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

We’ve long been supporters of External Fixation techniques in fracture repair. It’s why we supply a range of options in types of clamp. Plus of course the matching bars in a wide range of sizes and not forgetting an excellent spread of external fixation pins, both positive and negative thread.
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)

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)
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.

3. Free-form ESFs

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.

4. Hybrid ESF

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)
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.

**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?

- 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.
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 = craniodorsal & lateral

- **Humerus:**
  - Distal = medial & lateral
  - Proximal = craniodorsal
  - 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.

- **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 IB fixators to the humerus and femur whilst still achieving safe corridors, because of the cranial and caudal muscle bellies.

- **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.

- **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.
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.

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.

- 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).
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.

- 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 1 cm or a finger’s width from the skin; this clearance allows for wound maintenance and postoperative swelling (Fig. 21).

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 1 cm (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.

**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 double clamps.
- Use a different type of (stiffer) connecting bar. In order of decreasing strength/weight ratio:
  - Titanium > Carbon fibre > Aluminium > Stainless Steel

**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.

**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
- 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
- 001870TI: Small 1/4” (6.3mm) Bar x 100mm Titanium
- 001871TI: Small 1/4” (6.3mm) Bar x 150mm Titanium
- 001872TI: Small 1/4” (6.3mm) Bar x 200mm Titanium
- 001873TI: Small 1/4” (6.3mm) Bar x 250mm Titanium
- 001874TI: Small 1/4” (6.3mm) Bar x 300mm Titanium

SF Small Range

STANDARD FIXATORS (SF) CLAMPS - SMALL
- 001741: Small Single Clamp
- 001744-A: 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 Titanium
- 001863TI: Small 1/4” (6.3mm) Bar x 150mm Titanium
- 001864TI: Small 1/4” (6.3mm) Bar x 200mm Titanium
- 001865TI: Small 1/4” (6.3mm) Bar x 250mm Titanium

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
- 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 Titanium
- 001871TI: Large 3/8” (9.5mm) Bar x 150mm Titanium
- 001872TI: Large 3/8” (9.5mm) Bar x 200mm Titanium
- 001873TI: Large 3/8” (9.5mm) Bar x 250mm Titanium
- 001874TI: Large 3/8” (9.5mm) Bar x 300mm Titanium

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

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STANDARD FIXATORS (SF) SPANNERS & WRENCHES - LARGE
- 001564: Large Spanner 10mm
- 86687: Large Angled Wrench 10mm
- 001564T: Large T Bar Wrench 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

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
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.

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)

KE+ Type One Kit

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Clamps</th>
<th>Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>001570</td>
<td>Unilateral KE+ Kit Large 4 Clamps 1 Bar 240mm</td>
<td>4</td>
<td>1</td>
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<tr>
<td>001571</td>
<td>Unilateral KE+ Kit Medium 4 Clamps 1 Bar 150mm</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>001572</td>
<td>Unilateral KE+ Kit Small 4 Clamps 1 Bar 100mm</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>001570P</td>
<td>Unilateral KE+ Kit Large 6 Clamps 1 Bar 240mm</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>001571P</td>
<td>Unilateral KE+ Kit Medium 6 Clamps 1 Bar 150mm</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>001572P</td>
<td>Unilateral KE+ Kit Small 6 Clamps 1 Bar 100mm</td>
<td>6</td>
<td>1</td>
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</tbody>
</table>

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

KE+ Type Two Kit - Modified (Iib)

KE+ Type Two Kit

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Clamps</th>
<th>Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>001520</td>
<td>Bilateral KE+ Kit Large 6 Clamps 2 Bars, 240mm</td>
<td>6</td>
<td>2</td>
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<tr>
<td>001521</td>
<td>Bilateral KE+ Kit Medium 6 Clamps 2 Bars, 200mm</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>001522</td>
<td>Bilateral KE+ Kit Small 6 Clamps 2 Bars, 100mm</td>
<td>6</td>
<td>2</td>
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<tr>
<td>001530P</td>
<td>Bilateral KE+ Kit Large 8 Clamps 2 Bars, 240mm</td>
<td>8</td>
<td>2</td>
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<tr>
<td>001531P</td>
<td>Bilateral KE+ Kit Medium 8 Clamps 2 Bars, 200mm</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>001532P</td>
<td>Bilateral KE+ Kit Small 8 Clamps 2 Bars, 100mm</td>
<td>8</td>
<td>2</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Clamps</th>
<th>Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>001580</td>
<td>Large Standard KE+ Kit 4mm. 8 + 2 Double Clamps &amp; Bars 2 x Long 5/16” 240mm Long &amp; 2 x Short 5/16” 100mm Long</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>001581</td>
<td>Medium Standard KE+ Kit 3mm. 8 + 2 Double Clamps &amp; Bars 2 x Long 3/16” 200mm Long &amp; 2 x Short 3/16” 75mm Long</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>001582</td>
<td>Small Standard KE+ Kit 2mm. 8 + 2 Double Clamps &amp; Bars 2 x Long 1/8” 100mm Long &amp; 2 x Short 1/8” 30mm Long</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>001578</td>
<td>Stainless Box with Partitions</td>
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</table>

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.

Spanner Size and Clamp Type Reference Chart

<table>
<thead>
<tr>
<th>Clamp Type</th>
<th>Clamp Size</th>
<th>Clamp Code</th>
<th>Spanner Size</th>
<th>Spanner Code</th>
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<tbody>
<tr>
<td>KE+</td>
<td>Small</td>
<td>001527</td>
<td>7mm</td>
<td>001566</td>
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<tr>
<td></td>
<td>Medium</td>
<td>001526</td>
<td>8mm</td>
<td>001565</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>001525</td>
<td>10mm</td>
<td>001564</td>
</tr>
<tr>
<td>KE+ Double</td>
<td>Small</td>
<td>001594</td>
<td>7mm</td>
<td>001566</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>001592</td>
<td>8mm</td>
<td>001565</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>001584</td>
<td>10mm</td>
<td>001564</td>
</tr>
<tr>
<td>KE+ Extra Large</td>
<td>Single</td>
<td>EXL01</td>
<td>13mm</td>
<td>001562</td>
</tr>
<tr>
<td>ESF Hinge Joints</td>
<td>Double</td>
<td>EXL02</td>
<td>13mm</td>
<td>001562</td>
</tr>
<tr>
<td>KE+ Split Clamps</td>
<td>Small</td>
<td>001547S</td>
<td>7mm</td>
<td>001566</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>001547M</td>
<td>8mm</td>
<td>001565</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>001547L</td>
<td>10mm</td>
<td>001564</td>
</tr>
<tr>
<td>SF Clamps Single</td>
<td>Small</td>
<td>001740</td>
<td>7mm</td>
<td>001566</td>
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<tr>
<td></td>
<td>Large</td>
<td>001742</td>
<td>10mm</td>
<td>001564</td>
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<tr>
<td>SF Clamps Double</td>
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<tr>
<td></td>
<td>Large</td>
<td>001745</td>
<td>10mm</td>
<td>001564</td>
</tr>
</tbody>
</table>

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

FESSA External Fixation - Stainless Steel

Developed for use in the French army FESSA is a lightweight tubular fixator with a number of interesting features.

- The tube incorporates the pin clamping mechanism and is thus very strong and has extremely good angular pin rigidity.
- Available in 6 and 8mm & 12mm diameter Tubes.
- 6mm Tube accepts pins of shaft diameter 0.9mm to 1.8mm making it extremely useful in the management of fractures in cats and exotics.
- 8mm Tube accepts pins of shaft diameter 1.6mm to 3.2mm.
- 12mm Tube accepts pins of shaft diameter up to 4mm and M5 Grub Screws.
- Design allows placement of multiple parallel pins close together in small fragments.
- Pins can be placed at right angles to tube or angled through adjacent holes. Pins are locked into position by hex driven grub screws.

The FESSA Stainless Steel Starter Kit contains the following:
One of each 6mm tube and one of each 8mm tube (6 in total)
- 1 x 6mm Hinge and one 8mm Hinge
- 1 x 1.5mm Hex Screwdriver
- 1 x 2.0mm Hex Screwdriver
- 10 x 1.5 Locking Screws
- 10 x 2.0 Locking Screws
- All contained in a Stainless Steel Box with Silicone Insert.

FESSA STAINLESS STEEL

015500  FESSA Starter Set in Stainless Box
015502  FESSA Tube 6mm x 30mm
015504  FESSA Tube 6mm x 45mm
015506  FESSA Tube 6mm x 65mm
015507  FESSA Hex Driver Screwdriver Type 1.5mm
015508  FESSA Hex Driver Allen Key Type 1.5mm
015509  FESSA 6mm (1.5 Hex) Locking Screws (10)
015534  FESSA 6mm Hinge
015510  FESSA Tube 8mm x 100mm
015512  FESSA Tube 8mm x 150mm
015514  FESSA Tube 8mm x 200mm
SDHS24F  2.0mm Hex Screwdriver with PTFE Handle
015517  FESSA Hex Driver Allen Key Type 2.0mm
015520  FESSA 8mm (2.0 Hex) Locking Screws (10)
015536  FESSA 8mm Hinge
015540  FESSA Tube 12mm x 125mm
015542  FESSA Tube 12mm x 175mm
015544  FESSA Tube 12mm x 225mm
015545  FESSA 12mm (2.5 Hex) Locking Screws (10)
SDHHS15PSC 2.5mm Hex Screwdriver + Sleeve with PTFE Handle

FESSA Ultra-Lightweight Titanium FESSA

Standard Stainless Steel FESSA is already very light. The tubular structure acts as both clamp and bar. Birds, small furries and exotics demand even lighter constructs. Using Titanium tube of 5.0mm in diameter enables the surgeon to apply FESSA constructs weighing from as little as 1.5 grams.

Titanium Fessa tubes (015521 & 015522) are both supplied with 6 x M3 grub screws. Suitable for pins 0.8mm to 1.6mm. Uses 1.5 hex drivers, the same as 6.0mm FESSA.

The FESSA Titanium Starter Kit contains:
- 2 x 5mm x 30mm Ti Fessa Tubes
- 2 x 5mm x 45mm Ti Fessa Tubes
- 1 x 1.5 Hex Screwdriver
- 1 x Small Pin Vice
- 10 x M3 Grub Screws
- 6 x 0.8 Bicortical Negative Pins
- 6 x 1.0 Bicortical Negative Pins
- 6 x 1.5 Bicortical Negative Pins
- All contained in a Stainless Steel Box with Silicone Insert.

FESSA TITANIUM

015530  Titanium FESSA Set in Stainless Steel Box
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

To place an order contact our Vi Advisor Team on 0345 130 9596 or email info@vetinst.com