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Low-energy fractures

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Learning objectives

- Define low-energy fractures and explain their significance in orthopaedics.
- Recognise the common bones affected by low-energy fractures.
- Evaluate the clinical findings, history and examination techniques to diagnose and manage low-energy fractures.
- Differentiate imaging modalities to diagnose low-energy fractures based on their advantages and limitations.
- Understand the management options for low-energy fractures, including non-surgical approaches and surgical interventions when required.

Introduction

Low-energy fractures are a significant concern in orthopaedics. They encompass fractures resulting from minimal trauma or everyday activities that would not typically cause bone damage. Despite their seemingly minor cause, these fractures are surprisingly common and can have considerable consequences for patients.

These fractures predominantly affect the elderly, especially postmenopausal women, as age-related loss in bone density increases their vulnerability to low-energy injuries. Furthermore, low-energy fractures can result from bone cysts, infection and metastatic diseases due to their weakening effect on the bone structure, making it more susceptible to breaking under minimal force or stress.

The bones commonly affected by low-energy fractures include the distal radius, proximal femur, proximal humerus, distal fibula and vertebral bodies, leading to potential complications and reduced quality of life. Understanding the characteristics and impact of low-energy fractures is crucial in providing better management and preventive strategies.

Clinical findings

History

Patients who have experienced a low-energy fracture have signs of pain, injury, stiffness, swelling, deformity, instability, weakness or loss of function. These fractures are commonly observed in the geriatric population and are often the result of falls.

Commonly associated injuries include those affecting the head, pelvic region and lower extremities. The patients may report a history of a simple fall without any significant impact or force. However, it is crucial to thoroughly evaluate the patient's medical history, including any underlying conditions like dementia, haematologic diseases or liver disorders, as these factors may affect fracture management. Additionally, a detailed examination of the patient's medication history, particularly the use of anticoagulants and antiplatelet medications, is essential to assess the risk of bleeding complications. It is also important to inquire about other factors contributing to osteoporosis, such as alcohol consumption and medication usage (e.g. steroids).

Examination

During the examination, you should:

- **Look** for any wrist deformities or abnormalities in shape and posture. Observe the skin for discolouration, bruising, wounds, ulceration and scars that give clues to previous history. Look for open wounds or blisters in the soft tissue.
- **Feel** the skin, soft tissue, bones and joints, while also checking for signs of tenderness.
- **Move** the patient actively and passively to assess the degree of mobility.

Additionally, assess the neurovascular status, particularly the radial pulse and major nerves crossing the wrist, such as the ulnar and vital median nerves. Obtaining dedicated wrist views and other relevant radiographs can provide valuable insights into the fracture pattern.

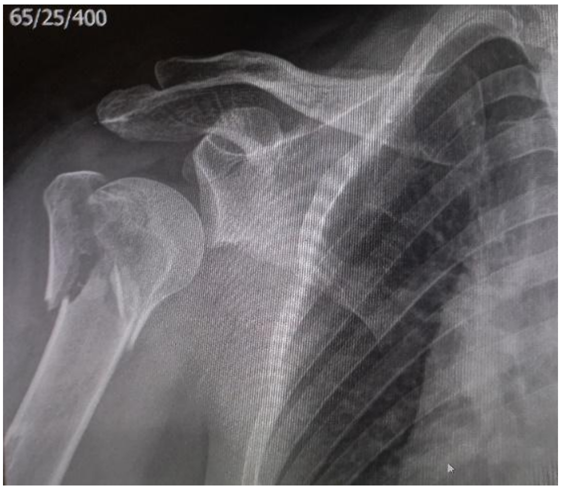


Figure 1: *X-ray showing a comminuted fracture of the proximal humerus*

Additional injuries to note

Vertebral compression fractures (VCFs) related to low-energy mechanisms often occur in the elderly, primarily due to osteoporosis. During a low-energy fall or trauma, the spinal column experiences rotation around a centre of axis, accompanied by an axial force due to flexion or extension of the spine. When this force exceeds the tolerable limits of the vertebral body, a compression fracture occurs, leading to the characteristic wedge-shaped deformity. These altered biomechanics may subject other spinal levels to additional stresses, increasing the risk of further fractures and progressive deformity.

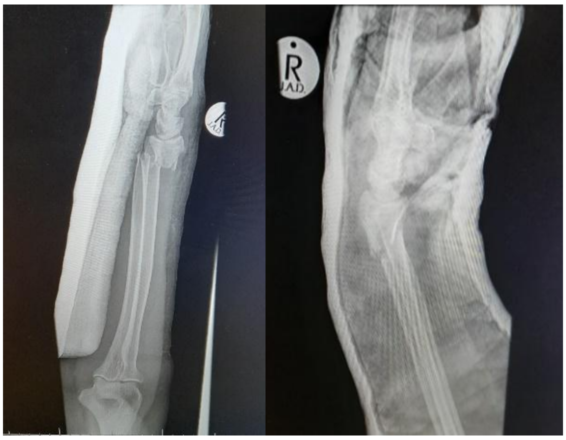
Clinical findings in patients with vertebral compression fractures may include localised back pain, kyphosis, tenderness on palpation, limited spinal mobility, neurological symptoms and loss of height. Management includes conservative approaches such as orthosis/bracing or minimally invasive surgical procedures like vertebroplasty or kyphoplasty.

With severe osteoporosis, a low-energy hip fracture may occur from simple twisting movements, where the fracture itself causes the reported fall. These fractures are defined as occurring between the articular margin of the femoral head and 5cm below the lesser trochanter. They can be subdivided into intracapsular and extracapsular fractures, with intracapsular fractures affecting the blood supply to the femoral head.

Mortality and morbidity risks are significant following a hip fracture, with a substantial number of patients experiencing another fracture, commonly in the wrist or proximal humerus at the time of the fall. These patients would have a history of falling, severe hip pain and an inability to walk. Displaced fractures may lead to external rotation and shortening of the affected leg, while impacted fractures can still allow some degree of walking. Treatment may include internal fixation and prosthetic replacement.

Figure 2: *Left neck of femur (NOF) fracture after a fall*

Distal radius fractures are frequently observed following low-energy falls or impacts on the wrist. Colles' fracture is a common type of distal radius fracture that occurs in the forearm near the wrist joint. This injury typically results from a fall onto an outstretched hand. Colles' fractures often affect older adults with decreased bone density such as those with osteoporosis. It involves a transverse fracture with dorsal displacement of the distal end of the radius bone, causing a characteristic "dinner fork" deformity of the wrist. Contrastingly, Smith's fractures occur after a fall onto the back of the hand, with a volar displacement of the distal fragment. Patients with these fractures may experience pain, swelling and limited wrist movement. Treatment options depend on the severity of the fracture, but may involve casting or splinting, closed reduction or surgical intervention with open reduction and internal fixation.



(A) *(B)*

Figure 3: *(A) Low-energy distal radius fracture, usually caused when trying to catch yourself after a fall; (B) x-ray after treatment with plaster of paris (POP) cast*

Figure 4: *"Dinner fork" deformity with Colles' fracture (Source: Sylvain Letuffe, CC0)*

Special investigations

In diagnosing low-energy fractures, various imaging modalities play crucial roles, each offering distinct advantages and limitations.

Plain radiography is commonly employed for initial assessments in the emergency department due to its speed, accessibility and relatively low radiation exposure. However, it has limitations in terms of spatial resolution and may not always detect subtle fractures.

Computed tomography (CT) is another valuable tool, particularly when vertebral fractures are uncharacterisable on x-rays or when suspected fractures are not visible on standard x-rays, such as undisplaced neck of femur fractures. CT provides high-spatial resolution and is rapid in obtaining images. Although it involves ionising radiation, CT is adequate in ruling out hip and pelvic fractures in elderly patients, making it a practical choice in the emergency setting.

Magnetic resonance imaging (MRI) offers superior sensitivity for detecting fractures and is particularly useful in identifying occult vertebral fractures. MRI provides high tissue resolution and does not involve ionising radiation, making it a safer option, especially in cases where repeated imaging is required. However, MRI is slower and not as universally available as other modalities.

Dual-energy x-ray absorptiometry (DXA) is useful for subclinical vertebral fracture screening, providing minimal radiation exposure and quick results. It is important to assess bone mineral density (BMD) in patients with low-energy fractures to diagnose osteoporosis. All patients with low-energy fractures should have a DXA scan, but it has limitations in spatial resolution and accessibility.

Figure 5: *X-ray showing a posteriorly displaced midshaft proximal femur fracture with medial angulation and an expanded intramedullary cavity following a low-velocity fall*

Management

Non-surgical

Non-surgical interventions focus on immobilisation and pain management. For stable fractures, immobilisation with casts, splints or braces may be employed to promote healing and prevent further injury. In some cases, weight-bearing restrictions or the use of assistive devices like crutches or walkers may be recommended to reduce stress on the affected area.

Pain control is achieved through analgesics and anti-inflammatory medications, allowing patients to remain comfortable during the healing process. Physiotherapy is often utilised to maintain joint mobility, prevent muscle atrophy and mitigate the risks of immobility-related complications, such as atelectasis and pressure sores in patients with immobilised fractures, especially in the elderly.

Prompt and essential initial management of hip fractures in the elderly is crucial for improved outcomes, reduced morbidity and mortality. Measures like skin traction for stabilisation and pain relief before surgery, deep vein thrombosis (DVT) prophylaxis to prevent life-threatening blood clots and optimising fluid balance for haemodynamic stability support better overall management and enhance recovery and quality of life.

Surgical

In cases where the fracture is unstable, significantly displaced or associated with intra-articular involvement, surgical intervention is often warranted. Orthopaedic surgical methods aim to achieve an anatomical reduction of the fracture fragments and stable fixation to facilitate proper healing and restore function.

Common surgical approaches include open reduction and internal fixation (ORIF) using screws, plates or nails, which provide stability to the fractured bone and allow early mobilisation. In more complex fractures, external fixation or minimally invasive techniques, such as percutaneous pinning, may be utilised. In some instances, such as NOF and humeral head fractures, joint arthroplasty or joint replacement may be considered to address severe joint damage resulting from the fracture.

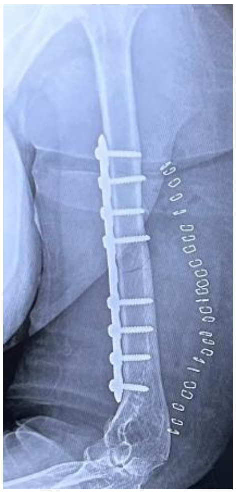


Figure 6: *Treatment of humerus midshaft fracture with ORIF plate fixation*

Figure 7: *Femur cephalo-medullary nail used to treat a proximal femur fracture*

Key takeaways

- Low-energy fractures are common orthopaedic concerns resulting from minimal trauma in everyday activities, particularly amongst the elderly.
- The wrist (distal radius), hip (proximal femur) and vertebral bodies are commonly affected by low-energy fractures in the geriatric population.
- Clinical evaluation should include thorough patient history, examination of soft tissue envelope and assessment of neurovascular status.
- Imaging modalities like plain radiography, CT and MRI play essential roles in diagnosing low-energy fractures, each offering specific advantages and limitations.
- Non-surgical management involves immobilisation, pain control and physiotherapy to promote healing and prevent further injury.
- Surgical intervention is indicated for unstable, displaced, or intra-articular fractures and includes methods such as ORIF, external fixation or joint replacement, depending on the severity of the fracture.

Assessment

1. A 70-year-old female patient with osteoporosis presents with a low-energy hip fracture. The fracture is displaced and the patient is deemed unfit for surgery due to medical comorbidities. What non-surgical management option is most appropriate for this patient?

   A. Immobilisation with a cast

   B. Immediate mobilisation and weight-bearing

   C. Bed rest and pain management

   D. Traction and physiotherapy

The answer is (A). Immobilisation with a cast is the most suitable non-surgical management option for displaced hip fractures in patients deemed unfit for surgery. It helps stabilise the fracture site and promote healing while minimising the risk of further injury.

2. Which imaging modality offers the highest spatial resolution and is most appropriate for evaluating complex intra-articular fractures, especially in the knee joint?

   A. DXA

   B. CT

   C. Plain radiography

   D. MRI

The answer is (B). CT provides the highest spatial resolution among the options listed and is particularly useful for assessing complex intra-articular fractures, especially in the knee joint. It offers detailed visualisation of bony structures and can aid in treatment planning.

3. A 78-year-old female patient with a low-energy hip fracture undergoes surgical management with ORIF. Postoperatively, she experiences persistent valgus deformity. What surgical technique could have helped prevent this complication?

A. External fixation

B. Minimally invasive percutaneous pinning

C. Joint arthroplasty

D. Bone grafting and osteotomy

The answer is (C). Joint arthroplasty, such as hip replacement, may be a more suitable option in elderly patients with severe low-energy hip fractures and underlying joint damage. It helps restore joint function and alignment, reducing the risk of postoperative deformities like persistent valgus deformity.

4. What is the most suitable surgical approach for managing unstable low-energy fractures with intra-articular involvement?

A. External fixation

B. Joint arthroplasty

C. Minimally invasive percutaneous pinning

D. ORIF

The answer is (D). ORIF provides anatomical reduction and stable fixation, facilitating proper healing in unstable low-energy fractures.

5. What is a potential complication associated with low-energy fractures in elderly patients on anticoagulant therapy?

A. Osteoporosis

B. Comminution

C. Compartment syndrome

D. Delayed union

The answer is (C). Elderly patients on anticoagulant therapy may be at risk of developing compartment syndrome following a low-energy fracture.

References and further reading

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ABOUT THE BOOK

This is the second volume of the *Orthopaedics for Primary Health Care* textbook edited by Michael Held, first published in 2021.

Most patients with orthopaedic pathology in low- and middle-income countries are tested by non-specialists. This book was based on a Delphi consensus study* with experts from Africa, Europe and North America to identify topics, skills and cases concerning orthopaedic trauma and infection that need to be prioritised in order to provide guidance to these health care workers.

The aim of this book is to be student-centred.

*Held et al. Topics, Skills, and Cases for an Undergraduate Musculoskeletal Curriculum in Southern Africa: A Consensus from Local and International Experts. JBJS. 2020 Feb 5;102(3):elO.

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This textbook is not intended as a substitute for the medical advice of physicians.

The information in this book is meant to supplement, not replace, orthopaedic primary care training.

The authors, editor and publisher advise readers to take full responsibility for their safety and know their limits. Before practicing the skills described in this book, be sure that your equipment is well maintained, and do not take risks beyond your experience, aptitude, training or comfort level.

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