Vi Veterinary Instrumentation

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Surgery Guide

Linear External Skeletal Fixation

Surgery Guide:
Linear External Skeletal Fixation

External Skeletal Fixation (ESF) is a very good technique for fracture repair and osteotomy stabilisation. It can be used for long bone fractures, spinal fractures and luxations, trans-articular immobilisation for joint instability, arthrodesis, angular limb deformity correction, and limb lengthening (distraction osteogenesis).

There are four main types of ESF:

- **Linear**
- **Free-form**
- **Circular**
- **Hybrid**

Vi supply equipment for both linear and freeform ESF. The FESSA system is also available, which is ideal for very small patients and exotics.

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- Advantages and Disadvantages of ESF
- ESF Terminology
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- Featured Products

Standard Fixator Construct

KE Plus Construct

FESSA Construct

Types of External Skeletal Fixator

Linear ESF

Linear ESFs have three components; pins, clamps and connecting bars. Pins penetrate the bone and are secured externally by clamps onto the connecting bar. The connecting bars give the ESF frame its length and structural rigidity. Linear ESF components are readily available and linear ESF is the most widely used, the simplest and easiest type of ESF to learn and apply (Fig. 1).

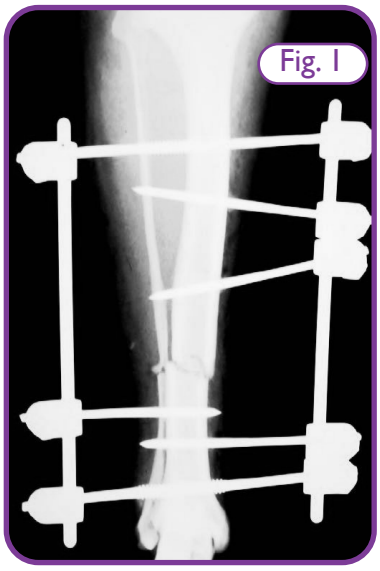
Fig. 1

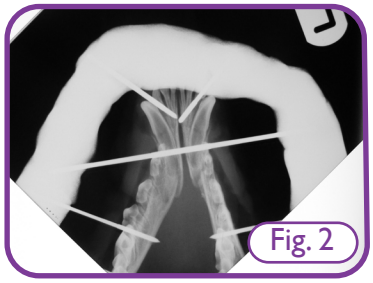
Fig. 2

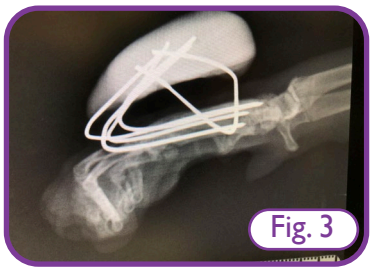
Fig. 3

Free-form ESF

Free-form ESFs are a subtype of linear ESFs; the clamps and connecting bar are replaced by epoxy putty. This gives the freedom to design the 3 dimensional shape of the ESF with more options than are accommodated by a single straight connecting bar. For most long bone fractures, free-form ESFs are not used, but the flexibility of pin placement is very useful in mandibular (Fig. 2) and maxillary fracture, digit fractures or luxations (Fig. 3), and specific examples such as radial fractures in cats. Although highly adaptable, these frames have the disadvantage that they cannot be adjusted once the putty has set.

Circular ESF (cESF) and Hybrid ESF

Circular ESFs (cESF) also called ring fixators, are constructed using thin wires 1.0-1.6mm in diameter that are driven across the bone; the wires are held in position by a ring (or circle) that encircles the bone and limb. Connecting bars are placed that connect the rings; this gives the frame its length and structural rigidity. cESFs are more adaptable and versatile than linear ESFs but cESFs are more complex to construct, and more demanding to manage. Because cESFs are more complex, they are usually reserved for more demanding applications e.g. complex juxta-articular fractures, angular limb deformity corrections and distraction osteogenesis (Fig. 4).

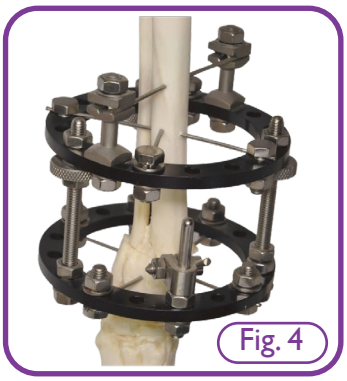
Fig. 4

Hybrid ESF is an ESF construct that is a hybrid usually of a linear frame proximally, and a circle frame distally. This is particularly useful for juxta-articular fractures where there is a very short bone segment and little bone stock for implant purchase. The single distal circle is attached to one or more linear connecting bars. Proximally, the connecting bars connect to the bone using clamps and linear ESF pins. These frames take advantage of the benefits of both linear and circular frame types in a single frame construct (Fig. 5).

Fig. 5

Advanatages and Disadvantages of ESF

Advantages

- ESFs can be applied using 'closed' or 'open' approaches i.e. zero to no surgical approach, or a standard open surgical approach. A limited approach minimises surgical dissection and trauma and can reduce surgical time, although working "blind" can be more challenging.
- ESFs are very adaptable; an infinite combination of frame and pin types can be constructed therefore the ESF can be adapted to many different types of fractures. Frame and construct stiffness can also be varied.
- Using epoxy putty extends the range of adaptability of ESF frames even further.
- ESFs are well suited for fracture repair configurations where reconstruction is not intended and construct stiffness and rigidity is low i.e. the bone is intended to heal by secondary (indirect) bone healing i.e. callus formation.
- ESFs are ideal for open fractures and shear injuries because metalwork can be placed away from the injury site thus providing stability to the bone or joint, whilst simultaneously allowing access for wound management including wound flushing, debridement and dressing application.
- ESFs do not involve permanent implants; the metalwork is eventually removed. This makes them particularly suitable for contaminated surgical sites such as open fractures or shear injuries.
- ESFs can be used for other applications other than fracture repairs e.g. joint stabilisation, angular limb deformity correction, or distraction osteogenesis/limb lengthening.
- ESFs can be combined with other implants such as an intra-medullary pin, orthopaedic wire, lag screws, positional screws and K-wires.
- ESF systems are relatively inexpensive.
- Most systems are modular therefore kits can be easily modified and augmented as required.
- Applying an ESF is relatively straightforward therefore the beginner surgeon can reasonably apply an ESF to a simple fracture,so long as the rules and principles are understood and followed.
- ESFs can be adjusted post-operatively to improve the alignment of the fractured bone and if necessary, to modify load sharing with bone.
- ESFs are adaptable and can be good for tricky fractures with very small pieces of bone e.g. fractures close to joints. This is because the frame can be built to maximise the number of pins that can be placed in a very small piece of bone, which might otherwise be very difficult to impossible to achieve with plates and screws.
- ESF can be used to place a number of pins in a very small area of bone, maximising the number of contact points with a bone fragment, but care must be taken not to weaken the bone with multiple pin tracts.

When an Ex Fix is applied, the bone fracture is not usually fully reduced (for example a comminuted fracture), or when the fixation is relatively flexible, small amounts of movement may occur at the fracture site. Under this circumstance, bone heals by secondary bone healing or callus formation i.e. there is a gradual transformation at the fracture site from fracture haematoma to granulation to fibrous to cartilaginous tissue, and finally to bone which then remodels over time. Callus healing is much quicker than primary bone healing (which is achieved with rigid internal fixation such as lag screws or axial (dynamic) compression), but callus healing is disadvantageous in particular fracture scenarios such as articular fractures and spinal fractures.

Disadvantages

- Like all techniques, successful application with minimal subsequent complications requires experience and "mastering the art".
- ESFs have their own unique set of associated complications.
- The most common complications are pin tract discharge, infection and pin loosening. These can be difficult for owners to manage,and when these occur, pin management is necessary and pin revision may be required.
- ESFs may not be the best choice for a fracture that is likely to take a long time to heal. This is because the chance of complications such as pin discharge or loosening is likely to occur before bone healing is complete.
- An uncommon complication of ESFs is fracture of the bone through the pin tract, before or after frame removal.
- ESFs are not applicable to all fractures. In particular, applications to the femur, humerus and radius are constrained by limitations of safe corridors, or the shape of the bone.
- ESFs are not appropriate for fractures where construct stiffness and fracture rigidity needs to be high so as to achieve primary bone union and avoid callus formation. For example ESFs would generally not be suitable for articular or spinal fractures.
- It is not possible to apply axial (dynamic) compression to a fracture using a linear ESF.
- ESFs can get caught on external objects such as cage bars, furniture, other animals or the owner. This can lead to further complications such as ESF dislodgment from the bone and/or damage to property.
- Rarely, animals have been known to self-remove their ESF frame.

ESF Terminology

Half Pins and Full Pins

- **Half pins** enter the skin and are connected to the connecting bar on one side of the limb only (Fig. 6). The pin is driven through the bone and stops so that the pointed tip of the pin is just exiting the trans (far) cortex. A threaded half pin has a thread on the end and is also called an end-threaded pin.
- **Full pins** enter through the skin on one side of the limb, go all the way through the bone, exit the skin on the other side, and are attached to a connecting bar on both sides (Fig. 6). A threaded full pin has the thread in the centre, also called centrally threaded or mid-threaded.

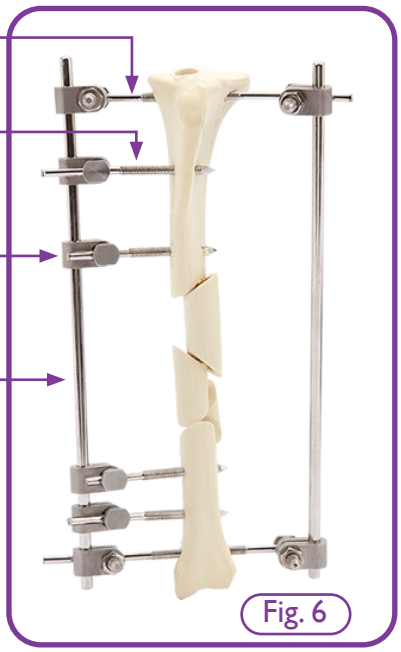

Fig. 6

Pin Thread

There are various types of pin thread configuration:

Fig. 7

Positive Thread

- The thread on the pin is a slightly wider diameter than that of the pin shaft. These pins have excellent holding power in bone (Fig. 7).

Fig. 8

Negative Thread

- The thread is cut into the shaft i.e. the shaft is narrower over the threaded portion. The shaft is relatively stiff compared with the threaded section. This creates stress concentration at the shaft-thread interface that may result in premature pin failure. Unicortical pins, also called Ellis pins (Fig. 8) pins only have a short threaded section. The thread engages only with the trans (far) cortex and the smooth part of the pin engages with the cis (near) cortex leaving the thread-shaft intersection positioned within the medullary canal where the point of weakness is better protected from premature failure.

Fig. 9

No Thread

- Most frequently with a trochar point (Fig. 9). The pin has a sharp tip on the end but no thread. This gives the weakest and least reliable purchase at the pin/bone interface, and has very low resistance to pin pull-out.

End Threaded

- The thread is at the end of the pin (also known as a half pin) (Fig. 10).

Fig. 10

Centrally/Mid Threaded

- The thread is at the centre of the pin (also known as a full pin) (Fig. 11).

Fig. 11

Pin Diameter

- Pins are labelled according to either the diameter of the shaft for non-threaded or negative threaded pins, or the diameter of both the shaft and the thread for positive threaded pins. For any given pin size, the thread diameter of a positive threaded pin is slightly greater than the shaft diameter. For a negative threaded pin, the thread diameter is the same as the shaft diameter and the core diameter is slightly narrower over the threaded portion.

Pre-Operative Guidance

- Make sure you complete a full clinical and orthopaedic examination of the patient.
- Only attempt fracture repair when the patient is stable and ready for an anaesthetic.
- Take orthogonal radiographs of the fractured bone i.e. craniocaudal and mediolateral views (Fig. 12). Inspect the radiographs very carefully; make sure you understand the fracture configuration fully. For example: Is the fracture simple or comminuted? Are there fissures?

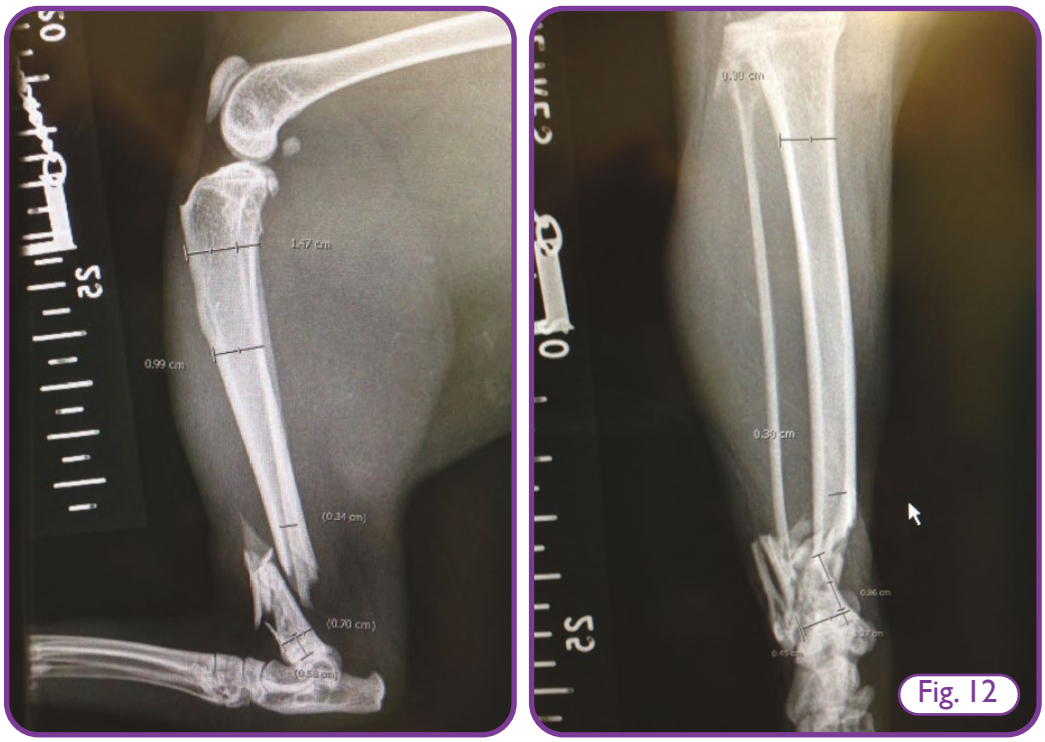

Fig. 12

- Plan the surgery carefully. Specifically for ESF application:
  - In each fragment of bone, is there enough space for at least 2, and ideally 4 pins?
  - There should be no fissures in the bone where ESF pins are to be placed.
  - The minimum distance between ESF pins and the end of bone should be half the bone diameter.
  - What is the external diameter of the bone at each intended site of ESF pin placement? Pin diameter should be 20-25% bone diameter and no more than 30% bone.
  - Which ESF clamps take this size of pin? This helps to indicate the size of ESF system to be used. Refer to Appendix 1 for pin and clamp sizing.
  - Are you intending to place an intramedullary pin in addition to the ESF? If so, measure the internal diameter of the bone; the size of intramedullary pin should be 30-50% the size of the medullary canal at the narrowest point to allow ESF pins to pass alongside.

Fig. 13

- Patient positioning: using a hanging limb preparation before fracture surgery helps to overcome fracture over-riding caused by muscle contraction (Fig. 13). During surgery, the hanging limb preparation helps to maintain correct length and alignment of the fracture fragments. This is particularly useful for minimally invasive surgery.

Surgical Technique - ESF Rules

1. Use Aseptic Technique

Although the ESF connecting bars, clamps and most of the pins are external, placement of an ESF is no different to any other surgery in that strict aseptic technique must be used when preparing the patient, operating room, surgical equipment, surgeon and post-operative care.

2. Use Safe Corridors for Pin Placement

Safe corridors are bone locations where pins can be placed that minimise risk of damage to soft tissue structures such as vessels, nerves and muscles. Safe pin corridors are the only locations that ESF pins should be placed.

Radius:	Distal = craniomedial and medial
	Proximal = craniolateral and lateral
Humerus:	Distal = medial and lateral
	Proximal = craniolateral
	Avoid the mid diaphysis
Femur:	Distal = medial and lateral
	Proximal = lateral
	Avoid the mid diaphysis
Tibia:	Entire length = medial or cranial

3. Frame Type

Select and use the ESF frame type that is most appropriate to the fracture type. In most cases, this is a type IA or type IB frame. Rarely is it necessary to place a type II ESF, and almost never is a type III frame necessary.

In increasing order of stiffness they are:

Type IA = Unilateral, Uniplanar (Fig 14). A single connecting bar is used; all the pins are half pins. The connecting bar is usually placed medially on the tibia, or laterally on the femur and humerus.

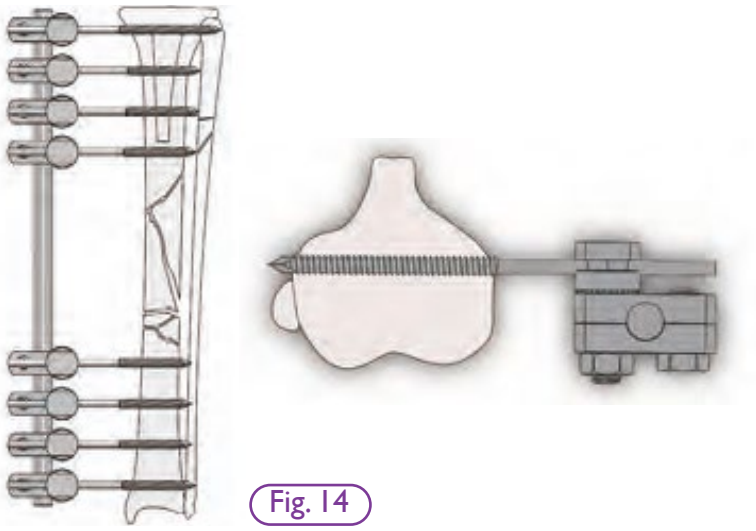

Fig. 14

Type IB = Unilateral, Biplanar. (Fig. 15). This is two Type IA frames adjacent to each other but in different planes. Two connecting bars are used. The connecting bars may be linked together which makes the construct stiffer. It is near impossible to apply type 1B fixators to the humerus and femur whilst still achieving safe corridors, because of the cranial and caudal muscle bellies.

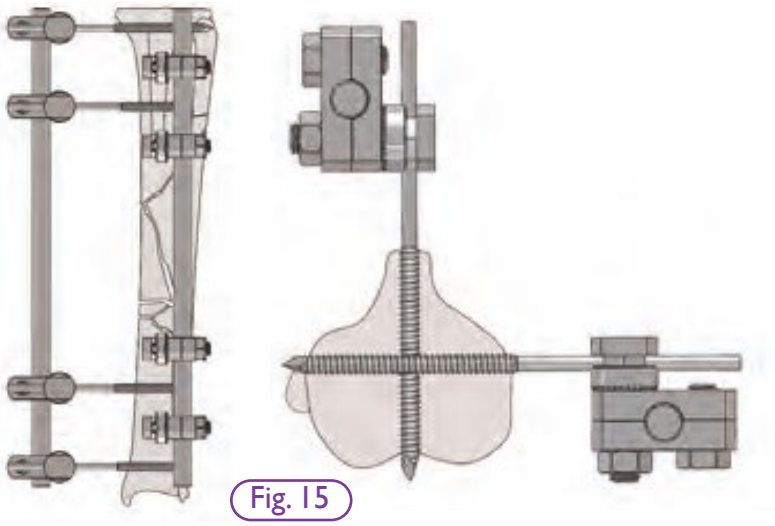

Fig. 15

Type II modified (type IIB): Bilateral, Uniplanar with full and half pins. (Fig. 16).

Two connecting bars are used; usually one lateral and one medial to the bone, hence bilateral. This ESF construct is in a single mediolateral plane; hence uniplanar. The most proximal and distal pins are full pins and the pins in-between are half pins.

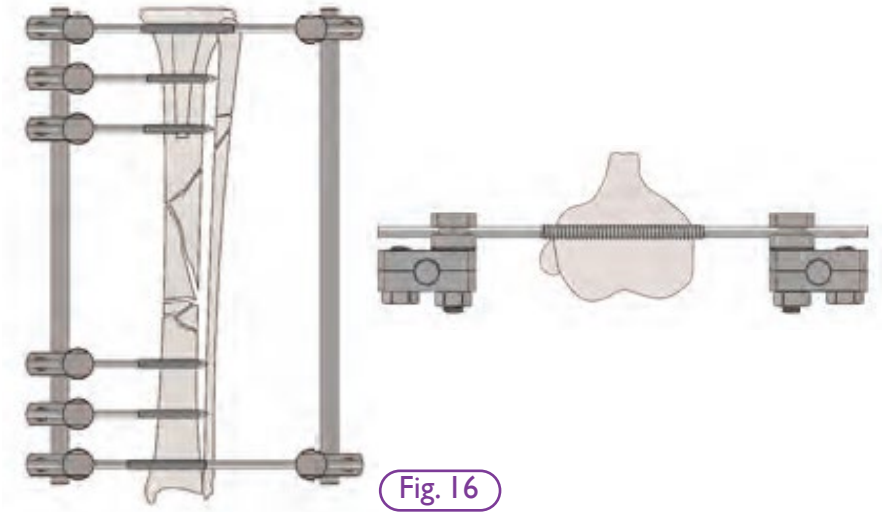

Fig. 16

Type II (type IIA): Bilateral, Uniplanar with only full pins. (Fig. 17).

This is the same as the type II modified/ type B frame except that there are no half pins; all the pins are full pins. This makes the type II frame more rigid than the type IIB frame, but it is more difficult to achieve because aiming the pins from one connecting bar to line up with the connecting bar on the other side is very challenging.

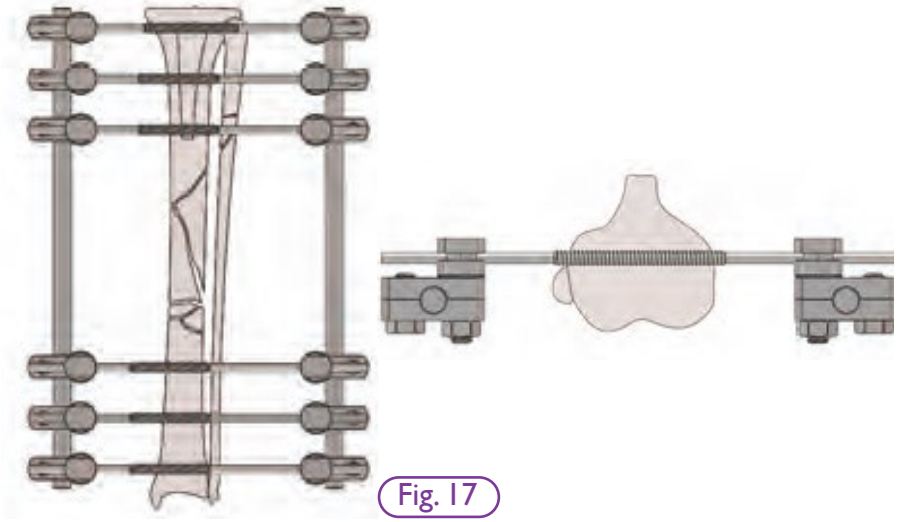

Fig. 17

Type III: Bilateral, Biplanar. (Fig. 18).

This is the application of a Type IA and a Type II frame together plus extra connecting bars to attach the two frames together. This is a big and heavy frame type; it is rarely necessary to apply such a rigid frame.

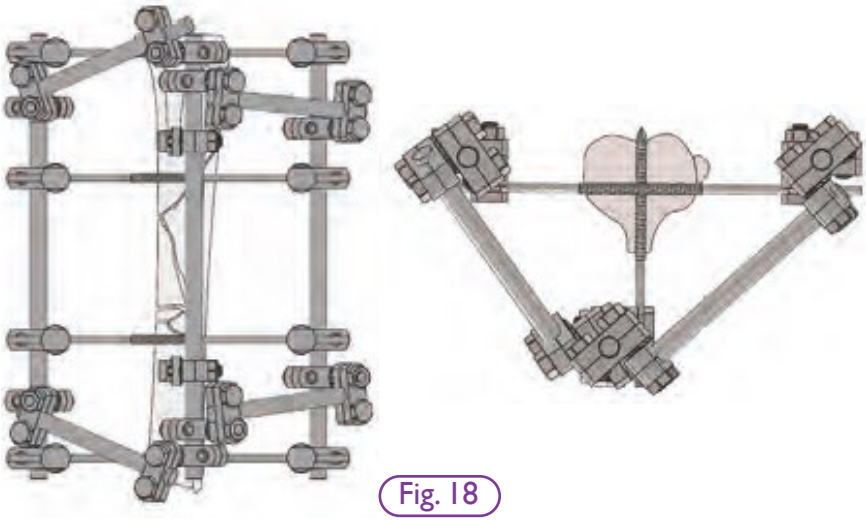

Fig. 18

4. Fixator Pins

Aim for 4 pins per bone segment.

The absolute minimum is 2 pins per bone segment (Fig 19a). Increasing pin numbers increases construct stability and decreases stress at the pin-bone interface. High stress at the pin-bone interface leads to bone resorption and pin loosening. Increasing the number of pins reduces the pin-bone interface stress of each pin but there is little beneficial effect beyond 4 pins; the ideal number is 4 pins (Fig. 19b).

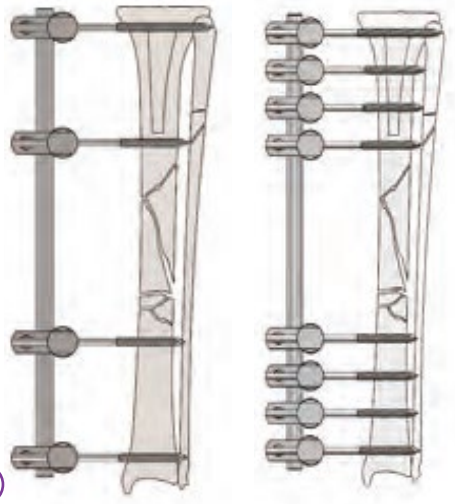

Fig. 19a

Fig. 19b

Use the Far-Near-Near-Far Principle.

In each bone segment, place pins as far away from the fracture and as near to the fracture as possible (Fig.20). This maximises bone (fragment) stability by reducing the lever arm on the fixator, and by shortening the working length of the connecting bar i.e. the distance between the central 2 clamps. The minimum distance between ESF pin and end of the bone or fracture is half the bone diameter.

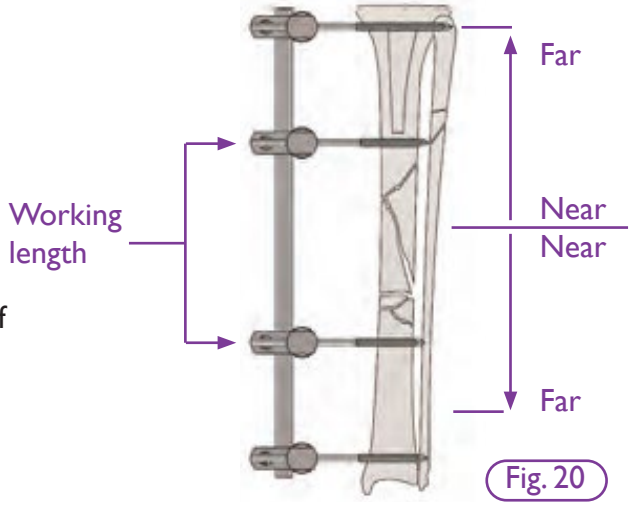

Fig. 20

Space pins as widely as possible.

Increasing pin spacing increases the bending stiffness of the frame; space the pins out as much as possible (Fig. 21a). Uneven pin spacing reduces the bending stiffness of the construct (Fig 21b).

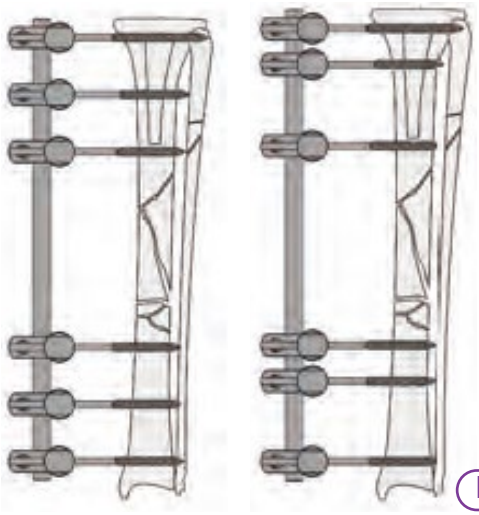

Fig. 21a

Fig. 21b

Use threaded pins.

Threaded pins are the most reliable (Fig. 22a) as they have much better holding power and pull-out resistance than smooth pins by a factor of at least x10. Because of this, pin angulation is not important. Smooth non-threaded trochar pins have little inherent resistance to pull-out. If smooth pins must be used, they should be inserted at different angles to each other, ideally placing them at 70 degrees to the long axis of the bone because this increases the pull-out resistance of the pins (Fig.22b). However, the use of smooth pins should be avoided where possible.

Fig. 22a

Fig. 22b

It is advisable that at least one, and preferably all, threaded pins are used per fragment. Mounting smooth pins on alternate sides of the connecting bar may also help to resist pull-out. Negative threaded pins (Ellis pins) are weakest at the junction of the pin shank and thread because this zone acts as a stress concentrator i.e. where the shank diameter gets narrower. Therefore the shank/thread junction should ideally be buried within the bone beyond the cis cortex to protect it from failure (Fig. 22c). This does not apply to positive threaded pins as the shank diameter is continuous therefore there is no stress concentration.

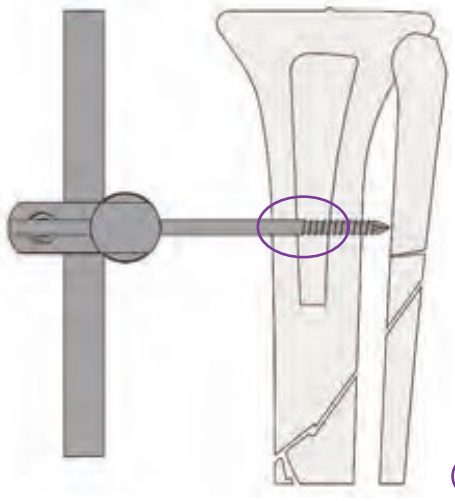

Fig. 22c

Pin size should be 20-25% bone diameter.

Thicker pins are stiffer than small pins, and small increases in pin diameter result in a disproportionate increase in pin stiffness. However, larger pins require larger holes in the bone, and larger holes in the bone weaken the bone which could then fracture. Pin thread diameter should not exceed 30% bone diameter (Fig. 23).

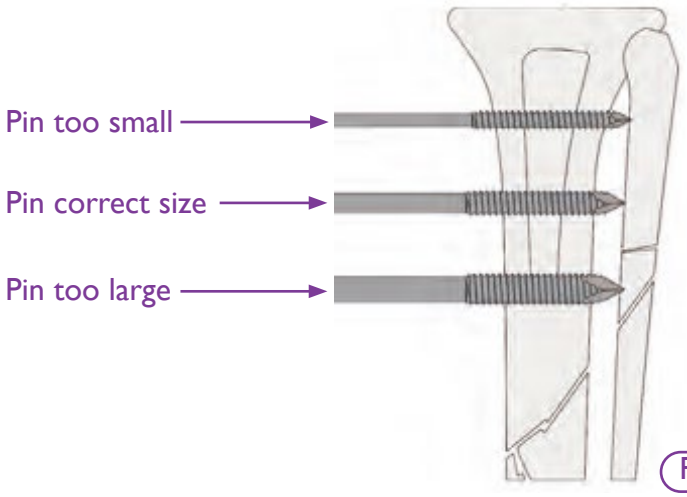

Fig. 23

Pin length.

Pin stiffness is inversely proportional to pin length i.e. a shorter pin is stiffer than a longer pin. The working length is the length of pin between the bone and the ESF clamp. The clamps and connecting bar should be about 1cm or a finger's width from the skin (Fig. 24); this is optimal clearance allowing for wound maintenance and postoperative swelling, whilst keeping the ESF construct as stiff as possible. In cases of severe soft tissue trauma and swelling, it may be better to place the connecting bar and clamps further away whilst the initial swelling subsides, and to then adjust and place closer at a later date.

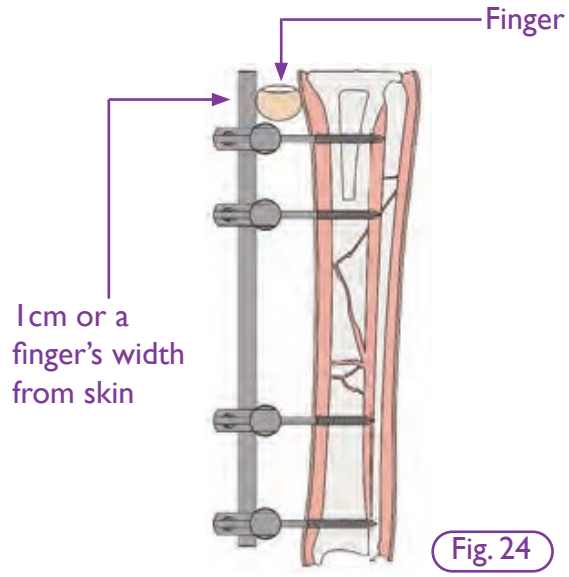

Fig. 24

Clamp orientation.

Orienting the ESF clamps so that the clamp mechanism is on the inside (Fig. 25a) rather than the outside (Fig. 25b) of the connecting bar also reduces the working length of the pin: this makes the construct stiffer.

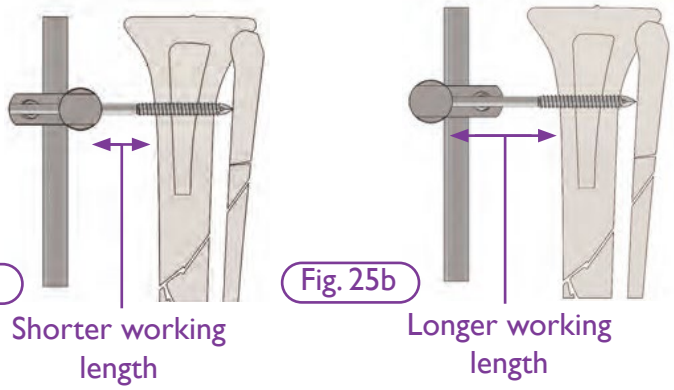

Fig. 25a

Fig. 25b

Pin placement.

- Use safe corridors to minimise risk of neurovascular damage, and to minimise the depth of soft tissue structures that are penetrated. If penetration of a muscle belly cannot be avoided, use haemostats to bluntly tunnel through the muscle belly.
- Place pins through fresh stab incisions using a #11 blade through fresh healthy skin. Do not place pins through the surgical incision or traumatic wound.
- Pre-drill the pin hole to minimise heat production and potential thermal bone necrosis during pin insertion. Pre-drill using a drill bit about 10% smaller than the pin shank diameter. For ease of application, use a drill guide and K-wire to maintain the position of the pin hole after withdrawal of the drill and before introduction of the ESF pin.
- To drive each pin, use a power drill at <150rpm to minimise heat production and bone necrosis; an electric drill driven slowly is ideal. Do not use a hand chuck as this creates wobble during pin insertion, which reduces the quality of the pin-bone interface and may predispose to premature pin loosening.
- Place the most proximal and distal pins first, and then apply the connecting bar and clamps.
- Pre-drill the pin holes into the bone through clamps placed on the connecting bar. This ensures that the pre-drilled holes (and therefore the ESF pins that are subsequently placed) line up with the clamps. This is not necessary for the most proximal and distal ESF pins that are placed first, as these dictate the position of the ESF.
- Ensure that pins are placed through both cortices of the bone (cis cortex and trans cortex). Correct pin placement (depth) can be gauged by:
    - The change in drill pitch noise as the pin enters and then exits the cis and then the trans cortex.
    - Placing another pin alongside the implanted pin and checking length and position.
    - Sometimes the pin tip exiting the bone can just be palpated if soft tissue cover is minimal.

5. Frame Stiffness

Increasing connecting bar stiffness decreases the load at the fracture site and the load on the pins. However, if the connecting bars or construct are too stiff, this may stress protect the fracture and delay fracture healing.

Frame stiffness can be increased by:

- Increasing the diameter of the connecting bar i.e. using a larger ESF system - but this may necessitate using larger pins,which may break the rule that pin size needs to be approximately 20-25% bone diameter. Larger connecting bars may also be excessively heavy or bulky for the patient.
- Adding a second connecting bar adjacent to the first (Fig. 26).
- For type IB or type III frames, link the connecting bars using double clamps.
- Use a different type of (stiffer) connecting bar. In order of decreasing strength/weight ratio: Carbon Fibre > Titanium Alloy > Aluminium Alloy > Stainless Steel

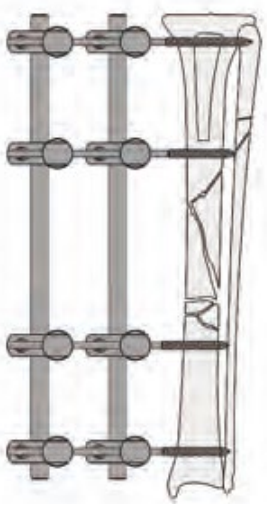

Fig. 26

6. Frame Size

The ESF frame size is dictated by the size of ESF pins that are placed. The size of ESF pins that are placed are dictated by the size of the bone. At each pin location, the diameter of the bone should be measured and pins that are 20-25% the diameter of the bone should be placed. The ESF frame size is then worked backwards from the pin diameter. Refer to Appendix 1 for pin and clamp sizing.

7. Use of an Intramedullary Pin

Using an intramedullary pin enables the fracture to be distracted and aligned, and the position of the proximal and distal bone fragments to be maintained whilst the ESF is applied. The intramedullary pin allows this to be accomplished relatively quickly and atraumatically, and minimises the amount of fracture manipulation that is necessary. When tied-in to the ESF construct, an intramedullary pin also increases the fixator construct strength and stiffness.

Choosing an intramedullary pin that is 30-50% of the diameter of the intramedullary canal increases frame stiffness and rigidity whilst still allowing ESF pins to be placed adjacent to the intramedullary pin.

Summary Step-By-Step ESF Frame Application

Ensure the fractured bone is correctly aligned and distracted to the right length; consider using an intramedullary pin and/or a hanging limb preparation to achieve this.

1. Place the most proximal and distal pins first. Remember to pre-drill the hole in the bone using a drill bit 10% smaller than the ESF pin diameter. Placing a small K-wire or A-wire into the hole will help maintain access and confirms hole alignment prior to pin placement.

2. Attach the connecting bar to the most proximal and distal pins using clamps. If using the KE Plus system, remember to pre-place all the clamps on the connecting bar(s) as it will not be possible to add extra clamps later without taking everything off and starting from the beginning. With the SF system, clamps can be easily added or removed at any stage.

3. Place all remaining pins in the proximal and distal segments. Pre-drill using a drill guide and through the pin hole of the clamp.

4. Ensure that bone alignment and length is correct, then tighten all clamps.

5. Take post-operative radiographs; adjust if necessary i.e. if pins need inserting further, then slacken the appropriate clamp, adjust the depth of the pin, and re-tighten the clamp. However, care should be taken when adjusting ESFs at post-op x-rays; much time can be spent adjusting ESF clamps and pins, but often to little improvement to fracture alignment.

6. Once satisfied, tighten all clamps.

7. Cut all ESF pins as close to the connecting bar as you can, using a suitable implant cutter. Take care to keep hold of the pin ends as they are cut to minimize the risk of the cut portion flying off.

8. If necessary, place a dressing to control soft tissue swelling and absorb discharge.

9. Dress the ESF apparatus using cohesive bandaging material or similar so that all sharp edges are covered and the patient cannot damage themselves, the owners, or their surroundings.

With thanks to Gareth Arthurs PGCertMedEd MA VetMB CertVR CertSAS DSAS(Orth) FHEA FRCVS RCVS Recognised Specialist in Small Animal Surgery (Orthopaedics)
for his invaluable assistance with the revised version (2023) of this Surgery Guide.

Appendix 1

Pin Reference Chart

	Bar Diameter	Small 3.2mm 1/8"	Medium 4.8mm 3/16"	Large 8mm 5/16mm	Mini 3.2mm 1/8"	Small 6.3mm 1/4"	Large 9.5mm 1/3"
	Clamp Style	KE Plus	KE Plus	KE Plus	Standard SF	Standard SF	Standard SF
Code	**Shaft Diameter**						
Positive Threaded Pins - End Thread							
CET0013	Positive End Thread Pin 1.0mm Shank 1.3mm Thread 65mm Long						
CET0014	Positive End Thread Pin 0.8mm Shank 1.1mm Thread 60mm Long						
CET0015	Positive End Thread Pin 1.2mm Shank 1.5mm Thread 65mm Long						
CET0016	Positive End Thread Pin 1.2mm Shank 1.6mm Thread 70mm Long						
CET0017	Positive End Thread Pin 1.4mm Shank 1.8mm Thread 70mm Long						
CET0018	Positive End Thread Pin 1.6mm Shank 2mm Thread 70mm Long	●	●		●		
CET0026	Positive End Thread Pin 1.8mm Shank 2.2mm Thread 80mm Long	●	●	●	●	●	
CET0019	Positive End Thread Pin 2mm Shank 2.4mm Thread 85mm Long	●	●		●	●	
CET0020	Positive End Thread Pin 2.4mm Shank 3.2mm Thread 100mm Long	●	●	●		●	
CET0020A	Positive End Thread Pin 2.7mm Shank 3.5mm Thread 110mm Long	●	●	●		●	
CET0020B	Positive End Thread Pin 3mm Shank 3.8mm Thread 120mm Long		●	●		●	●
CET0021	Positive End Thread Pin 3.2mm Shank 4mm Thread 130mm Long		●	●		●	●
CET0022	Positive End Thread Pin 4mm Shank 4.8mm Thread 150mm Long		●	●			●
CET0024A	Positive End Thread Pin 3.5mm Shank 4.3mm Thread 130mm Long		●	●			●
Positive Threaded Pins - Mid Thread							
CMT0013	Positive Mid Thread Pin 0.8mm Shank 1.1mm Thread 85mm Long						
CMT0014	Positive Mid Thread Pin 1.1mm Shank 1.4mm Thread 85mm Long						
CMT0015	Positive Mid Thread Pin 1.2mm Shank 1.5mm Thread 85mm Long						
CMT0016	Positive Mid Thread Pin 1.4mm Shank 1.8mm Thread 85mm Long						
CMT0017	Positive Mid Thread Pin 1.6mm Shank 2mm Thread 85mm Long	●	●		●		
CMT0018	Positive Mid Thread Pin 1.6mm Shank 2mm Thread 85mm Long	●	●		●		
CMT0018A	Positive Mid Thread Pin 1.8mm Shank 2.2mm Thread 90mm Long	●	●		●		
CMT0019	Positive Mid Thread Pin 2mm Shank 2.4mm Thread 105mm Long	●	●		●	●	
CMT0019A	Positive Mid Thread Pin 2.2mm Shank 2.6mm Thread 105mm Long	●	●			●	
CMT0023	Positive Mid Thread Pin 2.4mm Shank 3.2mm Thread 105mm Long	●	●	●		●	
CMT0023A	Positive Mid Thread Pin 2.7mm Shank 3.5mm Thread 115mm Long	●	●	●		●	
CMT0023B	Positive Mid Thread Pin 3mm Shank 3.8mm Thread 120mm Long		●	●		●	●
CMT0024	Positive Mid Thread Pin 3.2mm Shank 4mm Thread 130mm Long		●	●		●	●
CMT0024A	Positive Mid Thread Pin 3.5mm Shank 4.3mm Thread 140mm Long		●	●			●
CMT0025	Positive Mid Thread Pin 4mm Shank 4.8mm Thread 150mm Long		●	●			●
Trochar Pins							
001556	Trochar Pin 2.0mm	●	●		●	●	
001557	Trochar Pin 3.0mm	●	●	●		●	●
001558	Trochar Pin 4.0mm		●	●		●	●

Pin Reference Chart Continued

	Bar Diameter	Small 3.2mm 1/8"	Medium 4.8mm 3/16"	Large 8mm 5/16mm	Mini 3.2mm 1/8"	Small 6.3mm 1/4"	Large 9.5mm 1/3"
	Clamp Style	KE Plus	KE Plus	KE Plus	Standard SF	Standard SF	Standard SF
Code	Shaft Diameter						
Cortical Negative Threaded Pins - Ellis Type							
001528	Ellis Pin 1.1mm	●			●		
001529	Ellis Pin 1.6mm	●			●		
001533	Ellis Pin 1.8mm	●	●		●		
001550	Ellis Pin 2.0mm	●	●		●	●	
001530	Ellis Pin 2.4mm	●	●	●	●	●	
001550A	Ellis Pin 2.7mm	●	●	●		●	
001551	Ellis Pin 3.0mm	●	●	●		●	●
001531	Ellis Pin 3.2mm	●	●	●		●	●
001551A	Ellis Pin 3.5mm	●	●	●		●	●
001552	Ellis Pin 4.0mm	●	●	●		●	●
Bicortical Fine Negative Threaded Pins							
BCNET08	0.8mm Bicortical Pin Negative End Thread Pin 70mm						
BCNET10	1mm Bicortical Pin Negative End Thread Pin 70mm	●			●		
BCNET11	1.1mm Bicortical Pin Negative End Thread Pin 70mm	●			●		
BCNET13	1.4mm Bicortical Pin Negative End Thread Pin 70mm	●			●		
BCNET15	1.5mm Bicortical Pin Negative End Thread Pin 70mm	●			●		
BCNET16	1.6mm Bicortical Pin Negative End Thread Pin 70mm	●			●		
BCNET18	1.8mm Bicortical Pin Negative End Thread Pin 85mm	●	●		●		
BCNET20	2mm Bicortical Pin Negative End Thread Pin 85mm	●	●		●	●	
BCNET24	2.4mm Bicortical Pin Negative End Thread Pin 100mm	●	●	●	●	●	
BCNET27	2.7mm Bicortical Pin Negative End Thread Pin 110mm	●	●	●		●	
BCNET30	3mm Bicortical Pin Negative End Thread Pin 130mm	●	●	●		●	●
BCNET35	3.5mm Bicortical Pin Negative End Thread Pin 130mm	●	●	●		●	●
BCNET40	4mm Bicortical Pin Negative End Thread Pin 150mm		●	●		●	●
BCNET50	5mm Bicortical Pin Negative End Thread Pin 150mm		●	●		●	●

Featured Products

Please note, the following featured products are only a selection of those available in the range. Please refer to the Vi Catalogue or scan the QR code to view the External Fixation section of our website, and find full details of all relevant products.

Standard Fixators (SF)

0017695SC SF Full Kit With Steel/Carbon Bars

Please contact a member of the Vi team for a list of the contents of these kits.

SF Mini Range

001740 Mini Single Clamp
001743 Mini Double Clamp
001595 Mini 1/8" (3.2mm) Bar x 30mm Stainless Steel
001559 Mini 1/8" (3.2mm) Bar x 50mm Stainless Steel
001590 Mini 1/8" (3.2mm) Bar x 75mm Stainless Steel
001596 Mini 1/8" (3.2mm) Bar x 100mm Stainless Steel
001573 Mini 1/8" (3.2mm) Bar x 125mm Stainless Steel
001560 Mini 1/8" (3.2mm) Bar x 150mm Stainless Steel
001574 Mini 1/8" (3.2mm) Bar x 175mm Stainless Steel
001575 Mini 1/8" (3.2mm) Bar x 200mm Stainless Steel
SL2015 Insert Drill Sleeve 2.0mm O/D 1.5mm I/D
SL2418 Insert Drill Sleeve 2.4mm O/D 1.8mm I/D
001566 Spanner 7mm

SF Small Range

001741 Small Single Clamp
001744-A Small Double Clamp
001862C Small 1/4"(6.3mm) Bar x 100mm Carbon
001863C Small 1/4"(6.3mm) Bar x 150mm Carbon
001864C Small 1/4"(6.3mm) Bar x 200mm Carbon
001865C Small 1/4"(6.3mm) Bar x 250mm Carbon
001866C Small 1/4"(6.3mm) Bar x 300mm Carbon
001862TI Small 1/4"(6.3mm) Bar x 100mm Ti
001863TI Small 1/4"(6.3mm) Bar x 150mm Ti
001864TI Small 1/4"(6.3mm) Bar x 200mm Ti
001865TI Small 1/4"(6.3mm) Bar x 250mm Ti
SL3525 Insert Drill Sleeve 3.5mm o/d 2.5mm I/D
001565 Spanner 8mm

SF Large Range

001742 Large Single Clamp
001745 Large Double Clamp
001870C Large 3/8"(9.5mm) Bar x 100mm Carbon
001871C Large 3/8"(9.5mm) Bar x 150mm Carbon
001872C Large 3/8"(9.5mm) Bar x 200mm Carbon
001873C Large 3/8"(9.5mm) Bar x 250mm Carbon
001874C Large 3/8"(9.5mm) Bar x 300mm Carbon
001870TI Large 3/8"(9.5mm) Bar x 100mm Aluminium
001871TI Large 3/8"(9.5mm) Bar x 150mm Aluminium
001872TI Large 3/8"(9.5mm) Bar x 200mm Aluminium
001873TI Large 3/8"(9.5mm) Bar x 250mm Aluminium
001874TI Large 3/8"(9.5mm) Bar x 300mm Aluminium
SL4532 Insert Drill Sleeve 4.5mm O/D 3.2mm I/D
001564 Spanner 10mm

KE Plus

001579ND Boxed Full KE+ Kit No Doubles
001579NDP Full KE+ Kit In Stainless Steel Box

Please contact a member of the Vi team for a list of the contents of these kits.

KE Plus Small Range

001527 Small Single KE Plus Clamp
001594 Small Double Clamp
001595 Small Connecting Bar 1/8" (3.2mm) x 30mm
001559 Small Connecting Bar 1/8" (3.2mm) x 50mm
001590 Small Connecting Bar 1/8" (3.2mm) x 75mm
001596 Small Connecting Bar 1/8" (3.2mm) x 100mm
001573 Small Connecting Bar 1/8" (3.2mm) x 125mm
001560 Small Connecting Bar 1/8" (3.2mm) x 150mm
001574 Small Connecting Bar 1/8" (3.2mm) x 175mm
001575 Small Connecting Bar 1/8" (3.2mm) x 200mm
001597 ESF Hinge Joint Small
001566 Spanner 7mm

KE Plus Medium Range

001526 Medium Single KE Plus Clamp
001592 Medium Double Clamp
001588 Medium Connecting Bar 3/16" (4.8mm) x 75mm
001576 Medium Connecting Bar 3/16" (4.8mm) x 100mm
001587 Medium Connecting Bar 3/16" (4.8mm) x 150mm
001589 Medium Connecting Bar 3/16" (4.8mm) x 200mm
001589XL Medium Connecting Bar 3/16" (4.8mm) x 250mm
001589XXL Medium Connecting Bar 3/16" (4.8mm) x 300mm
001598 ESF Hinge Joint Medium
001565 Spanner 8mm

KE Plus Large Range

001525 Large Single KE Plus Clamp
001584 Large Double Clamp
001547L Large Split Clamp Single
001586 Large Connecting Bar 5/16" (8mm) x 100mm
001563 Large Connecting Bar 5/16" (8mm) x 150mm
001585 Large Connecting Bar 5/16" (8mm) x 240mm
001549 Large Connecting Bar 5/16" (8mm) x 340mm
001564 Spanner 10mm

FESSA External Fixation

FESSA External Fixation - Stainless Steel

015500 FESSA 6 & 8mm Set With 10 of Each Screw

6mm FESSA

015502 FESSA Tube 6mm x 30mm
015504 FESSA Tube 6mm x 45mm
015506 FESSA Tube 6mm x 65mm
015508 FESSA Hex Driver Allen Key Type 1.5mm
015509 FESSA 6mm (1.5 Hex) Grub Screws (10)
015534 FESSA 6mm Hinge

8mm FESSA

015510 FESSA Tube 8mm x 100mm
015512 FESSA Tube 8mm x 150mm
015514 FESSA Tube 8mm x 200mm
SDHS20-1 1.5/2.0/2.4mm Hex Screwdriver & Screw Holding Sleeve
015517 FESSA Hex Driver Allen Key Type 2.0mm
015520 FESSA 8mm (2.0 Hex) Grub Screws (10)
015536 FESSA 8mm Hinge

12mm FESSA

015540 FESSA Tube 12mm x 125mm
015542 FESSA Tube 12mm x 175mm
015544 FESSA Tube 12mm x 225mm
015545 FESSA 12mm (2.5 Hex) Grub Screws (10)
SDHS35POM-C 2.5mm Hex Screwdriver + Sleeve With PTFE Handle

FESSA Ultra-Lightweight Titanium FESSA

015530 Titanium FESSA Set In Stainless Steel Box

Components:

015521 5mm x 30mm Titanium FESSA
015522 5mm x 45mm Titanium FESSA
015509 FESSA 5mm (1.5 Hex) Locking Screws (10)
015508 1.5 Hex Allen Key
BCNET08 0.8mm Bicortical Negative Pins
BCNET10 1.0mm Bicortical Negative Pins
BCNET15 1.5mm Bicortical Negative Pins

Please contact a member of the Vi team for a list of the contents of these kits.

Spanners

Clamp Type	Clamp Size	Clamp Code	Spanner Size	Spanner Code
KE+	Small	001527	7mm	001566
	Medium	001526	8mm	001565
	Large	001525	10mm	001564
KE+ Split Clamps	Large	001547L	10mm	001564
KE+ Split Clamps	Medium	001598	8mm	001565
SF Clamps Single	Mini	001740	7mm	001566
	Small	001741	8mm	001565
	Large	001742	10mm	001564
SF Clamps Double	Mini	001743	7mm	001566
	Small	001744	8mm	001565
	Large	001745	10mm	001564

Pre-Drilling ESF Pin Tracts

H090202 1.9mm Pre-Drill For 2.0mm Shank Positive Pin
H090203 2.3mm Pre-Drill For 2.4mm Shank Positive Pin
H090205 3.0mm Pre-Drill For 3.2mm Shank Positive Pin
H090207 3.8mm Pre-Drill For 4.0mm Shank Positive Pin
H090101 1.5mm Pre-Drill For 2.0mm Shank Negative Pin
H090102 2.0mm Pre-Drill For 2.4mm Shank Negative Pin
H090104 2.7mm Pre-Drill For 3.2mm Shank Negative Pin
H090106L 3.5mm Pre-Drill For 4.0mm Shank Negative Pin

Epoxy ESF Putty

EPOXY1 Epoxy ESF Putty 55G
EPOXY2 Epoxy ESF Putty 110G

ESF Pins

Please refer to the Vi catalogue for further information on each pin type.

Positive Threaded Pins - Cortical

End Thread

CET0014	0.8mm Shank 1.1mm Threads 60mm Long - End Thread
CET0013	1.0mm Shank 1.3mm Threads 65mm Long - End Thread
CET0015	1.2mm Shank 1.5mm Threads 65mm Long - End Thread
CET0016	1.2mm Shank 1.6mm Threads 70mm Long - End Thread
CET0017	1.4mm Shank 1.8mm Threads 70mm Long - End Thread
CET0018	1.6mm Shank 2.0mm Threads 70mm Long - End Thread
CET0026	1.8mm Shank 2.2mm Threads 80mm Long - End Thread
CET0019	2.0mm Shank 2.4mm Threads 85mm Long - End Thread
CET0020	2.4mm Shank 3.2mm Threads 100mm Long - End Thread
CET0020A	2.7mm Shank 3.5mm Threads 110mm Long - End Thread
CET0020B	3.0mm Shank 3.8mm Threads 120mm Long - End Thread
CET0021	3.2mm Shank 4.0mm Threads 130mm Long - End Thread
CET0024A	3.5mm Shank 4.3mm Threads 130mm Long - End Thread
CET0022	4.0mm Shank 4.8mm Threads 150mm Long - End Thread

Mid Thread

CMT0013	0.98mm Shank 1.1mm Threads 85mm Long - Mid Thread
CMT0014	1.1mm Shank 1.4mm Threads 85mm Long - Mid Thread
CMT0015	1.2mm Shank 1.5mm Threads 85mm Long - Mid Thread
CMT0016	1.4mm Shank 1.8mm Threads 85mm Long - Mid Thread
CMT0017	1.6mm Shank 2.0mm Threads 85mm Long - Mid Thread
CMT0018	1.6mm Shank 2.0mm Threads 85mm Long - Mid Thread
CMT0018A	1.8mm Shank 2.2mm Threads 90mm Long - Mid Thread
CMT0019	2.0mm Shank 2.4mm Threads 105mm Long - Mid Thread
CMT0019A	2.2mm Shank 2.6mm Threads 105mm Long - Mid Thread
CMT0023	2.4mm Shank 3.2mm Threads 105mm Long - Mid Thread
CMT0023A	2.7mm Shank 3.5mm Threads 115mm Long - Mid Thread
CMT0023B	3.0mm Shank 3.8mm Threads 120mm Long - Mid Thread
CMT0024	3.2mm Shank 4.0mm Threads 130mm Long - Mid Thread
CMT0024A	3.5mm Shank 4.3mm Threads 140mm Long - Mid Thread
CMT0025	4.0mm Shank 4.8mm Threads 150mm Long - Mid Thread

CMT0017 has a 16mm thread length.

CMT0018 has a 20mm thread length.

Positive Threaded Pins – Cancellous

CANET0026	2.4mm Shank 3.5mm Threads 115mm Long Cancellous End Thread
CANET0027	3.2mm Shank 4.8mm Threads 150mm Long Cancellous End Thread
CANMT0029	2.4mm Shank 3.5mm Threads 150mm Long Cancellous Mid Thread
CANMT0030	3.2mm Shank 4.8mm Threads 180mm Long Cancellous Mid Thread

Trochar Pins

001556	Trochar Pin 2mm
001557	Trochar Pin 3mm
001558	Trochar Pin 4mm

Cortical Negative Threaded Pins (Ellis Type)

		Pin Diameter	Overall Length
001528	Ellis Pin	1.1mm	76mm
001529	Ellis Pin	1.6mm	85mm
001533	Ellis Pin	1.8mm	127mm
001550	Ellis Pin	2.0mm	127mm
001530	Ellis Pin	2.4mm - (3/32")	127mm
001550A	Ellis Pin	2.7mm - (7/64")	127mm
001551	Ellis Pin	3.0mm	127mm
001531	Ellis Pin	3.2mm - (1/8")	127mm
001551A	Ellis Pin	3.5mm	127mm
001552	Ellis Pin	4.0mm	127mm

Bicortical Negative Threaded Pins

	Shaft Diameter	Thread Diameter	Thread Length	Overall Length
BCNET08	0.8mm	0.8mm	8mm	70mm
BCNET10	1.0mm	1.0mm	10mm	70mm
BCNET11	1.1mm	1.1mm	12mm	70mm
BCNET13	1.3mm	1.3mm	12mm	70mm
BCNET15	1.5mm	1.5mm	12mm	70mm
BCNET16	1.6mm	1.6mm	20mm	70mm
BCNET18	1.8mm	1.8mm	24mm	85mm
BCNET20	2.0mm	2.0mm	24mm	85mm
BCNET24	2.4mm	2.4mm	25mm	100mm
BCNET27	2.7mm	2.7mm	30mm	110mm
BCNET30	3.0mm	3.0mm	35mm	130mm
BCNET35	3.5mm	3.5mm	40mm	130mm
BCNET40	4.0mm	4.0mm	45mm	150mm
BCNET50	5.0mm	5.0mm	50mm	150mm

To place an order for any of the products featured in this Surgery Guide, please email info@vetinst.com or call 0114 258 8530.

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