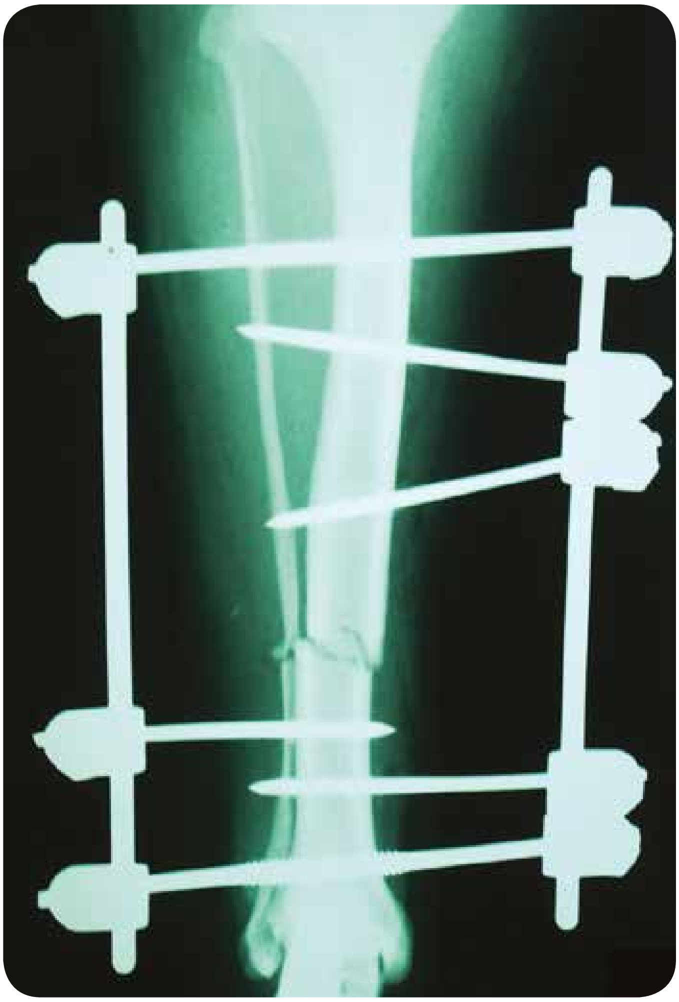
Issue 1 t +44 (0)114 258 8530 info@vetinst.com www.vetinst.com **Veterinary Instrumentation**

Vi Academy Step by Step

Linear External Skeletal Fixation: A Beginner's Guide: Step-By-Step



External Skeletal Fixation (ESF) is an excellent 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 categories of ESF:
Linear
Circle
Free-form
Hybrid


The key to external fixation
is flexibility
R
R

1. Linear ESFs

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

2. Circular ESFs (cESF)

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. 2)

Free-form ESFs are a subtype of linear ESFs; the clamps and connecting bar are replaced either by epoxy putty, or by acrylic that is poured into malleable tubing. This enables 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 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 or acrylic has set.

Fig. 3

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. 4)

Fig. 4

When an Ex Fix is applied the bone fracture is not 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 is disadvantageous in particular fracture scenarios such as articular fractures and spinal fractures.

What are the advantages of External Skeletal Fixation (ESF)?

- 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 or acrylic / resin frames for connecting bars 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 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.

What are the disadvantages of ESF?

- 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 a 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 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 by 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 enter the skin and are connected to the connecting bar on one side of the limb only (Fig. 5).
  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.

- FULL pins (Fig. 5) 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. A threaded full pin has the thread in the centre, also called centrally threaded or mid-threaded.

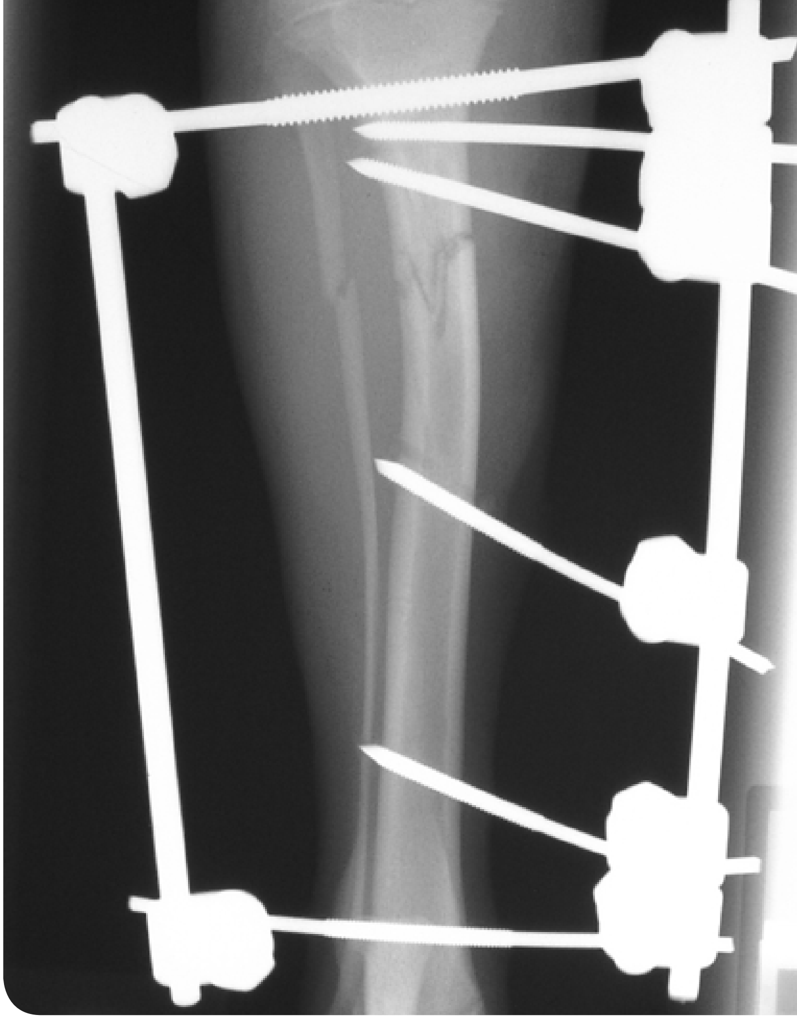


Fig. 5


Fig. 6

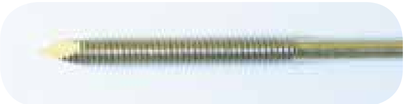


Fig. 7

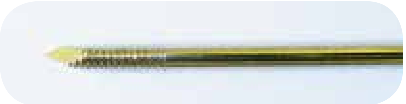


Fig. 8

PIN THREAD

There are various types of pin thread configuration:

- **No thread**
  Most frequently with a trochar point (Fig. 6). 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.
- **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).
- **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 (Ellis type 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 sitting within the medulla, an area in where it is better protected from excessive stresses.

- **END THREADED**: the thread is at the end of the pin.

- **CENTRALLY/MID THREADED**: the thread is at the centre of the pin.

- **PIN DIAMETER.** Pins are labelled according to the diameter of the shaft or the shaft and the thread, although thread dimensions are published and available. For a given pin size i.e. shaft diameter, the thread diameter of a positive threaded pin is slightly greater than the shaft diameter, and 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. Inspect the radiographs very carefully; make sure you understand the fracture configuration fully. Is the fracture simple or comminuted? are there fissures?

Fig. 9

Fig. 9

- Plan the surgery carefully (Fig. 9). Specifically for ESF application, you need to check:
- 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.
- 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.

- Patient positioning: using a hanging limb preparation before fracture surgery helps to overcome fracture over-riding caused by muscle contraction (Fig. 10). 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.

Fig. 10

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 automatic 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 i.e. :

Radius:	Distal = craniomedial & medial
	Proximal = craniolateral & lateral
Humerus:	Distal = medial & lateral
	Proximal = craniolateral
	Avoid the mid diaphysis
Femur:	Distal = medial & 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 increasing order of stiffness they are:

Type IA = Unilateral, Uniplanar (Figs. 11a & 11b).

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.

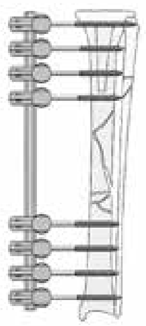


Fig. 11a

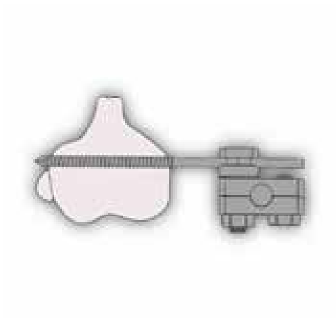


Fig. 11b

Type IB = Unilateral, Biplanar. (Fig. 12a & 12b).

In short, 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 more challenging to apply type 1B fixators to the humerus and femur whilst still achieving safe corridors, because of the cranial and caudal muscle bellies.

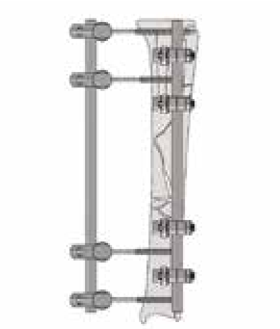


Fig. 12a

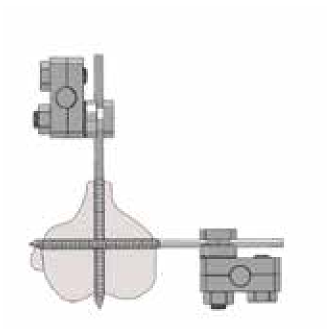


Fig. 12b

Type II modified (type IIB): Bilateral, Uniplanar with full & half pins. (Fig. 13).

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.

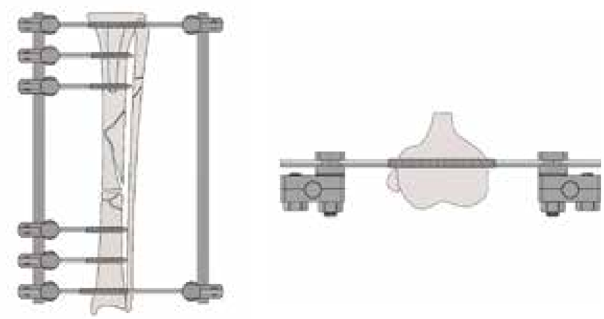


Fig. 13

Type II (type IIA): Bilateral, Uniplanar with only full pins. (Fig. 14).

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.

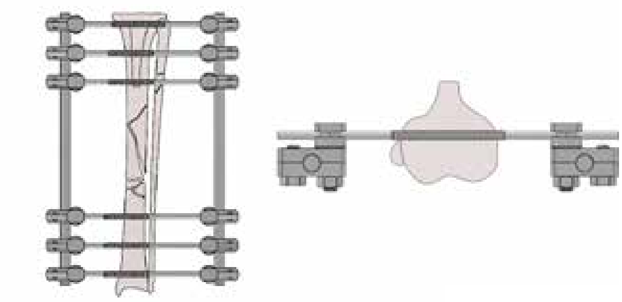


Fig. 14

Type III: Bilateral, Biplanar. (Fig. 15).
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.

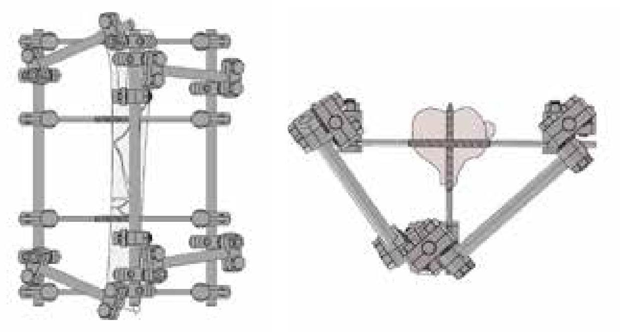


Fig. 15

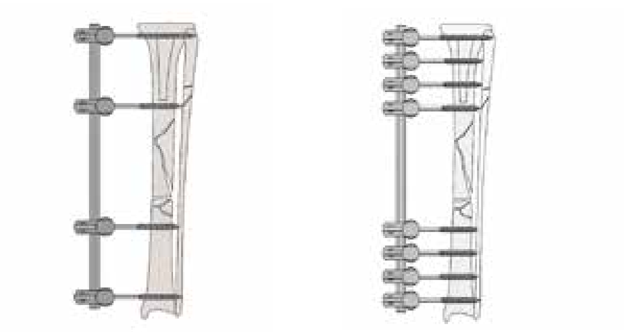


Fig. 16

4 Fixator Pins

- Aim for 4 pins per bone segment.
The absolute minimum is 2 pins per bone segment. 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. 16).

- 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.17). 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 & end of the bone or fracture is half the bone diameter.

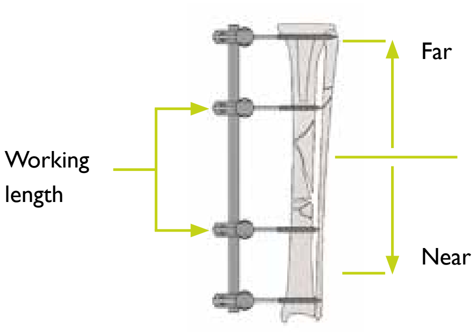


Fig. 17

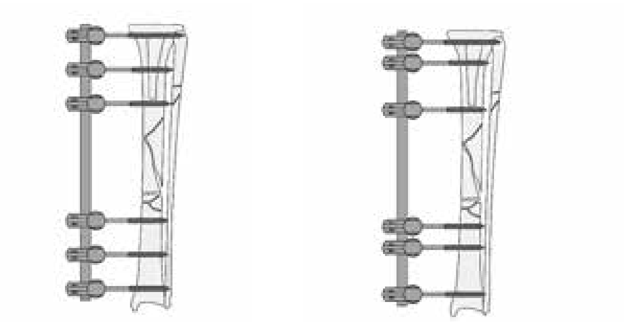


Fig. 18

- 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. 18).

- Use threaded pins.
Threaded pins are the most reliable (Fig. 19a) 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. Therefore if using smooth pins, 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. 19b).

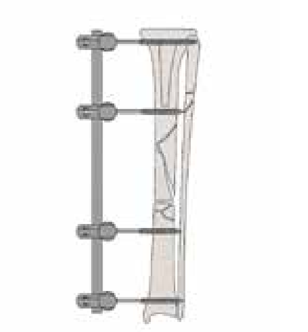


Fig. 19a


Fig. 19b

It is advisable that at least one, and preferably more 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. 19c). This does not apply to positive threaded pins as the shank diameter is continuous therefore there is no stress concentration.

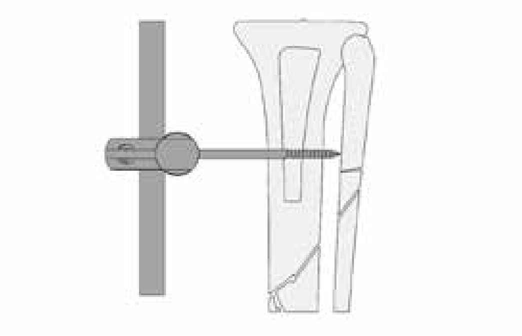


Fig. 19c

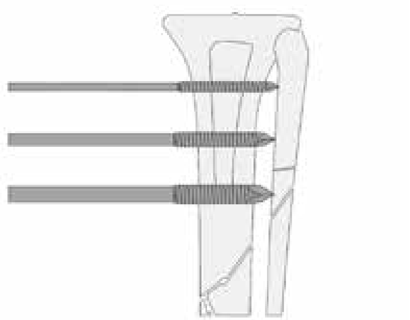


Fig. 20

- **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. 20).

- **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; this clearance allows for wound maintenance and postoperative swelling (Fig. 21).

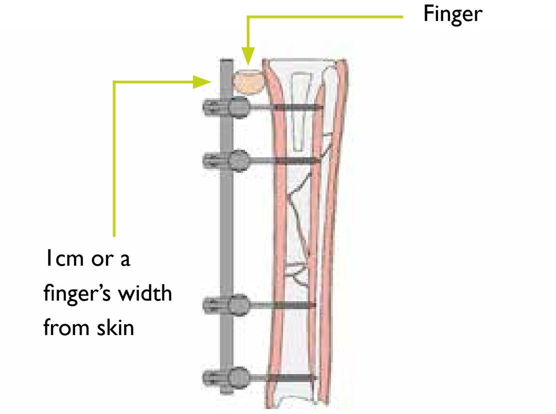


Fig. 21

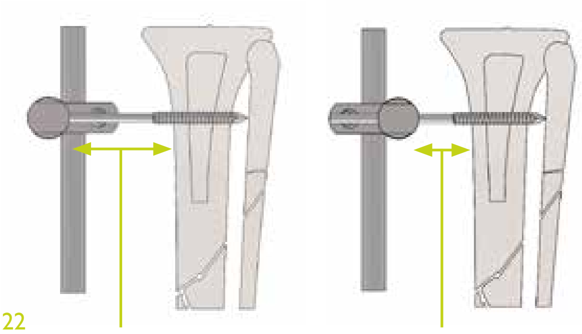


Fig. 22

Orienting the ESF clamps so that the clamp mechanism is on the inside rather than the outside of the connecting bar also reduces the working length makes the construct stiffer (Fig. 22).

Placing the connecting bar about 1cm (or one finger's width away) from the skin is an optimal combination of allowing enough soft tissue clearance 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 from the skin whilst the initial swelling subsides, and to then adjust and place closer at a later date.

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.
- Drill the pins through clamps on the connecting bar otherwise the holes in the bone (and therefore the ESF pins that are placed) won't 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.
- Pre-drill pins: 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.
- 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.
- Ensure that pins are placed through both cortices of the bone (cis cortex and trans cortex). Correct pin placement (depth) noise can be gauged by:
- The change in drill pitch noise as the pin enters and then exists 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.

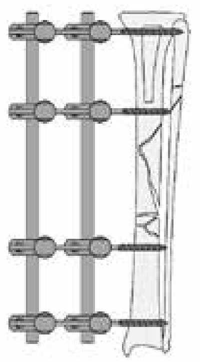


Fig. 23

5 Connecting Bars

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 (Fig. 23):

- 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 less 20-25% bone diameter. Larger connecting bars may be excessively heavy or bulky for the patient.
- Adding a second connecting bar adjacent to the first (Fig. 23)
- For type IB or type III frames, link the connecting bars using doule clamps.
- Use a different type of (stiffer) connecting bar. In order of decreasing strength/weight ratio:
  Titanium > Carbon fibre > Aluminium > Stainless Steel

6 Choosing the correct 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.

7 Intramedullary Pins

Using an intramedullary pin enables the fracture to be distracted, aligned and the position 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 size 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.

Step-by-step Linear ESF Frame Application

Ensure the fractured bone is correctly aligned and distract 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 a KE 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 of backing out, then slacken the appropriate clamp, adjust the depth of the pin, and re-tighten the clamp.

6. Once satisfied, tighten all clamps.

7. Cut all ESF pins as close to the connecting bar as you can. Take care to hold onto 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 Vetrap™ or similar so that all sharp edges are covered and the patient cannot damage himself / herself, owners, or surroundings.

STANDARD FIXATORS (SF)

SF Mini Range

STANDARD FIXATORS (SF) CLAMPS - MINI

001740	Mini Single Clamp
001743	Mini Double Clamp

STANDARD FIXATORS (SF) BARS - MINI

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

INSERT DRILL SLEEVES - MINI

SL2015	Insert Drill Sleeve 2.0mm o/d 1.5mm i/d
SL2720	Insert Drill Sleeve 2.7mm o/d 2.0mm i/d

STANDARD FIXATORS (SF) SPANNERS & WRENCHES - MINI

001566	Mini Spanner 7mm
001566T	Mini T Bar Wrench 7mm

SF Small Range

STANDARD FIXATORS (SF) CLAMPS - SMALL

001741	Small Single Clamp
001744	Small Double Clamp

STANDARD FIXATORS (SF) BARS - SMALL

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

INSERT DRILL SLEEVES - SMALL

SL3525	Insert Drill Sleeve 3.0mm o/d 2.5mm i/d
SL4532	Insert Drill Sleeve 4.5mm o/d 3.2mm i/d

STANDARD FIXATORS (SF) SPANNERS & WRENCHES - SMALL

001565	Medium Spanner 8mm
86685	Medium Angled Wrench 8mm
001565T	Medium T Bar Wrench 8mm

SF Large Range

STANDARD FIXATORS (SF) CLAMPS - LARGE

001742	Large Single Clamp
001745	Large Double Clamp

STANDARD FIXATORS (SF) BARS - LARGE

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

STANDARD FIXATORS (SF) SPANNERS & WRENCHES - LARGE

001564	Large Spanner 10mm
86687	Large Angled Wrench 10mm
001564T	Large T Bar Wrench 10mm

SF Kits

MINI SF STARTER KIT (STAINLESS STEEL BARS)

0017601SS	SF Mini Starter Kit with Stainless Bars

SMALL SF STARTER KIT (CARBON BARS OR TITANIUM BARS)

0017602C	SF Small Starter Kit with Carbon Bars
0017603TI	SF Small Starter Kit with Titanium Bars

LARGE SF STARTER KIT (CARBON BARS OR ALUMINIUM BARS)

0017604C	SF Large Starter Kit with Carbon Bars
0017605AL	SF Large Starter Kit with Aluminium Bars

SF FULL KIT
(INCLUDES PINS AND DRILL BITS– NO DOUBLE CLAMPS)

0017690SALT	SF Full Kit with Steel/Titanium/Aluminium Bars
0017695SC	SF Full Kit with Steel/Carbon Bars

Clamp	Pin Shaft Dia	Bar Dia	Spanner
Mini	0.9 - 2.5mm	3.2mm	7mm
Small	2.0 - 3.2mm	6.3mm	8mm
Large	3.2 - 4.8mm	9.5mm	10mm

KE PLUS

KE Plus Small Range

CLAMPS - SMALL

001527	Small Single KE Plus Clamp
001546	Small Single KE Plus Clamp - Pack of 6
001594	Small Double Clamp
001547S	Small Split Clamp Single

CONNECTING BARS - SMALL

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

ESF HINGE - SMALL

001597	ESF Hinge Joint	Small

SPANNERS & WRENCHES - SMALL

001566	Small Spanner 7mm
001566T	Small T Bar Wrench 7mm

KE Plus Medium Range

CLAMPS - MEDIUM

001526	Medium Single KE Plus Clamp
001545	Medium Single KE Plus Clamp - Pack of 6
001592	Medium Double Clamp
001547M	Medium Split Clamp Single

CONNECTING BARS - MEDIUM

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

ESF HINGE - MEDIUM

001598	ESF Hinge Joint	Medium

SPANNERS & WRENCHES - MEDIUM

001565	Medium Spanner 8mm
86685	Medium Angled Wrench 8mm
001565T	Medium T Bar Wrench 8mm

KE Plus Large Range

CLAMPS - LARGE

001525	Large Single KE Plus Clamp
001544	Large Single KE Plus Clamp - Pack of 6
001584	Large Double Clamp
001547L	Large Split Clamp Single

CONNECTING BARS - LARGE

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

ESF HINGE - LARGE

001599	ESF Hinge Joint	Large

SPANNERS & WRENCHES - LARGE

001564	Large Spanner 10mm
86687	Large Angled Wrench 10mm
001564T	Large T Bar Wrench 10mm

Extra Large Range

CLAMPS - EXTRA LARGE

EXL01	Extra Large Single Clamp
EXL02	Extra Large Double Clamp

CONNECTING BARS - EXTRA LARGE

EXL09	Extra Large Connecting Bar 100mm
EXL05	Extra Large Connecting Bar 150mm
EXL06	Extra Large Connecting Bar 200mm
EXL07	Extra Large Connecting Bar 300mm
EXL08	Extra Large Connecting Bar 400mm

SPANNER - EXTRA LARGE

001562	Extra Large Spanner 13mm

Boxed KE+ ESF Kits (Spanners included)

The full kit comprises one of each "standard kit" (see overleaf) plus a compartmentalised stainless steel box in which to sterilise it. However typically, double clamps weaken frames and are to be avoided if possible. 001579ND is based on single clamps only. For ideal construction use at least 3 pins in each fragment. Kits save 10% on component costs.

001579NDP

NB: pins are only supplied with Kit 001579NDP which includes positive pins of all appropriate sizes.

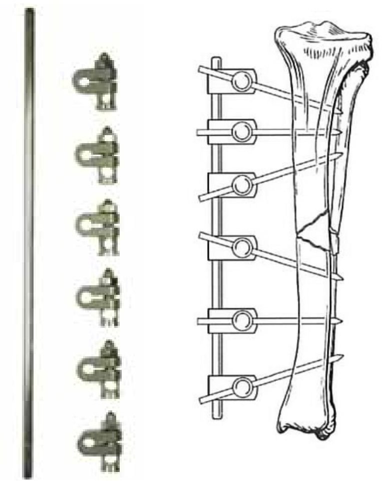
BOXED KE+ ESF KITS (SPANNERS INCLUDED)

001579	Boxed Full KE+ Kit (including doubles) in Stainless Box. S/ M/ L Std Kits + Spanners.
001579ND	Boxed Full KE+ Kit No Doubles. As above but with no double clamps
001579NDP	Full KE+ Kit in Stainless Steel Box. Includes for each of the 3 sizes: 8 Single Clamps, 2 Long Bars, Spanner, 2 Mid Thread Positive Pins, 4 End Thread Positive Pins, the correct Predrill and an ESF Tissue Protector

KE Plus Kits

When purchased as kits there is typically a 10% reduction in total cost. All single clamps will be KE+.

KE+ Type One Kit (Ia)



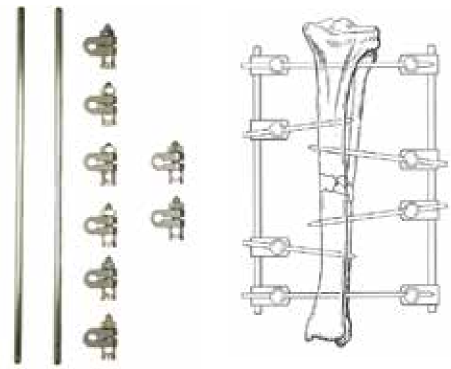
Contains a long bar and 4 or 6 KE Plus single clamps. Pins and spanners are not included. This is the minimum frame you should try to use. Two pins only in the distal fragment is more acceptable than 2 pins proximally. Pin complications are usually fewer in the distal fragment.

TYPE ONE KE+ KIT

001570	Unilateral KE+ Kit Large 4 Clamps 1 Bar 240mm
001571	Unilateral KE+ Kit Medium 4 Clamps 1 Bar 150mm
001572	Unilateral KE+ Kit Small 4 Clamps 1 Bar 100mm
001570P	Unilateral KE+ Kit Large 6 Clamps 1 Bar 240mm
001571P	Unilateral KE+ Kit Medium 6 Clamps 1 Bar 200mm
001572P	Unilateral KE+ Kit Small 6 Clamps 1 Bar 150mm

NB: No pins or spanners are supplied with these kits.

KE+ Type Two Kit - Modified (IIb)



Contains two long bars and 6 or 8 KE Plus clamps. Pins and spanners are not included. Use to create a bilateral frame using a long (preferably mid-threaded) pin proximally and distally.

TYPE TWO KE+ KIT (MODIFIED)

001520	Bilateral KE+ Kit Large 6 Clamps 2 Bars, 240mm
001521	Bilateral KE+ Kit Medium 6 Clamps 2 Bars, 200mm
001522	Bilateral KE+ Kit Small 6 Clamps 2 Bars, 100mm
001520P	Bilateral KE+ Kit Large 8 Clamps 2 Bars, 240mm
001521P	Bilateral KE+ Kit Medium 8 Clamps 2 Bars, 200mm
001522P	Bilateral KE+ Kit Small 8 Clamps 2 Bars, 100mm

NB: No pins or spanners are supplied with these kits.

KE+ Standard Kit

Consists of 8 Single KE Plus Clamps,
2 Double Clamps, 2 Long Bars, 2 Short Bars. Some fractures and some patients require more elaborate frames using either more clamps or more connecting bars. The Standard Kit will enable you to deal with most situations.

STANDARD KE+ KIT

001580	Large Standard KE+ Kit 4mm. 8 Single + 2 Double Clamps & Bars 2 x Long 5/16" 240mm Long & 2 x Short 5/16" 100mm Long
001581	Medium Standard KE+ Kit 3mm. 8 Single + 2 Double Clamps & Bars 2 x Long 3/16" 200mm Long & 2 x Short 3/16" 75mm Long
001582	Small Standard KE+ Kit 2mm. 8 Single + 2 Double Clamps & Bars 2 x Long 1/8" 100mm Long & 2 x Short 1/8" 30mm Long
001578	Stainless Box with Partitions

NB: No pins or spanners are supplied with these kits.

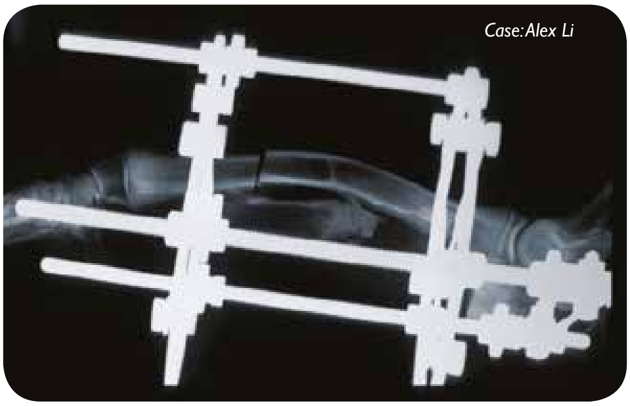
Spanner Size and Clamp Type Reference Chart

Clamp Type	Clamp Size	Clamp Code	Spanner Size	Spanner Code
KE+	Small	001527	7mm	001566
	Medium	001526	8mm	001565
	Large	001525	10mm	001564
KE+ Double Clamps	Small	001594	7mm	001566
	Medium	001592	8mm	001565
	Large	001584	10mm	001564
KE+ Extra Large Clamps	Single	EXL01	13mm	001562
	Double	EXL02	13mm	001562
KE+ Split Clamps	Small	001547S	7mm	001566
	Medium	001547M	8mm	001565
	Large	001547L	10mm	001564
KE+ ESF Hinge Joints	Small	001597	7mm	001566
	Medium	001598	8mm	001565
	Large	001599	10mm	001564
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

CIRCULAR ESF

Circular ESF Kits

Well rounded starter kits presenting a number of options for the most commonly used frames.



Small (M4) Kit

A newly configured kit for the smaller patient.

Contents:

3 x 40, 50 and 60mm Rings (Aluminium)
2 x 40, 50 and 60mm 5/8 Rings (Aluminium)
4 x 50, 75, 100 and 150 Threaded Rods
6 x 2 Cannulated Bolts
6 x 2 Offset Bolts
4 x Fixation Pin Clamps
3 x 2 Slotted Washers
8 x Spacing Washers (4 each of 2mm and 3mm)
3 x Spherical Washers
3 x Male To Female Hinges
3 x Female to Female Hinges
3 x Adjuster Nuts
30 x Nuts
20 x Nylon Locking Nuts
20 x Connecting Bolts
1 x M4 Wire Guide
1 x pack 1.0mm Ilizarov Wires
1 x pack 1.2mm Ilizarov Wires
1 x pack 1.0mm Ilizarov Olive Wires
1 x pack 1.2mm Ilizarov Olive Wires
2 x 7mm Spanners
Stainless Steel Container

SMALL (M4) KIT

0019850 Circular ESF Kit - M4 Aluminium

Large (M6) Kits

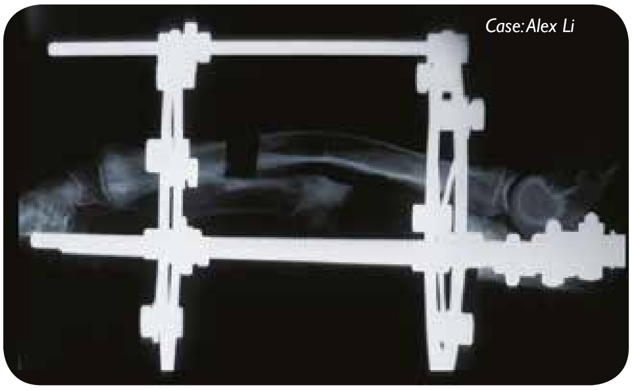
A re-configured kit to present the items in most popular use.

Contents:

3 x 50, 70 and 100mm Rings (please select aluminium or carbon)
2 x 50, 70 and 100mm 5/8 Rings (please select aluminium or carbon)
3 x 100, 150 and 200mm Threaded Rods
6 x 2 Cannulated Bolts
6 x 2 Offset Bolts
4 x Fixation Pin Clamps
3 x 2 Slotted Washers
8 x Spacing Washers (4 each of 2mm and 3mm)
2 x 3 Hole and 4 Hole Male Posts
2 x 2 Hole and 3 Hole Female Posts
3 x Spherical Washers
3 x Male to Female Hinges
3 x Female to Female Hinges
3 x Adjuster Nuts
30 x Nuts
20 x Nylon Locking Nuts
20 x Connecting Bolts
1 x M6 Wire Guide
2 x pack 1.5mm Ilizarov Wires
1 x pack 1.8mm Ilizarov Wires
2 x pack 1.5mm Ilizarov Olive Wires
1x pack 1.8mm Ilizarov Olive Wires
2x 10mm Spanners
1 x Angular Wrench
Stainless Steel Container

LARGE (M6) KITS

0019851 Circular ESF Kit - M6 Aluminium
0019852 Circular ESF Kit - M6 Carbon



We also have some interesting clamp free external fixation options such as the Fessa system, which are particularly useful in smaller patients.

To place an order contact a Vi Vet Tech Guru on +44 (0)114 258 8530 or email info@vetinst.com

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