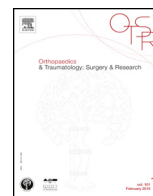




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Review article

Temporary fixation of limbs and pelvis

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ARTICLE INFO

Article history:

Received 23 January 2017

Accepted 7 March 2017

Keywords:

Temporary fixation

Conversion

Orthopedic trauma damage control

Sequential treatment

Multiple trauma

ABSTRACT

"Urgent, complete, definitive" treatment still today seems to be an appropriate attitude in many trauma cases. There are, however, several situations in which emergency definitive fixation is not the optimal strategy for all cases of fracture. Temporary fixation has a role to play in the orthopedic "trauma damage control" design comprising successive steps, as applied in multiple trauma, multiple fracture, severe multi-tissue limb lesions and soft-tissue lesions of unpredictable progression. The aim of this study is to define the strategies, indications, principles and limitations of temporary fixation in limb and pelvis fracture.

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Osteosynthesis is the surgical fixation of a fracture site. We here exclude applications other than in fresh fracture. Fixation may be internal or external and consists in stabilizing a fracture until consolidation is achieved, using material such as plates, screws, nails, K-wires or external fixators. Non-operative methods, traction and cast immobilization will also be excluded here.

"Temporary" here refers to a situation lasting only for a limited time. Temporary fixation is the provisional stabilization of a fracture awaiting lasting, definitive stabilization. It mainly uses external fixation, or, more rarely, temporary K-wires.

Temporary fixation is more a strategy for use in certain situations than a technique in itself. It is an element of "orthopedic trauma damage control" (OTDC), designating emergency fracture management by quick, temporary initial fixation, enabling definitive fixation to be postponed.

The decision to implement emergency temporary fixation in limb or pelvis fracture should not be taken without due consideration. The present study seeks to analyze the factors involved in this decision, dealing successively with:

- the general principles of temporary fixation;
- the specificities related to the context in which it is applied (multiple trauma, pelvic trauma, multi-tissue limb lesion, or soft-tissue lesion);
- its technical requirements and the modalities of conversion to definitive fixation.

1. What is temporary limb fixation? To whom is it applicable?

The last 50 years have seen many changes in the management of severe limb trauma. Former recommendations (non-operative treatment) gave way first to an all-in-one concept, and then to orthopedic trauma damage control.

"Urgent, complete, definitive" treatment still today seems to be an appropriate attitude in many trauma cases, if physiological status, local status and treatment conditions allow.

Multiple fractures can be managed as so many concomitant lesions. There are, however, situations in which one-step complete, definitive treatment is not the best option for the patient. Temporary fixation may be one of the primary steps in a more global concept of successive phases of OTDC.

"Damage control" was originally a term used by the US Navy to designate rough-and-ready repair of the most severe damage sustained by a combat vessel, to keep it afloat until it could reach harbor for definitive repair. "surgical trauma damage control" and its "orthopedic" subset apply the same principles.

Surgical trauma damage control was first developed to deal with abdominal trauma with massive hemorrhage, using a sequential approach to prevent a fatal cascade of events leading to death by exsanguination [1]. The term was first applied by Scalea [2] to management of multiple traumas involving long bone and pelvic fracture, with the objective of reducing surgical aggression by abstaining from ideal fixation in favor of quick, relatively non-invasive temporary stabilization, usually by external fixator. The concept was later extended to locomotor apparatus lesions of locoregional severity.

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OTDC systematically comprises 3 steps:

- emergency control of hemorrhage and infection, with temporary fixation;
- intensive care or surveillance of multi-tissue lesions;
- reintervention for definitive surgical treatment once the patient or local status has stabilized, with change or optimization of external fixation or conversion to internal fixation.

The term “damage control”, which strictly refers to emergency salvage procedures, is in fact currently used to cover all 3 steps.

Not all patients and situations are amenable to OTDC and certain indications are now well identified.

1.1. Limb trauma with associated life-threatening lesion(s)

Physiological status depends on associated lesions (abdomen, thorax, skull, limbs) but can be aggravated by surgery, the impact of which can notably be minimized by temporary fixation.

1.2. Multiple fracture involving long bones and pelvis

While the early total care (ETC) concept [3] advocates systematic primary definitive fixation, this attitude is not always well suited in case of severe trauma (Fig. 1).

Some casualties die due to underestimation of the severity of the initial trauma and of the impact of orthopedic lesions, to the surgeon's obsession with achieving perfect primary fixation and to failure of communication between anesthetists and surgeons.

As seen above, this is the original indication for OTDC. Tuttle et al. [4] showed that temporary external fixation of femoral fracture significantly reduced surgery time and blood loss.

1.3. Isolated but severe limb trauma

There are 3 situations corresponding to such a regional indication for OTDC:

- multilevel limb trauma, especially when involving the femur;
- multi-tissue trauma, especially in case of vascular lesion with ischemia;
- fracture impossible to treat in emergency, due to cutaneous damage and/or fracture complexity: e.g., high-energy epiphyseal or metaphyseal fracture just under the skin, mainly located in the proximal and distal ends of the lower limb.

Initial assessment can be difficult and lesion severity may be underestimated. In case of severe soft-tissue contusion or subcutaneous detachment, there is a high risk of complications associated with primary definitive intrafocal fixation. Stabilization by external fixator allows surveillance of skin and soft-tissue, postponing definitive fixation. Temporary fixation allows assessment to be completed on imaging, so that approaches and fixation can be planned in complex fractures. Such temporary fixation often involves bridging the knee or ankle joint; reduction in that case is by ligamentotaxis. K-wires are implanted at a distance from the epiphysis and metaphysis, sparing the site of secondary internal fixation [5].

Temporary fixation may be relayed by internal fixation, conserving the external fixator while associating minimal internal fixation or else replacing it by a hybrid external fixator [5]. The external fixator can be used for intraoperative distraction and reduction, compatible with secondary internal fixation via minimally invasive approaches.

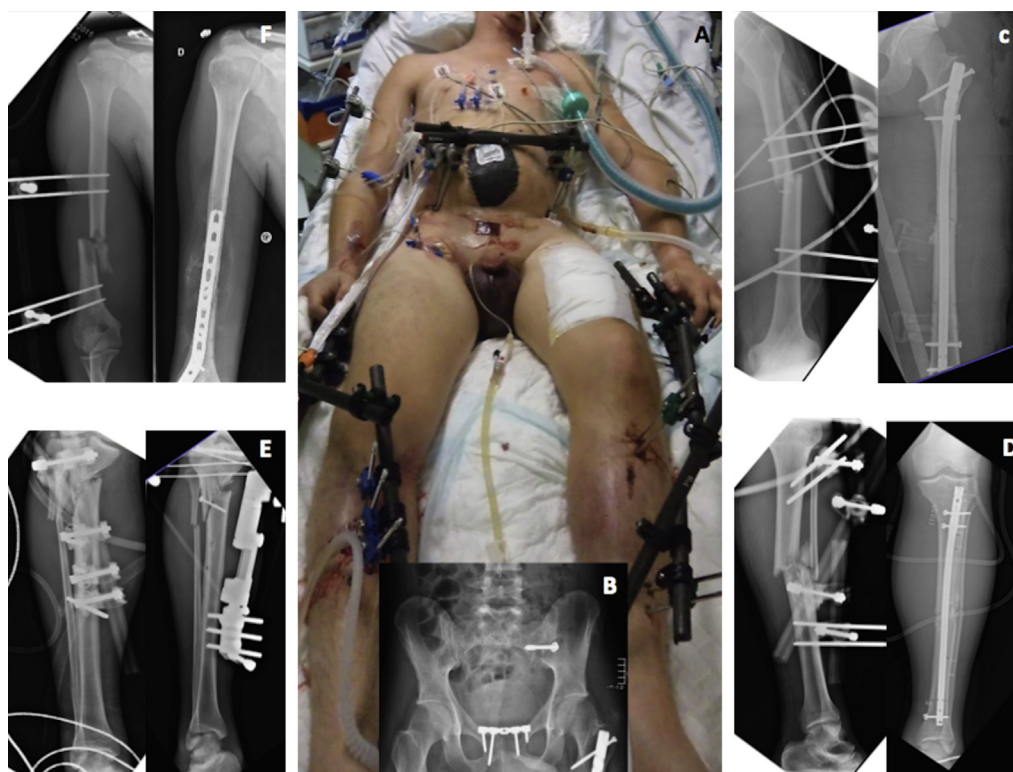


Fig. 1. Abdominal trauma damage control and orthopedic trauma damage control in a severe trauma victim with multiple fracture and visceral lesions. A. Exclusive temporary fixation of closed long-bone and pelvic fractures. B. Pelvic internal fixation at D2. C. Left femoral intramedullary nailing at D4. D. Left tibial intramedullary nailing at D4. E. Definitive hybrid external fixator on right tibia at D6. F. Left humeral internal fixation at D8.

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