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Fracture Classification Associated with the Orthopaedic Trauma

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Abstract
This study aimed at exploring the fracture classification associated with the orthopaedic trauma as the provision of care associated with orthopedic trauma shares an important goal, which is to restore and preserve function. A focused assessment that embodies subjective and objective data will assist the healthcare professional to determine a patient's needs and deliver the most appropriate level of care. Learning to collect data about factors associated with an orthopedic injury is an integral part of providing care for individuals who have sustained an orthopedic trauma. Fracture classification is the categorization of a fracture. It is used for documentation and research and gives surgeons and patients information about treatment options and prognosis. The process of obtaining this documentation is the process of diagnosis.

Acknowledgement
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1.1 Introduction

Fracture classification systems are the means by which physicians communicate, characterize fracture patterns, make treatment decisions and determine prognoses. These systems are also useful for reporting and comparing treatment results (Martin & Marsh, 1997).

In general, fracture classification systems should be reliable and valid. The Orthopaedic Trauma Association (OTA: *see Box 1*) along with the AO Foundation developed a comprehensive fracture classification[3], which has gained worldwide acceptance. Its validity has been confirmed by various studies (Meling Harboe & Enoksen, 2012).

The inter-observer and intra-observer reliability along with accuracy of this classification system has also been verified. The coding system associated with this classification provides a shorthand form and appears accurate and reliable in clinical practice. The classification is published in a readily available and electronically accessible form. It has been updated every ten years to incorporate new knowledge of fractures and classifications. The 2007 version reconciled any differences between the AO and the OTA Classification (Marsh, Slongo & Agel, 2007).

Box 1: The Orthopaedic Trauma Association (OTA)
Logo:

Orthopaedic Trauma Association

Mission: The mission of the Orthopaedic Trauma Association (OTA) is to promote excellence in care for the injured patient, through provision of scientific forums and support of musculoskeletal research and education of Orthopaedic Surgeons and the public.

Although there are numerous fracture classification systems available for specific fracture locations, the

OTA Fracture and Dislocation Classification Compendium is the most comprehensive. It applies consistent fracture classification principles to the entire axial and appendicular skeleton. It has incorporated the most useful concepts of individualized location classifications. Individualized location classifications are deficient at providing a common language for fracture classification, which can limit effective communication among orthopaedic surgeons (Walton, Harish & Roberts, 2003).

Individualized classifications commonly have unknown or poor inter-observer reliability and poor intra-observer reproducibility (Bernstein, Adler & Blank, 1996).

Fracture classifications have multiple purposes. They should facilitate communication among physicians and be useful for documentation and research. For clinical relevance, they should have a value to guide physicians in their planning and management of fractures. They should also inform both physicians and patients of the prognosis for the injury. The basis for all clinical activity, be it assessment and treatment, investigation and evaluation, or learning and teaching, must be sound data which is properly assembled, clearly expressed, and readily accessible. Numerous classification systems have been proposed in orthopaedics but only a small number of them are widely accepted in practice, such as the Müller AO/OTA Classification of fractures. Even fewer have stood the rigorous task of evaluation (Kellam & Audigé, 2007).

Orthopedic trauma is a severe injury to part of the musculoskeletal system, and often the result of a sudden accident requiring immediate medical attention. While not all orthopedic trauma is life-threatening, it is life altering (Perry, 2008).

Orthopedic trauma is also a broad term describing all kinds of injuries affecting the bones, joints, muscles, tendons, and ligaments in any part of the body that are caused by trauma. The term is wide-ranging and may refer to minor fractures or severely broken bones with a direct threat to the patient's life. It is considered as a sub-specialty of orthopaedic surgery and is focused on treating fractured bones and making sure the injured part of the body regains its original strength and maximum function it used to have prior to the injury (Gundle, 2014).

The many different types of orthopedic trauma are classified based on the affected body part.

- Upper extremity injury, which includes a broken arm or wrist, collarbone, or ribs.
- Lower extremity injury, which includes a broken ankle, hip, or legs.
- Soft tissue injury, which affects the muscles, tendon, and ligaments.

The most common causes of traumatic injuries are:

- Falls
- Twisting the ankle
- Sporting accidents
- Other types of accident
- Severe coughing
- Blows to specific parts of the body

Therefore, orthopedic trauma is a branch of orthopedic surgery specializing in problems related to the bones, joints, and soft tissues (muscles, tendons, ligaments) of the entire body following trauma. The main goal of this specialized area in orthopedics is the healing of the fractured bones, as well as restoring the anatomic alignment of the joint surfaces to allow for recovery and return to maximum function of the injured body part (Duckworth & Blundell, 2010).

1.2 Problem Statement

In patients with orthopedic trauma, musculoskeletal injuries are the most common lesions requiring surgical intervention with survivors frequently presenting challenging scenarios in terms of functional outcome and quality of life. Therefore, understanding of the mechanism of injury, physiological responses to trauma and appropriate clinical approach to patients are important. And the optimal timing of definitive fracture stabilization in trauma patients has probably been one of the most controversial topics. Hence, the problem of this study lies in the determination of the fracture classification associated with the orthopaedic trauma

1.3 AO/OTA Fracture and Dislocation Classification

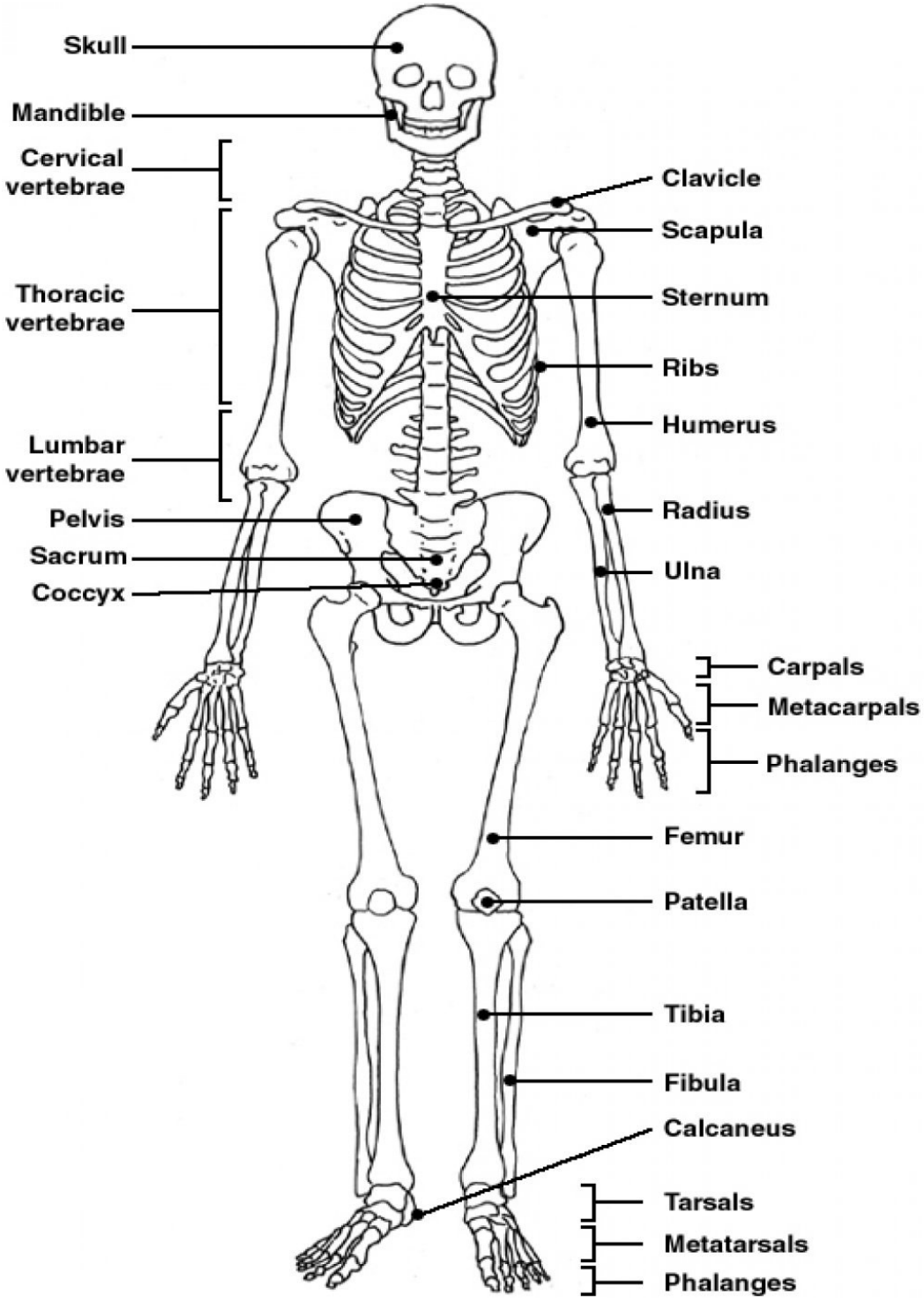


Figure (1): Skeleton Bones

Table (1): Definitions of fracture types for long-bone fractures in adults

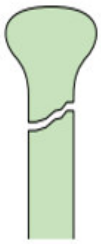
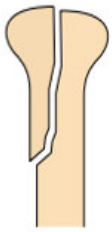
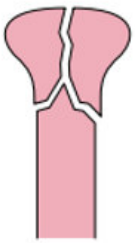
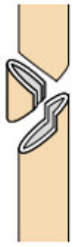
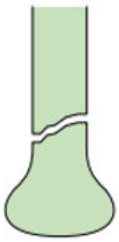
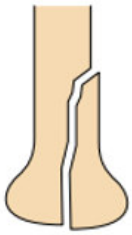
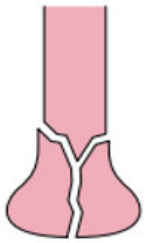
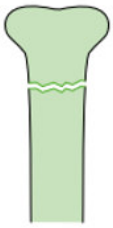
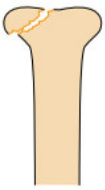
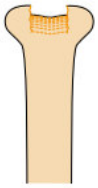
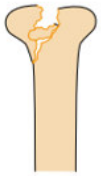
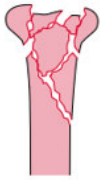
Segment	Type		
Proximal	Extraarticular 	Partial articular 	Complete articular 
Diaphyseal	Simple 	Wedge 	Complex 
Distal	Extraarticular 	Partial articular 	Complete articular 

Table (2): Classification of fractures of the diaphysis into the three fracture groups

Type	Group		
Simple	Spiral 	Oblique 	Transverse 
Wedge	Spiral 	Bending 	Multifragmentary 
Complex	Spiral 	Segmental 	Irregular 

Table (3): Classification of fractures of the end segment into the three fracture groups

Type	Group		
Extraarticular	Simple 	Wedge 	Complex 
Partial articular	Split 	Depression 	Split-depression 
Articular	Simple articular, simple metaphyseal 	Simple articular, complex metaphyseal 	Complex articular, complex metaphyseal 

1.4 Classification terminology

Articular: fractures which involve the joint surface. They are subdivided into partial articular and complete articular fractures.

Articular, partial: only part of the joint is involved while the remainder stays attached to the diaphysis.

Articular, complete: the joint surface is fractured and the entire joint surface is separated from the diaphysis.

Complex: fractures with one or more intermediate fragments in which there is no contact between the main fragments after reduction.

Extraarticular: fractures that do not involve the articular surface. Multifragmentary: a fracture with more than one fracture line so that there are three or more pieces. It includes wedge and complex fractures.

Multifragmentary depression: a fracture in which part of the joint is depressed and the fragments are completely separated.

Depression: an articular fracture in which there is only depression of the articular surface, without a split.

Split: articular fracture in which there is a longitudinal metaphyseal and an articular fracture line, without any additional articular surface lesion.

Simple: there is a single fracture line producing two fracture fragments. Simple fractures of the diaphysis or metaphysis are spiral, oblique, or transverse.

Wedge: fracture complex with a third fragment in which, after reduction, there is some direct contact between the two main fracture fragments.

1.5 Describing fracture morphology

The description of the morphology of a fracture is determined by a set of precisely defined rules. Following these rules allows the surgeon to classify a fracture according to its type, group, and subgroup. For all fractures the surgeon classifies the fracture by answering a well described set of questions. Müller and colleagues refined this process into a binary-type questioning. This means that there is either a yes/no or either/or answer. Different rules apply to fractures in the middle segments of long bones (diaphyseal) and fractures in the end segments (articular or metaphyseal)

1.6 End segment fractures (metaphyseal and articular)

The questions are:

1- Which bone?—Humerus, radius and ulna, femur, or tibia (Fig 1).
2- Which segment?—proximal or distal end segment.
3- Which type?
   A. Extraarticular—no involvement of articular surface.
   B. Partial articular—part of the articular surface is involved leaving the other part attached to the diaphysis.
   C. Complete articular—articular surface involved. Metaphyseal fracture completely separates articular component from diaphysis.
4- Which group?
   A. Extraarticular fractures:
      1. Simple fracture with two pieces of bone
      2. Wedge fracture
      3. Multifragmentary fracture
   B. Partial articular fractures:
      1. Split
      2. Depression
      3. Split depression
   C. Total articular fractures:
      1. Simple articular fracture with a simple metaphyseal fracture
      2. Simple articular fracture with a complex metaphyseal fracture
      3. Complex articular fracture with a complex metaphyseal fracture

1.7 Primary Assessment

The primary assessment of an individual who has sustained a traumatic injury is similar to that of any patient. What differentiates the type of care that is delivered is when caring for trauma victims, the goal is to quickly identify and initiate treatment of any potentially life-threatening problems before continuing with the remainder of the assessment (CPM Resource Center 2010).

Securing a patient's airway, for example, while protecting their cervical spine is essential and should always occur prior to examining a wound. Some care might occur concurrently, such as, maintaining the cervical spine while applying pressure to a wound with pulsatile bleeding (arterial bleeding or other related circulation problems). This condition can also be life-threatening and will require immediate intervention.

A primary assessment should include:

- Complete set of vital signs (blood pressure, heart rate, respiratory rate and temperature).
- Immediate pain level. Use the acronym "***PQRST***" for quick pain assessment:
  - **P** = Provoking factors (What brought on the pain?)
  - **Q** = Quality (Describe the pain - i.e. stabbing, throbbing, burning)
  - **R** = Radiation (Does the pain radiate anywhere?)
  - **S** = Severity/symptoms (How bad is the pain - rate it; Are there other symptoms with the pain?)
  - **T** = Timing (Is it constant? What makes it better/worse?)
- Level of consciousness.

1.8 Types of Fractures

When a break occurs that does not penetrate the skin, it is known as a "closed" fracture. If bone fragments penetrate through the skin, or a wound opens down to the broken bone, the fracture is called an "open" fracture. Open fractures have a higher chance for infection (American Academy of Orthopaedic Surgeons, 2012).

Common types of fractures include:

Stable fracture: The broken ends of the bone line up and are barely out of place, as shown in figure 2.

Figure (2): Stable fracture

Open, compound fracture: The skin may be pierced by the bone itself or by the actual trauma that breaks the skin at the time of the fracture. The bone may or may not be visible in the wound, as shown in figure 3.

Figure (3): Open, compound fracture

Transverse fracture: This type of fracture has a horizontal fracture line, as shown in figure 4.

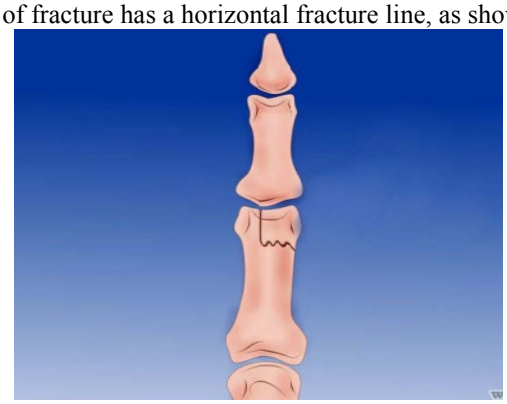


Figure (4): Transverse fracture

Oblique fracture: This type of fracture has an angled pattern, as shown in figure 5.

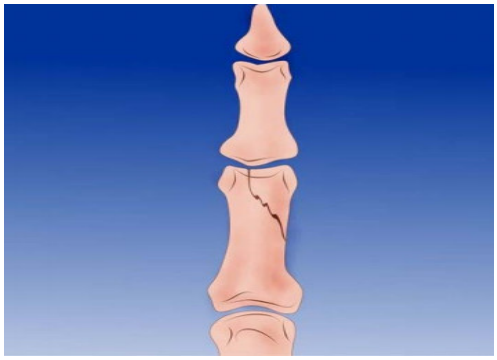


Figure (5): Oblique fracture

Comminuted fracture: In this type of fracture, the bone shatters into three or more pieces, as shown in figure 6.

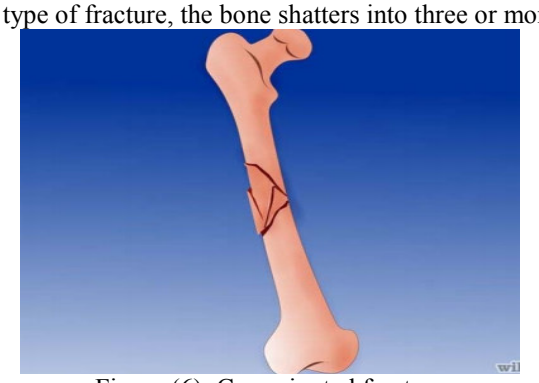


Figure (6): Comminuted fracture

Greenstick fracture: This type of fracture is common in children. This is an incomplete transverse fracture, due to the flexibility of the child's bones, as shown in figure 7.

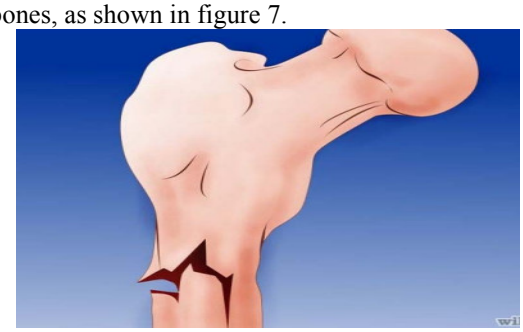


Figure (7): Greenstick fracture

1.9 Risks & Complications of Orthopedic Injuries

1.9.1 Infection

One of the goals when managing the care of a patient with a fracture(s) is minimizing the risk of infection and tissue degradation that can occur secondary to the fracture. Individuals who have sustained multisystem injury are at great risk of infection not only because of contamination of the wound, but also because of diminished inflammatory responses from hypo perfusion and hematomas (CPM Resource Center, 2010).

In addition, surgical wounds and devices may provide portals of entry for a variety of organisms. In some cases prophylactic use of antibiotics may be considered; however, no one antibiotic can eradicate all organisms. Different pathogens tend to occur at different times during the trauma cycle. Early on in the first five days, infection from staph aureus, streptococci, Klebsiella, mycoplasma, proteus, chlamydia, E.coli, and other anaerobes may set in. Early infections include community-acquired pneumonia, aspiration pneumonia, line-related infections, and wound infections. Possible mid-cycle infections (stay of more than six days in the intensive care unit) that can occur may be caused from Vancomycin Resistant (VRE) or Vancomycin Sensitive Enterococci (VSE) as well as fungi, Enterobacter, Acinetobacter, Methicillin Resistant Staph Aureus (MRSA), pseudomonas, clostridium difficile and more.

Infections related to these microbes include fungal infections, urinary tract infection, skin and wound infection, pneumonia, colitis, and more. Late infections after intensive care can be a combination of infections. Severe traumatic injury can also produce an inflammatory response, which can lead to Systemic Inflammatory Response Syndrome (SIRS).

1.9.2 Type of Fixation

Another factor that can influence managing fracture care is the type of fixation (internal versus external). The presence of a foreign body (appliance) is considered by some as a medium to increase bacterial growth, delayed union of the bones, interference with soft tissue healing and large open wounds.

1.9.3 Osteomyelitis

Infection involving bone and its marrow is called osteomyelitis and can be caused by:

- Trauma.
- A surgical procedure.
- Spread of another contagious infection.
- Hematogenous infection spread from another site.

1.10 Conclusion

The provision of care associated with orthopedic trauma shares an important goal, which is to restore and preserve function. Fracture classification is the categorization of a fracture. It is used for documentation and research and gives surgeons and patients information about treatment options and prognosis. The process of obtaining this documentation is the process of diagnosis. Throughout this process, the surgeon will learn to understand the fracture, that is "the essence," and be able to determine its treatment. This system is based on a well-defined series of definitions which are an important aspect in clinical practice. Finally, there are attempts at the present time to determine whether fracture classifications are valid. In other words, can they be used reproducibly and do they represent what is truly seen clinically so that clinical outcome research can be based on solid data.

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