POLILOCK SYSTEM

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The implantation technique of the Polilock system is straightforward and is designed to minimize complications external fixators encounter concerning torsional forces. This type of external fixation is recommended for stabilizing fractures in small patients.

The system consists of various parts and can be used in different configurations: monolateral monoplanar configuration type IA, T-shaped monolateral configuration, double-bar configuration, and other more complex configurations.

Regardless of the chosen configuration, it is recommended to always use self-tapping pins with pre-drilling to ensure the best possible quality thread in the bone cortex. As for complications, we mainly find the same as with external fixators.

The Polilock external fixation system is designed to stabilize fractures in small patients weighing up to 5 kg. It is made with plastic ball joints and 5 mm carbon rods, making it very lightweight and versatile, and also minimizing radiological interference (Figure 1). If more pins and connecting rods are added, the system's structure changes, potentially allowing it to be used in heavier patients.

SYSTEM COMPONENTS

The system consists of various parts: plastic ball joints, locking hooks, short hooks for pins (Figure 2) and rods (Figure 3), a long pin hook for double-bar configuration (Figure 4), M3 locking nuts, carbon rods, self-tapping pins, and nails.

The 20 mm plastic ball joints allow the locking of threaded pins from 0.8 mm up to threaded nails of 2.5 mm. Moreover, they can be used singly or in pairs to lock with one or two carbon rods as required (Figure 5).

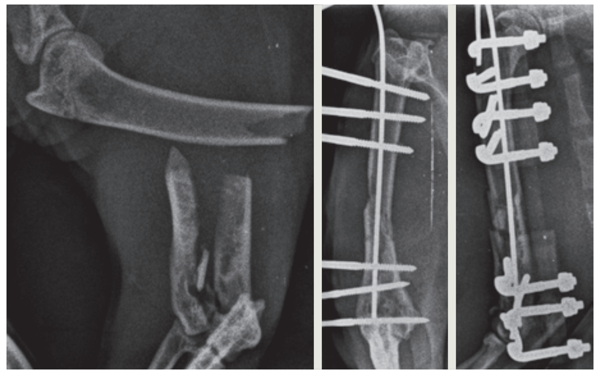


Figure 1 Polilock external fixation system. Notice that the fixator allows viewing of the bone through the bar and clamps.

The main advantage of the PLK system's ball joint design is that, by using the three aligned-hole design or the unaligned-hole ball joints (generally called "Mickey Mouse" due to the hole pattern), we can lock two threaded pins onto the clamp and also lock them to the carbon rod (Figure 6).

Regarding the locking hooks, there are three different designs with different shaft lengths to lock pins up to 2.5 mm and 5 mm carbon rods. They can also be used in double-clamp configurations. M3 locking nuts (Figure 7) fix the hooks to the clamps. Their plastic coating minimizes the possibility of loosening due to vibrations caused by weight loading. The 5 mm carbon rods (Figure 8) can be used in both single and double-bar configurations on the same clamp. In the case of a double bar, system strength increases for patients over 5 kg.

Finally, the threaded nails (Figure 9) are self-tapping but require pre-drilling and are handled exactly like screws.

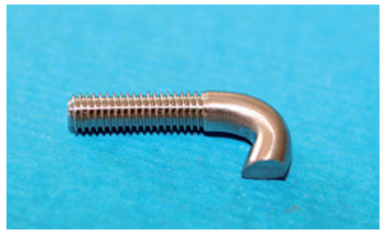


Figure 2. Short hook for pin.

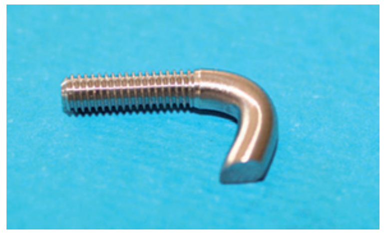


Figure 3. Short hook for bar.

Figure 4. Long hook for pin in double-bar configuration.

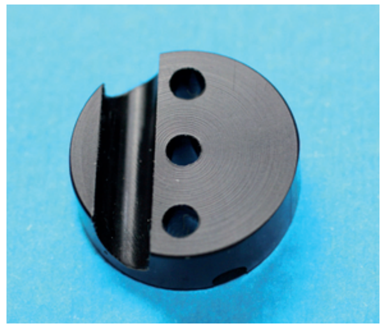


Figure 5. Plastic clamp with aligned holes.

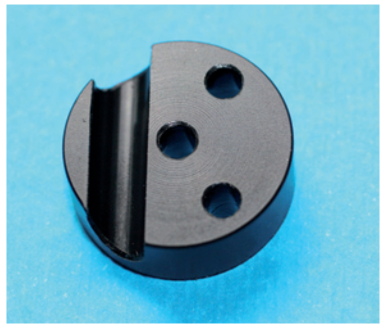
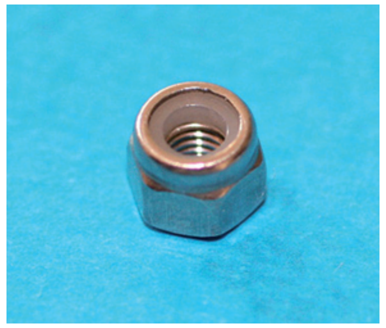


Figure 6. Plastic clamp with angulated holes (Mickey Mouse type).



FFigure 7. M3 locking nut.

Figure 8. 5-mm carbon rod.

Figure 9. Self-tapping nail.

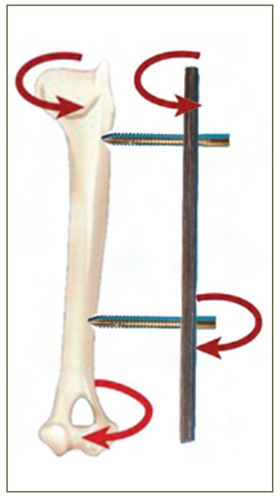


Figure 10. Diagram of torsional forces.

Furthermore, they have the same sizes as orthopedic screws (2.0 and 2.4 mm) so that the same 1.5 and 1.8 mm drill bits, respectively, can be used for pre-drilling. When inserted correctly, the nails have excellent bone grip due to a much better thread quality than achieved with trocar-point nails.

CONFIGURACION TYPES

The implantation technique is straightforward and aims to minimize complications encountered by external fixators when stabilizing torsional forces (Figure 10).

The weakest point of all linear fixators with a single connecting bar is the structure's torsion around the bar axis. This pivot effect is significantly reduced by using hooks that stabilize the bar against the clamp, so special attention should be paid to this point to keep the torsion risk under control.

Assembly is done by fixing the pin onto the ball joint with a short hook and then locking the ball joint to the bar with a short bar hook (Figure 11).

One of the system's advantages is that it allows two pins to be locked on the same clamp using the ball joints with unaligned holes (Figure 12).

Below are some recommendations for the clinical application of the assembly structures. As it is a linear fixator, the surgeon must decide the type of configuration based on their experience and case analysis.

MONOLATERAL MONOPLANAR CONFIGURATION TYPE IA

This represents the lightest structure but is biomechanically the weakest (Figures 13 and 14). Different strategies can be used to minimize risk:

- Use three pins and at least two hooks per bone fragment.
- Use a tie-in configuration whenever possible, connecting the IM pin to a clamp of the connecting bar with hooks.

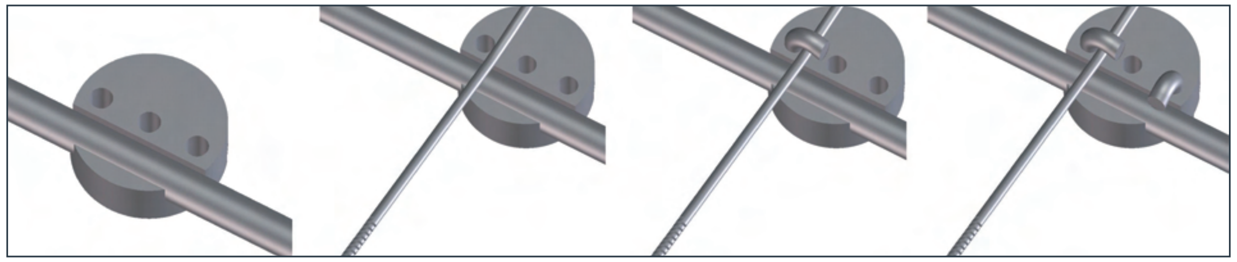


Figure 11. Assembly of the Polilock external fixation system.

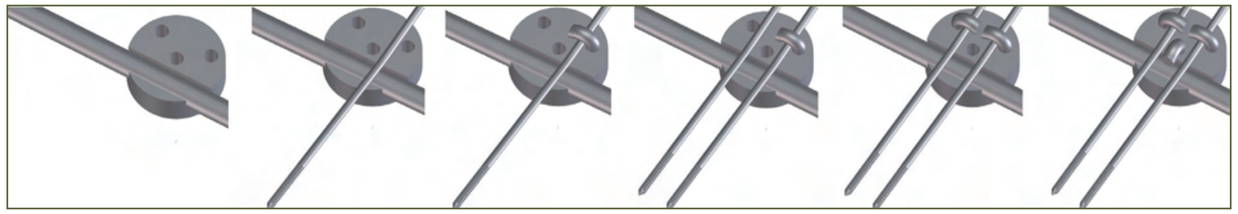
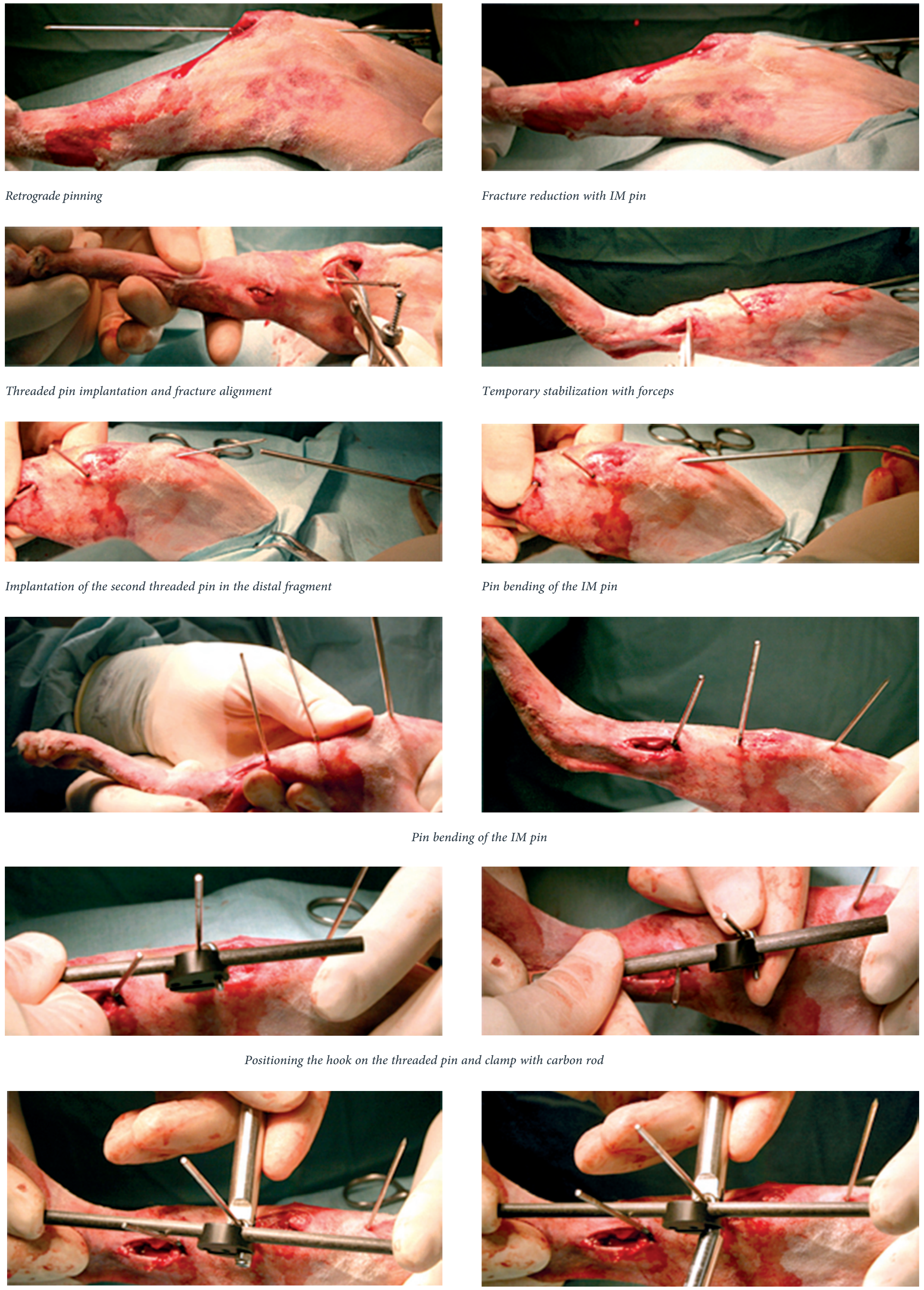


Figure 12. Polilock system variant assembly, with two pins locked on the same clamp.



Retrograde pinning

Fracture reduction with IM pin

Threaded pin implantation and fracture alignment

Temporary stabilization with forceps

Implantation of the second threaded pin in the distal fragment

Pin bending of the IM pin

Pin bending of the IM pin

Positioning the hook on the threaded pin and clamp with carbon rod

Locking the hook

Securing the hook with a locking nut

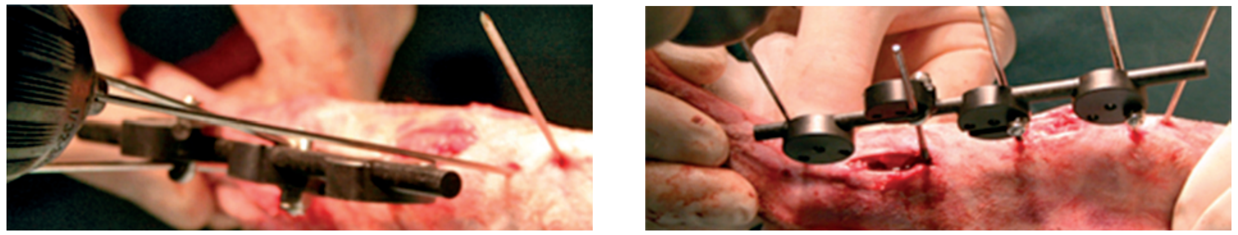
Figure 13. Sequence of the surgical process for placing the system in monolateral monoplanar configuration Type IA (Part 1).

Fracture alignment

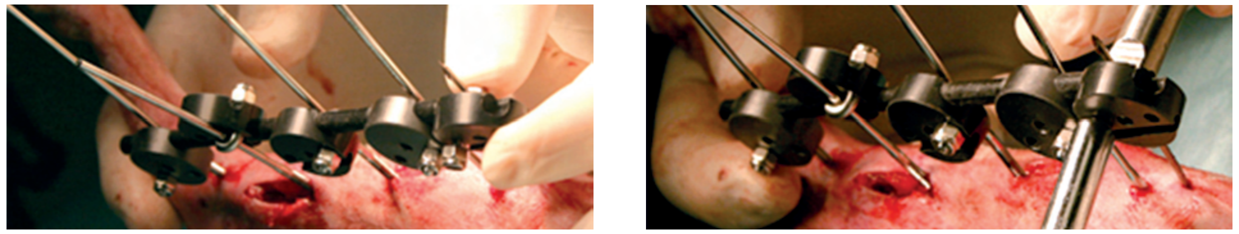
Positioning the second clamp

Locking and securing the second clamp

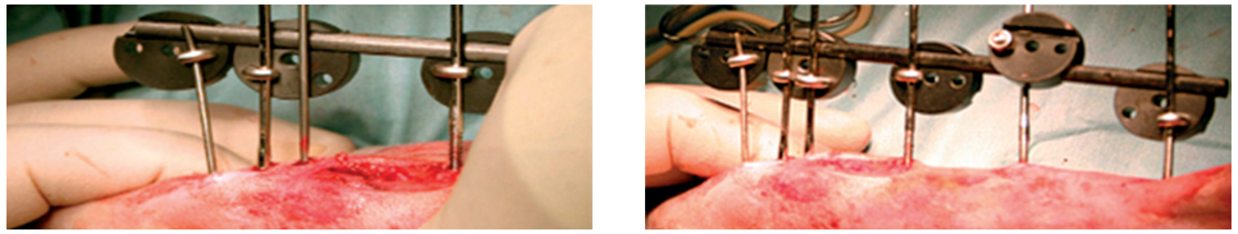
Check the correct reduction through the mini-approach



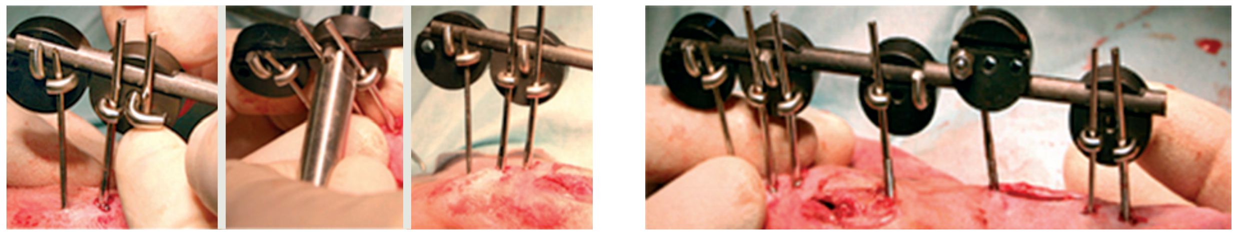
Connecting the third and fourth threaded pins on the carbon rod



Connecting and locking the IM pin on the carbon rod



Use of clamps with angulated holes to reinforce the system with more threaded pins



Carbon rod fixation and locking with long hooks

Figure 14. *Sequence of the surgical process for placing the system in monolateral monoplanar configuration Type IA (Part 2).*

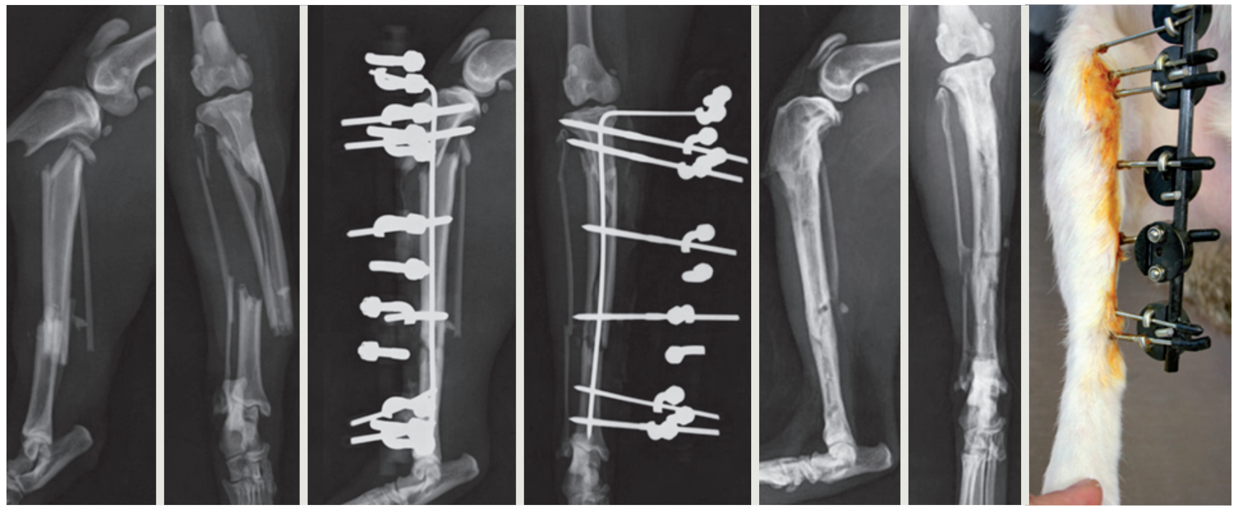
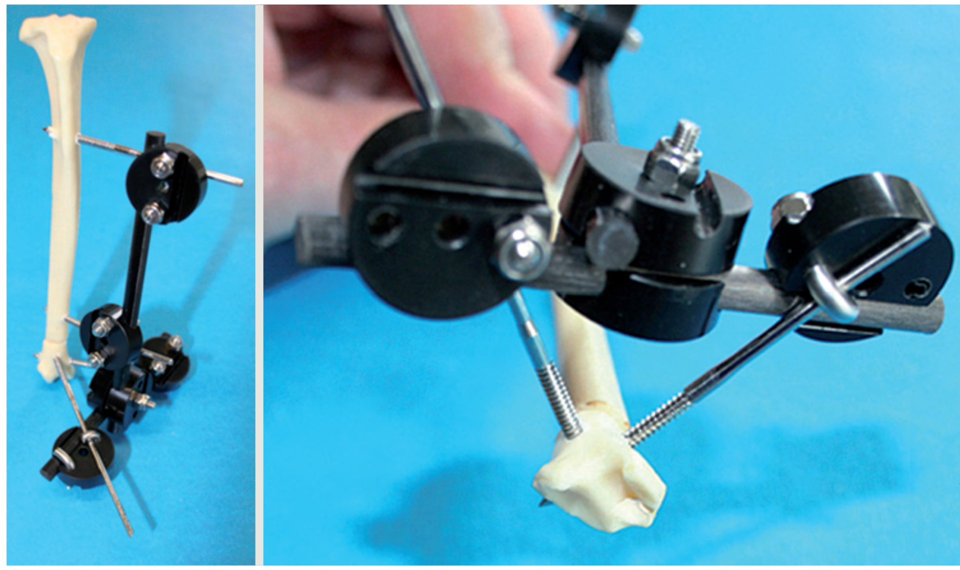


Figure 15. *Clinical case resolved surgically using the system in monolateral monoplanar Type IA configuration. Positioning IM pin to align bone segments. Implantation of two threaded pins in two Mickey clamps to stabilize proximal and distal fragments. Implantation of threaded pins in two clamps with aligned holes to stabilize the intermediate fragment. IM pin fixation to the carbon rod with a clamp with aligned holes.*

- Consider using a T-shaped configuration when a bone fragment is very small. This structure is recommended in very young animals weighing less than 3 kg and with transverse fractures.
- Consider using a secondary structure with fewer pins on the tension side of the primary structure (type IB). This system can be left on during the first few weeks of treatment and later be weakened by removing it to transform it into type IA.
- As an example of this type of configuration, you can see the clinical case in *Figure 15*.

MONOLATERAL T-SHAPED CONFIGURATION

This represents a variation of the type IA configuration and is used to stabilize small distal fragments. Its assembly is based on connecting two carbon bars at an angle using two clamps with an M3x20 mm screw (Figure 16). In this way, the longer fragment is stabilized with pins positioned in the vertical arm of the structure, while the shorter fragment is stabilized with pins positioned in the horizontal arm of the structure. To achieve this, a clamp must be placed on each side of the horizontal arm, and the pins should be positioned in the bone convergently (Figure 17).



FFigure 16. *Example of T-shaped monolateral configuration.*

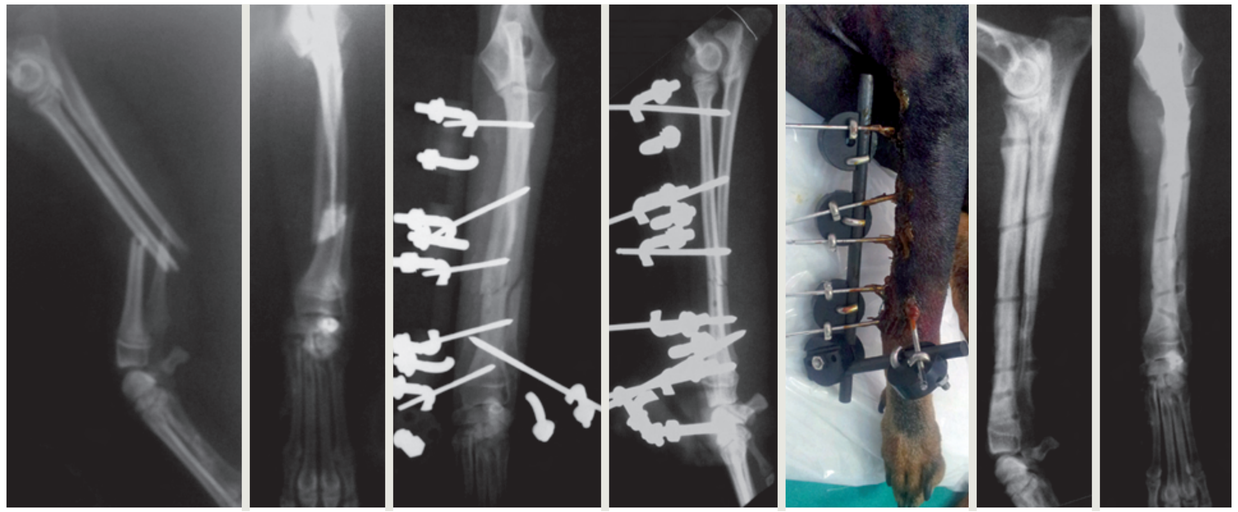


Figure 17. *Placement of the clamp and positioning of the pins in T-shaped monolateral configuration.*

In the end, a connecting bar, a distal pin, and a proximal pin can be added to increase the structure's stability. When the distal fragment is less than 5 mm, the use of a hybrid circular fixator should be considered.

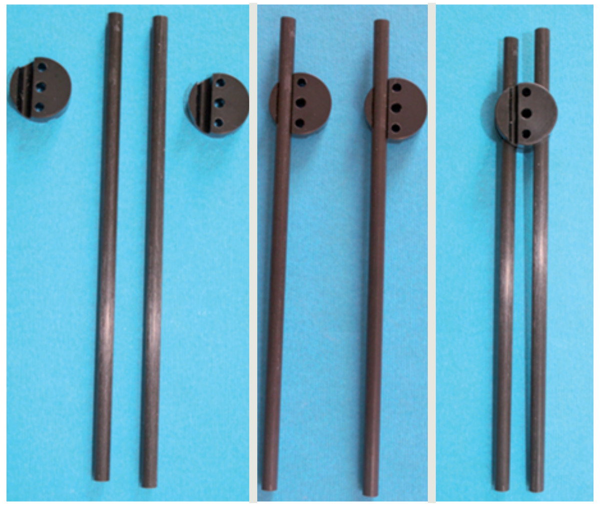


Figure 18. *Material required for double-bar configuration.*

DOUBLE BAR CONFIGURATION

One of the most peculiar features of the Polilock system is the possibility of connecting pins with a double connecting bar using the same clamp (Figure 18). Thus, the structure's weight and inconvenience are reduced compared to the Meynard system, as a double line of ball joints is not necessary. Torsion is not an issue with this type of system, and it should be used in fractures where torsional instability may occur.

The correct assembly sequence would be as follows:

- Connect two clamps with aligned holes with a carbon bar of the correct length.
- Rotate one of the clamps with the connecting bar upside down and position it opposite the other clamp.

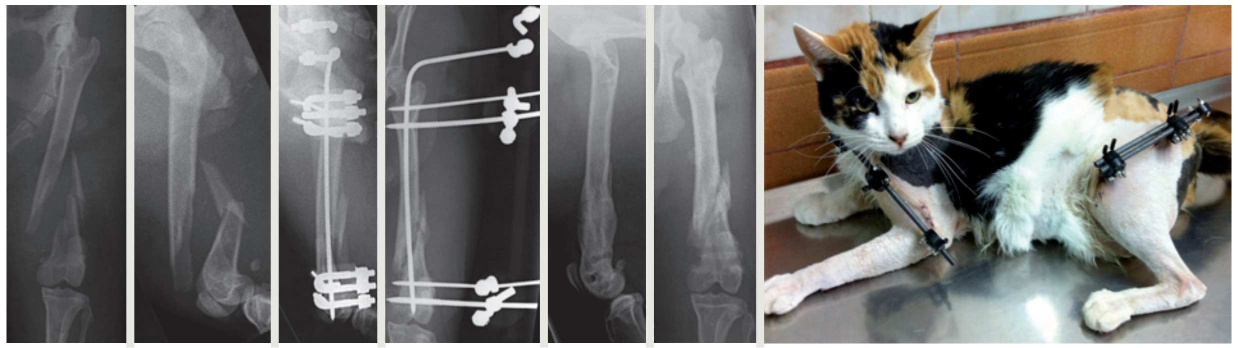
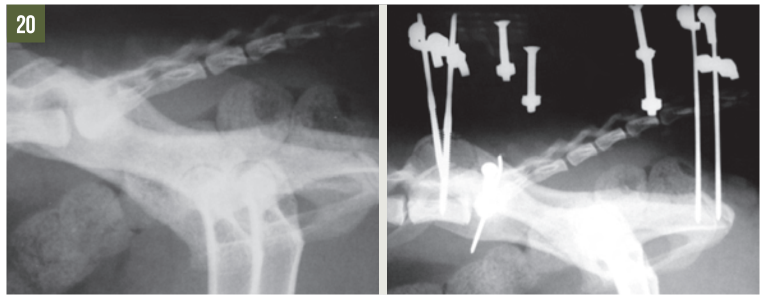
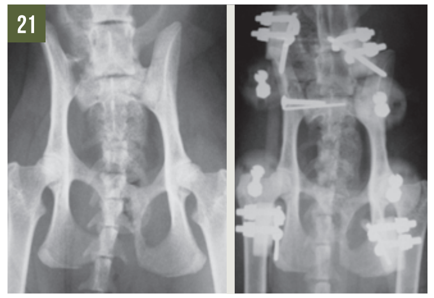


Figure 19. *Example of double-bar configuration.*





Figures 20/21. *Ejemplos de configuraciones más complejas en pelvis.*

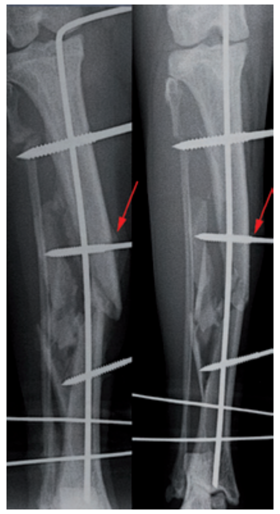


Figure 22. *Loosening due to the use of a trocar-point pin.*

Figure 23. *The pins should have a progressive change between the thread and the shaft.*

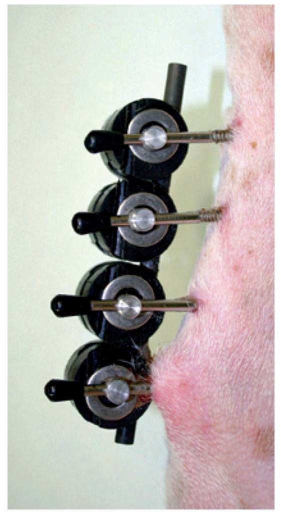


Figure 24*Infection in a case managed without a large skin incision.*

Figure 25. *Residual deformities due to low fixator stability.*

- Use a hook with a long axis that passes through the hole in both jaws and stabilizes the needle. If all three holes are aligned, at least two with long-axis hooks could be used to fix the needles..
- Ensure that the jaws at the opposite end of the bar have the same alignment and use long-axis hooks to fix the programmed number of needles (figure 19).

OTHER CONFIGURATIONS

We can use the fixator with more complex configurations to treat pelvic fractures since these assemblies are very useful due to the stabilization of this problematic area. They can also be associated with internal fixation since the fixator's lever arm is much greater compared to an internal implant (screw or plate). When used in combination, after a few weeks and once the callus has developed, the fixator can be removed, leaving the internal implants as they will be subjected to lower loads (Figures 20 and 21).

RECOMMENDATION FOR USE

Once autoclaved, it is recommended to let the system cool down to room temperature to avoid implant loosening, as the expansion of the plastic clamp due to heat can cause hook loosening when it cools.

Moreover, it is recommended to check the nuts' locking on the hook 15 minutes and 24 hours after implantation since, being a plastic and elastic system, plastic deformation of the ball joint may cause slight nut loosening.

On the other hand, always use self-tapping pins with pre-drilling to ensure the best possible thread quality in the bone cortex. Finally, never force the pin to adapt to the clamp, as it can bend to minimize stress on the cortex.

COMPLICATIONS

The main complications we will encounter are common to using external fixators. Regarding implant loosening, the primary cause is not performing pre-drilling or using poor implantation technique without respecting RPM and constant cooling, causing thermal injury in the cortex, leading to thread necrosis and loosening. Additionally, using trocar-point pins increases the likelihood of loosening compared to self-tapping pins (Figure 22). On the other hand, implant breakage is usually due to incorrect size selection and underestimating the patient's activity. The weakest point of a threaded pin is the transition between the thread and the shaft; thus, it is recommended to use pins with a progressive change in diameter between the threaded part and the shaft (as the tapered run-out pins) to minimize force concentration (Figure 23).

To avoid possible infection, it is recommended to make a wide incision in the dermis and not touch the pin tip before introducing it into the drilled hole. This allows inflammatory fluid to drain through the skin wound. Implants without a wide skin incision will suffer greater load and can cause cortical injury, favoring infection (Figure 24). Finally, residual deformities can also occur due to low fixator stability (Figure 25).

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