

Original Research Article

Radiographic imaging of metabolic bone disorders in consonance with biochemical parameters

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ABSTRACT

Background: Bone is a strong dynamic organ of the endoskeleton playing a vital role in structural integrity envisaging keeping proper shape and maintenance of the body, mineral reservoirs, blood production, coagulation and immunity. Metabolic bone diseases are a heterogeneous group of disorders that interrupt the normal homeostasis of bone formation and resorption. Bone regulates as well as acts as a host for hematopoiesis by providing niche for proliferation and differentiation of hematopoietic cell. Bone is a dynamic tissue but metabolically active as it is being constantly formed (modelling) and reformed (remodelling). Metabolic bone diseases comprise of a broad spectrum of inherited and acquired disorders characterized by abnormalities in calcium metabolism and bone cell physiology- that lead to an altered serum calcium concentration and skeletal failure.

Methods: After taking a properly informed written consent and complete history, thorough clinical examination was done and these patients were subjected to radiographic imaging and biochemical analysis.

Results: With regards to fracture relating to different skeletal structures frequency was more in vertebra (38%), the maximum to be reported in 38 cases followed by hip fractures (17%) in 17 cases. Pelvis fractures were reported as (11%) in 11 cases and tibia fractures were reported to be only (7%) in meagre population of 7 cases, while remaining skeletal organs had (27%) fractures with subject to realisation in other 27 cases.

Conclusions: In all the osteoporotic cases irrespective to age of patients, values of serum calcium, serum alkaline phosphatase, serum phosphorus, serum potassium, serum sodium, serum calcidiol were within normal limits.

Keywords: Compression, Fracture, Osteophytes, Osteopenia, Osteoporosis, Radiolucency, Spondylolisthesis, Wedge

INTRODUCTION

Bone consists of an extracellular matrix and cellular constituents. The extracellular components of bone consist of organic components which include Osteoid [type 1 collagen (95%) and type 2 collagen (<5%)], non-collagenous proteins (albumin, osteocalcin, osteonectin, fibronectin, osteopontin, thrombospondin, bone sialoproteins).¹ Inorganic components includes [hydroxyapatite crystals with carbonate content].² The

cellular constituents include mesenchymal derived osteoblast lineage and osteoclast.² Most important types of metabolic bone key diseases encompasses wide range i.e., osteoporosis, osteomalacia, osteogenesis imperfecta, osteopetrosis, renal osteodystrophy, hyperparathyroidism, Paget's disease, acromegaly, rickets and scurvy.² Bone acts as a reservoir for minerals and other ions for homeostatic function. It also facilitates in blood production and provides immunity.^{3,4} The quantity of bone in skeleton entirely depends on balance between

bone resorption, formation and on peak bone mass. Osteoporosis is the most common metabolic bone disease, in which weight of bone gets decreased leading to insufficiency (low-trauma) fractures.⁵⁻⁷ Rickets and osteomalacia are due to defective mineralization of bone osteoid due to vitamin D, phosphate and calcium deficiency that lead to impaired epiphyseal growth plate calcification and a qualitative abnormality of bone and Hyperparathyroidism in which stimulation of osteoclasts and increase in parathyroid hormone due to parathyroid glands tumour or hyperplasia.⁸

Patients with risk of these bone related deformities can be benefitted from early diagnosis, periodic surveillance and timely cure of defects by overcoming disorders. In this paper healthy discussion has been made pertaining to commonly encountered metabolic bone disease and specifically reviewing the radiographic imaging features with latest trends to derive successful remedy and to get relieved from intolerable pain due to intricated bone disorders.⁸ The purpose of presenting this paper is highly constructive and in true sense is to explicitly appreciate the distinguished radiographic imaging features and relevant characteristics involved in common types of metabolic bone disorders with crystal clear highlights of clinically derived authentic information so that expert hands can better judge differential diagnosis and formulate recommendation to be furnished from the very beginning till successful and complete curing of the patient suffering from particular disease.

Successful radiographic imaging plays an important and highly constructive role in accurate diagnosis, detection, monitoring authenticity in treatment and to encounter risk involved to cure the relevant deformity and abnormality. Radiologist should be well acquainted and well aware with the disease and attained guaranteed skill to explore and solicitely perfect to furnish radiographic findings and natural instinct of generating multimodality expertise to frame the opinion judiciously in consonance with the quality of medicines prescribed to achieve the genuine target of curing strategy and remedial measures to be undertaken for obstructing spread and prevention of curable disease. For the reasons mentioned as above a thorough search and proper investigation has to be made from the grass root level till successful cure of the disorders. For this most accurate and up-to-date information can be sought perceiving several intricated metabolic bone diseases such as osteoporosis, osteogenesis imperfecta, osteopetrosis, osteomalacia, rickets, renal osteodystrophy, hyperparathyroidism, Paget's disease, acromegaly, scurvy having direct impact on the bone. These disorders may have shared both characteristics features that can be recognized as well as explained through imaging.

Osteoporosis

Osteoporosis is the second most common metabolic bone disease in India. The term describes a group of bone

disorders in which low bone mass per unit volume leading to deterioration of microarchitecture of the skeleton responsible for increased propensity to bone fragility and risk of fractures.² Osteoporosis is a quantitative abnormality of bone, means reduction in bone quantity too little bone but actual quality of the bone remaining normal. Osteoporosis is classified into three types that is (1) Generalized, (2) Regionalized and (3) Localized. It is a silent underlying condition which often remains asymptomatic until fragility fractures occur.²

Radiographic features include increased radiolucency of bones, cortical thinning, altered trabecular patterns and fracture deformity. Common osteoporotic fractures include those of the vertebral body, humerus, hip, forearm and pelvis. There will be altered vertebral shape like vertebral plana which is a vertebral body compression, a deformity involving loss in both the anterior and posterior vertical heights. It can involve multiple segments. Other name for this is pancake vertebra or silver dollar vertebra. The incidence of vertebral and hip fractures increases exponentially in old age in both men and women. Wedge vertebra is a vertebral body compression deformity characterized by loss of anterior vertebral body height with preservation of the posterior vertebral body height although fractures rates at these sites in men increases about 10 years later at an age around 75 years as compared to women. Osteoporosis can also be defined using bone mineral density (BMD) criteria. Thus, osteoporosis is defined as a BMD T-score less than -2.5, a BMD that is more than 2.5 standard deviations below the mean value in the young healthy population. By using these diagnostic criteria, 50% of women have osteoporosis by the age of 80 years.²

Biconcave deformities

Central gradual depression of the vertebral body endplates may be involving multiple segments. Other name for this is fish mouth, cod fish, hourglass vertebra.

Osteoporosis is categorized as²

Generalized osteoporosis

Primary osteoporosis

Primary osteoporosis is further divided into

- Involutional and idiopathic
- Involutional (most common osteoporosis in which no underlying cause can be detected)

A) Type 1 postmenopausal osteoporosis

In this, 3 times more trabecular bone loss at the time of menopause because of oestrogen deficiency. Age of occurrence between 51-74 years; parathyroid function is curtailed causing parathyroid hormone to over stimulate osteoclasts. Fractures occur at the sites of the skeleton

enriched with trabecular bone including the vertebral bodies and distal forearm.^{2,8}

B) Type 2 senile osteoporosis

its prevalence is typically seen in the 5th and 6th decade, type -2 occurs due to age related impaired bone formation along with secondary hyperparathyroidism or due to impact of low intestinal calcium absorption as a result of low levels of 1, 25 (OH)₂ D production in the old age patient. Bone loss visible due to raised bone turnover. Parathyroid function gets enhanced. There is reduction in both cortical and trabecular bone. The syndrome persists due to hip fractures and wedge fractures of the vertebrae.

Idiopathic has been further classified into^{2,8}

- a) *Idiopathic juvenile osteoporosis* – self-limiting condition, children aging between 7 to 14 years are prone to be affected. The disease follows an acute course over a period of 2-4 years, during which fractures and growth arrest is specially observed. There is a broad spectrum of severity, thus both cortical and trabecular bones found to be affected.⁸
- b) *Idiopathic adult osteoporosis* – short course is followed with multiple vertebral fractures over a prolonged period along with condition of loss in height are the commonest features noted in adult osteoporosis.

*Secondary osteoporosis*⁸

Osteoporosis in which there is an underlying reason with Glucocorticoid excess bone formation gets curtailed due to a direct effect on the osteoblast, and enhanced osteoclastic activity, probably mediated through secondary hyperparathyroidism, stimulated due to decreased gastrointestinal absorption of calcium.

Regional osteoporosis

Reflex sympathetic dystrophy syndrome

An acute painful osteoporosis persists in reflex sympathetic dystrophy syndrome (Sudeck’s atrophy) following history of recent trauma to the underlying bone. Most common in patients after attaining the age of 50 years with neurovascular imbalance raising to osseous hyperemia with cytokines stimulated excessive bone resorption noted.⁸

Radiographic features: Metaphysis of bones most commonly involved with mottled or patchy osteoporosis.⁸

Disuse and immobilization osteoporosis

Osteoporosis ensues due to immobilization such as after wearing a plaster cast for a long period of time in association with paraplegia and poliomyelitis. So,

traumatic injuries that are immobilized and inflammatory lesions of bones and joints are the predisposing factors.⁸

Radiographic features: Cortical lamination, uniform, spotty scalloping bands.⁸

Transient regional osteoporosis

Most common age of occurrence is 20-40 years associated with pregnancy in females but males are more frequently affected than females. Density of proximal femur gets curtailed.⁸

Radiographic features: Periarticular bone involvement is common manifestation at the sites e.g. Femoral head > femoral neck > acetabulum in decreasing order are commonly involved sites. Lower extremities are commonly affected.⁸

METHODS

The study was carried out in the Department of Radio diagnosis, Bapuji Hospital and Chigateri Government Hospital attached to Jagadguru Jayadeva Murugarajendra Medical College, Davangere, Karnataka, India over a period of 24 months. Patients with the signs and symptoms relating to continuous pain, weakness and fracture were referred from various Departments of JJMMC Davangere. Total 100 patients were selected on the basis of clinical, Radiographic findings and those with osteoporotic changes were further referred to biochemical analysis. After taking a properly informed written consent and complete history, thorough clinical examination was done and these patients were subjected to radiographic imaging and biochemical analysis. Clinical and radiological data from the study was recorded as per the proforma.

RESULTS

With regards to sample population maximum number of cases (68%) were reported in the individuals who have crossed the age limit of 60 years followed by (22%) cases aging between 51-60 years and merely (10%) of the cases had been reported in the age group of 41-50 years.

Table 1: Age distribution of the sample.

Age in years	Frequency	Percentage
41 – 50	10	10
51-60	22	22
> 60	68	68

Osteoporosis

Gender discrimination pertaining to case reports revealed (40%) male and (60%) with still higher frequency in females i.e., females were prone to be affected more as compared to male population.

Table 2: Sex distribution.

Sex	Frequency	Percentage
Male	40	40
Female	60	60

With regards to fracture relating to different skeletal structures frequency was more in vertebra (38%), the maximum to be reported in 38 cases followed by hip fractures (17%) in 17 cases.

Pelvis fractures were reported as (11%) in 11 cases and tibia fractures were reported to be only (7%) in meagre population of 7 cases, while remaining skeletal organs had (27%) fractures with subject to realisation in other 27 cases.

Table 3: Distribution of fracture.

Fracture	Frequency	Percentage
Vertebra	38	38
Tibia	7	7
Hip	17	17
Pelvis	11	11
Others	27	27

Table 3: Blood serum chemistry – normal values.

Test	Normal range
Serum sodium	135-145 mEq/L
Serum potassium	3.5-5.0 mEq/L
Serum alkaline Phosphatase	53-128 U/L
Serum phosphorus	Children 4.5-5.5 mg/dL Adults 2.5-4.5 mg/dL
Serum calcium	8.4-10.4 mg/dL
Total T4 (ELISA)	5-12 µg/dL
Total T3 (Chemiluminescence)	120-190 ng/dL
TSH (Radioimmunoassay)	0.5-4.5 mIU/ml
Free T3 (Chemiluminescence)	0.2-0.5 ng/dL
Free T4	0.7-1.8 ng/dL
Plasma tyrosine	60-70 µ mol/L
Serum calcidiol	20-40 ng/mL 75-250 nmol/L

DISCUSSION

Postmenopausal osteoporosis

Wedge compression fracture

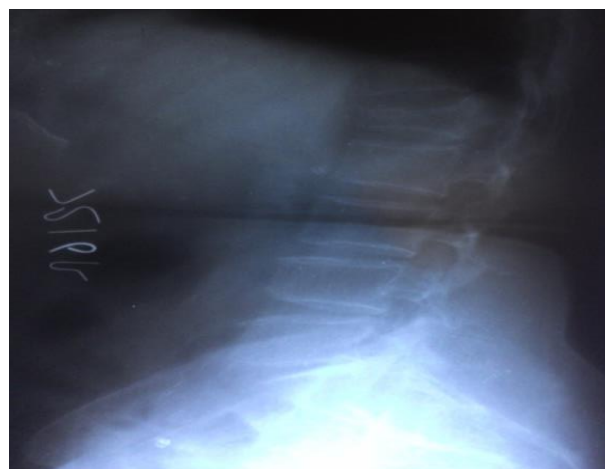
A 65 years old female patient entered in to ortho OPD with major complaints of lower backache, pain while getting up from lying down position, also complains of pain while standing from sitting posture.

X-ray L-S spine

Wedge compression fracture of L1 vertebral body. Anterior listhesis of L5 over S1, Cortical thinning with altered trabecular pattern, Anterior Osteophytes in the L4, L5 vertebral body, Posterior elements appear normal, IVD spaces appear normal, Feature suggesting of Gross Osteoporotic changes and early lumbar spondylosis.

Biochemical findings of the patient were normal. serum calcium (arsenazo) 9.2 mg/dl, serum alkaline phosphatase 71 U/L, serum phosphorous 3.8 mg/dl, serum sodium 137 meq/L, serum potassium 4.4 meq/L, serum calcidiol 116 nmol/L (normal range 75 to 250 nmol/L). In osteoporosis mineral to matrix ratio is reduced, thinning of trabecular elements with the total loss of some trabeculae drastically reducing the strength of bone. Sometimes the biochemical markers are also useful in monitoring the response to treatment and assessing the risk of fractures.⁸

The necessary investigation in a patient who has osteoporosis will depend upon the extent to which the low bone mass can be accounted with regards to calcium, phosphorous and alkaline phosphatase levels in the blood depicted to be normal. X-rays are the easiest modality to diagnose osteoporosis, but it is evident only after loss of 30 % to 50% of bone mass.⁸

**Figure 1: Postmenopausal osteoporosis.**

Senile osteoporosis

Wedge compression fracture

A 56 years old male patient visited ortho OPD with major complaints of backache, chest pain and pain over pelvic region. On clinical examination the patient was severely anaemic.

X-ray LS spine

Wedge compression fracture of L1 Vertebra noted. Degenerative changes noted in the form of marginal

anterior osteophytes at the level of L4 vertebra. Posterior elements and IVD spaces appears to be normal, Features suggestive of early lumbar spondylosis with wedge compression fracture of L1 Vertebra.

Patient biochemical findings were normal. serum calcidiol 150 nmol/L(normal range 75 to 250 nmol/L), serum calcium (arsenazo) 9.3 mg/dl, serum alkaline phosphatase 77 U/L, serum phosphorous 4.2 mg/dl, serum sodium 141 meq/L, serum potassium 3.8 meq/L. Moreover vitamin D deficiency leads to impaired intestinal absorption of calcium, which results in decreased levels of ionized and serum total calcium levels. This hypocalcemia gives rise to secondary hyperparathyroidism because of PTH induced increase in bone turnover; alkaline phosphatase levels are often increased. PTH also increases bone resorption which leads to increased urinary calcium excretion while promoting phosphaturia, eventually results in hypophosphatemia so indirectly exacerbates the mineralization defect in the skeleton.⁸



Figure 2: Senile osteoporosis with wedge compression fracture.

Compression fracture with gross osteoporotic changes

A 55 years old male patient entered in to ortho OPD with major complaints of lower backache, pain while getting up from lying down position, also complains of pain while standing from sitting posture and during walking. On clinical examination patient was found to be an anaemic.

X-ray LS spine lateral view

Anterior wedge compression fracture of L1 vertebra, Evidence of cortical thinning with altered trabecular pattern features suggestive of gross osteoporotic changes, Patient biochemical findings were normal, serum calcium (arsenazo) 10.0 mg/dl, serum alkaline phosphatase 114 U/L, serum phosphorous 3.1 mg/dl, serum sodium 137 meq/L, serum potassium 4.6 meq/L, serum calcidiol 142 nmol/L (normal range 75 to 250 nmol/L). Osteopenia is defined as a BMD T score that is 1 to 2.5 standard

deviations below the mean value in the young healthy population. Low bone mineral density is an important predictor of future fractures. Loss of BMD is sometimes pathological response but more frequently occurs as a normal part of ageing.⁸

In women, late menarche and episodes of amenorrhoea with oestrogen deficiency further reduce bone mass in much the same way as early menopause amenorrhoea with oestrogen deficiency can trigger from a number of conditions like ovarian failure and hypothalamo pituitary dysfunction.⁸



Figure 3: Senile osteoporosis with compression fracture with gross osteoporotic changes.

Idiopathic adult osteoporosis

Gross osteoporotic changes

38 years old male patient visited ortho OPD with major complaints of severe backache radiating to lumbar regions, severe pain in the pelvic region and radiating to both thighs and pain was felt in the legs after walking for 10 mins. On clinical examination patient was quite anaemic.

X-ray pelvis with both hip AP view

Cortical thinning altered trabecular pattern with increased radiolucency of bones, Feature suggestive of gross osteoporotic changes.

Biochemical findings of the patient were normal. Serum calcium (arsenazo) 8.5 mg/dl, serum alkaline phosphatase 100 U/L, serum phosphorous 4.1 mg/dl, serum calcidiol 67ng/ml (normal range 30-80 ng/ml), serum sodium 143 meq/L, serum potassium 3.6 meq/L, Hb11 g/dl. With advancing age, the efficiency with which osteoblasts refill resorption cavities is curtailed and there is also an increase in bone resorption associated with hypogonadism. The most frequent symptoms are backache, (kyphosis) deformity of the spine and loss of height. In the proximal femur loss of BMD begins in both sexes in the third and fourth decades, whereas in women

BMD in the lumbar spine is probably stable until the perimenopause.^{2,8}

In osteoporosis the rate of bone resorption exceeds that of bone formation. Normally the bone mass is gradually reduced in both sexes, but in women the rate of bone loss is accelerated after the menopause. The loss of sex hormones has a deleterious effect on bone mass at the same time it occurs in both men and women. It is anoestradiol deficiency that appears to be severe and critical.⁸

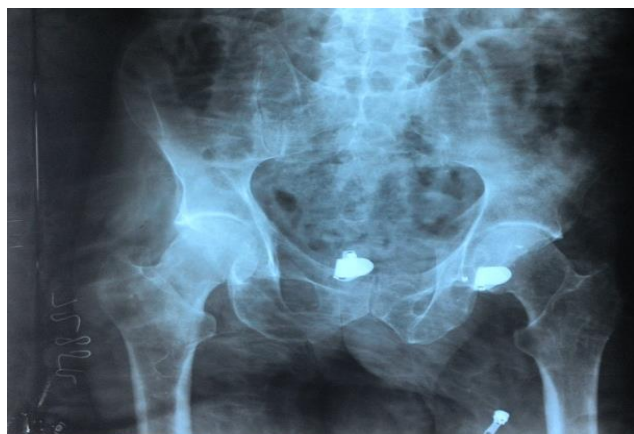


Figure 4: Idiopathic adult osteoporosis with gross osteoporotic changes.

Wedge compression fracture with osteoporotic changes

A 27 years old male patient entered in to ortho OPD with major complaints of lower backache radiating to both lumbar region, pain while getting up from lying down posture, pain while walking, sitting, doing routine activities also complains of pain while standing from sitting position. On clinical examination no tenderness was noted as such

X-ray L-S spine

Anterior wedge compression fracture of L3 vertebra, There is no evidence of spondylolysis / Listhesis, Posterior elements appears normal.

Biochemical findings of the patient were normal. Serum calcium (arsenazo) 9.4 mg/dl, serum alkaline phosphatase 85 U/L, serum phosphorous 2.9 mg/dl, serum sodium 136 meq/L, serum calcidiol 59 ng/ml (normal range 30-80 ng/ml), serum potassium 3.7 meq/L. Pain usually exists due to collapse of the vertebral bodies specially in the lower dorsal and upper lumbar regions. It is critically acute during onset. Generalised bone tenderness would predict co-existing osteomalacia. Impaired movement of thoracic cage triggers cardiopulmonary embarrassment, exercise intolerance and disability.

Bone turnover is a term referring to both osteoblastic bone formation and osteoclastic bone resorption.

Biochemical markers of bone turnover includes formation markers (in BLOOD) are ALP, OSTEOCALCIN, PICP AND PINP and Resorption markers(in blood) are ICTP, NTX, CTX, TRAP, cathepsin K. In urine are hydroxyproline, hydroxylysine, pyridinoline, deoxypyridinoline, NTX and CTX. Serum alkaline phosphatase is a good marker in rickets and osteomalacia, ICTP in osteoporosis, pyridinoline, deoxypyridinoline in primary hyperparathyroidism, serum PICP in renal osteodystrophy. However, the main use of markers is to establish whether a high bone turnover state exists with its various consequences is a feature of the more common metabolic bone disease and a key target of currently available therapies.⁷

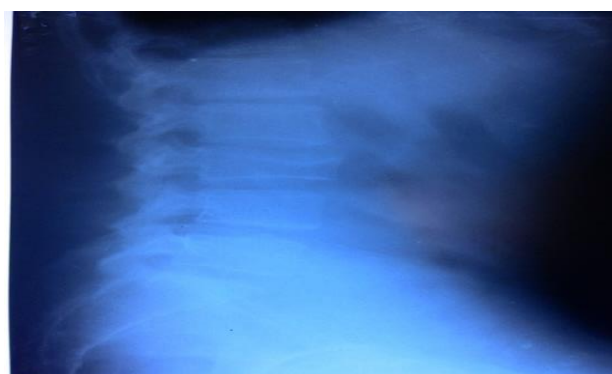


Figure 5: Idiopathic adult osteoporosis with wedge compression fracture with osteoporotic changes.

Regionalized osteoporosis: reflex sympathetic dystrophy syndrome (Sudeck's atrophy)

Fracture with gross osteoporotic changes

A 63 years old male patient with history of RTA(road traffic accident)one month back entered in to ortho OPD with major complaints of pain over left wrist joint, swelling with tenderness. On clinical examination pain was severe with tenderness and very feeble movement of left hand and patient was complaining of weakness and aches throughout the body for a long period of time.



Figure 6: Sudeck's atrophy, Fracture with gross osteoporotic changes.

X-ray wrist joint

Visualized bones appears to be osteoporotic, Evidence of fracture noted at the distal end of left radius.

Biochemical findings of the patient were normal. serum calcidiol 54 ng/ml (normal range 30-80 ng/ml), serum calcium (arsenazo) 10.2 mg/dl, serum alkaline phosphatase 69 U/L, serum phosphorous 3.2 mg/dl, serum sodium 139 meq/L, serum potassium 4.2 meq/L. TSH 0.1mIU /mL, Total T3 360 ng / dl, Total T4 17.2 ug /dl, Free T4 5.9 ng/dl. Neurovascular imbalance rising to osseous hyperemia with cytokines stimulated excessive bone resorption noted. Most common in patients after attaining the age of 50 years.⁸

Secondary osteoporosis: secondary to hyperparathyroidism

Comminuted fracture with gross osteoporotic changes

A 40 years old male patient entered in to ortho OPD with previous history of hyperparathyroidism and pathological fracture of tibia due to multiple brown tumours and surgical fixation 1 month back with major complaints of pain over left knee joint and tenderness. On clinical examination left knee joint swelling and tenderness were noted in particular. Biochemical parameters with muscle weakness of the patient were indicative of hyperparathyroidism

X-ray left knee joint

Evidence of comminuted fracture of proximal end of left tibia with surgical fixation in situ, Cortical thinning and altered trabecular pattern suggestive of gross osteoporotic changes.

Biochemical findings of the patient were suggestive of abnormal values deviating from the normal revealed as under serum calcium (arsenazo) 11.4 mg/dl, serum alkaline phosphatase 333IU/L, PTH136pg/ml, serum phosphorous 4.9 mg/dl, serum sodium 140 meq/L, serum calcidiol 143 nmol/L (normal range 75 to 250 nmol/L), vitamin D deficiency is linked to the development and severity of depression. Bone mass is the result of the amount of bone enhanced during growth and at maturity results in subsequent rate of bone loss. The bone remodelling which consists of continuous bone formation and resorption is a strenuous life long process. In normal individuals following closure of the epiphyses, skeletal mass remains constant for many years and the rate of bone formation and resorption i.e. bone remodelling have been found to be appropriately balance

Primary hyperparathyroidism is characterized by hypercalcemia and elevated parathyroid hormone (PTH) levels. The disease today bears little resemblance to the severe disorder of “stones, bones and groans” described by Fuller Albright and others in 1930s.

Age has an important impact on bone density in both sexes, and also leads to skeletal fragility, independently of BMD men with inactivating mutations in the genes encoding either the aromatase or the oestrogen receptor having low BMD, despite the presence of normal or high testosterone concentrations.⁸



Figure 7: Secondary osteoporosis with comminuted fracture with gross osteoporotic changes.

Disuse and immobilization osteoporosis

Fracture with gross osteoporotic changes

A 65 years old female patient entered in to casualty OPD with history of RTA (road traffic accident) three and half months back and major complaints of pain over left knee joint since RTA with swelling and tenderness .On clinical examination swelling and tenderness noted over left knee joint .Patient was wearing a plaster cast for a long period of time at knee joint.

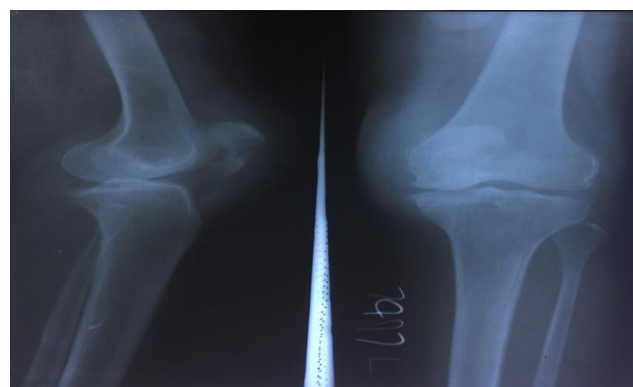


Figure 8: Disuse and immobilization osteoporosis Fracture with gross osteoporotic changes.

X-ray left knee joint

Fracture of left Patella with decreased medial joint space and marginal osteophytes, Evidence of cortical thinning with altered trabecular pattern with soft tissue swelling above knee joint, Features suggestive of gross osteoporotic changes with osteoarthritis. Patient

biochemical findings were normal. serum calcidiol 62 ng/ml (normal range 30-80 ng/ml), serum calcium (arsenazo) 10.0 mg/dl, serum alkaline phosphatase 103 U/L, serum phosphorous 4.0 mg/dl, serum sodium 138 meq/L, serum potassium 4.8 meq/L. Traumatic injuries that are immobilized and inflammatory lesions of bones and joints are the predisposing factors.⁸

Transient regional osteoporosis

Malunited fracture

A 37 years old pregnant female patient entered in to ortho OPD with major complaints of pain in left leg for the last 2 years, pain was severe while doing routine activities. Patient was feeling uncomfortable while walking. On clinical examination no swelling or tenderness noted.

X-ray of left tibia and fibula with knee joint

Evidence of mal united fracture noted at the distal 1/3rd shaft of left fibula and distal 1/3rd shaft of left tibia. Old oblique fracture of upper 1/3rd shaft of left tibia. Evidence of cortical thinning and altered trabecular pattern noted Feature suggestive of osteoporotic changes of visualized bones.



Figure 9: Transient regional osteoporosis with malunited fracture.

Biochemical findings of the patient were normal. Serum calcium (arsenazo) 10.1 mg/dl, serum alkaline phosphatase 113 U/L, serum phosphorous 3.1 mg/dl, serum sodium 141 meq/L, serum potassium 4.5 meq/L, serum calcidiol 96 nmol/L (normal range 75 to 250 nmol/L). In the underweight, the low body weight itself has a severe impact on bone density. Adipose tissue is an important site of oestrone production and high fat mass is associated with higher circulating concentrations of a number of bone anabolic factors including insulin, leptin and amylin. Cigarette smoking accelerates the metabolism of oestrogens to biologically inactive forms which is associated with reduced body weight followed by an early menopause and may directly inhibit osteoblastic function. Consequently, BMD tends to be lower in smokers than in non-smokers.⁸

CONCLUSION

In most of the experimental cases belonging to patients having age more than 40 years with major complaints of backache and knee pain profound osteoporotic radiographic changes have been noted. In all the osteoporotic cases irrespective to age of patients, values of serum calcium, serum alkaline phosphatase, serum phosphorus, serum potassium, serum sodium, serum calcidiol were within normal limits.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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