

# The Constant Fragment: A Unifying Principle in Fracture Reduction and Fixation

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## Learning Point of the Article:

Technology evolves, implants change, and surgical approaches become less invasive. Yet some principles in orthopedic trauma remain remarkably unchanged. Among them, the concept of the constant fragment continues to influence every outcome of fracture reduction and fixation.

## Introduction

Orthopedic trauma has witnessed enormous progress over the past few decades. Three-dimensional computed tomography (CT) reconstructions, patient-specific instrumentation, computer-assisted planning, navigation, robotics, and artificial intelligence are reshaping how surgeons understand and treat fractures. The concept of a constant fragment has remained timeless, despite the technological advances. Most surgeons use this concept every day, knowingly or unknowingly, without consciously naming it [1]. During fracture reduction, we first identify a fixed reference point, i.e., the fragment that has preserved its anatomical relationship through intact ligamentous or muscular attachments. Once this fragment is identified, every other displaced piece begins to make sense. Thus, reduce everything else to it. The constant fragment is therefore the anchor of fracture reconstruction [2].

## Anatomy

One of the common mistakes among trainees is to think of fracture surgery in terms of implants. Which plate? Which nail? Which screw configuration? Reduction comes first. Implant

selection comes later. We then search for where to fix the mobile or fracture fragment, which should be fixed to a stable or so-called constant fragment. Once this stable reference is identified, we need to decide the order of reduction, the surgical approach, and finally the implant [3]. Constant fragments do have a place in orthopedic trauma because bone fractures, powerful ligaments, joint capsules, tendons, and muscular attachments often continue to maintain the position of one part of the bone while the remaining fragments are displaced by the deforming forces. The constant fragment is therefore not constant because of the bone itself; it is constant because biology preserves it [4]. This explains why fracture displacement follows predictable patterns rather than occurring randomly. Although the term became popular through pelvic and acetabular surgery, the underlying principle applies throughout orthopedic trauma (Table 1) [5].

The examples differ anatomically, but the philosophy remains identical. Modern imaging has made this concept even more relevant. Three-dimensional CT scans allow surgeons to appreciate fracture morphology with unprecedented clarity [6]. Virtual reduction software predicts the optimal reduction

## Author's Photo Gallery



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**Table 1: Constant fragments: Surgical relevance**

| Region           | Constant fragment                    | Basis of stability                                    | Surgical implication                                    |
|------------------|--------------------------------------|-------------------------------------------------------|---------------------------------------------------------|
| Scapula/Glenoid  | Glenoid                              | Coracoclavicular and capsuloligamentous attachments   | Reduce scapular body to the glenoid                     |
| Proximal humerus | Humeral head                         | Intact capsuloligamentous attachments                 | Reduce tuberosities and shaft to the head               |
| Pelvic ring      | Sacrum                               | Stable axial skeleton                                 | Reduce hemipelvis to the sacrum                         |
| Acetabulum       | Ilioischial (weight-bearing) segment | Preserved pelvic continuity                           | Reconstruct remaining columns to this fragment          |
| Distal femur     | Intercondylar articular block        | Cruciate ligament attachments                         | Restore articular block before metaphyseal fixation     |
| Tibial plateau   | Medial plateau                       | Dense cortical bone and ligamentous support           | Reduce lateral plateau to the medial reference          |
| Distal tibia     | Posterior malleolus                  | PITFL attachment                                      | Restore syndesmosis and articular alignment             |
| Calcaneus        | Sustentaculum tali                   | Strong talocalcaneal and deltoid ligament attachments | Reduce tuberosity and lateral wall to the sustentaculum |
| Distal radius    | Lunate facet                         | Short radiolunate ligament attachment                 | Begin articular reduction from the lunate facet         |

sequence. Therefore, while approaching a fracture, we should think about the answers to the following simple questions:

- I. Which fragment remained anatomically stable?
- II. Which soft tissues are preserving it?
- III. Which deforming forces displaced the remaining fragments?
- IV. In what sequence should the mobile fragments be reduced back to the constant fragment?

These questions lead to the correct reduction strategy, regardless of fracture type. The constant fragment therefore represents more than anatomy; it represents a way of thinking.

### Controversies and Limitations

The constant fragment concept is a surgical guide, not an absolute rule. Its application depends on the presence of a fragment that retains its anatomical relationship through preserved ligamentous, capsular, or muscular attachments. Complete articular fractures (AO/OTA type C) require careful interpretation. The fracture fragments of the entire articular block are separated from the metaphysis and appear mobile. The osteoligamentous fragment with the most stable attachment to the adjacent skeleton serves as the reference for articular reconstruction. The reconstructed articular block is then reduced to the metaphysis. Highly comminuted fractures, segmental injuries, severe open fractures with bone loss, pathological fractures, and some fracture-dislocations may lack such a fragment or have a revascularized one, limiting its value as

a reduction reference. Revision surgery and established non-unions may also obscure the original anatomy. The fragment itself may occasionally be fractured, as in sustentaculum tali fractures [7,8]. The remaining fragment with the most stable attachment then becomes the new reference for reduction. The identity of the constant fragment therefore varies with the fracture pattern and the integrity of the surrounding soft tissues. In these situations, successful reconstruction relies on restoration of the articular

block where feasible, correction of length, alignment and rotation, preservation of biology, and stable fixation. The constant fragment is not a fixed piece of bone. It is the most reliable anatomical reference available in a given fracture pattern.

### Conclusion

The constant fragment is one of those deceptively simple concepts. It changes the way we analyze fractures. It guides reduction before fixation, biology before mechanics, and principles before technology. The constant fragment should be regarded as a guiding principle rather than a rigid rule. While it provides an invaluable anatomical reference in many fractures, its applicability depends on preserved soft-tissue attachments and recognizable fracture morphology. In highly comminuted injuries, fracture-dislocations, pathological fractures, and cases with segmental bone loss, other reconstructive principles including restoration of length, alignment, rotation, and biology may take precedence.

### Clinical Message

The constant fragment reminds us that fractures are not merely broken bones; they are injuries of an osteoligamentous unit. Identifying what remains stable is often the first step toward successful fracture reconstruction.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil    **Source of support:** None

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