# Radiological Discrimination of Benign from Malignant Compression Spinal Fractures

Essay submitted in the partial fulfillment of M.Sc degree in Diagnostic Radiology

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# LIST OF ABBREVIATIONS

**ABC**: Aneurysmal Bone Cyst
**ADC**: Apparent Diffusion Coefficient
**AVC**: Anterior Vertebral Compression
**CT**: Computed Tomography
**DWI**: Diffusion Weighted Image
**DXA**: Dual-energy x-ray absorptiometry
**EPI**: Echo Planar Imaging
**FDG**: 2-flouro-2-deoxy-D-glucose
**GCT**: Giant Cell Tumor
**LCH**: Langerhans cell Histiocytosis
**MDCT**: Multi Detector Computed Tomography
**MRI**: Magnetic Resonance Imaging
**PET**: Positron Emission Tomography
**SE**: Spin Echo
**SNR**: Signal to Noise Ratio
**SSFP**: Steady State Free Precession
**SSFSE**: Single Shot Fast Spin Echo
**STE**: Stimulated Echo
**STIR**: Short Time Inversion Recovery
**TE**: Echo Time
**TIC**: Time Intensity Curve
**TR**: Repetition Time
**VCF**: Vertebral Compression fracture
**WI**: Weighted Image

# دور التصوير الطبي في تمييز الكسور المضغوطة الحميدة من الخبيثة بالعمود الفقري

رسالة مقدمة من الطبيب

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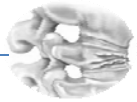
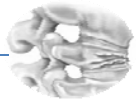


# Introduction and Aim of Work

Vertebral compression fractures are common. Osteoporosis is the most common cause of compression fractures in the elderly ***(Jung et al, 2003)***. In addition to osteoporosis other causes of benign compression fracture include trauma, eosinophilic granuloma, Paget's disease, haemangioma, etc. Malignant compression fracture can be either metastatic or primary (bone tumours, multiple myeloma, malignant lymphoma, leukaemia, etc.) ***(Uetani et al, 2004)***. Metastatic disease of the spine is common and accounts for up to 39% of all bone metastases ***(Jung et al, 2003)***.

Differentiation between malignant and benign vertebral compression fractures is often problematic. This is particularly difficult in the elderly patients who are predisposed to benign compression fractures caused by osteoporosis especially if there is a known primary malignancy elsewhere. ***(Uetani et al, 2004).*** Considering up to one-third of vertebral collapses in patients with a known primary malignancy are benign, the diagnosis becomes even more difficult. Additionally, because primary cancer patients may be immunocompromised, the possibility of infectious vertebral collapse should be also entertained ***(Tehranzadeh and Tao, 2004)***.

Because of the differences in the clinical course, prognosis, and treatment for the two disorders (benign and malignant), accurate diagnosis at an early stage of the fracture is extremely important. One would prefer to limit the risk, expense, and discomfort of biopsy to patients with a significant probability of a pathologic lesion ***(Yuzawa et al, 2005)***.

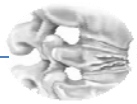


Vertebral compression fractures may be detected on many radiologic studies. In today's clinical environment, the specific discrimination between benign and malignant vertebral compression fractures relies heavily on MR imaging features ***(Bhugaloo et al, 2006)***.

MR imaging is excellent in the assessment of the bone marrow. Structural changes of the vertebral bodies and changes surrounding the vertebra have also been used to distinguish benign from malignant fractures ***(Falcone, 2002)***. Recently, diffusion-weighted sequences have been proposed as a helpful adjunct in the differentiation of benign from malignant compression fractures of the spine ***(Baur et al, 2001)***.

High-resolution CT using multi-detector row can provide many useful signs for differentiation between benign and malignant vertebral compression fractures, and its diagnostic ability is sufficient for clinical use ***(Kutoba et al, 2005)***. By combining the findings common to MRI and CT scans of vertebral fractures, a simple scoring system was advised. This scoring system was found to enhance the accuracy of imaging diagnosis of fractures caused by benign or malignant spinal lesions ***(Yuzawa et al, 2005)***.

This work is to review the literature of different causes of vertebral compression fractures and to review the radiological techniques used to better diagnose benign and malignant vertebral collapse. With the help of the rapidly evolving science, there is hope that the diagnostic accuracy reaches its maximum.



**Chapter 1**

# BASIC PATHOLOGICAL CONSIDERATIONS

Causes of Vertebral Compression Fractures:

## 1- Benign

1-1 Non-neoplastic:

- 1-1-1 Osteoporosis (and its causes)
- 1-1-2 Trauma
- 1-1-3 Infection
- 1-1-4 Paget's disease (lytic phase)
- 1-1-5 Sheuermann's disease.
- 1-1-6 Sickle cell anaemia
- 1-1-7 Congenital non-fractural vertebral deformities

1-2 Neoplastic:

- 1-2-1 Haemangioma
- 1-2-2 Giant cell tumour
- 1-2-3 Aneurysmal bone cyst
- 1-2-4 Eosinophilic granuloma

## 2- Malignant

- 2-1 Metastasis
- 2-2 Multiple myeloma/plasmacytoma
- 2-3 Lymphoma and leukemia
- 2-4 Langerhans cell histiocytosis

***(Chapman and Nakielny, 2003)***

# 1- Benign Causes

## 1-1 Benign non-neoplastic causes of vertebral compression fractures

### 1-1-1 OSTEOPOROTIC FRACTURES

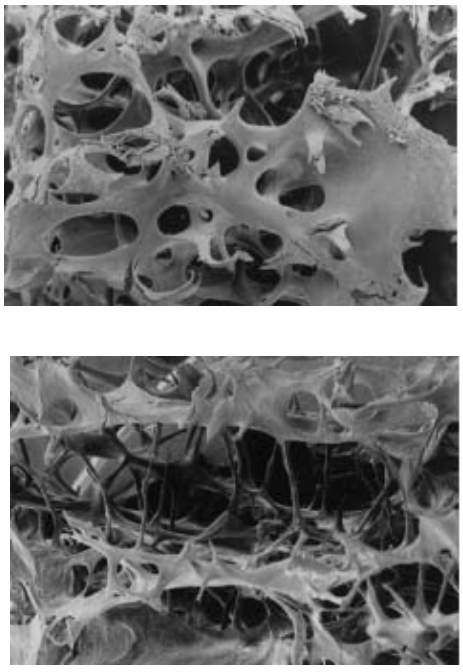
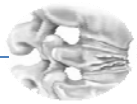



Fig. 1-1 Scanning electron micrographs of (A) normal and (B) osteoporotic bone ***(Sambrook et al,2001)***

Osteoporotic vertebral compression fractures are a frequently encountered clinical problem, and they are becoming more important as the median age of the population continues to increase ***(Rao and Singrakhia, 2003)***.

Bone is composed of a compact cortical compartment and a metabolically active trabecular compartment. The osteoblasts and osteoclasts in trabecular bone participate together in a bone formation/resorption process, which is responsible for the continuous remodeling of bone. Uncoupling of bone remodelling begins when an individual is approximately thirty years old,



continues with a steady 3% to 5% loss of bone per decade, and can eventually result in osteoporosis. This manifests as a reduction in the number, thickness, and interconnectivity of the trabeculae. Osteoporotic bone becomes more fragile, which predisposes it to eventual fracture with relatively minor trauma. ***(Rao and Singrakhia, 2003)***

Trabecular thinning contributes to bone loss with age in both sexes, but trabecular loss occurs to a greater extent in women. Alterations in the physiologic turnover of bone occur with age and may be influenced by many hormonal, hereditary, medical, and lifestyle factors (Table1-1). ***(Rao and Singrakhia, 2003)***

| Physiologic Conditions | Pathologic conditions |
|---|---|
| • Lack of estrogen (postmenopausal)<br>• Advanced age (senile) | • Immobility/disuse<br>  ➢ Paralysis<br>  ➢ postoperative<br>• Genetic<br>  ➢ Osteogenesis imperfecta<br>  ➢ homocystinuria<br>• Hormonal<br>  ➢ Hyperparathyroidism<br>  ➢ Hypo/hyperthyroidism<br>  ➢ Hypogonadism<br>  ➢ Hypercortisolism<br>  ➢ Insulin-dependent diabetes mellitus<br>• Systemic disease |