Introduction

The Handbook of Orthopaedic Trauma Care is intended for physicians and other healthcare professionals in charge of the immediate management of patients suffering from trauma. This book is designed to provide them with the vital information needed for the immediate assessment and management of these patients in a concise and easily understandable structure.

This handbook gives basic information as to how bone and soft-tissue injuries heal and how medical care can influence this process. Specific injuries are discussed region by region throughout the body and the pathologies described not only cover fractures and dislocations but also soft-tissue injuries. Each chapter in turn is divided into individual pathologies and information is given as to the mechanism of the injury, clinical presentation, diagnostics, classification, treatment, duration of injury, and prognosis. The text is complimented by simple illustrations showing key clinical points in the management of trauma patients.

The Handbook of Orthopaedic Trauma Care was developed from an earlier book in Dutch titled “Letsels van het steun- en bewegingsapparaat” by Prof Dr Christian van der Werken (ed), Prof Peter RG Brink, Prof Dr Henk J Klasen, Dr Sam de Lange, Prof Dr René K Marti, Dr Ad JG Nollen, Dr Ernst LFB Raaijmakers, and Dr Luuk S de Vries that was published in 2000 by Elsevier. Later the rights of translation of that book were granted by Elsevier to AO Publishing. The content and illustrations have been updated and reworked by an international group of trauma surgeons to reflect changes in practice.

We hope that this book will provide invaluable support to physicians and other healthcare professionals when faced with emergency situations about which they may not be familiar. We believe that the information presented will allow the healthcare professional to make more rapid and accurate decisions, which in turn will result in a higher standard of care.

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1 Principles

1.1 Fracture classification

“A classification is useful only if it considers the severity of the bone lesion and serves as a basis for treatment and for evaluation of the results” (Maurice E Müller, 1988).

Goals of fracture classification systems:
- Evaluate the injury systematically
- Assist surgeons in developing a treatment plan for specific fractures
- Predict the expected outcome
- Facilitate communication among physicians
- Assist in documentation and research

Of many classification systems that have been proposed so far, the Müller AO Classification of fractures—long bones is one that is most widely accepted and used.

1.2 Müller AO Classification of Fractures—Long Bones

The Müller AO Classification of Fractures—Long Bones use a five-element alphanumeric code.

\[ \text{Diagnosis} = \text{personality of the fracture} \]

<table>
<thead>
<tr>
<th>Bone Localization</th>
<th>Morphology</th>
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<tbody>
<tr>
<td>1 2 3 4</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>Segment 1 2 3</td>
<td>Type A B C</td>
</tr>
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<td></td>
<td>Severity 1 2 3</td>
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<tr>
<td></td>
<td>Subgroup .1 .2 .3</td>
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4 long bones 3 or 4 segments 3 types 3 groups 3 subgroups

Fig 1-1 Alphanumeric structure of the Müller AO Classification of fractures—long bones.

To make full use of this system, we need to recognize, identify, and describe the injury to the bone according to the defined terminology. This description can then be converted to an alphanumeric code for documentation and research purposes.
1.3 Description of fractures

To accurately describe a fracture we need to define its location and characteristics or morphology.

Location

The location can be described with the bone and segment concept. The anatomical location is designated by two numbers: one for the bone and one for its segment.

Bone:  1 Humerus 2 Radius/ulna 3 Femur 4 Tibia/fibula
Segment: 1 Proximal 2 Diaphyseal 3 Distal 4 Malleolar

Fig 1-2 Anatomical location of the fracture is designated by two numbers: one for the bone and one for its segment (ulna and radius as well as tibia and fibula are regarded as one bone). The patella and the malleolar segments are assigned segment 4 as 34 and 44, respectively. Proximal or distal segments are defined by a square which has the same length as the widest part of the epiphysis (exceptions 31 and 44).
**Determination of the center of the fracture**

Before a fracture can be assigned to a segment the center must first be determined. In a simple fracture, the center of the fracture is going to be the center of a spiral or oblique fracture line. In a wedge fracture, the center is the broadest part of the wedge. In a complex fracture, the center can only be determined after reduction.

If the fracture is associated only with an undisplaced fissure which reaches the joint, it is classified as metaphyseal or diaphyseal depending on where its center is.

By assigning numbers for each bone and segments, the location of the fracture can then be expressed with two numbers.

**Morphology: type, group, subgroup**

- The morphology of the fracture is described according to a defined terminology.

All fractures are either simple or multifragmentary.

**Simple:** A term used to characterize a single circumferential disruption of a diaphysis or metaphysis, or a single disruption of an articular surface. Simple fractures of the diaphysis or metaphysis are spiral, oblique, or transverse.

**Multifragmentary:** A term used to characterize any fracture with one or more completely separated intermediate fragments. In the diaphyseal and metaphyseal segments, it includes the wedge and the complex fractures.

**Wedge:** A fracture with one or more intermediate fragments in which, after reduction, there is some contact between the main fragments.

**Complex:** A fracture with one or more intermediate fragments in which, after reduction, there is no contact between the main proximal and distal fragments.
Fig 1-3  A simple fracture has one fracture line and cortical contact exceeds 90% after reduction. A wedge fracture has three or more fragments, and main fragments have contact after reduction. Complex fractures have no contact between main fragments after reduction.
**Description of fractures involving diaphyseal segment**

Type: simple (A)  
wedge (B)  
complex (C)

Group: simple (A)  → spiral (A1), oblique (A2), transverse (A3)  
wedge (B)  → spiral wedge (B1), bending wedge (B2), fragmented wedge (B3)  
complex (C)  → spiral (C1), segmental (C2), irregular (C3)

<table>
<thead>
<tr>
<th>Type</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td>A</td>
<td>Spiral</td>
<td>Oblique</td>
<td>Transverse</td>
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<tr>
<td>B</td>
<td>Spiral</td>
<td>Bending</td>
<td>Multifragmentary</td>
</tr>
<tr>
<td>C</td>
<td>Spiral</td>
<td>Segmental</td>
<td>Irregular</td>
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**Fig 1-4** Description of diaphyseal fractures.