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ORIGINAL PAPER

SICOT contribution to natural disaster assistance: the external fixator

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Introduction

One of the problems encountered by most of volunteer orthopaedic surgeons taking part in the humanitarian missions during natural disasters is to prepare them for unusual environments. To operate in a remote area with limited equipment, deficient infrastructure and small medical teams is not usually taught at medical school or as part of university training. To prepare these volunteers with a minimal knowledge of what they will encounter is the objective of the symposia we have been holding on natural disasters since the SICOT Congress in Gothenburg, 2010, where we had a debriefing after the Haiti earthquake. In 2011, the symposium was on the controversial topic of amputation [1–6], in 2012 on triage [7–11] and in 2013 on external fixator application [12–15]. In 2014 in Rio, it will be on the prerequisite regarding training, equipment and infrastructure.

The external fixator is probably the best device with which to fix fractures during the difficult conditions of a natural disaster, providing the infrastructure to allow pin implantations in sterile conditions. Among others, the main advantage of external fixators, including treatment of closed fractures, is a very physiological way of ensuring bone healing. Many types of devices are available, but only a few of them respect the following principles:

1. From a biomechanical aspect, they should allow a stable but elastic fixation of bone fragments. This means that micromotion is allowed between bone fragments, and when contact is restored between cortices, they permit transmission of cyclic compression forces at the fracture site.
2. Frame stability protects the reduction from any secondary displacement. Minimal resistance of the clamps must be validated on bench test., and frame rigidity must be adaptable in light of the evolution of fracture healing to allow more mechanical flexibility at the end.
3. Very few foreign materials—pins only—interfere with bone and soft tissue vascularisation and do not present the same risk for infection as a bulky internal fixation.
4. From a practical point of view, and this is especially true for the natural disaster environment, they should be flexible and polyvalent. This means that they comprise the same modules but can be assembled in different configurations and adaptable to the main anatomical regions and for different indications (fractures, non-unions, arthrodesis, joint stabilization,…) in adults and children. The ancillary must also be simple and polyvalent. The surgical procedure is fast.
5. To be efficient, the surgical protocol must respect strict rules. The device must allow implantation of the pin or group of pins independently in the main bone fragments. Approximated reduction is recommended to allow good orientation of soft tissue just before pin insertion but not the definitive reduction required by some external fixators in which all pins must be strictly aligned for fixation.
6. To prevent local conflicts and skin compression under pin clamps, clamps must be fixed two fingers distant from the skin at the time of surgery to tolerate possible soft tissue oedema.
7. After pin insertion, bone fragments are, if possible, mathematically reduced. If an urgent and fast procedure is required, a simple alignment may be obtained and reduced correctly in a second surgical procedure. After correct reduction is obtained, firm fixation must be easily achieved.

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8. To ensure stable fixation, pins must be as close as possible to the fracture gap (2 cm), depending on soft tissues damage. Using the smallest number of pins is recommended to adapt to bone anchorage quality.
9. Thin cortises and epiphyseal spongiosus bones require more pins. A principle of symmetry related to the same mechanical resistance of the anchorage on both sides of the fracture must be respected (e.g. two pins in cortises combine with three pins in epiphysis).
10. Pin size must be adaptable to bone size (e.g. femoral and tibial cortises, two 5 mm Ø; humerus, two 4 mm Ø; forearm, two 3 mm.
11. Frame configuration should be the simplest possible according to location and stability to allow easy access for wound dressing. Also, the configuration must respect normal function and be as little bulky as possible.
12. If, for emergency reasons at the time of first surgery, correct reduction is not achieved, a secondary reduction can be done using the same implantation pins. If at that time interposition does not allow correct reduction, an *a minima* open approach to the fracture gap is recommended.
13. Nursing consists of simple daily cleaning of pins tracts with physiological saline and ethanol and light sterile dressing during the first days.
14. Suspension may be easily achieved using the frame.
15. Ideally, the external fixator must be maintained until bone healing. Mostly in natural disaster environments, there are more disadvantages to converting external to internal fixations. Initially the external fixator should be used as a definite fracture fixation with the same rigor and not considered a temporary treatment, as is a plaster cast.
16. Finally, at fracture healing, the internal fixator may be removed easily without anaesthesia.

Applying external fixation using the above recommendations and rigorously following the surgical procedure represents an indispensable and excellent model with which to treat fractures in a natural disaster environment.

During the symposium, MSF France and Belgium, and teams from Pakistan and the French Army, reported their experiences [12–15].

References

1. Hinsenkamp M (2012) SICOT contribution to natural disasters assistance. Int Orthop 36(10):1977–1978
2. Herard P, Boillot F (2012) Amputation in emergency situations: indications, techniques and Médecins Sans Frontières France's experience in Haiti. Int Orthop 36(10):1979–1981
3. Wolfson N (2012) Amputation in natural disasters and mass casualties: staged approach. Int Orthop 36(10):1983–1988
4. Rigal S (2012) Extremity amputation: how to face challenging problems in a precarious environment. Int Orthop 36(10):1989–1993
5. Awais SM, Dar UZ, Saeed A (2012) Amputations of limbs during the 2005 earthquake in Pakistan: a first hand experience of the author. Int Orthop 36(11):2323–2326
6. Demey D (2012) Post-amputation rehabilitation in emergency crisis: from pre-operative to the community. Int Orthop 36(10):2003–2005
7. Hinsenkamp M (2013) SICOT contribution to natural disaster assistance: the triage. Int Orthop 37(8):1427–1428
8. Herard P, Boillot F (2013) Triage in surgery: from theory to practice, the Medecins Sans Frontière experience. Int Orthop 37(8):1429–1431
9. Rigal S, Pons F (2013) Triage of mass casualties in war conditions: Realities and lessons learned. Int Orthop 37(8):1433–1438
10. Wolfson N (2013) Orthopedic triage during natural disasters and mass casualties: Do scoring systems matter? Int Orthop 37(8):1439–1441
11. Awais S, Saeed A (2013) Study of the severity of musculoskeletal injuries and triage during Pakistan earthquake 2005. Int Orthop 37(8):1443–1447
12. Boillot F, Herard P (2014) External fixators and sudden-onset disasters: Médecins Sans Frontières experience. Int Orthop. doi:10.1007/s00264-014-2344-8
13. Bertol M-J, Trelles M. (2014) Limb salvage with external fixation. Int Orthop. DOI
14. Awais S., Sami AL, Shah AA, Saeed A (2014) External fixation of limb injuries: experience in the 2005 Pakistan earthquake. Int Orthop. DOI
15. Mathieu L, Ouattara N, Poichotte A, Saint-Macari E, Barbier O, Rongiéras F, Rigal S (2014) Temporary and definitive external fixation of war injuries: use of a French dedicated fixator. Int Orthop. doi:10.1007/s00264-014-2305-2