Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

Research Paper

External Skeletal Fixation for Fracture Management In Animals

Veterinary

KEYWORDS : Fracture, Animals, External Skeletal Fixation

Dr. Bini Joy — Department of Veterinary Surgery and Radiology, College of veterinary and animal sciences, Mannuthy, Thrissur, Kerala, India.

Dr. Syam K Venugopal — Associate Professor, Department of Veterinary Surgery and Radiology, College of veterinary and animal sciences, Mannuthy, Thrissur, Kerala, India.

ABSTRACT

External skeletal fixation is one of the novel technique used for fracture management in animals . It has been widely used in human practice. The external skeletal fixation has lot of unique advantages in its application which popularize its use in animals.it can be used in any type of fractures like open, closed, simple or comminuted with least invasiveness and much stability to fracture by preventing the fracture forces. It can be used in conjunction with internal fixation and its configuration can be altered even after application or during the bone healing process. It has wider application in cases like limb or bone lenghtening, treatment of inected bony conditions etc. its adaptability helps in widely using it in veterinary practice.

Summary

External skeletal fixation is an external coaptation technique used to stabilize bone fragments or joints with percutaneous wires or pins held together by an external frame. The technique is simple in its application with least effort to surgeon and less invasiveness to animal. It can be used in all conditions where the use of internal fixation device fails. It can be applied in case of long bone fractures (open, closed, simple or comminuted), treatment of choice for highly comminuted fractures that cannot be anatomically reconstructed, treatment of choice in osteomyelitis, treatment of choice for high-energy fractures, limb lengthening procedures etc. Direct or indirect healing noticed depending on alignment of fracture site. Healing by biological fracture fixation or bridging osteosynthesis. Some degree of interfacing motion /loading is accepted if fracture is stabilized in a manner that minimally disrupts soft tissues and vascular supply. Fracture healing is manipulated by Dynamization or progressive disassembly hastens healing (6wk). Modification done to reduce rigidity. Distraction osteogenesis also occurs in external skeletal fixation. More of that the clamps and connecting bars are reusable and so economical too. Thus external skeletal fixation is gaining much popularity among veterinary

1. Introduction

External skeletal fixation is an external coaptation technique used to stabilize bone fragments or joints with percutaneous wires or pins held together by an external frame. It will helps to stabilise bone fragments or joints with percutaneous pins or wires held together by an external frame , otherwise method of treating skeletal injuries by attaching bone to an external device. In the veterinary practice this technique have lot of unique advantages apart from other internal fixation techniques and coaptation techniques, which strongly recommends its use among veterinary patients.

2. History

The use of external fixators to treat human injuries was first reported in 1897 and a fixator specifically for veterinary use was designed in the late 1940s by Ehmer, based on a human design. Their use in man declined following a high incidence of complications associated with the treatment of fractures during World War II. The history of external skeletal fixation dates backs to 4 th century with the time of Hippocrates. KE apparatus discovered in 1940.

3. Indications for use.

- long bone fractures(open, closed, simple or comminuted)
- treatment of choice for highly comminuted fractures that cannot be anatomically reconstructed
- treatment of choice in osteomyelitis
- treatment of choice for high-energy fractures and soft- tissue injuries and vascular compromise
- in case of nonunion / with bone graft /
- corrective osteotomy for antebrachial or tibial growth deformities in one dimension
- limb lengthening procedures- with type II configuration and distraction body
- transarticular ESF in arthrodesis or temporary splintage during healing of soft tissue or osseous structures
- conjunction of ESF with internal fixation- screws, cerclage, IM pin (tie-in configuration)-in humeral, femoral or tibial fractures
- hybrid ESF system-in humeral, radial or tibial fractures with very short distal or proximal fragment
- mandibular or maxillary fractures- usually with acrylic fixators
- lumbosacral fractures and luxations
- avian limb fractures
- for fracture repair in small exotic mammals

4. External fixation devices comprises of three basic units -

I. Transfixation pins inserted into bone to hold the major bony fragments
II. External connectors to support fractured bone
III. Linkage device that attach transfixation pins and external connector

External connectors are made of stainless steel, aluminum or acrylic. The linkage device connect transfixation pins and connecting bars . As the size and number of connecting bars increase the stiffness and strength increases.

4a.Fixation pins

Threaded or non-threaded Steinmann pins, Ellis pins, Imex pins or Kirschner wires can be used . Threaded pins offer better purchase .The disadvantage of pins with negative profile (or 'cut in') threads is that they develop a point of stress concentration at the end of the threaded portion. Commonly a mixture of positive profile threaded pins and non-threaded Steinmann pins are used to create an ESF.

4b. Connecting clamps:

Traditionally a system of clamps and connecting bars have been used to stabilise the fixation pins. Various types based largely on the Kirschner-Ehmer apparatus have been marketed and are available in 'small', 'medium' and 'large' kits . Single clamps are used to anchor each fixation . Occasionally, short connecting bars are used to connect the pins in the proximal and distal fragments and then these two are connected by a third using double connecting clamps.

4c. connecting bars: made of stainless steel or aluminum.

Acrylic connections: Instead of using metal clamps and connecting bars, the fixation pins may be joined together using an acrylic material such as polymethylmethacrylate. The acrylic may be applied directly over the pin ends or else injected into some form of tubing which is first placed over the pin ends.

Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

The main advantage of an acrylic system is that a variety of sizes and orientations of pins can easily be accommodated due to the flexibility of the connecting bar.Materials is less expensive in terms of initial outlay, but the metal clamps and connecting bars are reusable.

Disadvantage of acrylic systems is that it is far more difficult to make adjustments to the frame once the material has set and postoperative radiographs have been taken. The APEF system overcomes this by allowing temporary clamping of the fixation pins and then, after radiographs have been taken, the acrylic bars are added.

Pin/bar sizes :
The fixation pin size chosen depends on the size of the animal and bone involved. As a general rule, the diameter of the pin should not exceed one-third the width of the bone into which it is being placed, otherwise stress-related fractures may occur.

5. Classification of ESF frames/constructs:
The frames have traditionally been referred to as types I, II and III according to on how many sides of the bone there were connecting bars. More recently the terms unilateral and bilateral have been used, depending on whether the fixation pins occupy up to or more than 90° of the bone's circumference, and uniplanar or biplanar, according to whether they lie in one or two planes.

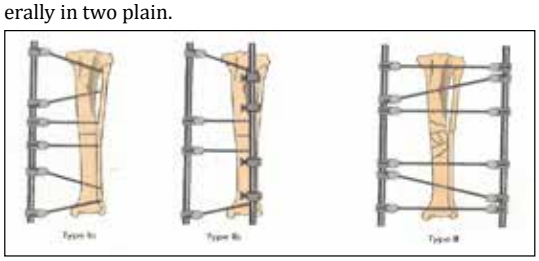
5a. Linear frames :
Unilateral -uniplanar : (type Ia) **.** Here pins are inserted unilaterally only.

Used in fractures of femur and humerus where the pin contact with body have to be avoided.

Unilateral biplanar : (type Ib). Here pins are introduced unilaterally in two plains.

Bilateral uniplanar : (type II). Here pins are introduced bilaterally in single plain.

Bilateral biplanar : (type III). Here pins are introduced bilaterally in two plain.



5b. Free form :
pins are interconnected using a polymer not a rigid connecting bar. It is perfomed with PMMA columns of conn bar. Polymer of doughy consistency around. Plastic tubing with polymer inside. With thermoplastics or epoxy putty connecting bar.

5c. Circular exfix :
Rings connected by threaded rods. Method of placement is called Ilizarov method. Frame fixed to bone with small diameter wires and with half pins

Types of circular frames:
Simple circular frames – for length deficits, joint sub luxation Frames with hemispheric washers- for minor limb deformity.

Hinged fixators - for simple limb length deficits, angular deformity, sub luxation

Advantages :
Unlimited geometric adaptability.

6. Optimisation of frames :
Factors involved in selection of frames:
Frame type and configuration- pin type, number ,configuration, connecting rod number. 3 or 4 pins per fragment of bone to be introduced. Smooth pins are angled to increase rigidity. Threaded pin introduced perpendicular to bone. Stiffness is directly proportional to 3rd power if length and forth power of diameter of pin. Pins not closer than 3 times its diameter or half the diameter of the bone from joints ,fractured edges. Central pins not in contact with fracture edge. Coating with hydroxyapatite improve pin bone interface. Pin placement cause structural and thermal damage . Predrilling with bit needed(300 rpm or less). Circular used for tibial, radial , short fracture segment , bone defects present and Postoperative adjustment needed .

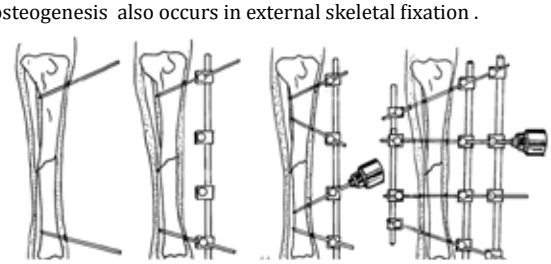
Placement principles :
Biological response have to be enhanced. Radiological evaluation by mediolateral view. Choice of frame selected. Potential preassembly have to be done. Frame assessment done.

For Fissure fracture - less stability

Circular –tibial, radial deformity, nonunion, highly comminuted fractures

Steps :
- Suspend limb from ceiling
- Frames placed in closed fashion
- Pin paced through safe corridors
- Pin order : proximal and distal pins first inserted followed by pins near to fracture site.
- BUILT FRAMES that allow FULL WEIGHT BEARING without interfering limb usage

BONE HEALING
Direct or indirect healing noticed depending on alignment of fracture site. Healing by biological fracture fixation or bridging osteosynthesis. Some degree of interfacing motion /loading is accepted if fracture is stabilized in a manner that minimally disrupts soft tissues and vascular supply. Fracture healing is manipulated by Dynamization or progressive disassembly hastens healing (6wk). modification done to reduce rigidity. Distraction osteogenesis also occurs in external skeletal fixation .



7. Clinical application :
Linear fixation mainly for long bone. Circular for limb deformities. Used as Load sharing device in comminuted fracture - buttress fixation. Exfix adjunct to cerclage, lag screw, IMP- neutralization device. To protect surgical repair of tendon injuries

Fixation –radial & tibial fracture :
Radial- unilateral & bilateral
Distal radial fracture - free form of exfix
Safe corridor- Proximally – lateral approach. Distally –medial & craniomedial Curved conn bar from proximal to distal is ideal

Humeral & femoral fracture :
Proximally – unilateral / unilateral biplanar
Distally –unilateral or bilateral . A curved connecting bar is used. Proximally – craniomedial approach using half pins. Distally -laterally

8. Post operative care
Gauze sponges, padding, bandage with soft dressing. Cleaning with 0.05 % chlorhexidine .Frames covered. Leash walks given. Antibiotics for 1 week.Radiograph taken 3-4 weeks, 6-8 wks, 12weeks if needed. Dynamization done generally after 4-6 wks , Bilateral changed to unilateral. Restricted activity – after 3 weeks of removal .

9. Complications

Compications include Pin /wire loosening, breakage, Failure of fixation, Pin tract infection,Delayed union, Fracure ,Malunion ,osteomyelitis ,Neurapaxia ,Loss of range of motion,Muscle atropthy ,Muscle contracture.

Conclusions:

External skeletal fixation technique have certain advantages like succesful in treating closed and open fractures, Limb deformities, non unions , Stabilization of joints during healing of luxation or arthrodesis ,Adjustability after surgery ,Less invasive to fracture site etc. More of that the clamps and connecting bars are reusable and so economical too. The only drawback is of patient compliance and aesthetic appeal.

REFERENCE

Crauss. H. K., Toombs.P.J. , Ness.M.G.,(2003). External fixation in small animal practice. Blackwell publishing. pp 8-193 | Denny .H.R., Butterworth.S.J., (2000). A guide to canine and feline orthopedic surgey .4th Edn. Blackwell publishing. pp 97- 107 | Fossum.W.T., Small animal surgery , 3rd Edn.Mosby publications .pp735-742 | Piermattei .D., Flo.G.,Decamp.C.,(2006).Hand book of small animal orthopedics and fracture repair.4th Edn.Saunders.pp 73-77 |