REVIEW ARTICLE

The Use of External Fixators: A Review of Literature and Experiences in a Developing World.

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ABSTRACT

Background: *The introduction of external fixation devices has brought significant improvement in the management of complex open fractures.*

Its importance and versatility ranges from its use as temporary fixation device in fractures with soft tissue and vascular injuries to its use in definitive correction of limb length deformities and congenital malformations. It avoids extensive soft tissue damage and enhances easy management of associated soft tissue injuries.

Method: *This was an overview of the clinical experience at the University of Calabar Teaching hospital and a review of literature.*

Result: *The paper highlight the usefulness of external fixation devices and the need to encourage its use in the developing world. It also stresses the constraints encountered in a Nigerian teaching hospital.*

Conclusion: *A call is made to all surgeons particularly those in rural areas to make use of this simple appliances after due training. Government should equip the hospitals with these tools and encourage the fabrication of such in our environment.*

KEYWORDS: *External fixators; Advantages; Fractures; Constraints; Developing world.*

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INTRODUCTION

An external fixator is a device placed outside the skin which stabilizes bone fragments through pins or wires connected to one or more longitudinal bars/tubes[1]. Fractures can be stabilized by transfixing the pins or tensioned wires which pass through the bone above and below the fracture and are attached to external frame /bar[1,2]. This is typically applied to tibia and pelvis but can be modified for use on the femur, humerus, radius and bones of the hands, and feet[1,2,4]. Rigaud, Malgaigne and Levy were the first to use claw-like devices for olecranon and patella immobilization in the 1850s[2].

Between 1907 and 1954, scientists in different parts of the world like Lambotte, Anderson, Hoffmann, Hey Groves, Stader, Judet, Keettley and Ilizarov contributed to the improvement in designs and techniques of external fixations[1,3].

The A.O. group, Vidal and Hoffmann rekindled interest in the principles of application. They laid emphasis on rigidity in the use of the systems and therefore introduced the more complex systems[1,2,4]. However Burny in 1979 opined that external fixations should be non-rigid to allow for healing by callus formation. These divergent concepts led to the inventions of various sizes and designs with minimal side effects. Though some are expensive they can be easily fabricated to meet local needs. Presently standard devices are manufactured by the A.O. group, Ilizarov, Shefield (Orthofix), Hoffmann and the Osteofix[1,3]. There are also many other unbranded devices which are cheaper and easier to use even in non-specialized centres[5].

Classification of external fixation devices

All External Fixators are made up of the transfixing pins/screws, the connecting bars/rods and the clamps[1,2,4,5]. These could be designed into:

1. Frames (Pin fixators)
2. Single bar-system
3. Ring (wire) fixators.
4. Hybrid and the pinless fixators[1].

FRAMES

These are the commonest and simplest form of fixators. They could be designed into unilateral, bilateral, triangular and quadrangular applications. Examples are Hoffmann, AO fixators and the Osteofix.

THE SINGLE-BAR

The single-bar device is simple to apply. Its frames have sufficient strength and versatility but it is expensive, examples are the Huges and Orthofix bars. The modern form of single-bar fixator is the Mefisto fixators which were mainly designed for limb lengthening and bone transport[1].

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THE RING FIXATORS

The Ring fixators are more complex.
Typical examples are the Ilizarov, Sheffield and the A O ring fixators. They could be arranged in semi or circular configurations. Apart from conferring rigidity, the single bars and the Ring systems are useful in complex corrective procedures[7,8,9].

Other types

These include the pinless and the Hybrid fixators. The Hybrid combines pins and wire fixation and is used in complex fractures that are close to the joints[1]. The pinless fixator makes use of periostal forceps which does not penetrate the medullary canal.

Indication for use of external fixators

External fixators can be used for the treatment of the following:

(I) Fractures associated with:[1,9] Soft tissue damage, soft tissue loss, neurovascular damage, burns, bone loss, comminution Failure of previous treatments. Delayed union, Non-union and infected non union.[11] Major Pelvic distraction.

(II) Stabilization following: Polytrauma [9], Arthrodesis, Osteotomy, Massive bone resection, Leg lengthening and Soft tissue stretching.

Components of standard external fixators

The main components are:

1. Pins (Schanz screw/Steinmann pins)
2. Stainless steel tube or carbon fibres (rods).
3. Various shapes and sizes of clamps to fasten pins/wires to rods/tubes.
4. Clamps to connect rods to rods or tubes to tubes.

Technique of application

External fixators are most commonly used in the management of type 3 open fractures[1,11]. After thorough debridement in theatre, incisions are made (at distances dictated by the extent of soft tissue injury above and below the wound laterally except in the tibia where antero-medial border ensures no muscle transfixion (Safe corridors)[4].
Details of application techniques are available in modern Orthopaedic/Trauma texts[1,2]. Except for the ring fixators which require some expertise, the application method is simple and can be applied at the non-specialist centres. If the simpler devices are made available and properly introduced to practicing doctors in the Developing world, many limbs could be saved at all levels of our healthcare[5,12].

The advantages of external fixation

1. It is generally cheaper than internal fixation[10,11].
2. It is easy to apply and can be fabricated or modified to meet demand.
3. It gives allowance for soft tissue management[11].
4. It can correct axial, rotational and limb length discrepancies.
5. It does not require a second operation for its removal
6. It has fewer complications than internal fixation methods
7. Except the Ilizarov device, it does not require prolonged learning or surgical skill as in open reduction and internal fixation (ORIF)[1].
8. It is a safe procedure in cases associated with bone sepsis.
9. It causes minimal damage to blood supply of bone and soft tissues.
10. Most of them are well tolerated by patients[1,2].

Complications/disadvantages of external fixation:

The use of external fixators is associated with very few complications compared to open reduction.
The common complications of external fixation include:[1,8,9,13].

(1) **Infection:** This can be caused by improper skin incisions/ wound care and can be contributed by the stiffness of the transfixion pins.

(2) **Pin Loosening**: These usually accompany pin tract sepsis. It can also result from wrong pin placement or over zealous mobilization by the patients.

(3) **Neurovascular/soft tissue Transfixion:** This can occur if the safe corridors are not observed[4]. Sural or saphenous nerve transfixion occur in rare cases[9].

(4) **Over Distraction:** Proper union is unlikely to occur if there is no contact between the bone fragments.

(5) **Poor Acceptability**: Some of them are cumbersome and not well tolerated by patients. It may also restrict joint movements.

Outcome of fractures treated by external fixation:

The average healing time of grade (III) open fractures is about 30-40 weeks[2,6]. This is affected by the degree of soft tissue damage and bone comminution. In developed countries, it is easy to grade the healing potentials of externally fixed fractures[1,4]. For example, after extensive study by Lawyer and Luthers the following observations were reported[4].
Grade (II) open fractures healed in an average of 20-weeks.

Grade (1) open fractures healed in an average of 21-weeks while closed fracture healed in an average of 23-weeks.

This increase in union time in the close fracture is interesting. It is probably related to degree of damage and subsequent release of factors of wound/fracture healing which are more in Grade (III) and (II) open fractures. It also indicates that these fractures and type (I) open fractures may heal faster with cast application or open reduction/internal fixation and should be treated by these other methods.

Many surgeons in Nigeria are not yet conversant with the complex fixators and their uses in corrective surgeries of the limbs because they are not available[7,12,13]. Those who had experience with these facilities outside Nigeria are fast losing their skills because of the above reason[10,14]. Government and philanthropists should come to our aid.

Our experience and major constraints:

The major constraints in our environment are due to inadequate external fixation device and high cost of instrumentation.

In the last five years our hospital had been managing with only five (5) sets of the device. The rest were either bought directly by the patients or the surgeons. There was also the problem of outdated or complete lack of basic Orthopaedic/trauma theatre equipment. The cost of the device and the operations range between 25,000 to 35,000 Nigerian Naira (about 190-270 Dollars) per patient. This is quite costly considering our economy and the category of patients involved in this type of trauma (mostly commercial motorcyclists)[13]. However, since the introduction of the cheaper forms of the device (from Malaysia) into Nigeria its use has increased remarkably. Commonest in our series were crushed injuries affecting the tibia/fibular, radius/ulnar and the hand. The devices used in our hospitals include the A.O. frames, the unbranded ones and occasionally the pin-in-plaster (PIP) techniques[13,15,16]. In the cases of (PIP), long Steinmann pins are passed above and below the fractures, these are then incorporated in a cast. Sometimes these systems are modified and used for the treatment of open intra-articular injuries, chronic Osteomyelitis (i.e. infected non-union) and traumatic bone loss. The complications encountered in this series were pin tract infections, Osteomyelitis and temporary equinus deformities of the ankle[12]. The Principles of application and techniques is now mastered by the Resident Doctors in our centre and should spread to the rural areas if the facilities are made available[1,16,17].

CONCLUSION

External fixation has brought remarkable improvement in the management of skeletal injuries[15,16,18,19]. Cheaper and easy-to-use alternatives are now available but these are still outside the reach of the ordinary Nigerian[18]. Government, individuals and non-Governmental agencies should assist in this direction.

Proper emergency care programme and National health insurance would improve healthcare and frustrations encountered by specialist working in Nigeria.

All surgeons and general practitioners especially those working in the rural areas should avail themselves of this simple techniques by attending seminars and Hands-on-Workshops/short courses in Traumatology.

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