Health Care for Older People

Holistic Approach

Bone Health & Fractures

Sri Lankan Association of Geriatric Medicine

2020

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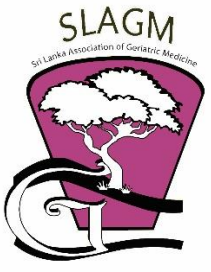

Sri Lankan Association of Geriatric Medicine

2020

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The book is intended to strengthen the knowledge of the members of the multi-disciplinary team and care givers. It is may not be used for the diagnosis of the disease and treatment purposes.

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An attempt to develop and promote multidisciplinary mutual coordination and collaboration among the teams involved in care of older patients at various levels in the health and social services sector.

'Team work divides the task and multiplies the success'

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Contents

1. Editorial

Sri Lankan Association of Geriatric Medicine is launching the 4th Bulletin in the series under the theme "Health Care for Older People- Holistic Approach, on Bone health and Fracture Care". This Bulletin series was initiated with a view of educating different levels of health care professionals caring for older people in the country.

As population ageing occurs, incidence of bone fragility and fracture risk increases inexorably. The risk of osteoporotic fracture in older people (>75 years) and especially the older old (> 85 years) is a major cause of morbidity and mortality. The impact of a major fracture on a patient's life is immense and often heralds the transition from independent living to total dependence with numerous socio- cultural implications. Awareness regarding how our bone structure behaves from young age to old age is vital in order to preserve bone health among older people, awareness regarding how our bone structure behaves from young age to old age is vital. This is so that proper nutrition, exercise and life style modification indeed help reduce the morbidity related to fractures.

Ortho-geriatric care is a concept developed in the West in late 1950s and refers to integrated, holistic, multi-disciplinary and patient centered care given to older people who have sustained a fracture. Commonly this involves close liaison between the geriatric and the orthopaedic teams in providing comprehensive coordinated in a fracture setting with the help of the multidisciplinary team members that includes nursing care, physiotherapy, occupational therapy and other allied health care workers. In this bulletin we have authors from the multi-disciplinary team addressing eloquently the issues related to bone health and management of fractures in their respective fields of expertise. Although orthogeriatrics as an independent specialty does not exist in Sri Lanka, management of an older person care in the setting of a fracture requires adoption of a multidisciplinary approach for better outcomes and patient satisfaction.

We are most thankful to all the authors for their kind contribution to make this bulletin a success. The time and dedication provided by the authors who are busy professionals in their own fields in indeed commendable and highly appreciated. This series of bulletins was initiated by our outgoing President, Dr. Padma S Gunaratne and was supported by the Councils of the SLAGM. We hope this will provide continued education to health care professionals caring for older people in the country.

Dr. Achala Balasuriya & Dr. Shehan Silva
Editors
June 2020

2. Physiology of the Ageing Bone and their Determinants

Prof. Piyusha Atapattu

INTRODUCTION

Bone though widely thought be a hard-inert structure, is a dynamic living tissue with multiple functions: It provides a framework to support and protect the body structures, facilitates mobility, stores minerals (especially calcium) and is the main site of haemopoesis. Maintaining bone size and strength is important in maintaining optimum bone functions.

Bone continues to change with development and ageing. The old bone gets resorbed and new bone is formed, permitting remodelling in response to the stresses and strains that are subjected. Bone remodelling occurs throughout life. In early life however growth predominates whereas with ageing resorption takes prominence.

NORMAL BONE STRUCTURE

Bone is a connective tissue consisting of calcium and phosphate salts (particularly hydroxyapatites), cells, lipids, and water within a collagen framework. The framework is mainly type I collagen. Other types of collagen and several non-collagenous proteins are also present. It is well vascularized and has a blood flow of 200–400 mL/min in healthy adults.

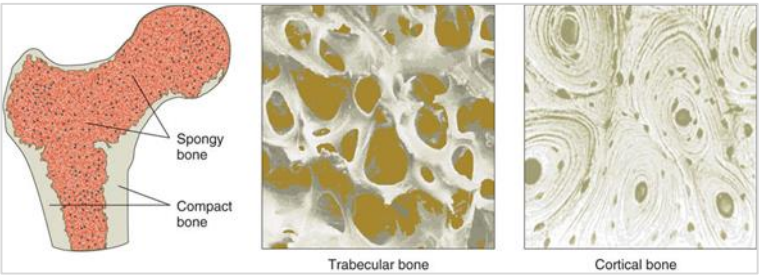

Figure 1: Structure of the bone

The outer surface of the bone is covered by the periosteum, except at the joint surfaces. The outer compact or cortical bone comprises 80% of the total bone volume while the inner trabecular or spongy bone comprising the remainder (Figure 1).

BONE METABOLISM

Bone growth begins in foetal life, with most bones being formed by endochondral ossification, or growing cartilage systematically being replaced by bone. Some compact and spongy bone (e.g. facial and cranial bones, clavicles) develop by intramembranous ossification, or by mesenchymal cells directly forming bone.

Long bones increase in length by new bone being formed at the epiphyseal plates at the ends of the shafts (figure 2). During adolescence after the pubertal growth spurt, cartilage cells stop proliferating and epiphyseal closure occurs, after which there is no increase in linear growth or height. Epiphyseal closure in both sexes is triggered by oestrogen.

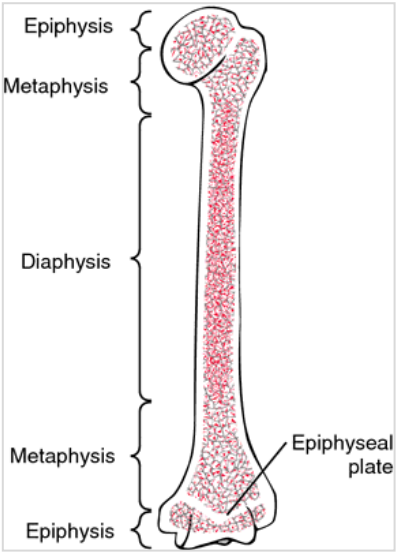

Figure 2: Epiphysis and epiphyseal plates

BONE REMODELLING

Bone remodelling occurs continuously throughout life in both trabecular and cortical bone to maintain a healthy skeleton. The shape of bones may also change as bone is resorbed in one location but added in another. Constant bone turnover promotes good health, bone health and calcium homeostasis.

Remodelling occurs by the combined action of 3 types of cells: osteocytes, osteoclasts and osteoblasts (figure 3). Osteocytes comprise 90–95% of cells in bone tissue whereas osteoclasts and osteoblasts comprise approximately 5%. Osteoblasts are modified fibroblasts. They down type 1 collagen and form new bone. Osteoclasts are members of the monocyte family which erode and absorb previously formed bone. Osteocytes sense mechanical loading and/or micro- damage to old bone and are the key regulators of formation and activity of both osteoblasts and osteoclasts.

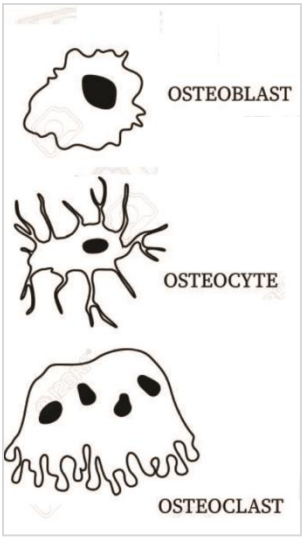

Figure 3: Bone Cells

Osteoclasts formation from precursor cells is stimulated by two principal cytokines, (e.g. monocyte/macrophage colony-stimulating factor (M-CSF) and receptor activator of nuclear factor kappa-B ligand (RANKL).

As bone resorption progresses, more osteoblasts are formed coupling bone formation with resorption. Finally, mineralization of osteoid (newly formed bone tissue) completes the process of bone remodelling.

FACTORS AFFECTING BONE REMODELLING

The bone-remodelling process is primarily under endocrine control and is related in part to the stresses and strains imposed on the skeleton by gravity.

Parathyroid hormone (PTH) and Vitamin D play a major role in bone metabolism. Bone growth in childhood and adolescence is primarily promoted by PTH, Vitamin D, growth hormone, IGF-1, thyroid hormone and sex hormones. Dietary calcium is necessary for bone mineralization, and its absorption is directly increased by vitamin D.

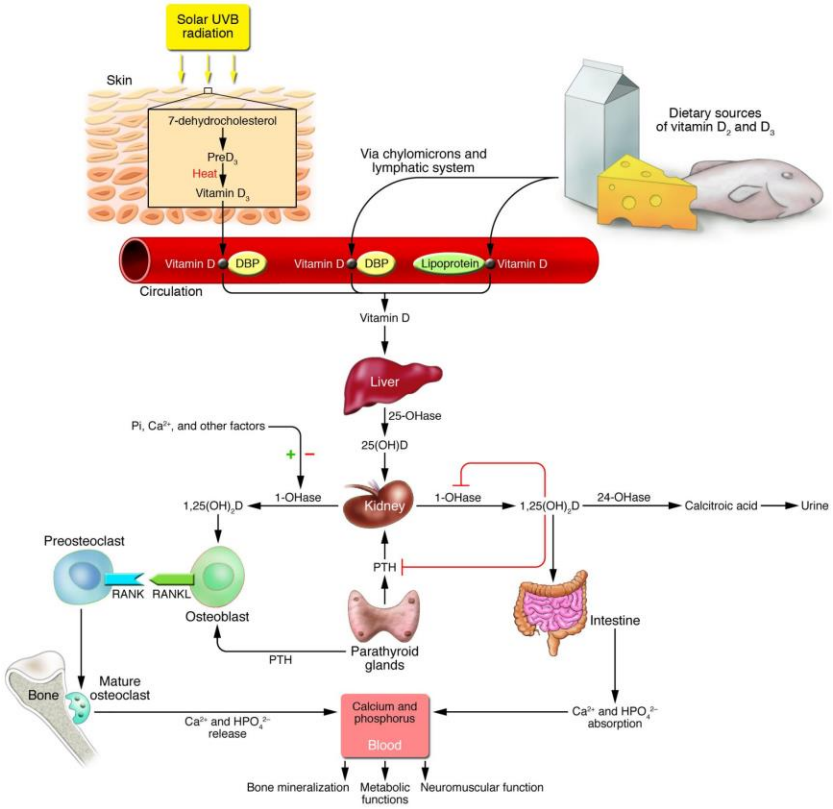

Figure 4. Calcium and phosphate metabolism

When plasma calcium level is low, plasma PTH and vitamin D levels are increased, and they attempt to increase plasma calcium by accelerating bone resorption. Oestrogens slow bone resorption by inhibiting the production of bone-eroding cytokines. Calcitonin too plays a role in decreasing bone resorption.

PEAK BONE MASS

Bone mass continues to increase during childhood, with increase height and bone density. The peak bone mass is attained between the ages of 25 and 30 years of age after which the bone mass gradually declines with age (figure 4). During the pubertal growth spurt 25%–50% of the

peak bone mass of adulthood is rapidly achieved. Peak bone mass is mostly determined by genetics, and is enhanced by regular physical exercise, good nutrition especially calcium, vitamin D and protein.

Peak bone mass is a major determinant of osteoporosis and fracture risk later in life. The higher the peak bone mass achieved, the lower the chances of having an osteoporotic fracture later in life.

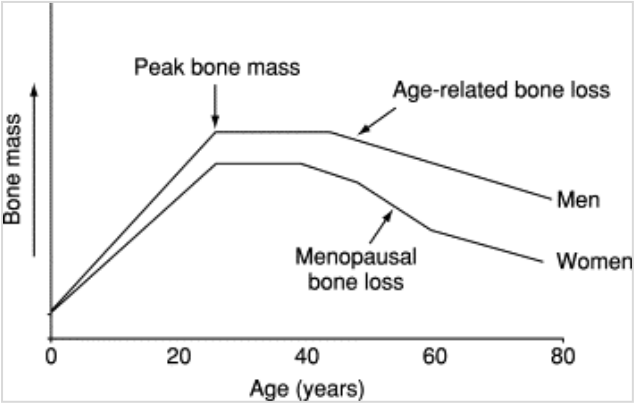

Figure 5: Changes in bone mass with age

BONE CHANGES WITH AGEING

Bone changes occur during normal ageing in both men and women. Decrease in bone loss is invariable with ageing, and is one of the most important factors predisposing to osteoporotic fracture risk in the elderly. Bone loss begins in late twenties, and continues with ageing, affecting both trabecular and cortical bone. Men achieve a greater peak bone mass, and show a lesser bone loss than women. In women, the rate of bone loss is increased after menopause, as reduction in plasma of oestrogen increases the rate of bone resorption (figure 5). Bone loss is accelerated in chronic inflammatory conditions and disuse, both of which are more common in older people, contributing to the decreased bone mass in the elderly.

Other changes of quantitative and qualitative in nature are also seen in bone with ageing: The normal process of bone resorption and formation may be interrupted, and resorption takes prominence. This

leads to reduction in bone mineralization. Changes in bone architecture occur with thinning of periosteum, enlargement of the medullary cavity etc. Localized disparity in the concentration of deposited minerals may cause hypo mineralization in some areas and hyper- mineralization in others. Changes may occur in the protein content of matrix material.

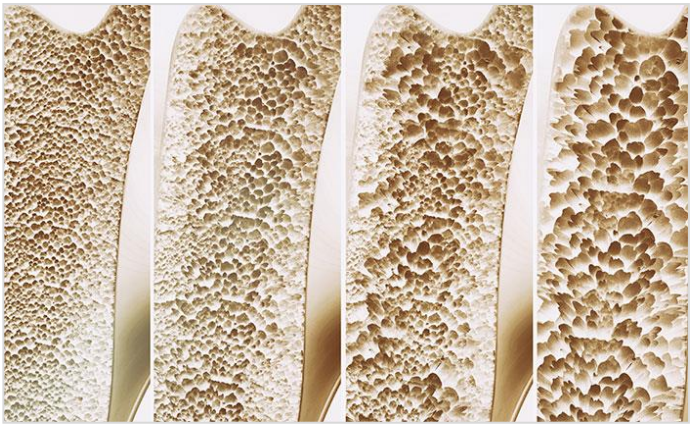

Figure 6: Changes in bone structure with ageing

The outcome of such changes includes poorly mineralized bone, with excavations in the trabecular bone causing more porous bone and accumulation of microfractures (figure 5). The ultimate result is that older adults may be left with reduced bone strength and bone mineral density, leading to bone pain, osteopaenia, osteoporosis and deformity.

Age related changes in the status of calcium and phosphate regulating hormones can also occur. These include increase in parathyroid hormone and decrease in production of the most active metabolites of vitamin D3. Oestrogen concentration in women decreases markedly, predisposing to bone resorption. These hormonal changes interfere with the maintenance of normal bone homeostasis.

Lifestyle changes in elderly may also have a significant influence in bone in the elderly. Bone remodelling is promoted by mechanical loading during weight bearing exercises. Decline in physical activity, especially in immobilized persons cause significant loss of bone mass. Poor

nutrition, especially calcium, phosphate and protein, due to multiple reasons is common in the elderly, contributing to the reduction in age-related loss of bone tissue and bone strength. However, the adverse bone changes can be improved with appropriate changes in lifestyle and medication.

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3. Preserving Bone Health for Healthy Ageing

Dr. Achala Balasooriya

Ageing is a universal phenomenon with many physiological and anatomical changes as time progress. Changes that takes place in skeletal system and muscle adversely affects the functional mobility of the ageing person and his quality of life. As mobility gets restricted, loss of intrinsic capacity and functional ability results in physical frailty. Active ageing in terms of maintaining healthy bone and muscle mass should commenced not at 60 years of age but much earlier before loss of bone mass occur in the accelerated pace.

OSTEOPAENIA

Loss of bone mass is referred to as osteopenia. This may progress to a more profound loss of bone density known as osteoporosis. This is a condition which increases likelihood of fragility fractures associated with ageing. Skeletal ageing is accelerated in women in comparable levels to men due to hormonal influences that follows menopause. Apart from that, other factors such as genetics, hormonal influence, nutritional deficiencies, life style changes and comorbidities may also affect bone loss. It has been observed that in normal ageing there is an increase of formation of advanced glycation end products (AGEs) which promotes osteoclast induced bone resorption and disturbs bone remodelling. The imbalance between calcium absorption and secretion following oestrogen depletion promotes bone loss in postmenopausal women. In males, low testosterone levels that occurs with ageing is associated with bone mass reduction. Calcium and vitamin D deficiency due to dietary factors, malabsorptive states or endocrine disorders also enhances bone mass reduction. High alcohol intake and smoking also speeds up bone loss. Nutritional deficiencies occur in late life mainly due to poor food intake as most older people experience loss of appetite due to poor taste reception, difficulties in mastication and deglutition, and sometimes due to lack of availability of food contributed by socioeconomic constraints. Overall reduction in food intake leads to loss of muscle mass (sarcopaenia) and loss of body

weight. Low protein intake among older people is a common nutritional issue. Proteins are important nutrients in the elderly as adequate intake is necessary as a source for muscle protein production as absorbed amino acids have a stimulating effect on muscle protein synthesis. Stepping up of protein intake needs to be done to maintain nitrogen balance and to protect against muscle mass loss. As per life style changes, adequate exercise is the key factor to maintain healthy muscle and bone during late years of life. Comorbidities like diabetes mellitus, chronic obstructive airway disease, cardiac failure, malabsorptive states, chronic gastritis, stroke, mobility restrictions as well as malignancies, hypoparathyroidism and hypogonadism may also affect loss of bone mass due to multiple factors.

Table 1: Risk factors for osteoporosis

Bone Mineral Density Dependent *Respond to bone directed therapy*	**Bone Mineral Density Independent** *Requires additional intervention (e.g. fall prevention)*
Female sex	Increasing age
Caucasian/Asian	Previous fragility fracture
Immobilisation	Family history of hip fracture
Low dietary calcium intake	Low body mass index
Vitamin D insufficiency	Smoking
Gastrointestinal disease	Excess alcohol use
Hypogonadism	Glucocorticoid therapy
Cushing Syndrome	High bone turnover
Hyperthyroidism	Increased risk of falling
Hyperparathyroidism	Rheumatoid arthritis
Diabetes mellitus	
Chronic obstructive pulmonary disease	
Gastrointestinal disease	
Mastocytosis	
Multiple myeloma	
Osteogenesis imperfecta	

PROTECTION OF BONE MASS IN OLDER PERSONS

It is essential to know how to safeguard bone health in late years to be able to lead a good quality life without compromising mobility.

Nutrition

Adequate nutrition has a profound effect in retarding the progression of osteopaenia. Ensuring recommended levels of calcium and vitamin intake can promote musculoskeletal growth. The National Osteoporosis Foundation (NOF) of USA recommends adults under age 50 to have an intake of 1,000 mg of calcium and 400-800 IU of vitamin D daily and adults age 50 and older to have an intake of 1,200 mg of calcium and 800-1,000 IU of vitamin D daily. Foods that are high in calcium include low fat yoghurt, non-fat milk, cheese and green leafy vegetables. Sources of Vitamin D include exposure to sunlight, dairy products and nutritional supplements and food nutrients. Vitamin D requirement varies with season, latitude, adiposity and skin tone. A revision of meta-analyses and clinical trials of older community-dwelling and institutionalized persons demonstrated that serum 25 hydroxyvitamin D (25(OH) concentration of 30 ng/mL (75 nmol/L) should be the minimum goal to achieve in older adults, particularly in frail adults, who are at higher risk of falls, injuries, and fractures. Low phosphorous is a rare aetiological factor for osteomalacia. Phosphates are found in most foods. Most clinical causes of low phosphates attributed to poor bone mineralisation results from rare genetic disorders.

Protein intake is vital to maintain the integrity of bone. A moderate intake of 0.8-1.2 mg/kg/day is endorsed by the International Osteoporosis Federation. A higher dietary intake has shown to improve bone density, reduce the risk of complications and reduced rehabilitation time.

Vitamin K plays a role in carboxylation of osteocalcin, allowing it to bind to hydroxyapatite in bone. However, evidence is ambiguous regarding supplementation to prevent osteoporosis. This is also observed in the case of Vitamin C. Vitamin A in supplemental but not dietary intake has shown to increase fracture risk.

Exercise

Studies have shown that walking and weight training have a positive impact in preserving bone density among middle age and older adult. Engagement in regular weight bearing and muscle strengthening exercises can reduce the incidence of falls and fractures as well as strengthening the bone structure by increasing micro-architectural bone arrangement.

Tai Chi programs have shown to be effective primary prevention in decreasing the number of falls, the risk of falling, and the fear of falling, in addition to improving functional balance and physical performance in physically inactive persons aged 70 years or older. Postural stability program and Otago exercise program has demonstrated to have a role in secondary prevention of falls. Yoga and Nordic walking show promising results as modalities of improving wellbeing of patients and muscle strengthening. However, they do not have any effect on reducing falls risk.

People over 65 years of age should attempt to get 150 minutes of moderate intensity every week in bouts of 10 minutes or more. These include walking, water aerobics, dancing, riding a bike on level ground etc.

Reduce tobacco and alcohol consumption

Alcohol intake and smoking are harmful to musculoskeletal health in general and excess alcohol weakens bone mass. Heavy alcohol intake is associated with high cortisol and parathyroid levels, which are detrimental to bone health. Chronic alcohol use gives rise to pancreatic abnormalities, thereby reducing absorption of calcium and Vitamin D. Furthermore, alcohol damages osteoblasts.

More than two drinks per day for women and more than three drinks per day for men have been shown to increase the risk of falling.

Medications

Medications are sometimes necessary to maintain bone health in older people. Although individual countries may differ in their choice of management and initiating treatment to prevent bone mass, the United

States Food and Drug Authority (FDA) has approved treatment for the following groups: people with history of fracture of the hip or spine, individuals with BMD in the osteoporosis range (T-score of -2.5 or lower), and BMD in the low bone mass or osteopenia range with a higher risk of fracture defined by FRAX score for major osteoporotic fracture 10-year probability of 20% or higher OR hip fracture 10-year probability 3% or higher. (Please refer to chapter – Osteoporosis: an overview)

Physical Medicine and Rehabilitation (PM&R)

Being physically active helps to reduce the incidence of falls among older people. Rehabilitation along with exercise is recognized as a modality that improves musculoskeletal function and helps to maintain physical independence activities of in daily living. Studies have shown that physical medicine and rehabilitation can reduce disability, improve physical function, and lower the risk of subsequent falls in patients with osteoporosis. Moderate to vigorous physical activity is associated with a hip fracture risk reduction of 45%.

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4. Medication Related Bone Disorders

Dr. Chiranthi K. Liyanage

With the rising tide of older adults worldwide, medication related disorders are also likely to increase as many of them are on multiple medicines for multiple chronic disorders. Studies have shown that on an average 2 to 9 medicines per day are taken by each person over the age of 65 years. Hence, older adults are more susceptible to developing medication related problems due to alterations in pharmacokinetics and pharmacodynamics with ageing, polypharmacy and medication errors. Bone disorders warrant special consideration as they lead to loss of mobility and physical independence, with particularly devastating effects. It is vital that clinicians take all precautionary measures to prevent these medications related bone disorders and identify and treat them early. Rationalized prescription of medicine is also an essential aspect in this process.

I. MECHANISMS OF MEDICATION RELATED BONE DISORDERS

Medicines affect bone health through various mechanism. They could directly modify osteoblastic and osteoclastic activity and lead to microarchitectural changes or indirectly interfere with vitamin D and calcium homeostasis. Consequently, these medicines lead to osteoporosis or osteomalacia. Moreover, medicines which cause hormonal alterations promote bone loss such as hypogonadism and hyperthyroidism could also lead to bone disorders. In addition to the above, certain medicines also increase the fall risk and thereby increase of the risk of fractures in elderly. Whilst how some medicines cause these disorders remain poorly understood, some may cause bone disorders through a combination of the above mechanisms.

II. MEDICINES AFFECTING BONE REMODELLING AND DRUG-INDUCED OSTEOPOROSIS

Osteoporosis is an insidious disease of multifactorial aetiology. It is characterised by low bone mineral density (BMD) with accompanying microarchitectural changes which result in increased bone fragility.

Medicines cause osteoporosis by uncoupling the delicate balance that exists between of bone resorption and bone formation leading to a net loss of bone mineral content with microarchitectural derangement.

Although osteoporosis is most commonly reported with glucocorticoid therapy, other medicines including thiazolinediones, aromatase inhibitors, anti-androgen therapy, antidepressants, L-thyroxine, heparin, oral anticoagulants, anticonvulsants, antiretroviral drugs, and immunosuppressive agents such as calcineurin inhibitors have also been shown to cause bone loss with fractures.

Glucocorticoids

Glucocorticoids at doses as low as prednisone 2.5mg per day have been associated with fractures and approximately 30 to 50 percent of patients receiving glucocorticoids are found to have radiographic evidence of fractures. High cumulative dose as well as high daily dose of glucocorticoids increase the risk of fractures. They exert a wide range on effects on the skeleton. Glucocorticoid excess suppresses osteoblastogenesis and stimulates osteoblast and osteocyte apoptosis while prolonging the lifespan of osteoclast. Changes in the production of local growth factors and their binding proteins such as insulin-like growth factors (IGF) may also contribute to this process. Furthermore, there are indirect effects of decreasing calcium resorption, suppression of growth hormone and alteration in parathyroid and sex hormones contributing to bone loss. However, glucocorticoid therapy is a potentially reversible risk factor as the BMD increases and fracture risk declines when treatment is terminated.

Bisphosphonates are currently the standard of care for prevention and treatment of glucocorticoid-induced bone loss. However, current recommendations hinge on fracture risk assessment with clinical assessment, FRAX and BMD testing in those over the age of 40 years. It is recommended that all adults taking prednisone at a dose of 2.5 mg/day or more for 3 or more months have an optimal daily calcium intake (1,000–1,200 mg/day) and vitamin D intake (600–800 IU/day) along with lifestyle modifications addressing other risk factors for osteoporosis. Treatment with oral bisphosphonates is recommended in those with a moderate to high fracture risk. Intravenous

bisphosphonates, teriparatide, denosumab and raloxifene are alternative therapies when oral bisphosphonates are contraindicated or not tolerated.

Oral Hypoglycaemic Agents

Thiazolidinediones (e.g. rosiglitazone, pioglitazone) are agonists of peroxisome proliferator-activated receptor γ (PPARγ) used in the treatment of type 2 diabetes mellitus. PPARγ is found in osteoblasts, osteoclasts and the stromal cells of the bone marrow and their activation results in diversion of bone marrow stromal cells from the osteoblast lineage into the adipocyte lineage. The net effect is a decrease in bone formation and an increase in adipogenesis. It also promotes osteoclast differentiation and bone resorption. Studies have shown that thiazolidinediones increase the risk of non-vertebral fracture by 1.2 to 2-fold and the risk appears to be higher in women than in men. Although, there are no proven strategies to reduce the fracture risk of thiazolidinediones, they are best avoided in patients with established osteoporosis.

Sodium-glucose co-transporter 2 (SGLT2) inhibitors (e.g. empagliflozin, canagliflozin) are the newest class of oral medicines in the antidiabetic armamentarium. In some studies, the incidence of fractures was found to be higher in those on SGLT2 inhibitors than the controls. Although orthostatic hypotension resulting in postural dizziness and falls may be a possible mechanism particularly in the elderly, a reduction in bone mineral density has also been noted with SGLT2 inhibitors.

Antidepressants

Selective serotonin reuptake inhibitors (SSRIs), norepinephrine reuptake inhibitors (SNRIs) and tricyclic antidepressants (TCAs) have been associated with an increased risk of hip and non-vertebral fragility fractures. Serotonin receptors are found on osteoblasts and osteoclasts and it regulates bone homeostasis via endocrine, autocrine, paracrine, and neuronal pathways. In some studies, the use of SSRI has been associated with low BMD in older men. However, the risk of fracture is very rapid, and it decreases with time, implicating that the mechanism is likely to be a combination of factors including sedation and postural

hypotension, which increases the risk of falls. Patients who are considered for SSRIs therapy with other risk factors for osteoporosis may benefit from fracture risk assessment and BMD testing and the treatment decision should be individualized.

Anticoagulants

Although short-term use of heparin has not been found to have any significant effects on the bones, its long-term use has been shown to cause a reduction in BMD and increase fractures. Studies have revealed that heparin increases bone resorption and decreases bone formation. Low molecular weight heparins are thought to have less adverse effects on bone than unfractionated heparin. However, the clinical significance of its effects is likely to be trivial because unfractionated heparin is usually given only for brief periods. Limited data from cross sectional and retrospective cohort studies suggest that long-term exposure to warfarin is associated with low BMD and increased risk of vertebral and rib fractures, but this has not been confirmed by other studies.

Adjuvant therapy for breast cancer

Aromatase inhibitors (AIs) are used for adjuvant endocrine therapy for oestrogen receptor (ER)-positive breast cancer in postmenopausal women. These inhibit the enzyme which is responsible for the peripheral conversion of androgens to oestrogens and thereby lead to an oestrogen deficiency. This in turn results in an increased bone resorption and a rapid bone loss. Other adjuvant therapies such as surgical oophorectomy, gonadotropin-releasing hormone (GnRH) agonists and chemotherapy that induces ovarian failure, all cause a reduction in endogenous oestrogen. These too cause bone loss and increase the risk of fractures. Patients with high fracture risk may benefit from treatment with bisphosphonates or denosumab for prevention of osteoporosis and all should be advised to optimise daily vitamin D and calcium intake.

III. MEDICINES AFFECTING VITAMIN D AND CALCIUM HOMEOSTASIS

Medicines may disrupt vitamin D and calcium homeostasis in the body by altering vitamin D metabolism, reduced absorption of vitamin D and calcium or excess renal loss of calcium and phosphate. Persistent vitamin D deficiency results in hypocalcaemia which causes secondary hyperparathyroidism leading to demineralization of bones. Osteomalacia ensues when vitamin D deficiency is prolonged and severe. Older adults are particularly at a high risk of developing osteomalacia due to limited exposure to the sun and inadequate diet. Therefore, medicine which alter vitamin D and calcium homeostasis are of special concern in the older persons. These include antiepileptics, loop diuretics, proton pump inhibitors, aluminium-containing antacids which reduce phosphates absorption, excessive vitamin A intake and chemotherapeutic agents such as imatinib. Furthermore, several observational studies have shown polypharmacy to be associated with vitamin D deficiency in older persons as well.

Antiepileptic Drugs

Antiepileptic drugs (AEDs) are indicated in the treatment of many disorders including migraine headaches, bipolar disorder, and chronic pain in addition to epilepsy. Both osteoporosis and osteomalacia with vitamin D deficiency has been associated with AED therapy due to increased rates of bone loss and abnormalities in bone and mineral metabolism.

Induction of the cytochrome P450 system by AEDs result in increased vitamin D catabolism (e.g. phenytoin, primidone, carbamazepine, and phenobarbital). This leads to a subsequent rise in PTH, which increases the mobilization of bone calcium stores and bone turnover. Moreover, several other mechanisms including inhibition of intestinal absorption of calcium and direct stimulation of osteoclastic bone resorption (e.g. phenytoin) have also been postulated as or bone loss with AED use independent of vitamin D deficiency has been noted in some studies.

In order to prevent bone disease associated with AEDs, it is recommended that all patients receive adequate calcium and vitamin D,

combining diet and supplements if needed. Lifestyle measures including regular weight bearing exercise, limiting alcohol intake and preventing falls similar to any patient at risk of osteoporosis would also be beneficial. It is reasonable to measure the BMD in those who have risk factors for osteoporosis AED-related bone disease. Vitamin D levels, along with serum calcium and phosphate should be checked in patients on long-term AEDs. Treatment of AED related bone disease should follow general guidelines, but care must be taken to ensure that patients are vitamin D replete before starting anti-resorptive therapies.

Proton pump inhibitors

Medicines that reduce gastric acid secretion such as proton pump inhibitors (PPIs) and H2 blockers may reduce optimal absorption of calcium because insoluble calcium (e.g. calcium carbonate) requires an acid environment for absorption. These medicines may cause a significant adverse impact on skeletal health particularly in older individuals as there is a further reduction in calcium absorption with aging. Several meta-analyses have shown that the risk of hip, spine, and fractures at any site increased modestly but significantly in patients taking PPIs and the risk was highest in those on high doses for longer durations. Furthermore, H2 blockers have also been associated with an increased risk of hip fracture in some reports.

Loop diuretics

Loop diuretics impair calcium reabsorption from the loop of Henle and increase renal calcium loss. This resultant negative calcium balance has been associated with a decrease in BMD and an increase in risk of hip fracture. Although, several randomised control trials have found serum 1,25(OH)2D levels to be elevated in patients on loop diuretics, others have shown low levels of 25[OH]D. This rise in 1,25(OH)2D levels might be explained by higher levels of PTH as a result of hypocalcaemia, stimulating renal 1,25(OH)2D synthesis.

Chemotherapeutic medicines

Patient who are treated for cancer are at an increased risk of osteoporosis as a result of hypogonadism due to chemotherapy and radiation therapy or glucocorticoid therapy. However, direct negative

effects on skeletal health have been described with several chemotherapeutic agents (e.g. ifosfamide, imatinib). For example, ifosfamide is known can damage the proximal tubules, causing renal phosphate and calcium loss and in severe cases it can lead to hypophosphataemic osteomalacia. Imatinib mesylate is also associate with low-normal serum calcium, secondary hyperparathyroidism, and renal phosphate wasting.

IV. MEDICINES INCREASING THE RISK OF FALLS AND FRACTURES

Fractures are frequent in older adults. Most fractures are due to the effects of osteoporosis and falls. Even a low impact fall such as a fall from a standing height could result in a fracture in this population. Approximately on third of people aged 65 years or more in the community fall at least once a year. Although majority of falls result in minor injuries such as bruises, approximately one tenth require treatment in an emergency department (ED), the commonest presentation to EDs being with fractures of the hip, wrist or upper arm.

One of the commonest as well as most modifiable risk factors for falls is medication use. Studies have revealed that in addition to the type of medicine, being on a greater number of medicines, recent dose adjustments as well as poor adherence to therapy increase the fall risk. Medicines that are most commonly associated with falls and fractures include those that affect the central nervous system such as neuroleptics, benzodiazepines, and antidepressants and vasodilatory antihypertensives.

V. MISCELLANEOUS MEDICATION RELATED BONE DISEASE

Incidence of microcrystal disorders such as gout and calcium pyrophosphate dihydrate deposition (CPDD) disease also increase with age. Use of certain medicines such as loop and thiazide diuretics, low dose aspirin and cyclosporine A has been associated with hyperuricaemia and gout. Although CPDD disease is mostly idiopathic in older perons, oral bisphosphonate therapy has been found to precipitate acute attacks.

PREVENTION OF MEDICATION RELATED BONE DISORDERS

Older adults are more prone to developing medication related problems due to being on multiple medicines, pharmacokinetic and pharmacodynamic changes that occur with ageing, organ impairment due to commodities and increased risk of medication errors. Preventing or minimising such medication related bone disorders can be particularly challenging.

Clinicians involved in the care older adults should be aware of potential medication related ill effects on bone health and should be vigilant about these during follow-up of patients. Minimising the use such medicine in patients who are at risk and keeping the dosage as well as duration of therapy to as low as possible is of paramount importance. Regular medication reviews with reassessment are necessary to avoid over treatment or prescribing errors. Moreover, ensuring adequate intake of vitamin D and calcium through diet or supplements, along with lifestyle modifications to improve muscle strength and stability could mitigate the deleterious consequences of these bone disorders. Early identification and timely intervention are mandatory to prevent progression and reduce ensuing disability.

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5. Osteoporosis; an Overview

Prof. Sarath Lekamwasam

Osteoporosis is the most prevalent metabolic bone disease seen among postmenopausal women and older men. Fractures, particularly those in the spine, proximal femur and distal forearm are the most sinister clinical outcomes of the disease. Apart from high health care cost, these fractures are associated with increased mortality and morbidity and dependency. Nearly 50% of hip fracture survivors have limitations of functional capacity at one year. The excess mortality seen following hip fracture persists for many years and many studies have shown that male gender and age, are risk factors of higher mortality.

The causes of bone loss are multitude. Clinicians should be aware of prevalent underlying causes of osteoporosis such as chronic inflammatory diseases, rheumatological conditions, endocrine diseases and malignancies which may not be clinically overt. Basic investigations including full blood count, blood picture, inflammatory markers (erythrocyte sedimentation rate and C reactive protein), serum calcium, and liver and renal functions tests are routine. Investigations such as serum vitamin D, myeloma screening and bone profile are done in selected cases

The diagnosis of osteoporosis is based on bone mineral density (BMD) assessment by dual energy x-ray absorptiometry (DXA) in high risk patients. BMD based diagnosis of osteoporosis is made on the minimum T score of femoral neck, total hip or total spine. T score is defined as deviation of a BMD of patient in comparison to a 30-year-old female Caucasian (WHO standard). Those with T score less than or equal to -2.5 are considered to have osteoporosis while those above -1.0 are believed to have normal BMD. Those in between have osteopaenia, a technical phenomenon than a clinical condition. The main indications for DXA include,

- Women more than 65 years of age
- Men more than 70 years of age

- Postmenopausal women younger than 65 years and men between 50-70 years of age with at least one risk factor for osteoporosis or fracture

Other indications for DXA include prolonged (>3 months) use of glucocorticoids, inflammatory arthritis, other chronic inflammatory diseases, malabsorption and endocrine diseases that can affect bone metabolism.

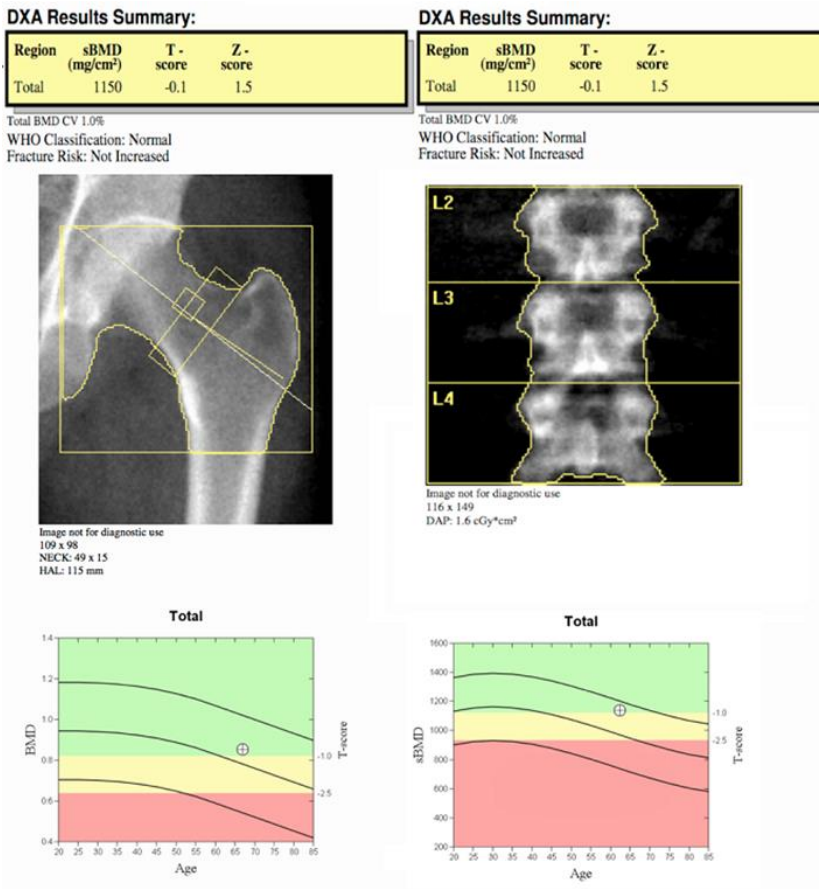

Figure 1 A DXA scan report

Although it is intuitive to believe that fractures are mainly confined to those with osteoporosis and that fractures would be uncommon among those with osteopaenia and normal BMD, epidemiological studies have shown the opposite. In the community level, more hip fractures occur in those in the osteopaenia category than osteoporosis category. This emphasizes that BMD is not the sole risk factor and there can be other major determinants of fracture and "fracture risk" estimation requires incorporation of all clinical risk factors.

The FRAX® algorithm is the most validated fracture risk assessment model in current use. FRAX® estimates probabilities of major osteoporotic and hip fractures for the next 10 years based on femoral neck BMD and clinical risk factors. Considering that fracture incidence has a geographical variation, country-specific FRAX® models incorporating local data have been developed. The Sri Lankan FRAX® model was introduced in 2012 with hip fracture data from a surrogate population.

Although femoral neck BMD is an input in FRAX® calculations, studies have shown that FRAX® outputs with and without BMD input are concordant. Furthermore, in regions where access to DXA is restricted, fracture risk can still be estimated with FRAX® using clinical risk factors alone. This is understandable since most of the clinical risk factors included in FRAX® calculation are related to BMD and they probably compensate for the lack of this information.

Table 1: Risk factors used in FRAX® algorithm

Age:	the model accepts ages between 40 and 90ys
Sex:	male or female
Weight:	in kg
Height:	in cm
Previous fracture:	a previous fracture in adult life occurring spontaneously or a fracture arising from trauma which, in a healthy individual, would not have resulted in a fracture

Parent fractured hip:	history of hip fracture in the either of patient's parents
Current smoking status:	yes or no
Glucocorticoids:	yes, if the patient is currently on oral glucocorticoids or taken oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids)
Rheumatoid arthritis:	yes, if patient has confirmed rheumatoid arthritis
Secondary osteoporosis:	yes, if the patient has one of the following diseases • insulin dependent diabetes • osteogenesis imperfecta in adults • untreated chronic hyperthyroidism • untreated chronic hypogonadism • untreated premature menopause (<45 years) • chronic malnutrition • malabsorption • chronic liver disease
Alcohol >3 units per day:	one unit of alcohol is roughly equivalent to, a glass of beer (285 ml) a single measure of spirits (30 ml) a glass of wine (120 ml) or 1 measure of an aperitif (60 ml)
BMD:	select the make of DXA scanner first and then enter the actual femoral neck BMD (in g/cm2). Alternative is to use the T-score based on the NHANES III female reference data. In patients without a BMD test, the field should be left blank.

It is essential for a country to define intervention thresholds to help clinicians making therapeutic decisions. While those 'above intervention thresholds' are considered for treatment, decision to treat those 'below intervention thresholds' should be left to the clinician who would consider other risk factors which are not included in the FRAX® calculation. These risk factors include but are not limited to history of falls and frailty. Intervention thresholds for Sri Lankan FRAX® model was first introduced in 2013 and updated in 2019. According to the updated intervention thresholds, a woman with major osteoporotic fracture risk >9% or hip fracture risk >3% should be considered for specific osteoporosis treatment. However, these recommendations are applied only for postmenopausal women and the current information is inadequate to make recommendation about men. Figure 2 illustrates the major osteoporotic and hip fracture probabilities (6.3% and 2.3% in this case) calculated for a 60year old woman (weight 65kg and height 165cm) with osteoporosis (femoral neck T score -2.6) but no other clinical risk factors. Despite having osteoporosis, her fracture thresholds are below the intervention thresholds indicating that she may not require specific drugs.

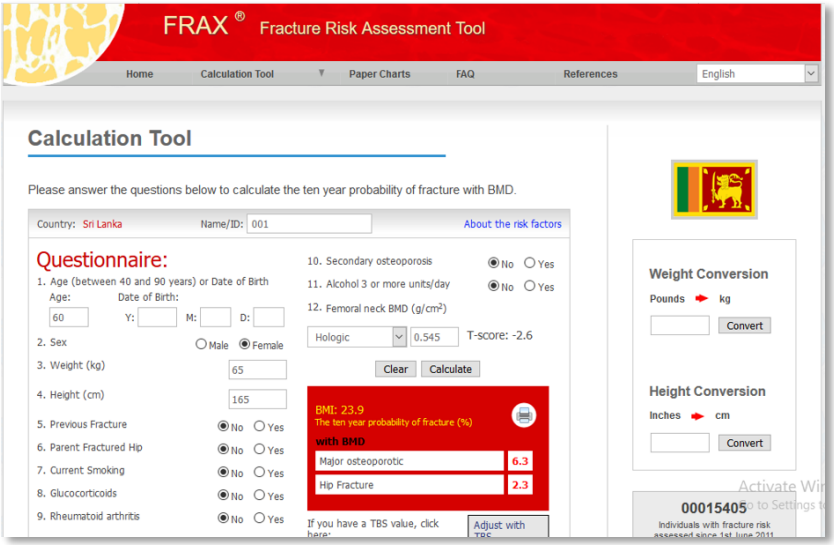

Figure 2

Apart from those who have a higher fracture risk estimated by DXA, there are other categories of people who need specific treatment. These include older men and postmenopausal women who have already sustained a fragility fracture. The management guidelines and patient care pathways by major professional organizations such as the International Osteoporosis Foundation, the National Osteoporosis Guideline Group in the UK and the National Osteoporosis Society in the USA recommend treating all postmenopausal women and men older than 50 years of age presenting with a low energy fractures regardless of BMD, once the nature of the injury is confirmed and underlying causes are excluded. BMD assessment in these patients is not mandatory and would only help in monitoring the treatment efficacy.

Figure 3 illustrates the fracture probabilities of a 75-year-old woman (BMI 25) who has no clinical risk factors. Without BMD input, her fracture probabilities; major fracture 9.6% and hip fracture 3.2%, exceed the recommended intervention thresholds indicating that she should be considered for specific treatment.

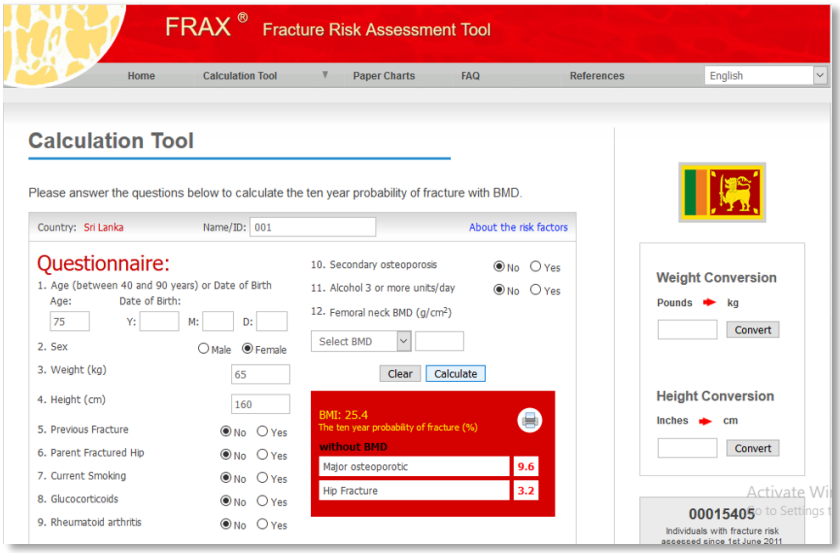

Figure 3

The long-term use of glucocorticoids is common among older persons and as a result, they are vulnerable for fractures. It is logical to treat women aged 65 years or more who have been on and those who are going to be on glucocorticoid for more than 3 months with specific osteoporosis drugs when access to DXA is not readily available. A woman of 65 years on glucocorticoids with BMI 25 without other risk factors has major osteoporosis fracture risk of 9.4% and hip fracture risk of 2.6% (Figure 4) and hence qualifies for treatment. The fracture risk would be greater with advancing age, lower BMI, prevalent fracture and higher dose of glucocorticoid.

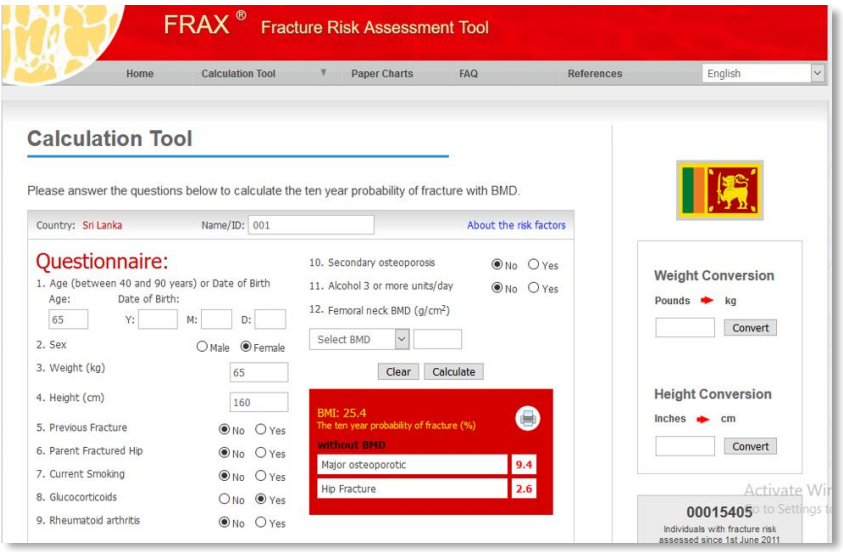

Figure 4

Many therapeutic options are available for clinicians to treat patients with higher fracture risk. The reduction of fracture risk and thereby preventing either the first or subsequent fractures is a main goal of the treatment. Drugs vary in cost, efficacy and adverse effect profile and it is helpful to get patient and care givers involved in selecting the most appropriate drug (patient centred care). Bisphosphonates are the most extensively studied and widely used of all the drugs available. They are available in both oral form; alendronate, risedronate and ibandronate

and intravenous form, zoledronic acid. Use of teriparatide is limited to those with very high fracture risk at the baseline and those who do not adequately respond to or unable to tolerate bisphosphonates. Denosumab, a human monoclonal antibody is expensive and not yet available in Sri Lanka. In addition to specific therapy, all patients with osteoporosis should receive adequate dose of vitamin D3 (800-1000 IU/day) and adequate calcium either in the diet or as a supplement.

Poor adherence to medication is common among patients with osteoporosis. They should be reminded and encouraged to continue medication without interruption. The usual practice is to continue oral bisphosphonates for 5 years and intravenous agents for 3 years. The remaining fracture risk should be estimated with FRAX before terminating treatment and the period of treatment should be extended in those who still have a high fracture risk. One must ensure that the patient did not have a fracture while on treatment, no additional risk factors emerged while on treatment and that the most recent femoral neck T score is greater than -2.0 before terminating treatment.

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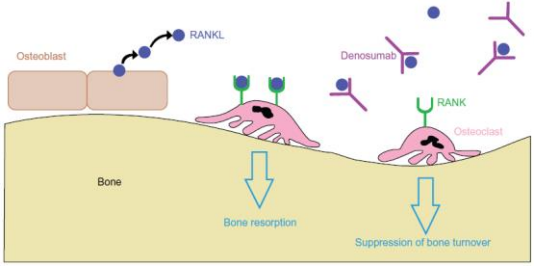
Annexure 1: Drugs used in Osteoporosis

Drug	Action	Side Effects and Contraindications	Comments
Bisphosphonates Oral – alendronate, risedronate, ibandronate Intravenous – zoledronate	Inhibit recruitment of osteoclast and apoptosis and thereby inhibit bone resorption	Oral preparations can cause upper gut ulceration zoledronate - 'Flu' like symptoms of fever, headache, nausea, vomiting and diarrhoea *Osteonecrosis of the jaw* – a rare complication especially in those taking high doses for malignancy, steroids and those having poor oral hygiene. Bisphosphonates are not recommended if CrCl <35 ml/hr.	Oral preparations – Weekly administration on empty stomach with adequate amount of water. Patient need to remain upright to prevent oesophageal ulceration, and remain fasting for 30 minutes. Ibandronate - monthly oral preparation or 3 monthly injection. IV zoledronate - given annually. Dentists should be informed prior to invasive dental procedures that patients are on bisphosphonates. Concerns of atypical subtrochanteric fractures (with characteristic 'beak' appearance radiographically)
Strontium ranelate	Precise mechanism is unknown although it is thought to increase bone growth and reduce loss	Side effects – diarrhoea nausea and increased risk of thromboembolic disease	Preparation available as a sachet that needs to be dissolved in water and taken at bed time. Therefore, it can be given for those not tolerating bisphosphonates
Teriparatide (Recombinant 1-34 PTH)	Given intermittently, PTH is anabolic and stimulates osteoblastic activity. (PTH in	Side effects - gastrointestinal irritation Contraindicated in renal disease	Restricted to those with severe disease who have not responded or tolerated other modalities.

	continuous secretion endogenously is catabolic)		Expensive. Maximum duration of 18 months
Selective Oestrogen Modulators (SERMs) e.g. raloxifene, bazedoxifene	Oestrogen agonist in bone and liver while being an antagonist in breast and uterus. (Increases bone density without increasing risk of malignancy)		Reduces vertebral fractures only
Calcitonin	Synthetic analogues of calcium inhibit bone resorption		Given subcutaneously, intramuscularly or intranasally. Not effective as other agents. Useful adjunct in pain control following acute vertebral wedge fracture
Denosumab	A monoclonal antibody to RANK ligand (Receptor activator of nuclear factor kappa-B)	Side effects – cellulitis, eczema and few reports of osteonecrosis	Correction of Calcium and vitamin D levels are required prior to administration. Patients need to be on another osteoporosis medication if denosumab is discontinued to prevent rebound bone remodelling



6. Miscellaneous bone disorders among older adults

Prof. Sarath Lekamwasam

OSTEOMALACIA

Osteomalacia is still seen among children and older adults, although it is considered rare in current clinical practice. It is a condition where there is reduced calcification of the osteoid matrix. The amount of bone is normal but is soft and weak. In older adults, the disease is characterized by chronic muscle pain, muscle tenderness and weakness involving mainly the girdle muscles. The clinical features are subtle and may be considered as part of ageing by patient and family members leading to late diagnosis and treatment. A shuffling 'penguin gait' or 'waddling gait' is characteristic, although there are other causes of this abnormality. Clinicians involved in the care of older adults should look out for subtle clinical features of osteomalacia which may not be the principal or presenting complains. A detailed and focused history is required to elicit proximal muscle weakness which manifests as difficulty in getting up from chair or commode, climbing steps and walking, and in the upper limb actions such as combing hair. In addition, recurrent falls are common among patients with proximal muscle weakness.

Among many causes, hypovitaminosis D is the commonest cause of osteomalacia seen among older people. They are particularly prone to hypovitaminosis D, believed mainly due to inadequate sun exposure. Poor diet, chronic skin disease and inability of ageing skin to synthesize vitamin D are other contributory factors. Frail and institutionalized older people are particularly prone to hypovitaminosis D and osteomalacia. Patients with chronic liver or renal diseases have disarranged vitamin D metabolism and tendency to develop osteomalacia. A detailed history is required to elicit poor nutrition and features of malabsorption. It is not uncommon to find older adults with previous surgeries involving gastrointestinal tract (patients may have difficulty in recalling details). Certain long-term medications such as anticonvulsants, glucocorticoids, anti-TB drugs and laxatives can be associated with hypovitaminosis D.

Investigations in a patient suspected of osteomalacia should include serum calcium, phosphate, alkaline phosphatase and radiographs of selected regions. Typical abnormalities seen in osteomalacia include hypocalcaemia, high alkaline phosphatase and phosphate level varying according to the underlying cause. Radiographs may show insufficiency fracture (Looser zone) at typical sites such as scapular borders, pubic rami and ribs. Radiological abnormalities, however, are uncommon and it is not unusual for an older person with osteomalacia to have normal lab investigations.

Figure 1 – Looser Zone
(Milkman lines or pseudofracture)

The diagnosis of hypovitaminosis D requires estimation of serum 25-hydroxy vitamin D and PTH in selected cases. However, older people are more likely to have hypovitaminosis D as more than 50% of them in the populations are either vitamin D deficient or insufficient. Many guidelines recommend estimation of serum vitamin D only for those with suggestive symptoms or biochemical abnormalities to avoid this confusion.

The treatment of osteomalacia primarily depends on the aetiology. If medications are attributed, either termination or substitution is required. Chronic liver and renal diseases need treatment based on the standard protocols related to those conditions. Other patients require long term vitamin D and sufficient calcium intake. There is an uncertainty regarding the optimum dose and method of correction of vitamin D deficiency. The usual practice is to treat those with vitamin D deficiency with a loading dose or repeated weekly or monthly parenteral doses of vitamin D. Doses varying from 20,000 to 50,000 IU weekly for 2-3 months have been recommended. A single loading dose of 600,000 IU has also been recommended. Oral vitamin D 1000-2000

IU per day would be sufficient for those with vitamin D insufficiency. However, those with malabsorption, especially after gastrointestinal surgery will require parenteral 50,000 IU monthly. In addition, the clinician must ensure that patients consume adequate calcium either in their diet or as supplements.

Vitamin D3 is the preferred drug in treating vitamin D deficiency as calcitriol and one alpha derivate of vitamin D are expensive and are associated with high risk of hypercalcaemia. Calcitriol and one alpha derivative would suit patients with chronic liver or renal disease, and very old patients who have limited capacity to absorb vitamin D from the gut. Iatrogenic hypercalcaemia has been reported in many countries and patients should be monitored for this complication.

PAGET DISEASE OF BONE

Paget disease is a rare chronic disease of the skeleton and it is often seen among older people. The disease is associated with an imbalance in normal bone remodelling process where the fine coordination between bone resorption and formation are severely disarranged. This leads to expansion of bone and weakening of bone strength giving rise to fractures. The disease remains asymptomatic in a high proportion of patients and is detected incidentally during radiological evaluation for another disease. Bone pain is the commonest presentation and when it is chronic, it can be mistaken for other diseases such as arthritis. Pain in Paget disease may arise from many sources such as expansion of bone, deformities, degenerative changes in nearby joints, compression of nerves and recent fractures. In the acute presentation, the affected area can be warm, tender and swollen. Although Paget disease can affect any bone in the skeleton, it mostly affects spine, pelvis, long bones and skull. Involvement of multiple sites is also seen.

The diagnosis of Paget disease is often made on radiological features which are characteristic of the disease. In early cases, radiological features may be subtle and confirmation would require isotope bone scan or bone histology. Elevated total alkaline phosphatase is seen in active disease but some patients require more specific bone specific alkaline phosphatase estimation. Urinary pyridinoline is another bone

marker used in Paget disease but not commonly used in clinical practice.

Figure 2. Radiological appearance of Pagetic bones

All patients with Paget disease do not require treatment as the disease tends to get inactive with time. Active disease signified by constant pain from Pagetic bone, elevated alkaline phosphatase or active lesions in the bone scan requires specific treatment to retard the disease process and prevent long term complications. Treatment does not cure the disease but can provide prolonged periods of remission. Bisphosphonates are first line treatment and alendronate and pamidronate are used most frequently. Newer bisphosphonates such as zoledronic acid is more potent than the first-generation agents. Calcitonin also can be used. Calcitonin-salmon is available in injectable and nasal-spray forms. All patients with Paget disease should also receive adequate doses of calcium (1,000 to 1,500 mg per day) and vitamin D (400 IU per day).

Non-pharmacologic treatment includes regular exercise to improve mobility and prevention of falls. Exercise programs, however, should be individualized to prevent stress on affected bones.

METASTATIC BONE DISEASE

Bone metastasis is a well-known complication of cancer and the incidence varies depending on the primary site and the type of cancer. It reaches 70–95% in multiple myeloma, up to 65–90% in prostate

cancer and about 65–75% in breast cancer. Bone metastases (BM) are less frequent in other malignancies such as colorectal tumours and lung cancer.

Patients with cancers, particularly those with higher risk of bone spread, should be regularly monitored for this complication as BM can be asymptomatic at the beginning. The clinical manifestations of BM include bone pain, pathological fracture, spinal cord injury and hypercalcaemia, and these patients generally have impaired quality of life. On imaging, they often appear as lytic areas although some malignancies are associated with sclerotic lesions. Plain radiography may not detect early and small lesions and an advanced imaging such as MRI, radioisotope studies and PET scan can be more useful.

Figure 3. Sclerotic lesions

Figure 4. Lytic lesions in multiple myeloma

The pathological process leading to BM is complex and varies depending on the cancer type. Primary malignancies at early stages can stimulate bone marrow stromal cells to prepare the pre-metastatic niches, an environment conducive to the metastasis of a primary tumour. Such process provides favourable conditions for the growth of cancer cells in a foreign and hostile environment. Meanwhile, epithelial tumour cells may undergo a morphological and functional remodelling such as losing of epithelial markers polarity and intercellular junctions This process, called the "epithelial-to-mesenchymal transition", enhances cancer cell migration and invasiveness, finally leading to BM. Migrated cancer cells lead to either lytic or sclerotic bone lesions. Lytic lesions secrete pro-osteoclastogenic cytokines, increasing bone resorption further. Growth factors (GFs) such as TGF-β, PDGF, etc) are released during this process, and stimulate cancer cell proliferation. Sclerotic BM are a result of enhanced osteoblastic response and reduced osteoclastic activity. A number of tumour-derived GFs such as TGF-β, BMPs, FGF and Wnt would enhance osteoblast differentiation

and activity, while ET-1 inhibits osteoclasts. In prostate cancer, prostate specific antigen is capable of cleaving PTHrP, shifting bone turnover towards osteogenesis.

Apart from pain control and specific anti-cancer therapy, bone targeting treatment includes orthopaedic management and systemic therapy. High dose zoledronic acid, which is a potent inhibitor of osteoclasts and denosumab, a human monoclonal antibody is used with varying success. Recently, novel therapeutic approaches have been developed, including the bone-targeting radiopharmaceutical Radium-223 dichloride, that has been licensed for the treatment of BM associated with castration-resistant prostate cancer.

RENAL BONE DISEASE (RENAL OSTEODYSTROPHY)

Metabolic bone disease is a common consequence of chronic kidney disease (CKD) and it includes a wide spectrum of disorders of mineral metabolism. The clinical manifestations of renal bone disease (RBD) are diverse and involve skeletal as well as extra skeletal systems and the determination of the type of bone disease based on clinical and biochemical abnormalities is somewhat problematic. Alterations in the regulatory mechanisms of calcium and phosphorus homeostasis occur early in the course of CKD and progress as kidney function decreases. These include abnormalities of serum calcium, phosphate, parathyroid hormone (PTH) and vitamin D metabolic axis and abnormalities of bone turnover markers. In the bone tissue, abnormalities in bone mineralization, volume, linear growth, and strength occur. Vascular and soft tissue calcification and accelerated atherosclerosis are the extra skeletal manifestations.

The pathophysiology of RBD begins with a series of biochemical abnormalities. The limited capacity of damaged renal tubules to excrete phosphate leads to phosphate retention and this in turn cause hypocalcaemia. Hypocalcaemia is aggravated by inability of the kidney to convert vitamin D to its active form; calcitriol, through the final hydroxylation process. Hypocalcaemia and hyperphosphataemia trigger parathyroid hormone (PTH) secretion (secondary hyperparathyroidism) which is central to many abnormalities to follow.

RBD is broadly classified to high-turnover bone disease which is characterized by high PTH level and low turn-over bone disease associated with normal PTH.

The high turn-over bone disease is associated with the typical biochemical alterations in CKD such as hyperphosphataemia, hypocalcaemia, hypovitaminosis D, high alkaline phosphatase and secondary hyperparathyroidism. The low turn-over bone disease is characterized by the lack of secondary hyperparathyroidism (normal PTH) and interference of bone mineralization due to excess aluminium in the bone tissue. Further, low turn-over bone disease is associated with the impairment of differentiation of bone marrow precursors into osteoblasts and osteoblast proliferation.

RBD is often complicated by other factors such as advanced age, postmenopausal state, use of glucocorticoids, inadequate nutrition and limited sun exposure. These factors either related or unrelated to CKD would aggravate the bone tissue deterioration. RBD is mostly asymptomatic and clinical features can vary widely. Adults tend to have osteomalacia while growth retardation is common among children. Pathological fractures may result from Brown tumours or amyloid deposits (beta 2 microglobulin). In addition, insufficient fractures (Looser zones) can occur due to osteomalacia. Other complications include vascular insufficiency due to accelerated atherosclerosis and vascular and soft tissue calcification.

As the disease is mostly asymptomatic and clinical features are non-specific, the diagnosis of RBD mostly depends on biochemical screening. Apart from fracture and skeletal deformities there are no specific clinical features of RBD.

Radiographic abnormalities are detected only when RBD is in late stage and these include Looser zones, Brown tumour, osteosclerosis and reduced mineralization (radiological osteopaenia). Spine may show alternating osteosclerosis and demineralization bands known as “Rugger Jersey” appearance. Radiological features of osteomalacia include widened growth plate and bone deformities. Further, soft tissue calcification too can be seen.

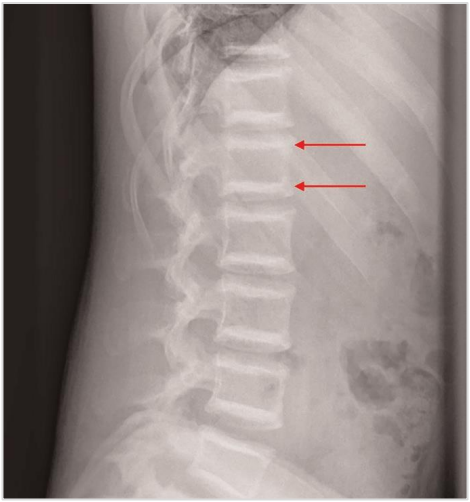


Figure 4. Rugger Jersey appearance

Bone histology (histomorphometry), although informative, is reserved for those young, with inconclusive biochemistry and recurrent fractures.

The management of RBD is complex and requires team approach. Phosphate binders such as calcium acetate, calcium carbonate and magnesium carbonate should be commenced early to prevent hyperphosphataemia and aluminium-based phosphate binders should be used with regular monitoring of serum aluminium to prevent aluminium toxicity. An adequate intake of calcium should be ensured to prevent hypocalcaemia and hyperphosphataemia. In addition, the correction of chronic metabolic acidosis should be done and vitamin D levels must be normalized. While calcitriol or one alpha derivative are commonly used to correct vitamin D status, a regular monitoring of serum calcium should be done to prevent overdosing. Parathyroidectomy is reserved for those with persistent hypercalcaemia, hyperphosphatemia and metastatic calcification. Patients with bone deformities and fractures need to be referred to orthopaedic surgeon for stabilization or correction.

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7. A Synopsis of Fractures in Older People

Dr. F. H. D. Shehan Silva

Fractures in older people are common due to increasing frailty, greater risk of falls and poor bone health. Most common fractures among older adults of age 65 and above include fractures in proximal femur, distal radius/ ulnar, proximal humerus, ankle and pelvis. Furthermore, hip fractures in the geriatric population sustain the most significant injury which require long term medical and rehabilitative care. Evidence indicates that the global prevalence of hip fractures continues to increase causing up to 20 - 24% deaths in the first year after a hip fracture with survivors losing their level of independence and functionality.

BASICS OF FRACTURES

A fracture is considered as a disruption in the continuity of bone or its' normal architecture. This is a phenomenon that occurs when a bone is subjected to stress greater than what it can endure. Fractures can be classified according to the type, degree of communication with the external milieu and its' anatomical location.

There are several types of fractures categorised according to the shape of the disruption and the force that have caused them.

a) Transverse fracture - the fracture line is perpendicular to the long axis of the bone. This is a result of direct application of violence or force.
b) Oblique fracture - Twisting forces give rise to angulated fracture line.
c) Spiral fracture - It is an extreme form of oblique fracture in which the fracture plane rotates along the long axis of the bone
d) Longitudinal fracture - The fracture line is nearly parallel to the long axis of the bone.
e) Comminuted fractures - Multiple fragments of bone are involved as a consequence of severe force.
f) Impaction - Vertical force drives the distal fragment into the proximal fragment.

g) Avulsion - A chip of bone is torn out by sudden and unexpected contraction of powerful muscles from its point of insertion.

N.B. Two important fractures in the skull are described. i.e. depressed (a segment of bone gets indented) and stellate (fracture line runs in varied direction) fractures.

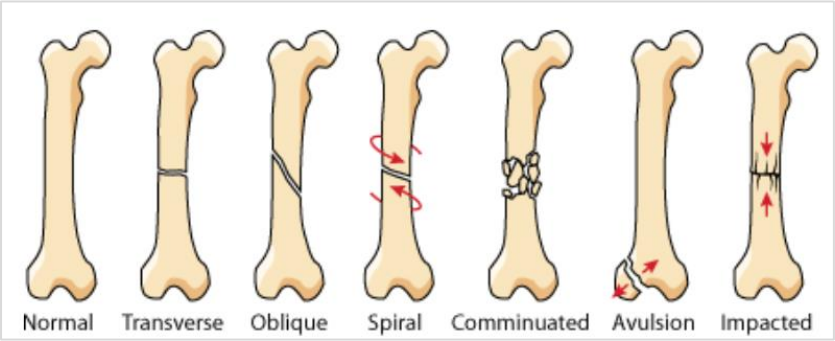

Figure 1. Common types of fractures

A closed or a simple fracture is one that does not communicate with the environment. In contrast, an open or a compound fracture that has a breach of the integrity of soft tissues. This variety can be complicated with superadded infections.

A pathological fracture occurs when there is weakening of the bone by an underlying disease. The fracture may be caused by trivial forces applied. Some causes of pathological fractures are as follows.

Congenital	Osteogenesis imperfecta
Infection	Chronic osteomyelitis
Metabolic	Osteoporosis, Osteomalacia, Hyperparathyroidism
Benign neoplasm	Bone cysts, Enchondroma
Malignant neoplasms	Primary bone tumours (rare) Metastatic bone disease (breast, kidney, prostate, thyroid and lung)
Other	Paget disease of bone

FRACTURE HEALING

Fracture healing is a process with many stages. Formation of a fracture haematoma occurs in the first stage. This surrounds the ends of the fragments occurs within the first 72 hours. Thereafter deposition and replacement of the haematoma by granulation tissue occurs. There is active phagocytosis of products of local necrosis due to initial deprivation of blood supply. Complete disruption of vasculature leads to avascular necrosis. The phase of granulation tissue generation extends from the 3 - 14 days of injury. There is acute inflammatory reaction similar to soft tissue healing. In the phase of callus formation, minerals and bone matrix are deposited in the osteoid (an unorganised network of bone formation visualised by x-ray). This phase requires a small amount of movement. Complete rigid fixation impedes healing.

The ossification of the callus occurs after 3 weeks to 6 months and continues till the fracture has healed. During this stage of clinical union, the cast may be removed and the patient may be allowed limited mobility in the affected area. As a general rule, external splintage needs to be maintained for 4-8 weeks for cancellous bones and 6-12 weeks for long bones in adults. The final phase is identified as consolidation, in which the distance between bone fragments diminish and close. This is equated as radiological union. Remodelling occurs and excess bone tissue is reabsorbed with completion of union. Union of a fracture is deemed adequate when there is not tenderness on direct pressure of the fracture site, little or no pain when stressed by angulation/ rotation and there is no movement of the fracture site. Furthermore, there will not be any gap and continuity of bony trabeculae will be observed radiologically.

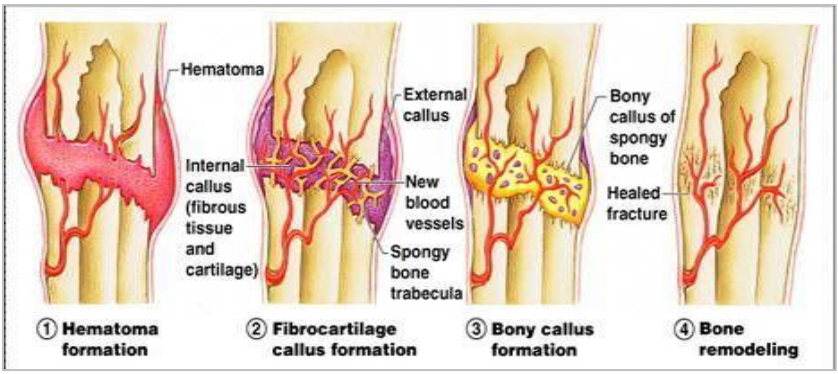

Figure 2. Fracture healing

There are various factors affecting fracture healing. As of any injury, advanced age impedes this process. Superadded infection and inadequate blood supply to fracture site delays healing. Furthermore, excessive movement at fracture site, interposition of soft tissue in between fragments, loss of apposition between fragments and pathological processes that destroy bone are also notable causes.

CLINICAL FEATURES

The history is very important in evaluating a patient who has sustained injury and a fracture in particular. A fall may be due to an accidental loss of balance or instantaneous loss of consciousness due to neurocardiogenic causes. As stated above one sustained following a trivial injury may point towards a pathological fracture. Furthermore, the mode and circumstance of a fracture may point to other latent fractures that have serious repercussions which may be missed easily. E.g.:

1) fracture of the foot bones following a fall from a height may be associated with hip/ vertebral.
2) a fall on an outstretched arm can give rise to fractures of scaphoid, radius (Colles), supracondylar fracture and surgical neck of the humerus, and clavicle commonly.

The time elapsed since the injury can be associated with infections (in an open fracture) or ischaemic damage (due to vascular injury).

Non accidental injury in the form of elder abuse is not uncommon even in Sri Lanka. Risk factors for this can be divided as follows.

a) Victim - heavy dependency, communication difficulty, dementia, behavioural abnormalities and aggression

b) Caregiver - change in lifestyle due to caring role, substance abuse, health problems (physical and psychological), division of loyalties (presence of old parent and young child), reversal of role (ageing child and aged parent), sense of isolation, selfish ambitions (financial abuse)

c) Shared – Poor socioeconomic background, lack of social support, lack of support from other members of the family, poor long-term relationships. Although diagnosis may be difficult to substantiate, it is essential that health care providers develop a keen intuition when atypical manifestations associated with fractures present under their care. These include

    - Recurrent falls and accidents, unexplained fractures.
    - Multiple/ variegated contusions, burn marks. (especially thumbprint bruises, cigarette burns)
    - Injury in the shape of objects
    - Patient attempts to conceal injury or is withdrawn, frightened, anxious or makes effort to please
    - Difficulty in gaining access to thorough examination.
    - Isolation or restraining the patient in the care setting.

The following clinical findings may be found in a fracture.

a) Swelling – haematoma formation and oedema generation
b) Deformity – seen in displaced fractures and described anatomically of the distal segment in relation to the proximal. e.g. in a fracture neck of femur, the distal leg is shortened and externally rotated.
c) Abnormal mobility
d) Crepitus
e) Abnormalities of skin integrity - abrasions, lacerations, ischaemia
f) Impairment Vascular perfusion and neurological function
g) Injury to internal organs and haemorrhage

COMPLICATIONS OF FRACTURES

Complications can be considered as early and delayed sequelae.

Early	Delayed
Local:	***Local:***
Infection	Malunion
Haemorrhages	Delayed union
Injury to viscera, vasculature and nerves	Non-union
Skin necrosis	Muscle atrophy
Deep vein thrombosis	Joint stiffness
Compartment syndrome	Osteoarthritis
	Delayed tendon rupture
Systemic:	Tardy nerve palsy
Hypovolaemic shock	Reflex sympathetic dystrophy
Fat embolism	Myositis ossificans
Orthostatic pneumonia	
Decubitus ulcers	***Systemic:***
Pulmonary embolism	Osteoporosis
	Lifestyle and psychological changes

Haemorrhage arise from the bone marrow, periosteum or surrounding tissues. It can be concealed in the early phase and manifestation of shock or haematoma formation may appear later. Such blood loss is commonly attributed in fractures of pelvis (2-3 L), femur (1-2 L), tibia and humerus (0.5 -1 L). Some bony injuries are associated with vascular damage. e.g. supracondylar fractures of humerus contuse brachial artery and 50% of knee dislocations can cause intimal tears of popliteal artery).

Compartment syndrome occurs when structures in the inelastic osseofascial compartments are injured. The oedema and the haemorrhage increase the intracompartmental pressure to levels that can affect venous drainage. There is increasing pain, paraesthesia, and paresis with pain on passive stretch and palpable tension in the relevant

compartment. The pulses are usually present in the early phase although in later stages arterial pulses will be absent. Irreversible damage to neurovascular structures occurs in 4-6 hours if not intervened. The skin is usually unaffected although disabling contractures of damaged muscle may result. This is known as Volkmann ischaemic contracture.

Fat embolism is a specific complication of fractures especially in those with multiple injuries. Fat from marrow of fractured bone enters circulation as large fat globules. Patients may present with confusion, tachypnoea and mild fever. Skin petechiae can appear. There will be reduced PO2 and thrombocytopaenia. Fat globules may be seen in urine. Supplementation of oxygenation is used as treatment modality.

Malunion follows after imperfect reduction or re-displacement after reduction. They cause deformity and loss of function. Delayed union is considered when the fracture has not united clinically or radiographically. The fracture may continue to heal slowly. A fracture is deemed to have non-union when the healing process has stopped before union occurs. In this condition, the fragments are united by fibrous tissues.

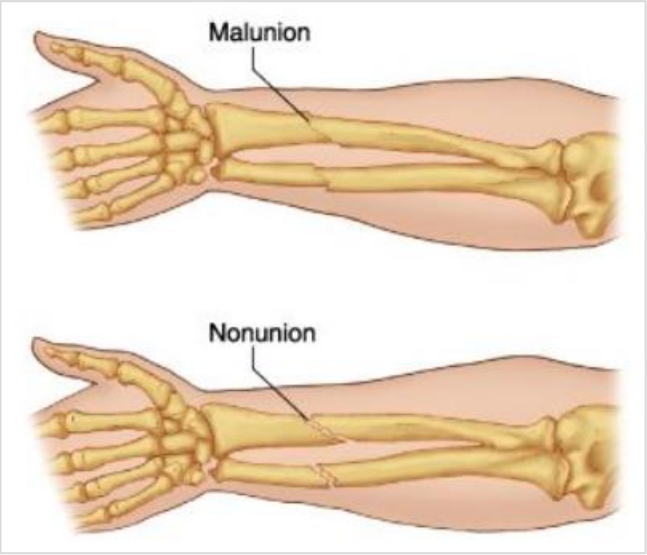

Figure 3 Malunion and Non-union

Complex regional pain syndrome (CRPS) type 1 (also known as Reflex sympathetic dystrophy/ Sudeck atrophy) presents days or weeks after injury. In this complication, there is disproportionate pain, abnormal sensation (dysaesthesia), joint stiffness, thickened soft tissues, abnormal sweating and loss of hair at injury site. This condition is caused by tight fracture orthoses, inactivity and by dependence of the limb. CRPS type 1 is prevented by immobilisation of the joint in the functional position and by early therapy/ exercise. Myositis ossificans is formation of heterotypic bone in muscles around the fracture. This is caused by too early or vigorous joint involvement

PRINCIPLES OF MANAGEMENT OF A FRACTURE

a) The patient who has endured injury should be resuscitated and stabilised as per guidelines common to any emergency. Always suspect that the casualty may have had head or spinal injury.

b) The primary care giver should be able to provide First aid. The casualty should be calmed, reassured and advised to keep still. The joints above as well as below should be supported with hands until the fractured region is immobilised. Ice (covered around avoiding soaking of tissues) can be applied to reduce generation of swelling soon after the injury. Adequate amount of padding should be placed around the injured zone. Securing this area can be done be immobilising with a sling (upper limb) or by strapping the injured limb to an uninjured area (strapping both legs together with broad fold bandages. It is essential that the knots are placed on the uninjured side. If in case of an open fracture, the wound needs to be covered with sterile dressing. Pressure should be applied to contain bleeding. Further to this, more clean padding should cover around the first dressing and then bandaged. It is essential that distal circulation is monitored after the application of first aid. The patient should be thereafter directed to an emergency medical facility for definitive care. Achievement of analgesia is paramount (Please refer to Chapter 13. Consequence of Impaired Mobility and Stability and Immediate Management. Stability and Mobility, SLAGM 2019)

c) Reduction is the manipulation of fractured bone to restore normal or near normal anatomy. Some fractures do not need aspect as they do not result in deformities (e.g. scapula) or the nature of the fracture is immaterial for final functional result (e.g. Single rib fracture). Reduction can be achieved by closed manipulation under general or regional anaesthesia. Mechanical traction can be used to reduce fractures of the spine or femur, and to hold the fracture in position of healing. Open reduction is necessary when closed reduction fails, when accurate reduction is required or when there is a neurovascular injury.

d) Immobilisation is done to hold the fracture to relieve pain, prevent displacement or avoid shear forces on tissues. This can be done by the following methods

   i. External splints – plaster or Paris, synthetic resin casts

   ii. Continuous traction – applied to the distal fragment by a skeletal pin or an adhesive tape on skin

iii. External fixation - a rigid bridging device is held in place by bony pins proximal or distal to the fracture

iv. Internal fixation – screws, plates and pins

e) Active movement and rehabilitation should occur as soon as possible after treatment proper. The patient is advised to move the injured part as much as fixation allows under the guidance of the physiotherapist. Slight movement produced at the fracture site helps to stimulate union, decrease disuse osteoporosis, prevent muscle atrophy and minimise joint stiffness. All external splints should be removed soon when there is evidence of union. The patient is commenced on a supervised program of active exercises to restore function.

ORTHOGERIATRIC CARE

Orthogeriatric care is a coordinated medical program for older patients with orthopaedic conditions. The concept first was introduced in 1950s which demonstrated shorter length of hospitalisation and greater proportion of patients going back to their homes rather than institutions furthermore, the approach facilitates the pursuit of patient's medical background and showed improved outcome. There are 4 models of orthogeriatric care.

a) Reactive Consultation Model

This is the traditional method of managing a hip fracture in an older patient by an orthopaedic surgeon, referring to a physician as on needed basis. This model is widely practiced in Sri Lanka. However, studies have shown that this approach leads to higher inpatient mortality and increased length of stay.

b) Orthogeriatric Liaison model

Patients with hip fractures will be admitted under the purview of the orthopaedic surgeon but is regular review by the medical team. Multidisciplinary team meetings ensure that care plans are discussed. This model has shown to reduce the inpatient mortality and length of

stay. However, there are irregularities in continuity of care and regular reviews.

c) Perioperative Geriatric Rehabilitation Model

There is shared care acutely with the orthopaedic and anaesthetic teams perioperatively. This is followed by an early postoperative transfer to a geriatric rehabilitation unit for continued care. Although the length of stay is reduced by this approach, lack of medical team involvement in the acute setting can compromise during the vulnerable period of admission.

d) Joint Model of Care

In this model there is joint sharing of care by the geriatrician and the orthopaedic team. In addition to the benefits of all the other models, there is reduction in the time to surgery and postoperative complication rates.

It is imperative that improvement of services should be provided to older persons with orthopaedic conditions by establishing a well-coordinated multidisciplinary comprehensive geriatric assessment and care. (Please refer to chapter 12 - Complex case scenarios of fractures in older people, for more details on orthogeriatric approach to a patient.)

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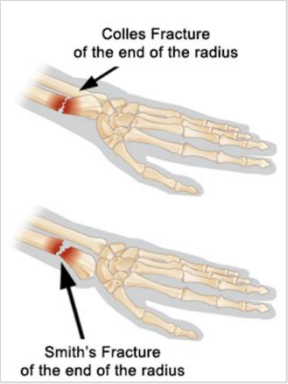
8. Common Fractures Among Older People

Dr. Chandana Karunathilake

Older people commonly suffer from fragility fractures of the distal radius, proximal humerus, spine, hip, pelvis and ankle. The objective of fracture management is to restore normal function. The surgeon's perspective lies at achieving anatomical reconstruction and fracture stabilization to allow early mobilization. Management of a fragility fracture is a challenge to an orthopaedic surgeon as the bone is weak and unstable. Lower bone mineral density along with increased risk of fractures, results in greater risk of fracture displacement and loss of reduction due to cutting off screws. A multi-disciplinary approach is essential and patients with fragility fractures should be considered on managing osteoporosis and engaging in rehabilitation. Rehabilitation programs should commence immediately after immobilization and thereafter intensified post cast removal. Such programs should consist of exercises to increase mobility and strength muscle.

DISTAL RADIUS FRACTURES



Anatomical reconstruction (axial height of bone and articular congruity) is important in restoring normal wrist function of physically active patients. Radiological accuracy is not crucial for the outcome in very old patients with low demands. Nondisplaced fractures can be fixed in a forearm plaster for four to six weeks.

Figure 1 – Common fractures of the wrist

Stabilization of the distal radius fractures can be achieved by

1. Manipulation and immobilization by plaster cast

2. Manipulation and stabilization with percutaneous K-wire, and immobilization by plaster cast
3. Open reduction and internal fixation (ORIF) with volar plates and locking screws
4. Manipulation and stabilization with external fixator.

Older patients often present with loss of reduction and displacement in the modality of manipulation and plaster cast immobilization. Loss of reduction and malunion are correlated with poor bone mineral density and age. Percutaneous K-wire stabilization technique is a minimally invasive method with better radiological results compared to plaster cast immobilization. However, post-operative pain is greater in the former. Maintaining radial length is not always feasible in older patients and can present with malunion. The modality of external fixation can be done by bridging or nonbridging. This can be complicated with pin loosening and infection. Volar plates are employed to treat distal radius fractures with palmar displacement (i.e. Smith fracture). These have the advantages of early mobilization and maintaining radial articular surface height. However, higher cost for volar plates, potential tendon irritation and rupture, and requirement for a second surgery for plate removal are some disadvantages.

PROXIMAL HUMERUS FRACTURES

Fractures of the proximal humerus presents as fragility fractures frequently in late middle-aged and older adults. A 65-year-old Caucasian woman has a 5% risk of sustaining a proximal humerus fracture by the age of 90. The proximal humerus is primarily composed of cancellous bone and has a propensity to be affected by osteoporosis. These fractures can be classified according to the Neer classification: a system based on the location and number of displaced bones fragments. The most severe fracture types with three and four parts are more frequent in old than in younger patients. The common zones of injury in the humerus are the anatomic head, tuberosity region, and surgical neck.

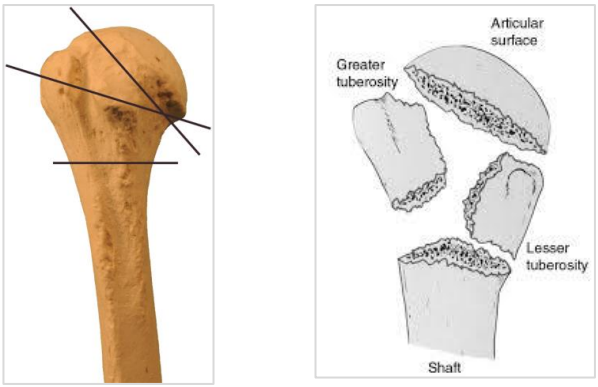


Figure 2 – Fractures of the proximal humerus head

The strength of screw fixation in the humeral head is less strong in areas with low bone mineral density such as the superior anterior part. In older patients, the bone within the articular segment is vacuous except for the subchondral bone. This makes ORIF challenging with postoperative collapses leading to articular penetration of the screw.

Displaced fractures or fractures associated with a dislocation may have obvious deformity, especially thin people. The standard x-ray views required are true shoulder (scapular) AP view and scapular lateral ''Y'' view and axillary lateral views.

Most valgus impacted and nearly all minimally displaced fractures are best treated with nonoperative care. Valgus alignment with an intact medial hinge (humeral calcar) tend to have a better prognosis with nonoperative treatment than those with varus alignment or medial hinge disruption.

Majority of displaced fractures are treated nonoperatively with a shoulder immobilizer or body bandage. The choice of treatment will depend upon the fracture type, the age and the individual demands of the patient. Most surgeons perform an ORIF in younger patients. In the older, osteoporotic patients no consensus on the superiority of treatment exists. Immobilization in a sling or brace, closed reduction and percutaneous fixation with K-wires or screws, intramedullary nailing, open reduction and wiring, open reduction and plate fixation

and prosthetic replacement can be performed. Surgical fixation however is complicated with screw cut out, perforation of screws through the humeral head and loss of reduction especially in those older than 60 years old. Prosthetic replacement instead of osteosynthesis has been recommended in fractures with a high risk of aseptic necrosis such as in four-part fractures or fractures with splitting of the humeral head. The disadvantage of hemiarthroplasty is a poor range of motion of the shoulder and the risk of non-union of the tuberosity. It can be concluded that there is a lack of randomized comparative trials to find out what treatment is best for displaced proximal humeral fractures in older patients and conservative treatment still may be a good option. Treatment must be individualized for the patient based on the fracture characteristics as well as the patient's functional demands.

PELVIC AND ACETABULAR FRACTURES

These are common injuries in the older patients after a minor fall. They may also occur from higher velocity forces.

A Pelvic ring fracture typically involves 2 or more bony areas: most commonly the sacrum and one or both pubic rami. Patients presents with pain in the hip or groin region. A difficulty may exist in distinguishing a pelvic fracture from a hip fracture clinically. Those with sacral fractures present with low back pain. Both pelvic and acetabular fractures may result in considerable bleeding especially in those on anticoagulation. Retroperitoneal hematomata may cause critical bleeding thus requiring the haemoglobin level to be monitored.

A standard x-ray AP pelvis should be helpful to identify the fracture site. Secondary inlet and outlet pelvis x-ray views will give better details of the fracture. A CT scan of the pelvis should be done to exclude hip fractures and to decide on further management if doubt that is driven clinically exists.

Pelvic ring fractures are most often treated nonoperatively, with bed rest and optional pelvic immobilizer in the older patients. Once pain is controlled, patients should be encouraged to mobilize with support

weight bearing (a walking frame). Surgery in pelvic ring fractures is recommended if patients have unstable fracture patterns which might cause further displacement and internal visceral structural damage (e.g. bladder), and for fractures which cause marked leg length discrepancy.

PROXIMAL FEMUR FRACTURES

Two main types of proximal femur fractures are recognized in the older person: intracapsular fracture and extracapsular fractures neck of femur.

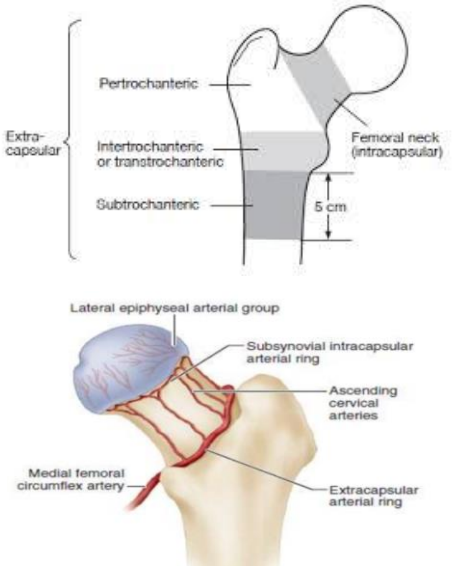


Figure 3 – Fractures of the proximal femur and the blood supply to the head of femur

Intracapsular Fracture

Approximately 50% of fractures of the hip are intracapsular and are well recognised for poor healing due to damaged trochanteric blood flow. Fixation with screws (osteosynthesis) is preferred over prosthetic hip replacement in intracapsular fractures with displacement (slight or otherwise) in the young. This is performed within 12 hours of injury to minimize the risk of avascular necrosis. Displaced fractures have a high risk of non-union and avascular necrosis after internal fixation. Screw cut out is a known complication of lag screw fixation. The positioning

of screws is important: placed spread apart and next to the cortex of the femoral neck inferiorly, superiorly, and posteriorly. Furthermore, the screw threads should not cross the fracture line and should be placed as deeply into the head as possible without penetration of the head of femur. The results of screw fixation for stable fractures are satisfactory with revision rates approximating 10% (more stable the fracture, the better are the results). Some cases may complicate later with shortening, osteonecrosis, non-union, or screw cut-out.

A fracture that is unstable or displaced can be managed either with open reduction and internal fixation (ORIF), hemiarthroplasty, or total hip arthroplasty (THR). ORIF should be reserved for younger patients. Hemiarthroplasty is an excellent choice for the older or medically unstable patient with a relatively normal acetabulum. THR has been shown to give the best outcomes for an active older patient. If the bone quality and physiological age is satisfactory, THR remains the preferred option for displaced fractures. Hemiarthroplasty does leave the patient susceptible for wear of the articular cartilage or pain in the hip secondary to mismatch of the size of the selected head and the native acetabulum. This potential disadvantage has led to the use of THR for patients who are active or physiologically young.

Extracapsular fracture

The preferred surgical treatment in the past used to be fixation with plate and screws (osteosynthesis) for extracapsular fractures. Currently they are most frequently stabilized with a sliding hip screw or an intramedullary nail. There are newer surgical fixation techniques. Dynamic hip screw (DHS) is a procedure commonly performed for extra-capsular fractures of proximal femur. It is a dynamic mechanism where when the patient bears weight, a screw slides within a barrel, allowing compression of the fracture site.

Successfulness of the fixation depend on intact medial calcar (medial wall) and optimum screw positioning. The key factor in the success of the DHS surgery is the placement of the screw within the femoral head. The screw should be as deep as possible and cantered with the head. Overall reported DHS failure rate is around 8%-13%. A successful DHS

surgery will facilitate the early supported weight bearing, basically immediately after surgery.

DHS may be complicated with many outcomes. These include screw cut-out, loss of reduction, non-union and malunion of the fracture, healing with varus/valgus deformity of the femoral neck, marked shortening of the affected limb, extensive collapse of the trochanteric region, avascular necrosis (AVN), screw breakage, plate pulling off from the femur, pseudoarthrosis, haemorrhage, and infection.

Unstable extracapsular fractures are characterized by comminution, a reverse obliquity fracture line, or extension into the shaft of the femur. In such cases, the lateral buttress will not be intact and will not provide an end point to sliding. Therefore, a sliding hip screw has a higher rate of failure. The unstable fracture is best treated with an intramedullary nail because it provides the buttress for the proximal fragment. A short or a long intramedullary nail may be used. Although the long nail may protect more of the femoral shaft, the bone can be at risk of fracture distally around the end of the nail above the knee. A fixed angle device, such as an angled blade plate, may also be considered.

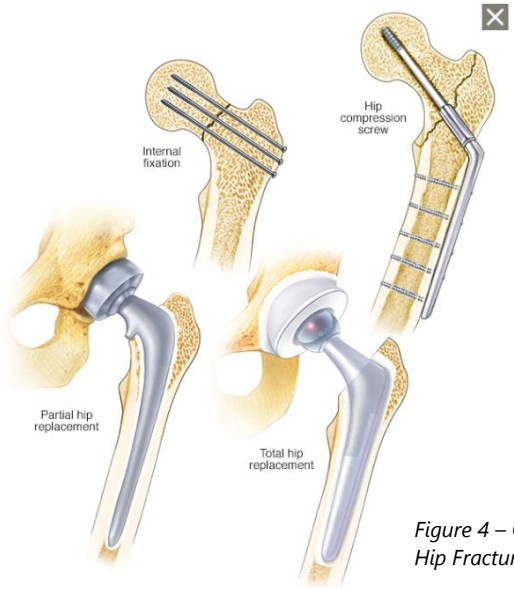


Figure 4 – Operative modalities of Hip Fractures

FOOT AND ANKLE

Ankle fractures can occur due to both high- or low-energy trauma such as slips, twists, and ground-level falls. The incidence of foot and ankle fractures among older women have been reported to be 3 per 1000 woman per year: fractures of the fifth metatarsal and distal fibula being the most common. The incidence of fragility fractures of the ankle begins to rise from middle age. Commonly associated risk factors are diabetes, immobilization, osteoarthritis of the ankle, low bone mineral density values, poor vision, other neurological disorders and high body mass index (BMI).

The mainstay of treatment for many fractures is nonoperative intervention. Most commonly fragility fractures occur in the tarsals and metatarsals. Stress fractures are common affecting the talus, navicular, great toe sesamoids, and other metatarsals. Initial x rays may be negative in minor trauma, but clinical suspicion should prompt appropriate initial treatment. In non-displaced or minimally displaced fractures plaster cast immobilization and none weight bearing or protected weight bearing is advised. Repeat x ray in two weeks after injury often show evidence of fracture lines or apparent callus formation that was not visible in the initial x rays. The fractured area is immobilized for 6 to 8 weeks. Fractures that are displaced or non-healing require operative stabilization with percutaneous pinning or screw fixation, open reduction and internal fixation, or excision, such as sesamoidectomy.

The primary goals are restoring a functionally stable ankle joint, return the patient to activities of daily living and pre-injury functional levels, and prevent prolonged immobilization. Non operative and operative treatment can be offered to the patient according to the fracture stability, but there is controversy regarding their optimal treatment in the older patients In the older population, conventional treatment modalities can be challenging secondary to poor bone quality, poor soft-tissue integrity, intrinsic instability, and difficulty in complying with weight-bearing limitations. Nonoperative Treatment for displaced ankle Fractures is cast immobilization for six weeks and serial radiographic follow up in every 2 weeks. Studies has shown even displaced, but well-

reduced and stable ankle fractures can be managed with a plaster cast in a non-operative manner successfully.

Operative intervention should be considered for ankle fracture dislocations and other unstable injuries. Surgical fixation of the ankle fractures will facilitate the early mobilization and reduced the risks of immobilizations and avoid the potential soft-tissue complications of long-term cast.

Individuals with diabetes mellitus have a higher risk of complications with either surgical or nonoperative management of their foot and ankle injuries. Diabetes related vascular diseases, neuropathy and bone changes predisposes for loss of reduction, delayed union, malunion, non-union, infections, and soft-tissue or wound complications.

VERTEBRAL COMPRESSION FRACTURES

A person who has sustained a vertebral compression fractures (VCF) has a 5-fold increased risk of for second VCF and 4 to 5-fold increased risk of a subsequent hip fracture in later life. The risk of fracture from physiological compressive forces increase as cortical and trabecular bone of vertebral bodies begin to decline in thickness and connectivity with age. Simple activities, such as standing from a sitting position can lead to fracture through the weakened bony trabeculae. Some

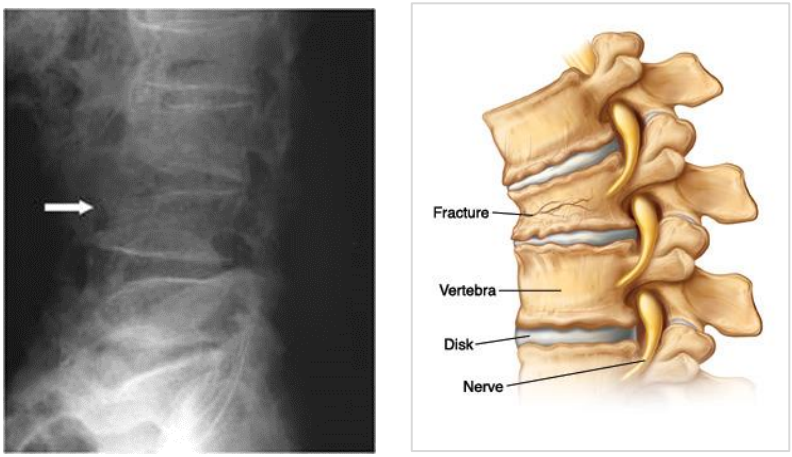


Figure 5 - Vertebral compression fractures

asymptomatic fractures can occur as a gradual micro-fracture process that leads to progressively worsening of anterior vertebral compression and wedging.

Acute VCF may present with debilitating back pain after minimal activity or an atraumatic event such as sneezing or change of posture. They can also experience neurological symptoms such as weakness or radiating pain (radicular) down the leg or across the chest wall. Chronic VCF is often diagnosed incidentally, and can result in reduction in standing height or with kyphotic deformity. Two-thirds of VCFs will not be noticed initially since they are asymptomatic or minimal symptoms at the time of the event. Postural fatigue can set in as the normal biomechanics of the spine is altered. Identification of fracture type as acute or chronic is important to determine the modality of medical care and surgical management for the patient.

Most of the older persons may have a combination of chronic and acute compression fractures. Simple anterior/ posterior and lateral view x-rays of the spine are useful whether they be of any type. The general percentage of collapse is described. A fracture fragment can displace into the spinal canal or compression of a nerve root in the neural foramen can occur. In such occasions a MRI scan (if contraindicated, CT scan) is important. Neurological compromise can be a serious complication and can lead to permanent weakness or disability. Imaging may also help to identify any malignant possibilities which is common in the older age.

Most patients with VCFs can be treated with nonsurgical options. Pain control is an essential part of the management as without adequate control patients cannot be mobilized. This leads to permanent functional disability and other complications with immobility.

Bracing is recommended for 8 to 12 weeks depending on the severity of the compression fracture. It helps with pain relief by reducing the micromotion at the fracture site, supplementation of muscle and improvement in the biomechanics of the spinal column. Braces provide a 3-point stability to the spine and prevent flexion at the thoracic and lumbar regions. However, most older patients are unable to tolerate

bracing for a longer period. They can result in skin irritation, pressure sores and thereafter decreased mobility with muscle atrophy. When bracing is the choice it has to be individually considered to the patient needs, body geometry and postural positions. The patient does not need to wear the brace in bed or when in supine position but only when upright or walking.

Surgical intervention for VCF is controversial: the choice between vertebroplasty and kyphoplasty is still very much debated. Surgery should be reserved for patients with painful VCFs for whom nonoperative treatments have failed. Kyphoplasty proponents argue that it more accurately restores the natural anatomy of the spine. Those in favour of vertebroplasty state that the balloon effects on restoring anatomy are minimal and that pain relief experienced from both procedures is secondary to stabilization of the fracture with cement. Vertebroplasty reduces the risk of iatrogenic cord compression due to retropulsed fracture fragment than with kyphoplasty.

Vertebroplasty is the injection of polymethylmethacrylate (PMMA) bone cement, into the collapsed vertebral body through a posterior transpedicular approach. Similarly, in kyphoplasty PMMA bone cement is used to stabilize the fractured vertebral body but differs by the fact that before it is injected, a balloon is inserted into the vertebral body and inflated to allow the vertebral body to be expanded more closely to its pre fracture position. Both procedures are thought to improve stability and subsequent pain reduction and functional stability. Recent published randomized placebo-controlled trials regarding efficacy of vertebroplasty in improving pain in patients with VCF found that there is no statistically significant difference.

Both vertebroplasty and kyphoplasty have potential risk of cement extrusion into the spinal canal, retroperitoneal space, or thoracic cavity. These include intravascular extrusion of cement, fat embolism syndrome and neurologic deficits from cement causing injury to local nerve roots or the spinal cord, or from subdural and epidural hematomata. Retropulsion of fracture fragments into the spinal canal due to the pressure effect when cement entering the enclosed space has been reported. This can be a devastating event. These two

procedures should not be performed in patients with retro pulsed posterior vertebral body wall or unstable posterior vertebral body wall.

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9. Nurses' Role in the Management of Fractures Among Older People

Ms. Kalpani Abhayasinghe

Differences and specific considerations relating to ageing exists although the overall management of older people who faced trauma, particularly fractures has some similarities to that for all trauma.

PLANNING OF NURSING CARE GOALS

The International Consortium for Health Outcomes Measurement (ICHOM) Standard Set for Older Persons (https://www.ichom.org/portfolio/older-person/) highlights the importance of measuring several indicators in order to understand how to improve the lives of older people. Some of these fracture-related outcomes include delaying frailty, avoiding falls, alleviating pain, improving functioning quality of life, minimising time spent in hospitals and the care giver burden.

Nursing care goals for a person survived fracture include the following:

- Achievement of immediate care goals including first aid and post-fracture stabilisation
- Pain relief
- Maintaining asepsis and prevention of infection to fracture site
- Maintenance of vital signs within the normal range
- Achievement of a pain-free, functional, and stable body part
- Prevention of complications and improve quality of life.

NURSING INTERVENTIONS

Immediate nursing interventions when receiving a patient with a suspected fracture

Nursing care for an older person who survived a fracture starts from the point of admission to hospital. The patient may present unconscious at the emergency unit or walk into the hospital several days after the incident depending on the mechanism of the injury, severity and how the fracture was sustained, the nurse must perform systematic

assessment and immediate post-fracture stabilisation is planned according to the type of injury at the time of admission. However, in all cases, it is important to follow 'A to E' approach for patient assessment (Table 1).

Table 1. *A to E primary assessment of the patient (Source: Frazer 2007; Jensen et. Al, 2018)*

		Things to check	**Considerations related to ageing**
A	Airway	Can the patient talk? Does the airway need to be opened? Is an adjunct required? Is there any potential injury to the cervical spine?	Degeneration of the physiological airway by ageing and musculo-skeletal pathology (e.g. osteoporosis) can reduce neck and spine flexibility, making airway management difficult
B	Breathing	Look, listen and feel. What is patient's respiratory rate and depth? Is there any use of accessory muscles or nasal flaring? Is there symmetry of breathing or noisy breathing? What is the oxygen saturation?	Older people are more at risk of respiratory failure because of the increased work of breathing
C	Circulation	What is the heart rate, rhythm and strength? What is the blood pressure? What is the capillary refilling time? Is there any bleeding? Are there any changes to skin colour and	Reduction in cardiopulmonary reserve in old age increases the risk of fluid overload when administering intravenous fluids (particularly colloids).

		temperature? What is the urine output? Assess wound drainage and injury. An electrocardiogram may be required.	They require closer monitoring. Use of beta-blockers and antihypertensive agents can mask the signs of deterioration of blood pressure and heart rate.
D	Disability	Assess the level of consciousness using the AVPU (Alert, Voice, Pain, Unresponsive) score or a full GCS (Glasgow Coma Score) if indicated. Are there any medications that may be affecting the level of consciousness?	Prolonged inactivity and disuse limit the ultimate functional outcome and impacts on survival.
E	Exposure	What is the temperature? Check for rashes, skin problems, wounds, bruising all over the body. Perform a pain assessment.	Skin and connective tissue undergo extensive changes with ageing, resulting in diminished thermoregulation, increased risk of infection, poor wound healing and increased susceptibility to hypothermia.

A head-to-toe assessment should be performed thereafter to identify all the potential injuries that would be disabling or lethal to the patient. A closed fracture is assessed for the absence of any opening in the skin at the fracture site whilst an open fracture is assessed for risk for signs and symptoms of infection, osteomyelitis, tetanus, and gas gangrene. Assessment of the neurovascular status of the patient is important to identify the signs and symptoms of compartment syndrome. This includes monitoring the 5Ps: pain, pallor, pulse, paraesthesia, and paralysis. The ability to perform a systematic nursing assessment of the fractured area is important to enhance bone healing, identify potential

complications early and reduce the time spent in the hospital. The patient and family may experience fear, distress and confusion. Therefore, provision of reassurance to the patient and family is equally important to obtaining their support when planning further care.

If the condition is life-threatening, the health care team need to intervene with resuscitation, to optimise oxygenation, ventilation, and perfusion. Monitoring of haemodynamic status is essential as the tissues must be well perfused to receive oxygen and nutrients required for healing and recovery. Immediate nursing interventions include clearance of the airway, provision of supplemental oxygen, providing assistance to ventilate the patient, control of haemorrhage, insertion of venous access devices, and replacement of fluids and blood/blood products. The patient's airway is opened using a jaw-thrust manoeuvre with manual, in-line stabilisation of the neck until cervical spine injury has been ruled out, Extraneous substances such as food, blood, vomitus, or other debris need to be suctioned out of the airway quickly to prevent aspiration. The patient may need to be carefully log-rolled to his side while manually stabilising the neck and spine. A cervical collar may be necessary with and movements performed using a spinal board if suspected cases of spinal injury. Splinting may be required to immobilise the fractures in extremities. A full comprehensive history (with or without collateral support) including past medical history, social history and previous functional ability should be obtained. Investigations such as radiographs or computer tomography scans further define the nature and severity of the injury and help guide the treatment plan.

Pain Relief

Fractures can be very painful and may contribute to worse outcomes. Older people are often reluctant to acknowledge and report pain. Those with cognitive impairment or dementia may not be able to communicate pain effectively. Therefore, nurses should be vigilant to identify signs of the possibility of pain and observe for behavioural and autonomic manifestations of pain. Interventions for pain relief include the following:

- Frequent accurate pain assessment: Acute pain should be continuously assessed at the time of presentation, within 30 minutes of administration of initial analgesia, hourly until the patient has settled in the ward and then regularly thereafter as part of routine nursing observations. This is done throughout the care pathway so that effective pain management can be implemented.
- Administration of prescribed medication to help relieve pain. Pain relief medications can be administered in the form of tablets, liquid preparations or injections. The nurse must be aware of the desired effect and side effects of the medication.
- Use non-pharmacological techniques. e.g. cognitive-behavioural strategies, breathing exercises, relaxation therapy, humour, music therapy and distraction.
- Encouragement of communication of patient's pain experience.
- Avoidance of activities that cause pain and encourage adequate rest for several weeks.
- Application of ice packs to the injured area.

Maintain asepsis and prevent infection to the fracture site

Wound care and prevention of infections are paramount nursing outcomes in the management of fractures. Some fractures need surgical correction to heal properly (e.g. internal fixations). The following are nursing interventions:

- Initiation of wound irrigation and debridement as soon as possible.
- Careful assessment for signs and symptoms of infection (redness, swelling, discharges and complain of pain).
- Administration of nonsteroidal anti-inflammatory medicines and elevation of the affected body part (usually the extremities) to reduce swelling.

Management of casts, internal and external fixation devices

Immobilisation of the affected body part can be carried out using casts made of plaster of Paris, synthetic materials or a cast brace. Synthetic casts are a good selection for older adults where early mobilisation is necessary. However, it may not be a good choice for new fractures as the synthetic casts do not allow space for swelling. Nursing interventions include the following:

- Elevation of the limb with cast to prevent oedema and support venous return.
- Avoiding resting the cast on a hard or sharp surface to prevent denting as this may cause pressure on the underlying skin.
- Usage of immobilisers, arm slings, bandages and adhesive strapping alongside the fixation devices to support the elevation if the fracture is in the upper limb.
- If traction is employed, nurses must ensure traction and counter traction are maintained in each shift and the weights are hung freely off the floor.
- Look for signs and symptoms of infection or formation of a pressure ulcer (e.g. burning pain, offensive odour and cast discolouration). Skeletal pin sites should be checked regularly for signs of infection and cleaned daily.
- Monitor circulation and nerve conduction regularly to ensure that they are not impaired.

Prevent pressure sores

Hip fractures are the commonest fractures in elderly and surgery is the preferred treatment for hip fracture as it provides stable fixation, facilitates full weight-bearing and decreases the risk of complications. However, surgery carries additional risks of immobility, thromboembolism, pressure sores and loss of independence. Long term immobility increases the risk of developing pressure sores. Any pain must be well controlled to facilitate due movement.

- The patient should be assessed for early signs and symptoms (e.g. erythema, pain in pressure areas).
- The patient must be encouraged to move their position in bed frequently.
- Pressure-relieving devices including air mattresses should be employed if patients cannot move or turn at all.
- Repositioning those who cannot move themselves regularly with supportive pillows.
- Support with physical activity to improve range of motion, mobility and strength.

Early mobilisation of the patient has proven to be beneficial in the prevention of the complications of mobility and in assisting recovery. However, turning a patient with a hip fracture onto the affected side should be avoided until it has been surgically fixed. Changing the patient's position should always be performed by two experienced nurses using good manual handling practice.

Manage other possible complications

Poor hydration, nutrition and constipation are common problems encountered in patients following fractures. It is necessary to encourage optimal fluid intake (with close monitoring of fluid balance) and adequate dietary intake.

Whilst addressing difficulties in accessing toilet facilities, prevention of constipation should be considered early in the care pathway. Nursing interventions should involve:

- Regular assessment of bowel function including frequency and consistency of defecation
- Provision and encouragement of a fibre-rich but palatable diet
- Increased fluid intake
- Assistance with a urinal, a bedpan, commode chair or improved access of toilets
- Rational use of laxatives

Deep vein thrombosis and pulmonary embolism are important complications that are needed to be considered. Patient risk assessment, usage of thromboembolic deterrent stocking (TEDS), inflatable cuffs around calves and prophylactic use of anticoagulants are key interventions.

Foot drop and muscle wasting (sarcopaenia) are sequalae in long term immobilisation. It is crucial to instruct exercises to maintain the health of the unaffected muscles and to increase the strength of muscles needed for transferring and for using assistive devices. This will further maximise mobility and preserve the optimal function of the affected extremity. A thorough knowledge and good understanding of the potential complications associated with fractures, surgery and the immobilisation devices used help the nurses to detect potential complications swiftly and dealt with accordingly.

Planning Discharge and Home Care

Patients may require home-based care until they gain full functionality upon discharge from the hospital. A holistic approach that incorporates both medical and psycho-social factors is necessary when planning home-based care so that patients and family caregivers can be motivated to rehabilitate. Affected older adults and their family members must be given home care instructions which include the following information:

- Approaches to reduce swelling and pain (e.g. elevating the extremity and taking analgesics as prescribed)
- Usage of immobilisation devices and care of the wound or incision if the patient underwent surgery
- Care of the cast if the patient is discharged with one
- Dietary modifications that promotes bone and wound healing
- Instructions regarding avoiding excessive use of injured extremity and weight-bearing limits
- It is also important to follow-up and reviews any underlying medical conditions (e.g. osteoporosis, dementia, Parkinson disease) that may cause falls and further fractures.

Some patients may have to live the rest of their life with assistance. In this case, the family members need to be educated regarding the use of mobility aids, modifying their home environment to promote the safety of the older adult.

Vigilant nursing assessment, early identification of risk factors and prompt interventions may prevent developing aforementioned complications and improve the quality of lives of the affected people. The underlying principle of high-quality nursing care is empathy, a therapeutic relationship involving the ability to understand the needs, meanings, fears, priorities and perspectives of affected older adults and their family members.

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10. Physiotherapy Services for Rehabilitation following Fractures in Older Adults

Mr. Iranga N. Aluthge

Physiotherapists working with older people for fracture rehabilitation can present with a set of challenges unparallel in various clinical conditions. Fracture rehabilitation in older people is not only of medical concerns but also has implications and linkages with the patients' social and psychological domains. Fractures may be associated with neurological, musculoskeletal and other systemic involvement apart from the primary focus. A patient therefore requires a physiotherapist who will approach, provide and ensure a holistic patient care in a patient centred approach.

The effects of biological ageing reduce the efficiency of the body systems. Optimum functions should be facilitated in each individual by strengthening the use of these systems to their maximum capacity so to enhance mobility and functional independence. When neither improvement or maintenance of functional mobility is a reasonable or feasible goal, the physiotherapist needs to assist patients remain comfortable and pain free.

Rehabilitation management of fractures can be addressed as management during immobilisation and after removal of fixation. The physiotherapist must be careful to avoid any factor that may impede the repair process or lead to non-union. Furthermore, he must be aware of the common complications and alert the medical team of any untoward signs and symptoms.

PHYSIOTHERAPY DURING IMMOBILISATION

The aim of physiotherapy during immobilisation of fractures in older people are recognized as

1. Reduction of oedema. This should be done as soon as possible to prevention of formation of adhesions and to decrease pain and spasm.
2. Facilitation of blood circulation

3. Maintain muscular functions by active or static muscle activity
4. Maintain possible maximum joint range
5. Gain much function as permitted by the particular fracture
6. Teach patients how to use and take care of special applications (e.g. crutches, walking sticks, frames)

Assessment of a patient is essential to formulate a plan. Patients should be taught to do his/her own exercise with close supervision independently as circumstances allow. It is important to motivate the patient in regards to commitment for physiotherapy by appreciation and encouragement while instruction and therapy is provided.

Generally, swelling is prevented or reduced by elevation of the limb and by active or static contractions of the concerned muscles which will minimize the formation of adhesions and stiffness. Muscles that do not produce movement of a joint due to the fixation or immobilisation and do not work statically will atrophy rapidly. Isometric and isotonic contractions can prevent excessive wasting. Encouragement of possible functional activity also help to limit the rehabilitation duration after the fixation is removed.

PHYSIOTHERAPY AFTER REMOVAL OF FIXATION

An assessment should be done after fixation has been removed. An individualised plan needs to be formulated with consideration of the following objectives.

1. Reduction of swelling – This aspect of management will be facilitated if exercises and general activities of daily living have been carried out during the period of immobilisation. A fracture involving the lower limb results in muscles to get weaker and loose joint range. These factors prevent the muscle pump action of venous return and contribute to oedema formation

2. Regaining full range of movement – The physiotherapist needs to initially identify the reason or reasons for loss of range of motion. These include severe pain, oedema, adhesions, weak musculature or disruption of joint surfaces.

3. Regaining maximum muscle power – Improvement of muscular power depends on gaining maximum muscular activity and acquiring all actions as prime movers, antagonists, fixator and associated movements with other muscles.

4. Re-education full function. – In most cases, the full function can be achieved. However, if it seems to be unrealistic, the focus should shift towards the optimum possible function of the older patient. Formulation of a plan also aims towards the needs of the patient in relation to home, work and leisure. Consideration of returning patients to work entails knowledge of working hours, type of work and use of various muscles and joints.

SOME PRINCIPLES OF MANAGEMENT OF COMMONLY ENCOUNTERED FRACTURE

Fractures of the skull and spine should be managed with neurosurgical and orthopaedic direction along with physiotherapeutic rehabilitation guidelines. Immobilisation procedure of these fractures vary.

Scapular fractures are not very common and usually occur as a direct trauma. Clavicular fractures often occur following a fall on to the side or as a result of an outstretched hand. These are usually immobilised by a brace, a sling, or a collar and cuff. Complications include restricted movements in shoulder joint and girdle with associated muscle weakness.

Fractures of the proximal humerus may be classified using the Neer classification.

Group 1 - minimal displacement
Group 2 - fracture at the anatomical neck with less than 1cm displacement
Group 3 - displaced or angulated surgical neck
Group 4 - displaced fracture of greater tuberosity
Group 5 - fracture of the lesser tuberosity
Group 6 - fracture dislocation.

Fracture of the surgical neck of the of the humerus usually occur in elderly people as a result of a fall on the outstretched hand. Displaced fractures and particularly those occurring in the elderly, are not usually reduced for numerous reasons. These include lack of good alignment that does not affect union and preference for non-operative mode in elderly unless essential. Early mobilisation is important to avoid a stiff shoulder. In fractures of the shaft of the humerus, the radial nerve may be affected as it winds through the radial groove. A wrist drop may result and physiotherapeutic intervention maybe needed. Wrist drop splint application, exercises for mobilization of joints and strengthening the muscles, stretching of the muscles and electrical stimulation may be required in the rehabilitation procedure. Fractures of the greater tuberosity and of the surgical neck of the humerus can be complicated with a stiff shoulder. These which requires a prolonged period of physiotherapy and rehabilitation can have persistent impairment despite intervention. Fractures of the condyles of the humerus are common following a fall: the supracondylar type is the commonest. The therapists' further goals are to maintain the muscle strength, mobilize the unaffected associated joints and improve the coordination. A serious complication of damage to the brachial artery needs to be considered and monitoring of distal circulation must be done.

Fractures of the radius, ulna or both may be manifested due to direct or indirect injury such as a fall on the outstretched hand. Colles fractures particularly in elderly may be complicated with stiffness of hand, elbow and radio ulnar joints, wasting of the hand and elbow muscles and even shoulder immobility. Physiotherapy intervention for these are specific to the underlying cause and include pain relief, mobilization of joints and muscles, strengthening of muscles and improve the dexterity of the hand by doing coordination exercises.

Fractures of the phalanges, metacarpal bones or carpal bones can result in deformity and stiffness of joints. It is essential to reduce the swelling as quickly as possible to prevent the formation of adhesions. As it is very disabling careful management is planned to produce the optimum results. In fractures of the hand and fingers, mobility of unaffected joints must be allowed to maintain the range of movements, while

considering soft tissue involvement. Intensive physiotherapy treatment is needed as per requirement of the patient after removal of fixation.

In lower limb and pelvic fractures, preparation of the patient for ambulation can be done with non-weight bearing, partial weight bearing and the full weight bearing techniques according to the requirement. The patients weight bearing status is dependent on many factors including type of fracture, quality of bone, age of the patient and the orthopaedic management undertaken.

Fracture of the neck of femur is the commonest and most significant type in terms of morbidity, mortality and socioeconomic impact. Avascular necrosis of the head of femur is a grave consequence. Physiotherapy management may vary according to the type of fracture and orthopaedic management undertaken. Generally, improvement of associated joint mobility with pain relief intervention, improvement of muscle strength (especially quadriceps femoris and hamstrings, improvement of knee and hip flexion movements and strengthening the rotators of the hip are considered. Furthermore, early ambulation is expected with early commencement of physiotherapeutic treatment process. Safe ambulation is carried out with a walking frame as axillary crutches may not be suitable with the instability of older people. Transition to a stick can be done later with improvement of strength and mobility. Ankle and foot fractures are managed according to the orthopaedic interventions used.

Spinal fractures may be complicated with damages to the spinal cord, cauda equina, spinal nerves and with intervertebral disc involvements. Physiotherapy management involve specific care about the acute management, care and training of the bladder and rehabilitation. Most of patients with complete transaction of the cord can be made reasonably independent and enabled to lead a useful life within the limits of their tragic disability despite severe permanent paralysis. A proportion would be able to walk short distances with callipers and crutches and for most part they will require permanent mobility in wheel chairs.

USAGE AND THE PURPOSE OF WALKING EQUIPMENT IN ELDERLY

A patient may be considered upon the use of a walking aid if there is a feeling of insecurity in walking, experience of weakness or pain after a fracture or surgical procedure or as a part of rehabilitative programme0

If the stairs are there in a house and use a walking aid, obtain a second one and keep one upstairs and one downstairs. Do not attempting to take a walking frame up and downstairs.

While standing from a chair, do not attempt to use a walking frame or stick due to the instability. Patient has to push up with your hands on the arms of the chair and only take hold of frame or stick once standing. If necessary, you can practice this with your physiotherapist.

Walking equipment should not be used in wet floor areas and if you want to access through wet room or shower area, needed to fixed the grab rails. Footwear should be well fitted and it is vital to that the walking aid is kept in perfect conditioning.

Annexure 2: Various Walking Aids

Aid	Description	Use	Disadvantages
Walking Stick	Made of wood or aluminium. Correct length is important for functional gait pattern. Can be used single or in pairs. Fisher grip (moulded hand grip) may improve function	Widens base of support. Support up to 25% body weight Use on same side to improve balance. Use on opposite side for weakness, painful or unstable joint	Need to be propped up/ held flat. Can be a trip hazard. Check ferrules for wear.
Tripod/ Quadrapod	Aluminium with base	Provides more support than a stick. Stands on its' own. Wider the base, wide the support. Use on opposite side for hemiplegia	Can be large and ungainly.
Elbow Crutches	Aluminium crutches with forearm support	Can support up to 80% body weight. Useful for non-weight bearing e.g. amputation or fracture Weight should be taken through the hands via hand pads Standing/ lying position – ulnar styloid to 15 cm lateral to foot	Risk of tripping. Needs cognitive power to use
Axillary Crutches	Weight bearing under the arm	For those who can bear weight on one leg Top pad pressed against lateral wall of chest 5 cm under the arm pit 15 cm lateral to foot	Brachial nerve palsy is a possibility
	Use of crutches If partial weight bearing – Weak leg placed forward with crutches by one step followed by normal leg If non weight bearing – Both crutches put forward first followed by a hop of unaffected leg stopping behind the crutches and keeping affected leg clear of ground		

Zimmer Frame	Aluminium tubing with four rubber feet	Maximum support to patient. Reduced weight bearing	Patient has to learn new gait pattern of lifting the frame and moving forward with steps. Difficult on a carpet. Encourages poor posture
Rollator	As above but with two front wheels	Patient can push frame continuously. Useful for parkinsonism Aid of choice for those with tendency to lean forward.	Poor posture. Slow gait. Difficulty in using outdoors
Gutter Frame	Support for forearm present	Useful for those with hand pathologies	As above
Delta Frame	Usually a three wheeled foldaway, often with a seat or receptacle.	More robust and can be used outdoors. Feel should be in line with back wheels when walking. Manoeuvrable with brakes.	Heavy. Must be fully opened and locked. Less stable than frames. Good hand strength too

Wooden stick

Folding stick

Crook handle stick

Tripod and Quadripod

Elbow crutch

Non-wheeled standard pulpit frame (Zimmer)

Folding pulpit frame

High Forearm Walker

Reciprocal Frame

Wheeled pulpit frame

Three-wheeler/ Four-wheeler rotators

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11. Orthotic Services for Fracture Rehabilitation

Mr. K. L. Jeewantha

A fracture orthosis (FO) is an external supportive appliance fitted to the body to protect and support fractured bone. Its' goal is to stabilise the fracture site and allow early mobilization, whereby enhancing the healing process. It may be prescribed after surgery or as a transitional application after removal of the plaster cast.

A FO provides fracture alignment stability but does not cause rigid immobilisation of the bone ends. It is appropriate for selected number of fractures with minimal displacement, shortening, or angulations. Orthosis is not appropriate immediately after the injury of open or grossly displaced fractures. Most often orthoses are used in fractures of the humerus, distal radius, ulna, metacarpal, femur, fibula, tibia, metatarsal and vertebral fractures.

The use of a fracture orthosis will be determined in conjunction with the multidisciplinary team. A careful assessment of the client and analysis of radiological investigations will be used to determine the most appropriate personalised treatment plan. It is important that the orthotist is involved in the selection of the type and design of fracture orthosis. FO is a specialised area of fracture management and may be used in conjunction with other treatment procedures.

PRINCIPLES OF FRACTURE ORTHOSIS IN THE HEALING PROCESS

A key feature of a functional FO is provision of firm circumferential stabilisation of the surrounding muscle and the soft tissues of the fractured long bone. As muscles contract within the rigid cylinder, an increase in size is translated into compressive forces within the cylinder. This internal force limits the motion around the fracture site and stabilises the fractured bone ends to return to the initial position and preventing the progression of the deformity.

The functional FO is an adjustable device allowing it to be applied firmly as swelling subsides and be removable when necessary. It is usually close fit and allows better movement of a joint that do not require

immobilisation. Orthosis provides alignment stability but not rigid immobilisation of the fracture site. This encourages functional activity to the entire limb. The Lower limb FO is encouraging partially weight-bearing and increase muscle activity during mobility. Active contraction of the muscle around the fracture site allows controlled micro-movement to take place and increased blood flow and mineral deposition to the fracture site. These factors appear to stimulate osteogenesis, providing a desirable environment to encourage healing. The period of immobilisation may vary with severity and location of fracture site and initiation of weight-bearing and functions.

TYPES OF FRACTURE ORTHOSES

Fracture Orthoses are indicated for all different types of fractures and can be ordered as prefabricated or custom fabricated. There are two common types of fracture orthoses.

1. Non-removable Orthosis

Once applied, the orthosis can only be removed by a trained person with appropriate equipment such as cast cutter or plaster scissors. These include plaster of Paris bandages and synthetic cast tapes. A non-removable fracture orthosis needs to be reviewed on a regular basis, as they are not adjustable for volume fluctuations.

Fig.1 Synthetic tape cast orthosis

2. Removable Orthosis

These orthoses are designed to protect and prevent deformity from non-displaced fractures and are applied with mechanisms for removal and adjustment for personal hygiene and wound care. Removable fracture orthoses enable volume adjustment as inflammation and swelling subside. However, they are potentially dangerous if removed without assessment or donning inappropriately.

Fig.2 Removable custom-made FO

INDICATIONS AND CONTRAINDICATIONS

Fracture with minimal displacement, shortening or angulations require FO and they can be treated as secondary immobilisation. Young children, and non-compliant or uncooperative patients who are poor candidates for extensive treatment of fracture rehabilitation should not be considered for application of a FO. FOs are contraindicated in the following

- Unacceptable reduction or position
- Hypersensitivity for materials used in orthosis
- Underlying skin sepsis
- Altered sensation - inability to sense force application

FRACTURE ORTHOTIC APPLICATION FOR THE LOWER LIMB

Ankle

Application of FO for ankle fractures is limited. They are used occasionally as a secondary immobilisation method to maintain alignment of a fracture, which has been reduced by other means. The

dynamics of the ankle is complex and is subjected to bear weight. Therefore, prolonged periods of immobilisation or rigid stabilisation is usually required.

Tibia and Fibula

A FO is applied as a secondary immobilisation after initial healing has occurred in the tibia and fibula. A below-knee fracture brace is usually appropriate for those distal to the proximal third of the tibia. If it is more proximal and indicate an above knee fracture, an orthosis with external knee joints is required. Fracture bracing may be indicated in the following instances:

- Closed, non-comminute mid-shaft (middle third) fractures of tibia and fibula.
- Compound fractures after the wound has healed.
- Fractures in which the intact fibula. Care must be taken to prevent varus angulation.

Fig.3 Tibial FO

Knee Joint

A FO is applied as either primary or secondary immobilisation after joint congruency has been restored. It acts to maintain the alignment of the femur over the tibia. It may be necessary to restrict knee range of motion initially, and extend the range of motion as healing progresses.

Femur

A FO for femur fracture is applied as secondary immobilisation after initial healing has occurred. Fracture bracing may be indicated in

- Closed fracture of the middle or distal third of the femur
- Compound fractures after the wound has healed
- Fractures involving the proximal third of the femur

If the hip joint is affected, a pelvic band is added to the standard FO.

Hip

This is usually achieved by other means rather than by an orthosis (i.e. Surgery). Fractures of the hip including acetabular fractures and fractures of the pubic symphysis can be treated with external fixation or conservatively with pelvic belts and corsets.

FRACTURE ORTHOTIC APPLICATION FOR THE UPPER LIMB

Wrist/hand

Immobilisation of fractures and dislocations of the wrist and hand may be achieved through FO as a secondary measure. Primary treatment will usually be performed with plaster of Paris cast or by open reduction and internal fixation in cases of severe or multiple fractures.

Radius and Ulna

Primary management usually consists of application of plaster of Paris during clinical healing. A forearm FO may be applied for delayed union.

Elbow

Elbow Orthoses are indicated for the elbow fractures, distal humeral fractures, and proximal ulna fractures. The primary management of fractures at the elbow is usually achieved with the application of a plaster of Paris cast. A Functional FO may be used after clinical healing where further protection is required or after internal fixation. Elbow orthoses immobilise at a fixed 90-degree angle.

Humerus

These are commonly treated with a functional FO. More commonly internal fixation is used. Circumferential stabilising orthoses (fracture brace) are used to stabilise and promote healing of fractures of long bones when joint immobilisation is neither required nor beneficial. Humeral FO should be used in conjunction with a sling. Correct positioning and immobilisation is important especially for mid-shaft fractures where impingement of the radial nerve is possible. Plaster of Paris casts are highly unsuccessful in the management of the fractured humerus unless they are adequately suspended.

Fig.4 Proximal Humerus FO

Scapula and clavicle

Alignment of the fragment ends of a clavicle can be achieved using a 'Figure of Eight' harness applied over both shoulders. The alternative management is bed rest with the shoulders in an extended position.

FRACTURE ORTHOTIC APPLICATION FOR THE SPINE

A spinal fracture occurs due to the distraction, axial rotational, translation or a combination of these forces. An unstable spine is usually treated primarily surgically followed by application of an orthosis. The design of orthosis depends on individual requirement of correct positioning and force application for malalignment. Spinal orthosis can be applied at any level of the spine. Common orthosis types for spinal fracture:

- CO - Cervical Orthosis
- CTO - Cervico Thoracic Orthosis
- TLSO - Thoraco Lumbo Sacral Orthosis
- LSO - Lumbo Sacral Orthosis

Cervico Thoracic spine

COs (e.g. cervical collars) often fitted pre-hospital by the emergency staff immobilise cervical spine during transferring. Orthosis prescribed will depend on the surgery that has been performed and considered stable fractures. The fusion of a single level fracture may be managed with collars. There are two types of cervical Orthosis:

- Soft Cervical Collars - Provides comfort and proprioception with minimal immobilisation. It acts as a reminder.
- Rigid Cervical Collars - Provides moderate immobilisation to the mid-cervical spine. Most rigid cervical orthosis are made as bi-valve plastic shells with removable pads. The Philadelphia collar is the most common orthosis use for cervical injuries.

Fig.5 Philadelphia collar type COs

CTOs are composed of support to chin and base of skull, and are attached with a thoracic vest. They provide more control compared to the COs and supports middle & lower cervical to upper thoracic spine. They may be prescribed as a recovery aids after cervical spine surgery (e.g. sterno occipito mandibular immobiliser (SOMI) and Minerva CTOs).

Fig.6 Sterno Occipito Mandibular Immobiliser (SOMI)

Halo thoracic orthosis (HTO) is a type of CTO which provide most rigid immobilisation to the cervical spine. They are effective in managing unstable fractures of the cervical spine.

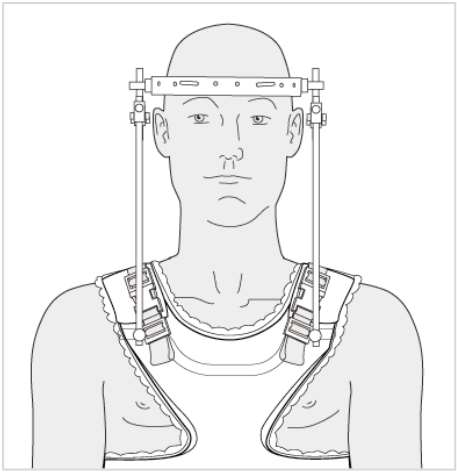

Fig .7 Halo Thoracic Orthosis

Thoraco Lumber spine

TLSO provides support and limit movement of lower thoracic and upper lumbar spine. Stable type of thoraco lumbar spinal fractures include vertebral body compression fracture, transverse process fracture, isolated pars defects and spinous fractures. The orthotic management of stable thoraco lumber fracture is to limit gross movement only in one plane. Vertebral body compression fracture is caused by sudden vertical hyperflexion. Jewett hyperextension orthosis provide limitation of the flexion and reduces stress on affected vertebral body by holding in extension position. Fractures of spinous processes and transverse processes are caused by sudden hyperextension forces by sudden wrenching motions. The aim by orthosis is to limit the hyperextension of the thoracolumbar spine with the Chairback or Taylor Orthosis.

Fig.8 Jewett hyperextention Orthosis

Fig.9 Chairback Orthosis

Fig.10 Taylor Orthosis

Unstable thoraco lumbar fractures caused by severe hyper flexion or hyperextension with rotation are almost treated with surgical interventions. Orthotic management for this type of fractures are needed in order to eliminate of movement in all planes. The orthotic aim is to improve and stabilise in all three planes and increase intra-abdominal pressure to reduce the flexibility of the spine by total contact TLSO.

Fig. 11 Total contact TLSO

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12. Case Scenarios in Fracture Management

Dr. Chandana Kanakaratne

A few common scenarios encountered in day to day clinical practice are mentioned below with a common approach that should be attempted to offer to all patients.

CASE SCENARIO 1:

Patient 1- Mrs A, an 83-year-old lady living with her family was found on the floor close to the toilet. When she was found, the daughter tried to help her to her feet but she couldn't get up due to severe pain in left hip region. She was transferred by three people to her bed. Mrs A was given some paracetamol and ibuprofen but the pain continued without much improvement. As she continues to remain bed bound, the following day her family decided to take her to hospital for further assessment and care. At the hospital she was found to have a fracture neck of femur on the left side. Following an orthopaedic assessment, she was referred to the medical team as she was found to have hypertension and uncontrolled diabetes for which she was two antihypertensive agents and two oral hypoglycaemic agents. Mrs. A was operated on the 3rd day of admission when the blood sugar was controlled. On postoperative day 1, she stopped eating and drinking properly and remained withdrawn during the day while becoming restless at night. She developed retention of urine needing catheterisation and was treated for possible UTI. She refused sessions with the physiotherapist initially. After a few days she started to improve with eating and drinking and engaged more with the rehabilitation process. She was partial on weight bearing. One week after the surgery Mrs A was considered for discharge with some physiotherapy input at home as arranged by the family and follow up with the orthopaedic surgeon was planned in 2 weeks.

CASE SCENARIO 2:

Patient 2 – Mr P, an 88-year-old previously independent and cognitively intact gentleman, living alone had a fall in the garden while watering

the plants in the back yard. He was lying there for many hours finally to be discovered by his son. He sustained a hip fracture and a pelvic fracture so that he could not get up from that position. His son found he was very restless and agitated and that he also became confused from time to time. He was brought to the hospital. Mr. P had also developed acute kidney injury due to long lie and dehydration.

CASE SCENARIO 3:

Patient 3 – Mrs. T, a 90-year-old bed bound very frail elderly lady with dementia fell off the bed and sustained fractures of ribs, right femur neck, and the left arm. She was confused on admission to hospital. Carers thought that her confusion was not any worse than usual.

1. WHAT MANAGEMENT STRATEGY SHOULD BE ADOPTED FOR THE ABOVE PATIENTS?

Managing someone with a fracture is usually multi-disciplinary involving surgeons, physician/geriatrician, emergency department staff, anaesthetists, therapists, nurses and many others, as needed.

2. WHAT KIND OF AN INITIAL ASSESSMENT WOULD HELP?

a) When and how did the fracture occur?

History about where it happened, what the patient was doing at the time and whether it was associated with a fall are important

b) Was it associated with a fall? Circumstances of the fall? Any loss of consciousness?

Most people fall in their normal living environment carrying out normal house-hold chores. Mechanical causes such as carpets, furniture, cords of electric appliances lying on the floor can easily cause falls. In addition, many organic causes such as co-morbid illnesses (acute or chronic) including medical, psychological and functional issues can lead to falls. (Please refer to the Stability and Mobility publication, 2019, of SLAGM)

c) What are the effects of fracture?

Pain, bleeding, immobility, incontinence, difficulties with activities of daily living, possible delirium. Patient 2 had features of delirium. Patient 3 possibly not had delirium.

d) What are the other associated issues?

Other fractures, head injury, other organ injury or dysfunction as a result of the same impact.

e) Was it a Fragility fracture?

A Fragility fractures result from mechanical forces that would not in ordinary circumstances result in a fracture in a young healthy adult (e.g. low-level trauma forces equivalent to a fall from standing height or less). Such fractures may indicate a higher risk of future fractures.

f) Is there any history of previous fractures?

If so, how did they happen? Was bone prophylaxis considered in the past?

g) Are there any co-morbid issues or non-communicable diseases?

It is important to determine the impact of previous co-morbid issues on the causation of falls and fractures. They may also affect the success and the outcome of a surgery. Therefore, the current status needs to be assessed to optimise peri-operatively to reduce complications.

h) What are the medication taken by the patient?

This will also have an impact on the causation of falls. Some drugs such as anti-hypertensives, antipsychotics, anti-epileptics, diuretics are more directly related than others for a higher falls risk. Some drugs such as steroids increase risk of fractures. Anticoagulants and anti-platelets would lead to increase bleeding with fractures and also during surgery. A collaborative approach with the medical team prescribing them along with a haematologist would allow adjustments of such treatment to enable surgery.

i) What investigations are performed at this stage?

- Radiological imaging of fracture site
- Full blood count, renal functions, serum calcium, vitamin D assay (in selected) prothrombin time (PT)/ INR, ECG, urine full report.
- Optional: Chest x-ray, Echocardiography

j) What are the drugs that are needed to be started?

- Analgesics using the pain ladder.
- Prophylaxis for pulmonary embolism/deep vein thrombosis with hip surgeries. Low molecular weight heparin (starting > 12 h preoperatively or > 12 h postoperatively) for a minimum of 10-14 days and up to 35 days
- Optimising glycaemic control: may need insulin
- Stopping antiplatelet agents after reviewing risks and benefits
- Antibiotics pre and post operatively - at the discretion of the surgeon.
- Patient's regular medications with adjustments if needed.

k) What was the level of premorbid functioning?

This is important to understand the prognosis and the goals for rehabilitation.

3. WHO IS A GOOD CANDIDATE FOR SURGERY?

Every patient who sustained a hip fracture should be considered for surgery unless proven otherwise. Complications of the fracture such as pain and immobility and other functional limitations are good indications for surgery as without it, severe pain will continue for a long time. Furthermore, the patient may remain bed bound with all the added risks such as orthostatic pneumonia, urine infections, constipation, pressure sores, thrombotic complications and depression. Some of these could be fatal. The presence of severe frailty is an independent risk factor for post-operative complications with poor outcomes. Frailty is commonly assessed using the 'Frailty The severity of the co-morbidities along with patient wishes also play vital roles in

making a decision. Specific risk assessment tools such as 'cardiac risk index' will help to decide risk associated with a particular surgery.

In exceptional circumstances where the presence of severe comorbid issues and/or severe frailty considerably increase the peri-operative mortality, surgery may be avoided as in patient 3. Patient 1 and 2 are obvious candidates for hip surgery.

4. HOW SOON SHOULD THE HIP SURGERY BE PERFORMED?

It should be done ideally on the day of sustaining the fracture or the day after. It depends on multidisciplinary co-ordination between accident and emergency departments, acute orthopaedic trauma services, geriatricians/ physicians, anaesthetists, and availability of appropriate theatre space. The patient has to be medically optimised pre-operatively which usually can happen in the first 24 hours.

Early surgery is associated with better success with the surgery.

5. HOW IS A PATIENT PREPARED FOR THE SURGERY?

- Correct the level of hydration.
- Improve nutrition.
- If anaemic consider blood transfusions.
- If hypercoagulable – correct the issue to acceptable levels.
- Optimise medical comorbidities such as glycaemic control and blood pressure.
- Address and improve delirium.
- Arrange intensive care stay for high risk patients in the postoperative phase.
- Some may need other input from other specialists such as cardiologists pre-operatively depending on the severity of the co-morbid illnesses.

6. WHAT ARE THE POSTOPERATIVE COMPLICATIONS?

Post- operative complications are many and they can be categorised as follows

a) Neurological – delirium, stroke
b) Cardiac – acute coronary syndrome, heart failure
c) Pulmonary – chest infection and atelectasis, aspiration
d) Miscellaneous infections – urine tract infections, infection of surgical incision site
e) Bowel and bladder manifestations – incontinence, urinary retention and constipation
f) Thromboembolic manifestations – deep vein thrombosis, pulmonary embolism
g) Psychological - depression, anxiety, frustration

These may not be clinically overt in the elderly and therefore may need proactive survey in each presentation.

Delirium

This is the commonest neurological complication. It can present as hypoactive or hyperactive delirium. In Hypoactive delirium (common and easily missed) the patient is withdrawn and is not agitated: stops eating and drinking and refuses to be engaged with rehabilitation and any active treatment process. Hyperactive delirium (easily noticeable) manifests with patient becoming restless and agitated. Delirium can occur in up to 50% of patients. Delirium increases mortality and leads to worse outcomes. Hence, it needs to be positively looked for and treated.

How can delirium be detected?

1. History: if consciousness, attention, memory, orientation in time, place and person get worse from usual for the patient over a period of days
2. Simple cognition assessment tests done periodically (daily or every few days) from the time of admission. e.g. mini mental score, 6-CIT, clock drawing test
3. Confusion assessment method

N.B. Myocardial infarction can occur during the immediate post-operative period and maximum incidence in the first day after the surgery. Post-operative stroke may occur over period of one month.

7. HOW SHOULD PATIENTS BE MANAGED POSTOPERATIVELY?

Management has to be on many different aspects.

Regular ward rounds with an orthopaedic team and the medical team (preferably with those medical teams with expertise in elderly care: orthogeriatric) are preferable. A joint decision making process with the use of multi-disciplinary teams will improve the success and outcome of the patients.

a) Pain control – Take a pain history. Treat using multimodal individualised pain control using pain ladder starting with simple analgesics. Caution: pain, unless treated well, could lead to delirium.

b) Optimising the pre-morbid medical issues.

c) Prevention, detection and treatment of complications proactively.

d) Correct hydration and nutrition - with pain, delirium, constipation, reduced mobility patient may not eat and drink well. Meticulous attention to hydration, oral or intravenous, is essential.

e) Correct anaemia

f) Correct of bowel and bladder functions

g) Falls risk assessment and interventions: See section 8 below.

h) Fracture risk assessment and appropriate interventions to minimise the risk. See sections 9 and 10 below.

i) Consider bone density assessment and bone prophylaxis: Bone density measurement can be offered to all but especially those under the age of 75. In some centres those over the age of 75 with a fragility fracture will be treated even without bone densitometry measurements.

j) Consider rehabilitation and offer an appropriate programme – see sections 11 -13 below.

k) Advanced care planning: This is helpful with all, especially, frail elderly and those with multiple medial comorbidities and functional

deficits. Advance care planning will ensure a safe discharge and safe care with continued medical support through to the full recovery.

l) Follow up: By orthopaedic surgeon, geriatrician/ physician with regards to medial and rehabilitation issues, rehabilitation team till achieving the goals.

8. CAN PATIENTS FALL AGAIN? WHAT CAN BE DONE ABOUT IT?

Falls risk assessment needs a reasonable attention for those who sustain fractures. If a patient continues to fall, in future, the likelihood for further injuries including fractures is considerable. Therefore, fracture risk assessment should essentially commence while patient is in hospital. Further assessment should continue with the subsequent follow up as patients may have not fully regained medical and functional recovery. This is a multi-disciplinary process involving doctors and therapists. There may be multiple causes (medical, psychological, functional and external) which can lead to falls even in the same patient. These factors need to be identified and corrected. More details are available in Stability and Mobility booklet by SLAGM, 2019.

9. HOW IS FUTURE FRACTURE RISK ASSESSED?

Fracture risk assessment tools such as FRAX, QFRACTUE are available online and can be employed. Bone-densitometry measurements (DXA scans) is also another index that will help to determine the likelihood of future fractures.

10. HOW CAN FUTURE FRACTURE RISK BE MINIMISED?

- Optimise the patient medically, psychologically, cognitively and functionally.
- Minimise the number of medications after careful consideration to benefits of them. Check the calcium and vitamin D levels in blood and correct the deficiencies and then maintain the optimum levels long term.
- Treat osteoporosis promptly.
- Ensure safe and adequate mobility and exercises.
- Continue with multi-disciplinary follow ups.

11. WHO IS A CANDIDATE FOR REHABILITATION?

Everyone should be considered for rehabilitation. It starts in the hospital and continues in to the community.

12. HOW IS A REHABILITATION PROGRAMME ESTABLISHED?

Rehabilitation is again a multi-disciplinary process which includes, at least the orthopaedic and medical teams, therapists, nurses and family and carers. There are others that may need to join depending on the necessity e.g. Mental health team, social worker etc. Rehabilitation should start on the first or second day post-operatively.

Orthopaedic surgeon will advise on the weight bearing status. Based on that and the status of medical issues, the rehabilitation team headed by the geriatrician/physician lays down an appropriate programme of rehabilitation with a view to achieving the pre-morbid level of function and independence as much as possible. The contribution by family/ carers is important. Training families and the carers with necessary skills to continue with the rehabilitation at home is also vital as rehabilitation is a daily routine with periodic adjustments by the team with the progress of the patient regularly.

13. WHAT KIND OF REHABILITATION CAN BE OFFERED?

With severe impairment of medical and functions, rehabilitation can happen in hospital set up with regular physiotherapy and occupational therapy input for a longer period. Ideally such patients can be transferred to rehabilitation wads, if available, for this purpose. In Sri Lanka, such a setup is still not possible. These the areas clinicians need to develop in time to come to accommodate anyone needing rehabilitation. Smaller peripheral hospitals could be utilised for this purpose. Such centres can be developed away from main acute hospital environment. Patients who recover fast can be discharged home with the provision of therapy services at home. This is also a service that needs to developed in time to come. Hence, the clinician has to adapt to the available resources at present. The ideal method is to train carers and families to do the therapy at home with periodic visits from

therapists. Follow up with medical and orthopaedic teams would also help.

14. WHEN AND HOW CAN A PATIENT BE DISCHARGED FROM HOSPITAL?

This should be a multi-disciplinary team decision. If the medical team is satisfied with the medical, psychological, and functional optimisation a patient can be discharged to an appropriate location, usually his/ her home, with plans for continued rehabilitation and follow ups.

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