Atypical Femur Fracture

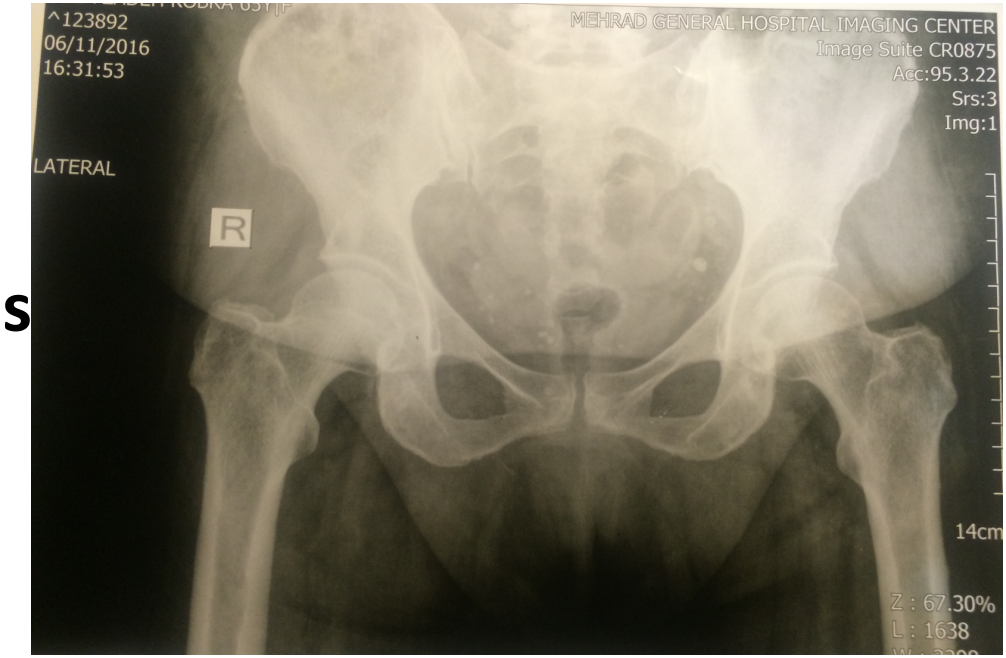
MA Enayatollahi MD

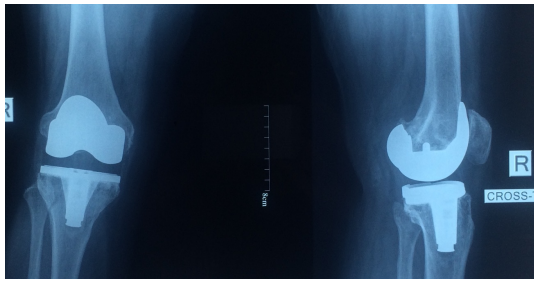
AO Trauma monthly seminar

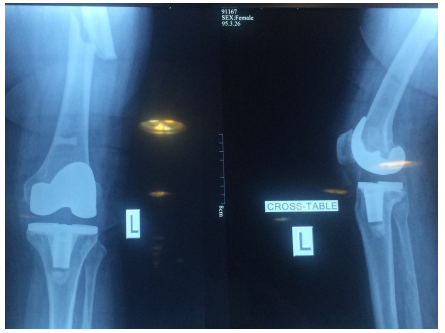
Tehran Jan 2018

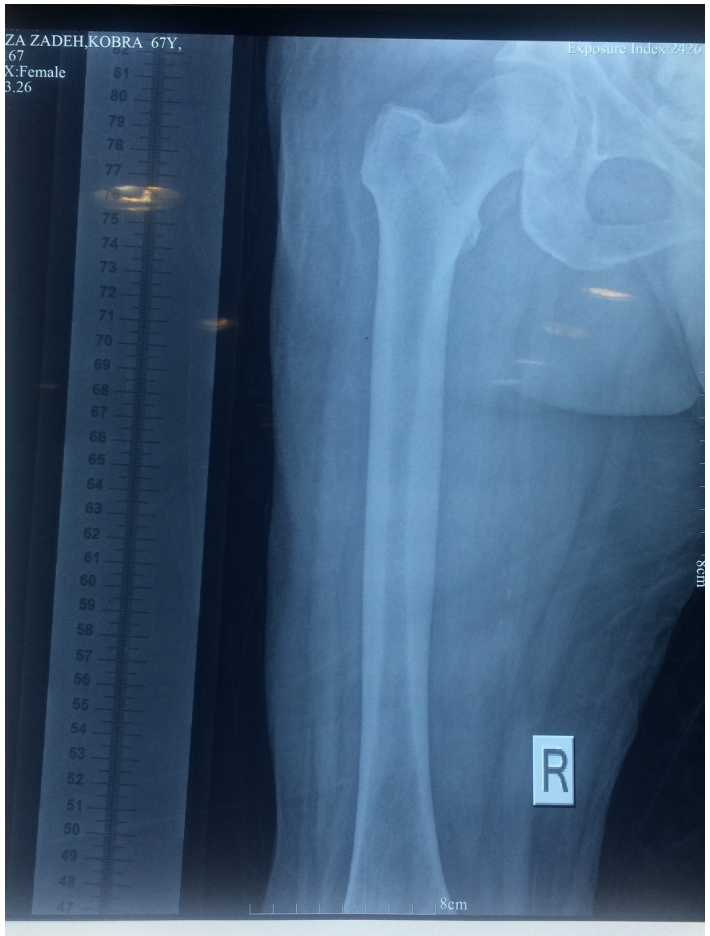
Case 95-M-3-26

- 68 y/o lady
- Suffering of back and thigh pain for months
- DM+, bi TKA years ago
- Alendronate Tx >10years
- Scheduled for spine surgery
- Twisting injury









Findings:

There is an ill-defined area of bone marrow edema involving the middle third of the left thigh associated with edema in the surrounding soft tissue in DDX insufficiency fracture, osteomyelitis & less likely bone deposits should be considered clinical correlation & if necessary CT or whole body bone scan is recommended.

Otherwise, the femoral heads and acetabula are of normal shape, and the femoral heads are well covered by the acetabular margins. The joint spaces are of normal width.

The articular surfaces are smooth and show normal cortical thickness .There is no marginal osteophytes or subchondral signal changes.

The bone marrow shows normal signal intensity, especially in the femoral head and neck.

Each femoral shaft has normal margins and contains a normal bone marrow signal.

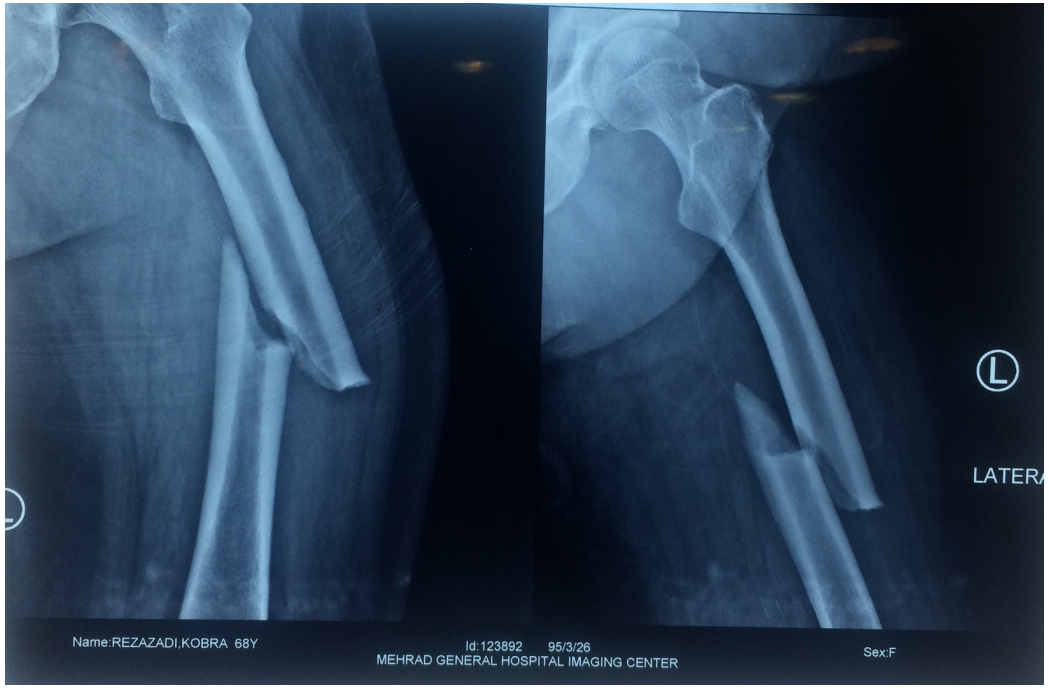
The imaged muscles and the lesser pelvis show no abnormalities.

Impression:

A focus of bone marrow edema in middle third of the left thigh associated with edema in the surrounding soft tissue (rule out insufficiency fracture, osteomyelitis, and bone deposits).

Sincerely Yours

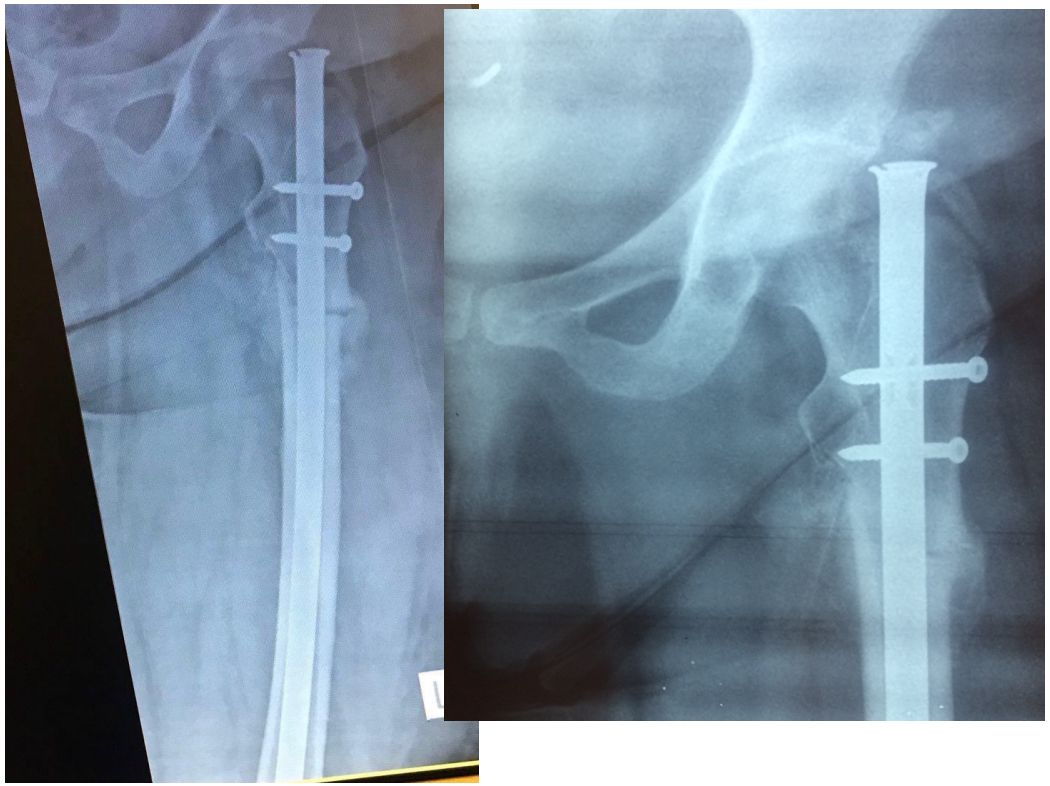
M.Mozaffarieh MD

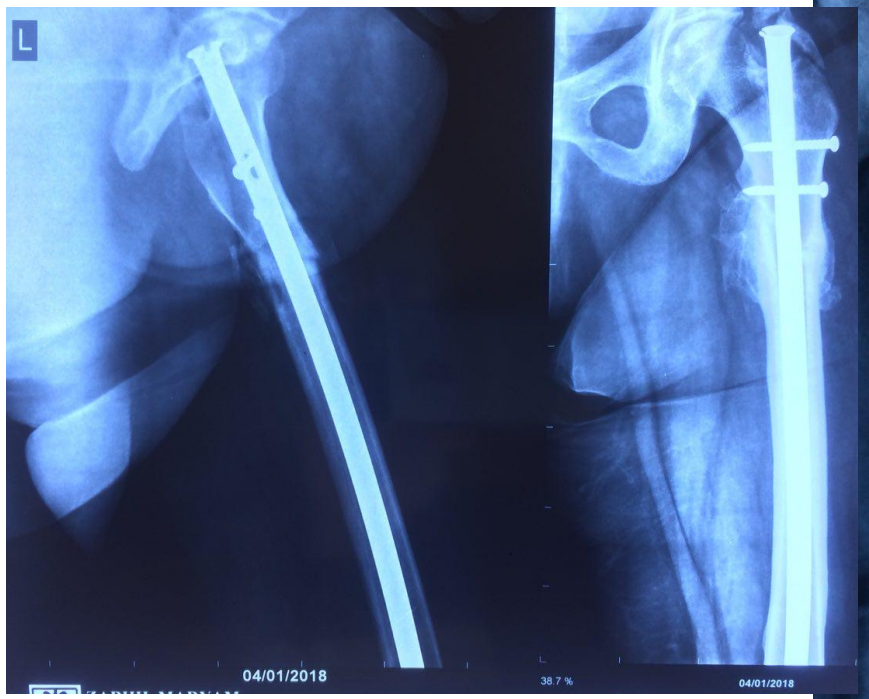


5 months post op.

Case 95-M-12-16

- 44y/o lady
- Falling down
- Prodromal thigh pain
- Myasthenia gravis
- BMI= 40
- Alendronate Tx

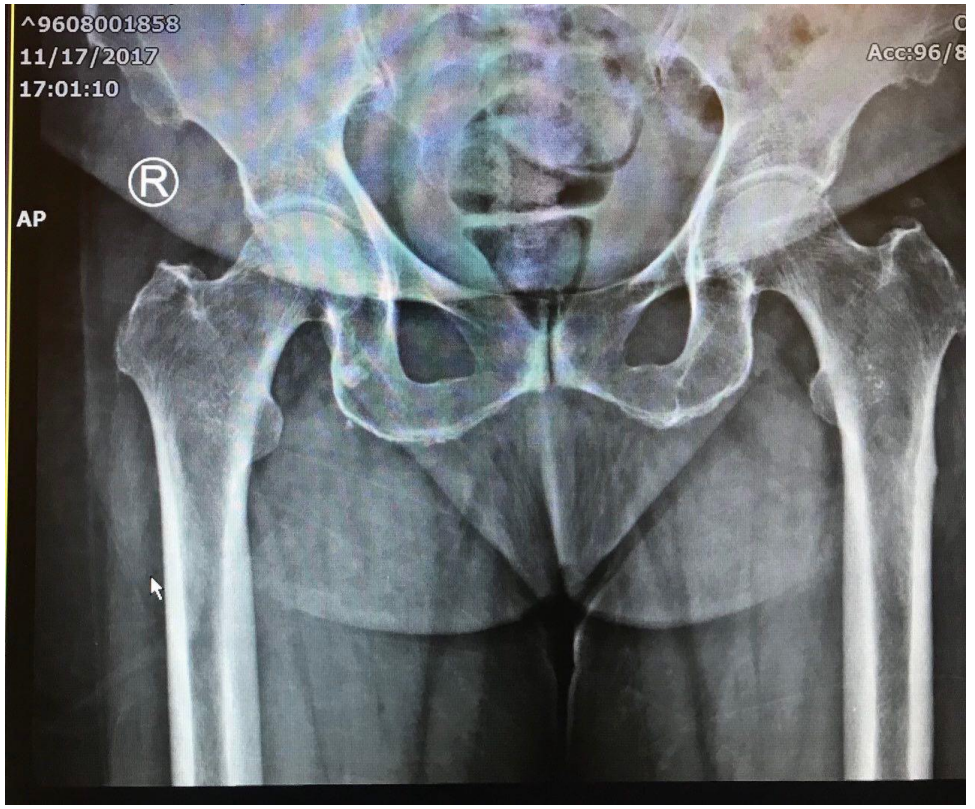


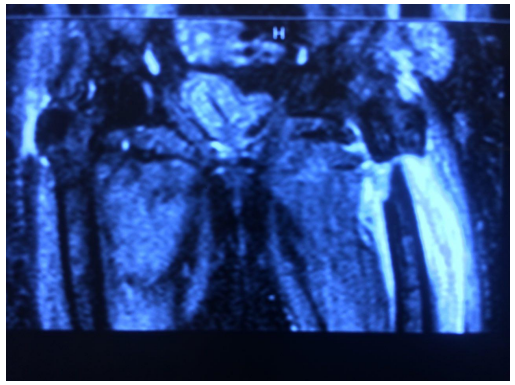


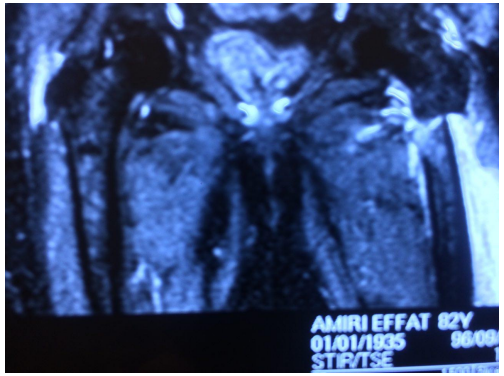
10 months post op

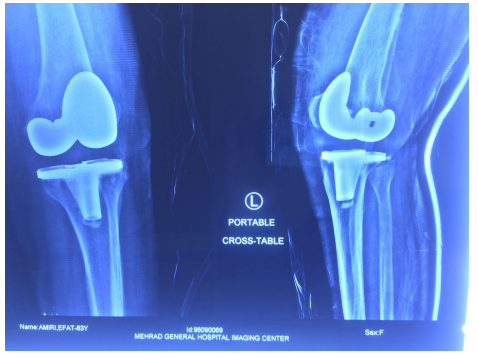
Case 96-M-5-17

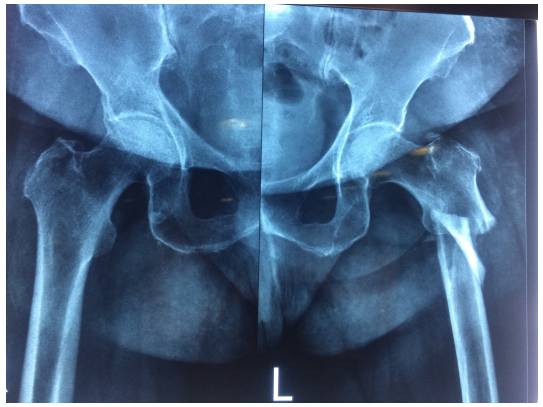
- 84y/o lady
- Hx of LBP and L thigh pain
- Scheduled for spine surgery
- RA, L TKA
- Alendronate use for 8 years

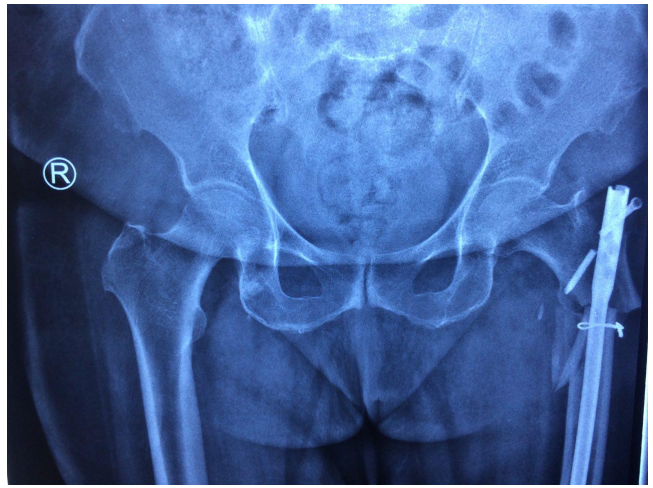












6 wks post op

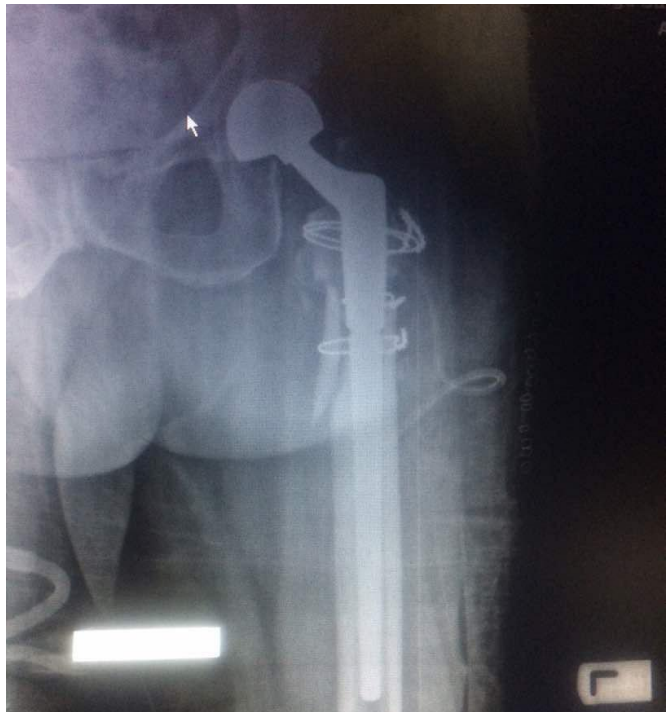


Table 3. ASBMR Task Force 2013 Revised Case Definition of AFFs

To satisfy the case definition of AFF, the fracture must be located along the femoral diaphysis from just distal to the lesser trochanter to just proximal to the supracondylar flare.
In addition, at least four of five Major Features must be present. None of the Minor Features is required but have sometimes been associated with these fractures.
Major features[a]
The fracture is associated with minimal or no trauma, as in a fall from a standing height or less
The fracture line originates at the lateral cortex and is substantially transverse in its orientation, although it may become oblique as it progresses medially across the femur
Complete fractures extend through both cortices and may be associated with a medial spike; incomplete fractures involve only the lateral cortex
The fracture is noncomminuted **or minimally comminuted**
Localized periosteal or endosteal thickening of the lateral cortex is present at the fracture site ("beaking" or "flaring")
Minor features
Generalized increase in cortical thickness of the **femoral diaphyses**
Unilateral or bilateral prodromal symptoms such as dull or aching pain in the groin or thigh
Bilateral **incomplete or complete femoral diaphysis fractures**
Delayed **fracture** healing

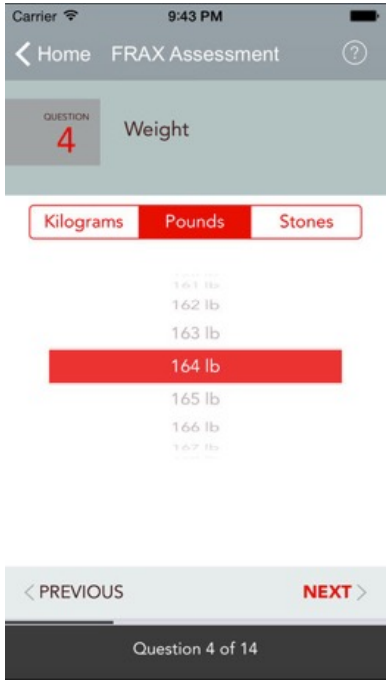
American Society for Bone and Mineral Research task force 2013

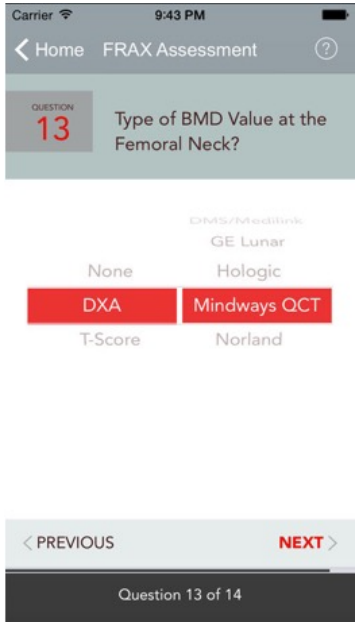
osteoporosis

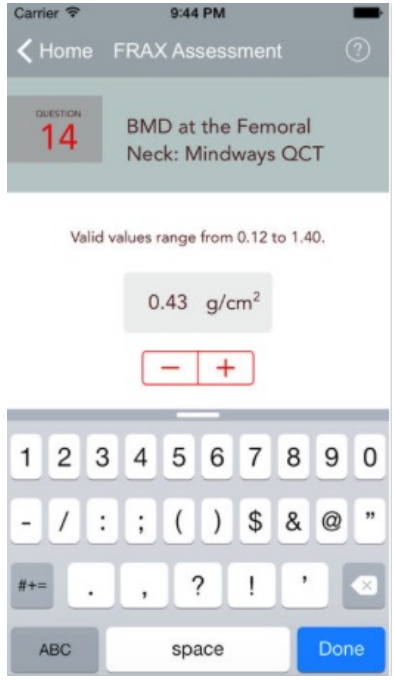
Who needs treatment for osteoporosis:

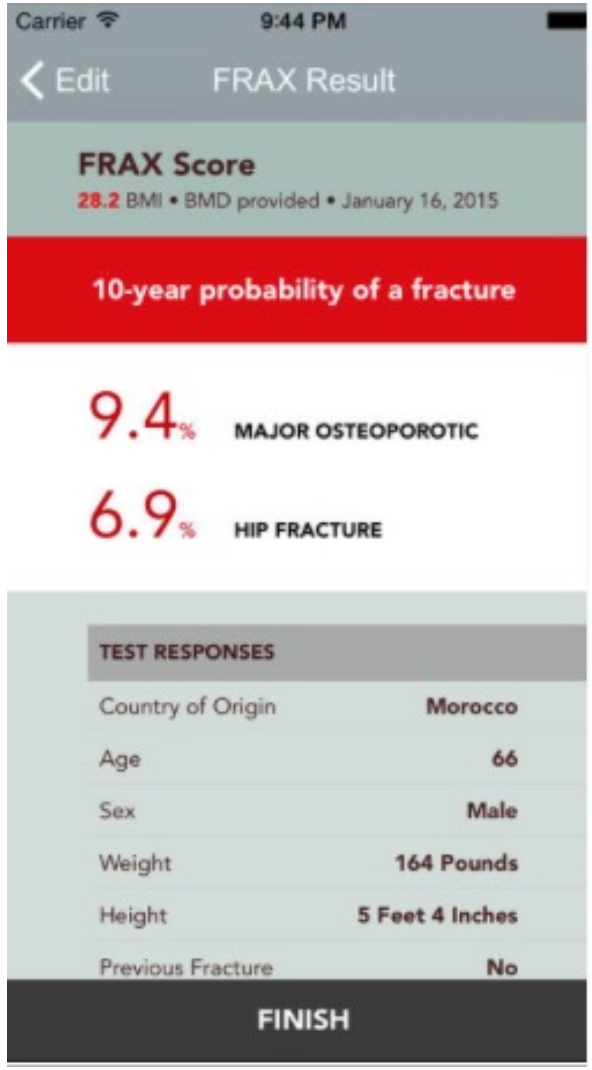
- **T-score <= -2.5**
- **-2.5 <= T-score <= -1:**
  - **Postmenopausal women**
  - **Men >= 50 y/o**
- **10 year hip Fx probability > 3%**
- **10 year major osteoporotic Fx >20%**


Carrier
6:13 PM
FRAX®
Fracture Risk Assessment Tool
START NEW TEST
CONTINUE TEST
SAVED ASSESSMENTS (0)


Carrier
9:43 PM
Home
FRAX Assessment
QUESTION 4
Weight
Kilograms
Pounds
Stones
162 lb
163 lb
164 lb
165 lb
166 lb
PREVIOUS
NEXT
Question 4 of 14


Carrier
9:43 PM
Home
FRAX Assessment
QUESTION 13
Type of BMD Value at the Femoral Neck?
GE Lunar
None
Hologic
DXA
Mindways QCT
T-Score
Norland
PREVIOUS
NEXT
Question 13 of 14


Carrier
9:44 PM
Home
FRAX Assessment
QUESTION 14
BMD at the Femoral Neck: Mindways QCT
Valid values range from 0.12 to 1.40.
0.43 g/cm²
1 2 3 4 5 6 7 8 9 0
- / : ; ( ) $ & @ "
#+= . , ? ! '
ABC
space
Done


Carrier
9:44 PM
Edit
FRAX Result
FRAX Score
28.2 BMI • BMD provided • January 16, 2015
10-year probability of a fracture
9.4% MAJOR OSTEOPOROTIC
6.9% HIP FRACTURE
TEST RESPONSES
Country of Origin Morocco
Age 66
Sex Male
Weight 164 Pounds
Height 5 Feet 4 Inches
Previous Fracture No
FINISH

osteoporosis

- **FDA approved agents for prevention/treatment:**
  - **Diphosphonates (eg, alendronate, ibandronate, risedronate, zoledronic acid)**
  - **Calcitonin**
  - **Estrogens and/or hormone replacement therapy**
  - **Parathyroid hormone (ie, teriparatide)**
  - **Estrogen agonist/antagonist (ie, raloxifene), and more recently denosumab**

J Am Acad Orthop Surg 2015

osteoporosis

- **One of every two Caucasian women and one in five men aged >50 years will experience an osteoporosis-related fracture at some point in their remaining lifetime.**

Osteoporos Int 2010

- **1995 release of Alendronate and other diphosphonates**
- **2005 concerns about association of diphosphonates and spontaneous non-vertebral fractures**

J Bone Joint Surg Br 2007

J Bone Joint Surg Am 2011

Subtrochanteric insufficiency fractures in patients on alendronate therapy

A CAUTION

S.-K. Goh,
K. Y. Yang,
J. S. B. Koh,
M. K. Wong,
S. Y. Chua,
D. T. C. Chua,
T. S. Howe

From Singapore General Hospital, Republic of Singapore

We carried out a retrospective review over ten months of patients who had presented with a low-energy subtrochanteric fracture. We identified 13 women of whom nine were on long-term alendronate therapy and four were not. The patients treated with alendronate were younger, with a mean age of 66.9 years (55 to 82) *vs* 80.3 years (64 to 92) and were more socially active. The fractures sustained by the patients in the alendronate group were mainly at the femoral metaphyseal-diaphyseal junction and many had occurred after minimal trauma. Five of these patients had prodromal pain in the affected hip in the months preceding the fall, and three demonstrated a stress reaction in the cortex in the contralateral femur.

Our study suggests that prolonged suppression of bone remodelling with alendronate may be associated with a new form of insufficiency fracture of the femur. We believe that this finding is important and indicates the need for caution in the long-term use of alendronate in the treatment of osteoporosis.

Diphosphonates

- **First-line treatment for patients with osteoporosis**
- **Treatment with alendronate has been shown to decrease the incidence of vertebral and femoral-neck fractures in post menopausal osteoporotic patients.**

***Lancet* 1996**

***J Clin Endocrinol Metab* 2000**

- **Every 100 reductions in typical hip fx secondary to diphosphonate use, there is an increased risk of one AFF**

J Am Acad Orthop Surg 2015

Diphosphonates

- **The appropriate length of diphosphonate treatment and the necessity of drug holidays is a debated topic**
- **Long biologic half-life of alendronate (ie, 10 years)**
- **Zoledronic acid showed persistent effects on BMD for 3 years.**

J Am Acad Orthop Surg 2015

Diphosphonates

Recommendations for Drug Holiday from Diphosphonates[11]

Patient Category	Recommendation	Comment
High risk: T-score ≤−2.5 at the hip, previous fracture of the hip or spine, or ongoing high-dose glucocorticoid therapy	Drug holiday not justified	Reassess the need for therapy at regular intervals
Moderate risk: Hip bone mineral density value is now >−2.5 (T-score) and no prior hip or spine fracture	Consider drug holiday after 3–5 years of alendronate, risedronate, or zoledronic acid therapy No information about ibandronate and drug holidays	These patients should not be forced to take a drug holiday. Decision should be an individual, informed choice with discussion of the potential benefits and risks.
Low risk: Did not meet current treatment criteria at time of treatment initiation	Discontinue therapy	Restart when indications for therapy are met

McClung et al, Am J Med 2013

Diphosphonates

- **Diphosphonates adverse effects:**

➢**Bisphosphonate-related osteonecrosis of the jaw (BRONJ)**

J Oral Maxillofac Surg 2007

➢**Delayed bone healing**

J Bone Joint Surg Am 2013

➢**Atypical Femur Fractures**

N Engl J Med 2010

J Orthop Trauma 2008

AFF

- **Potential Mechanism for Atypical Subtrochanteric Fractures**

- **The presence of diphosphonates encourages high levels of collagen cross-linking and reduces the toughness of bone and its ability to absorb energy : Brittle Bone**
- **larger compressive and tensile forces in subtroch. region (several times of body weight)**

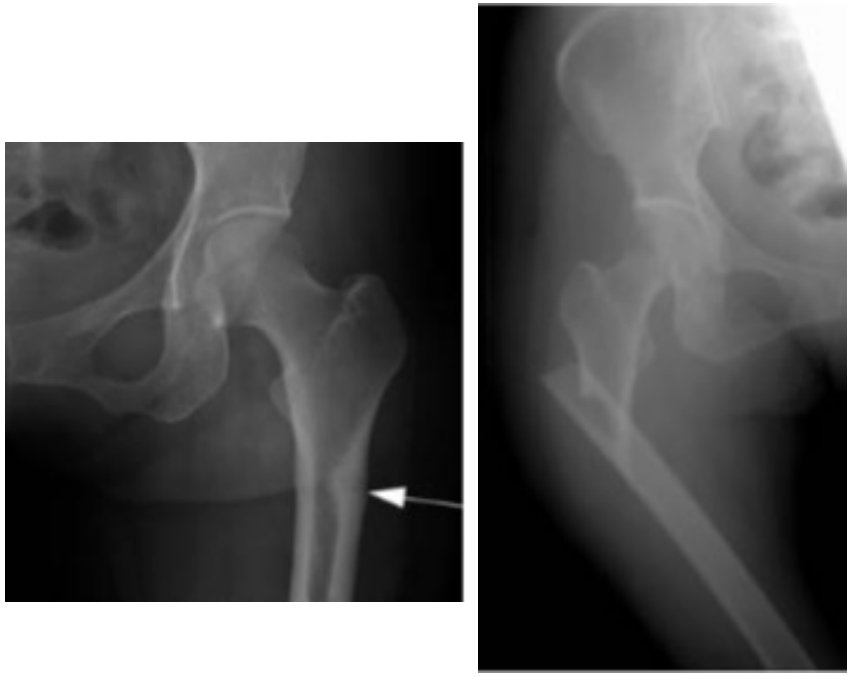
J Bone Miner Res 2010;

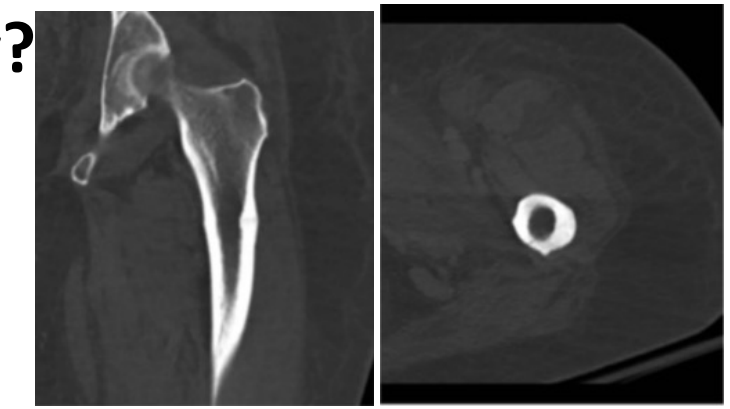
Rockwood and Green's Fractures in Adults, 2010

AFF

Treatment evaluation

- Physical examination and a thorough history
- Plain radiographs
  - focal lateral cortex thickening
  - Transverse fracture line
- MRI?
- Bone scintigraphy?
- CT?

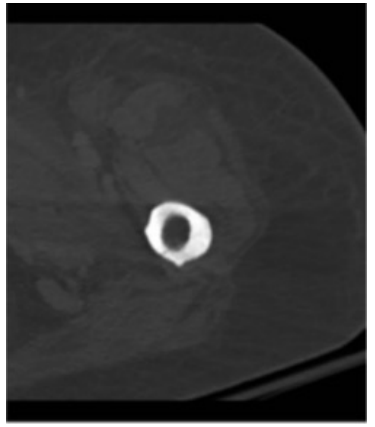




AFF

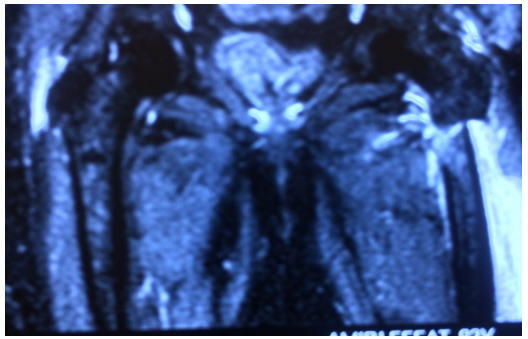
- **AFF sub-types:**

➢**Complete Fx**



➢**Incomplete AFF: Cortical lucency on CT**

➢**Stress reaction: Marrow edema (MRI) with no cortical lucency**



AFF Treatment

- **Incomplete Fx:**
  - ➢ **With pain: Prophylactic nailing**
  - ➢ **Minimal pain: If failed conservative Tx in 2-3 mo, then Prophylactic nailing**
  - ➢ **No pain: conservative Tx until no marrow edema or increased uptake**
- **Stress Fx**
  - ➢ **conservative Tx until no marrow edema or increased uptake**

AFF TASK FORCE REPORT , 2014

- **Complete Fx:**
  - ➢ **IM nailing or bridge plating**

J Am Acad Orthop Surg 2015

AFF Treatment

- **Implant of choice**
  - **Diphosphonates inhibit intramembranous fx healing**
  - **Implant should provide endochondral healing**

IM nail

Bridge plate

J Bone Miner Res 2010

AFF Treatment

- **A multidisciplinary approach**
  - **D/C of diphosphonates**
  - **Calcium/ Vit D level**
  - **Blood turnover biomarkers**
  - **Consider teriparatide (PTH)**

J Am Acad Orthop Surg 2015

Drug holiday

- **what to do?**
  - **BMD and biochemical markers level every 2-3 year**
- **When to resumption diphosphonate?**
  - **Significant decreased in BMD or**
  - **Increased serum markers**
  - **Hx of fragility Fx**
  - **Risk factors i.e steroid therapy**

Am J Med 2013

Useful papers on the topic

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 13, 2010 VOL. 362 NO. 19

Bisphosphonates and Fractures of the Subtrochanteric or Diaphyseal Femur

Journal of Bone and Mineral Research
JBMR
ASBMR
The American Society for Bone and Mineral Research

REVIEW

JBMR®

Atypical Subtrochanteric and Diaphyseal Femoral Fractures: Second Report of a Task Force of the American Society for Bone and Mineral Research

JBM J Bone Metab 2015;22:183-189
http://dx.doi.org/10.11005/jbm.2015.22.4.183
pISSN 2287-6375 eISSN 2287-7029

Review Article

Effect of Teriparatide on Healing of Atypical Femoral Fractures: A Systemic Review

Gun-Il Im, Seong-Hyun Lee
Department of Orthopaedics, Dongguk University Ilsan Hospital, Goyang, Korea

ORIGINAL ARTICLE

JBMR®

Evaluating Atypical Features of Femur Fractures: How Change in Radiological Criteria Influenced Incidence and Demography of Atypical Femur Fractures in a Community Setting

Erin S LeBlanc,[1] A Gabriela Rosales,[1] Dennis M Black,[2] Harry K Genant,[2] Richard M Dell,[3] Darin M Friess,[4] David L Boardman,[5] Douglas C Bauer,[2] Anne de Papp,[6] Arthur C Santora,[6] and Eric S Orwoll[4]

Atypical Subtrochanteric Femoral Fractures in Patients with Skeletal Malignant Involvement Treated with Intravenous Bisphosphonates

Mark E. Puhaindran, MBBS, Azeez Farooki, MD, Matthew R. Steensma, MD, Meera Hameed, MD, John H. Healey, MD, and Patrick J. Boland, MD

Investigation performed at the Memorial Sloan-Kettering Cancer Center, New York, NY

REVIEW ARTICLE

PARADOXICAL SIDE EFFECTS OF BISPHOSPHONATES ON THE SKELETON: WHAT DO WE KNOW AND WHAT CAN WE DO? †

Running title: Skeletal side effects of bisphosphonates

Jorge William Vargas-Franco[1,2], Beatriz Castaneda[3], Françoise Rédini[1], David Francisco Gómez[2], Dominique Heymann[4,5], Frédéric Lézot[1]*

Received 20 December 2017; Accepted 5 January 2018
Journal of Cellular Physiology

DOI 10.1002/jcp.26465

Cochrane Library

Cochrane Database of Systematic Reviews

Bisphosphonates for steroid-induced osteoporosis (Review)

Allen CS, Yeung JHS, Vandermeer B, Homik J

Allen CS, Yeung JHS, Vandermeer B, Homik J.
Bisphosphonates for steroid-induced osteoporosis.
Cochrane Database of Systematic Reviews 2016, Issue 10. Art. No.: CD001347.
DOI: 10.1002/14651858.CD001347.pub2.

www.cochranelibrary.com

WILEY

Review Article

Atypical Femur Fractures Associated With Diphosphonate Use

Tessa Balach, MD
Paul C. Baldwin, MD
Jessica Intravia, MD

Abstract

Osteoporosis-related fractures create a heavy economic and healthcare burden. Although diphosphonate medications have been successful at decreasing the risk of osteoporotic fragility fractures and have become staples in the treatment of osteoporosis, concerns have been raised about the association of diphosphonate therapy with spontaneous nonvertebral fractures. Diphosphonate fractures are characteristically transverse or slightly oblique in nature and occur in the lateral cortex, or tension side, of the subtrochanteric region of the femur where diffuse cortical thickening and fracture can be observed on radiographs. A multidisciplinary approach incorporating both medical and surgical teams should be used in the case of diphosphonate-associated fractures. Future medical and surgical developments that augment fracture fixation and counteract diphosphonate-associated osteoclast apoptosis may play a role in therapy. Although diphosphonate use has decreased the rate of osteoporosis-related fractures, increased awareness and association with atypical subtrochanteric fractures is an important concern for clinicians to keep in mind.

Published in final edited form as:
Ann N Y Acad Sci. 2015 January ; 1335(1): 1–9. doi:10.1111/nyas.12551.

Questioning the association between bisphosphonates and atypical femoral fractures

Michael Pazianas[1], **Se-min Kim**[2], **Tony Yuen**[2], **Li Sun**[2], **Sol Epstein**[2], and **Mone Zaidi**[2]

[1]Oxford University Institute of Musculoskeletal Sciences, Oxford, United Kingdom.

[2]The Mount Sinai Bone Program, Mount Sinai School of Medicine, New York

Sanchi Oil Tanker Disaster
A collision or ?