How I improvised an external fixator to manage open fractures

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Introduction

Orthopaedic surgery is a technical specialty. In Nigeria, as in most developing countries, insufficient funding is available for technological advancement [1]. Indigenous hospital technology can reduce cost of managing injuries needing surgery, many of which are caused by an epidemic of road traffic accidents [2]. This paper explains how to make and use an improvised external fixator for the management of open fractures and instruments used for its clinical application. This is an improved version of an earlier external fixator [3].

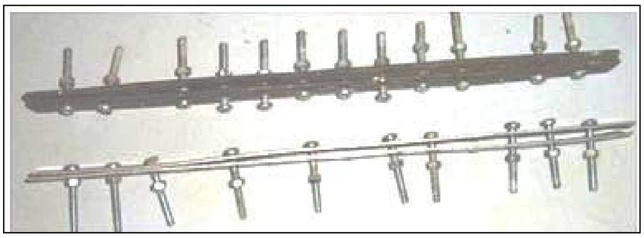

Figure 1. The improvised external fixator

Figure 2a. Plates, screws and nuts used for making the improvised external fixator.

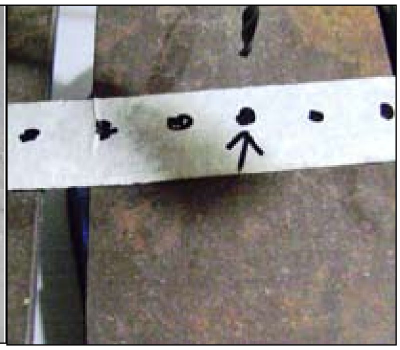

Figure 2b. Arrow points to an area marked for drilling of hole on a plate.

The improvised external fixator and accompanying instruments

A. The external fixator

The improvised external fixator (Figure 1) consists of two metal (iron or aluminum) plates (breadth 1.7 - 2cm; thickness 1.7 - 2mm). The plates are drilled so that the distance between two holes is 2cm and mirror symmetry of each other. Screws are passed through the holes. The length of the plate is customised. Tightening the nuts on the screws reduces the distance between the metal bars. In this way implants between them are clamped.

The grip between the metal plates is strong enough to retain a 15-kg weight and so strong that a cement bag, 50-kg weight cannot slip out of its grip. Kirschner wires, Schanz screws, Denham and Steinmann pins are implants that can be used with this external fixator. Denham and Steinmann pins are used as full pins. Schanz screws are used as half pins. Kirschner wires can be used as both full and half pins.

How to make the external fixator

Step 1(Figure 2a): The materials, plates (made of iron or aluminum), screws (made of iron; diameter=4mm) and nuts (made of iron) are usually sourced from the local junk yard. The plates are often donated. The screws are the type used to attach vehicle number plates in Nigeria. If the plate is too wide, it is cut to the required size (breadth between 1.7cm and 2cm; thickness between 1.7mm and 2mm) with an artisan's grinding machine.

Step 2 (Figure 2b): The desired plate is wrapped with a masking tape. A midline is drawn on it. Holes are drilled along the midline at 2cm intervals. This plate can be used as a template for drilling others.

The drilling machine used is usually a small bench drilling machine (power=350 watts; revolution not more than 2700 revolutions per minute; maximum diameter of drilling bit the machine can accommodate=13mm). The bit (diameter=4mm) used in drilling the plates is run at least twice. This widens the holes for the nuts (diameter=4mm).

B. The modified powered drill [4]

Powered drills designed for orthopedic surgery are expensive and the spare parts are not easily available in Nigeria. For this reason a commonly available powered technician's drill is modified by reducing the quantity of electricity it uses. This is achieved by diverting electricity through a domestic ceiling fan switch (a rheostat)

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Figure 3. Tools for assembling the fixator.

before reaching it. Thus the number of revolutions per minute(r/m) is reduced from 2500r/m to 800r/m. This also reduces the heat generated by friction. The more the heat generated during drilling of holes in bones the more the necrosis along the pin tracts and the higher the possibility of pin tract infection which will cause the pins to wobble and loosen. The chuck of the powered technician's drill does no communicate with the interior of the drill. For this reason only short drilling bits can be used. Long drill bits are not suitable becausethey can break as result of the torque.

C. Tools for assembling the external fixator

These are shown in Figure 3.

Notes for Figure 3. From left to right:

- Screw driver (one end is star-shaped and the other end is flat). This is used for tightening a screw when the head is under direct vision.
- Screw driver (one end is star-shaped and at right angle to the other end which is flat). This is used for tightening a screw when the head is not under direct vision.
- Flat spanner. This used for tightening a nut. It is specific for the particular nut and the distance between two holes is also specific for the flat spanner.
- A pair of long nose pliers. These are used for holding a nut that is under direct vision.

D. A distraction/compression device

This improvisation consists of a long threaded metal rod that passes through two pieces of metal pipe. A small piece of metal plate is welded at an angle to each pipe. The angle between the pipe and the metal plate face each other when compression between fracture fragments is required. The angles face opposite directions when distraction is required. During compression of fragments a washer is placed at the each end of the bolt. This washer

Figure 4. The improvised distraction/compression device mounted for compression

is succeeded by a nut at each of these two ends of the bolt (Figure 4). Turning of the nut pushes the wings of the pipes against the pins. During distraction of fragments two washers are placed in between the pipes but before these watchers two nuts had already been passed to the middle of the rod. Turning the nuts widens the distance between them. Thus fracture fragments are distracted.

Conclusion

This technology can be easily duplicated. The external fixator and compression/distraction devices are easily made in the hospital workshop from scraps. It takes on average an hour to make this external fixator. Although it looks primitive, its grip is a proof of its mechanical stability which prevents fracture re-displacement after reduction. Thus good outcome of treatment of open tibial shaft fractures can be assured. The only thing these devices lack is aesthetics which can be improved upon but this may increase costs – which defeats the purpose of reducing the costs through the development of indigenous technology. The implants used with this improvised external fixator are standard, factory-made types and purchased from international suppliers.

References

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