exchange nailing with a larger diameter cannulated nail is preferable. If the fracture site looks atrophic, further local measures to encourage union may be needed.

恢复正常的活动

RESUMPTION OF NORMAL ACTIVITY

如果患者是轻体力劳动或者从事办公室工作，在感觉舒适、软组织愈合满意后可以尽早恢复工作；如果患者从事重体力劳动，或者涉及潜在风险的情形，在放射学检查骨折愈合前不允许恢复工作，通常这很少少于受伤后 6 个月。

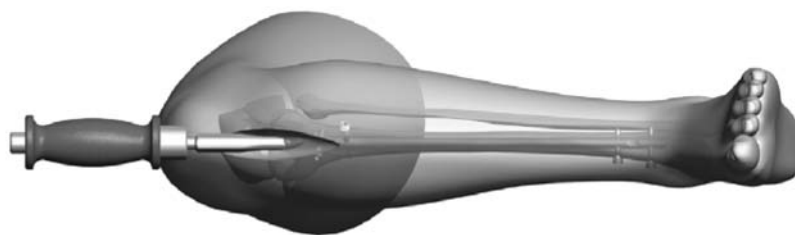
Patients employed in light work or in an office may resume their job as soon as they are fully comfortable, assuming that the state of the soft tissues is satisfactory. Patients in work that is heavy or involves potentially dangerous situations should not be allowed back before the bone is radiologically united, and this is rarely less than six months after the injury.

髓内钉的取出

NAIL REMOVAL

髓内钉的取出通常要到 18–24 个月后，有放射学证据骨折已经愈合。一般地来说，髓内钉植入胫骨后 6 个月骨折可能会愈合。而开放性骨折、骨不连、截骨矫形术的情形会有所不同。这些病例髓内钉至少要等到 24 个月后才能取出。作一个小切口，显露髓内钉尾部。钉尾部清除一些新生骨可能是必要的。用骨螺钉六角扳手取出封帽，将拔出器手柄拧入髓内钉尾部并拧紧。这个步骤应该在近端锁钉取出前完成以防止髓内钉向后扭转。

Nail removal may normally be carried out after 18-24 months provided that there is radiological evidence of union. Union may be expected to occur after 6 months with nailing procedures in the tibia. The situation may be different in open fractures, nonunions or corrective osteotomies. In such cases the nail should be left in situ for a minimum of 24 months. The proximal end of the nail is exposed through a small incision. It may be necessary to clear some new bone from the end of the nail. The nail end cap is removed with the Hex Screwdriver, and the Screw Adapter is screwed on to the nail, and tightened firmly. This should be accomplished prior to the removal of the proximal locking screws to prevent the nail from deflecting posteriorly.



髓内钉的取出（续）

NAIL REMOVAL (CONTINUED)

现在可以取出所有锁钉。当锁钉因为各种原因需要取出时（包括动态交锁，髓内钉取出，以及少数情况下锁钉长度不正确），可以按照下述方法使用骨螺钉螺纹扳手来完成：将骨螺钉螺纹扳手顶住锁钉头部，并且逆时针拧动。锁钉头部外沿上的螺纹是反向螺纹，所以在整个过程中必须逆时针拧动骨螺钉螺纹扳手。第一圈把扳手和锁钉头部锁扣住，继续拧动扳手可以使锁钉的螺纹从骨中旋出。当螺纹部分全部脱出骨皮质，应该直接往后拔出锁钉。由于没有螺纹嵌在骨内，继续拧动毫无意义。应该顺时针方向旋转扳手把锁钉从扳手上旋下，这和通常的方向相反。这时用钳子抓住锁钉杆部可能是必要的。

The locking screws are now all removed. When locking screws require to be removed for any reason, (e.g. nail dynamization or extraction, or in the occasional case where the length of the chosen locking screw is incorrect), this may be accomplished using the Locking Screw Extractor as follows: the Extractor is inserted down to the head of the screw, and is turned counterclockwise. The thread on the outside of the locking screw head is a verse thread, so it is necessary to turn the Extractor counterclockwise throughout this procedure. The first turns lock the extractor to the screw head, and further turns will release the screw thread from the bone. Once the thread has been disengaged from the cortex, the screw should be pulled out directly. Further turns at this point will achieve nothing, as no thread remains in the bone. Note that the locking screw is then disengaged from the extractor by turning the latter clockwise, which is the opposite direction to normal. It may be necessary to grip the smooth shaft of the screw with forceps during this procedure.

髓内钉可以通过抓住拔出器手柄向后拔出，或者连接打入拔出器至拔出器手柄尾端回敲拔出。

The nail is then removed, either by manual traction on the Screw Adapter, or by reverse hammering, after screwing the Sliding Hammer on to the proximal end of the adapter.



产品信息 PRODUCT ORDERING INFORMATION

工具 INSTRUMENTS

器械编号 Product No.	器械名称	Product Name	数量 Qty
15043-001	瞄准器手柄 (胫骨)	Nail Support Handle (Tibial)	1
15043-002	近端瞄准支架 (胫骨)	Proximal Outrigger (Tibial)	1
15043-003	锁轮 (M12)	Outrigger Locking Screw (M12)	1
15043-004	导杆 (胫骨)	Guide Bar (Tibial)	1
15043-005	远端瞄准支架 (胫骨)	Distal Outrigger (Tibial)	1
15041-004	吊紧螺栓 (M6)	Locking Rod (M6)	1
15041-006	支架锁轮 (M8)	Outrigger Locking Screw (M8)	1
15041-008	T 型定位杆 (Ø5.0)	T-Handled Stabilizing Rod (Ø5.0)	1
15041-110	软组织分离器 (Ø8)	Soft Tissue Protector (Ø8)	1
15041-311/411	钻套 (Ø4.2/Ø5.2)	Drill Guide (Ø4.2 / Ø5.2)	各 1
15041-117	开孔器 (大)	Pointed Awl (Large)	1
15041-118/218/318/418/518	髓腔绞刀 (Ø7/Ø8/Ø9/Ø10/Ø11)	T-Rigid Reamer (Ø7 / Ø8 / Ø9 / Ø10 / Ø11)	各 1
15041-420/520	骨钻 (Ø4.0/Ø5.0)	Drill Bit (Ø4.0 /Ø5.0)	各 1
15041-421	骨钻 & 限位器 (Ø4.0)	Drill Bit and Slide Limited Device (Ø4.0)	1
15041-022	T 型平底钻 (Ø5.0)	T-Drill Bit (Ø5.0)	1
15041-123	套管 (Ø10/Ø8.2)	Screw Guide (Ø10 / Ø8.2)	2
15041-025	直角定位杆	Stabilizing Rod	1
15041-026	测深器 (20 ~ 90mm)	Locking Screw Depth Gauge (20~90mm)	1
15041-127	丝锥 (HA6.0)	Tap (HA6.0)	1
15041-028	T 型六角扳手 (SW3.5)	Screw T-Wrench (Hex,SW3.5)	1
15041-029/129	L 型六角扳手 (SW2.5/SW5.0)	Screw L-Wrench (Hex, SW2.5 / SW5.0)	各 1
15041-130	打拔器手柄 (M6)	Sliding Hammer with Detachable Swing Arm (M6)	1
15041-131	打拔器 (大)	Adapter for Extractor (Large)	1
15041-032	锁钉取出器 (M8 左旋)	Locking Screw Extractor (M8×1, Left)	1
15043-000	器械盒	Instrument Case	1 套

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