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OSTEOPOROSIS AND ITS PROSTHODOCTIC CONSIDERATIONS- A REVIEW

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ABSTRACT

Osteoporosis is a disease of bone which is common in middle aged post-menopausal women. The osteoporotic bones will become weak and are prone to fractures. Osteoporosis means “porous bone” is a “silent disease”. Healthy bone microscopically appears like a honeycomb but, in osteoporotic patients the spaces are much bigger. The osteoporotic bone will have less density or mass and the structure of bone tissue is abnormal. As the bone becomes less dense, they become weaker and more likely to fracture. Women are four times more likely to develop osteoporosis than men. Oral health maintenance for adults with osteoporosis is important. Bone weakness and loss may also affect the ridges that hold dentures resulting in poor fitting dentures. The patients require new dentures more often than those who have strong, healthy bones. Best way to handle problems is avoid delaying or postponing the dental treatment. Regular dental visits and healthy lifestyle is necessary in strengthening and maintenance of good bone health. Well balanced diet with high amounts of vitamin-D & calcium with regular physical activity is recommended.

INTRODUCTION

Osteoporosis is an insidious and progressive systemic bone disease characterized by low bone mass, micro architectural deterioration of osseous tissue resulting in back pain and stooped posture which leads to an increased risk of fractures. This disease has definite adverse effects on both tooth stability and residual alveolar crest preservation. As the depleted bone is more prone to the injurious impact of mechanical forces residual ridge resorption is more prevalent in these patients. So, the prosthodontic management of a patient with osteoporosis should be aimed at

improving the prognosis by modification of the routine treatment plan with reduction of the forces which causes progressive bone resorption. Both males and females are affected during their life time but, is more prevalent in postmenopausal women. It is evident that half of all post menopausal women will have an osteoporosis related fracture[1].

If consistent features detecting early signs of osteoporosis could be found on dental radiographs, the prosthodontist would be in a position to identify such patients[8] , modify the treatment plan and refer such patients for prompt management[4-6]. Such radiographs have the added advantage of a high requirement need for treatment planning (compared to the rest of the body), and less full body radiation exposure[8].

Definition: Osteoporosis has been defined by WHO in 1994 as "a disease characterized by low bone mass and microarchitectural deterioration of bone tissue leading to enlarged bone fragility and a consequent increase in fracture risk". It's a disorder where the bone mineral density is 2.5 standard deviation below the mean peak value in young adults[2,3].

Classification: Osteoporosis is classified as primary osteoporosis (having unknown cause) and secondary osteoporosis (having traceable etiology). Primary osteoporosis is further classified as Type – I Post-menopausal (between 50-70 years of age) and Type – II Age related (more than 70 years of age affecting both trabecular and cortical bone)[4]. Osteoporosis can also be classified as localized and generalized osteoporosis. The generalized can be primary or secondary osteoporosis[5].

Clinical features: The chief clinical manifestations include vertebral and hip fractures, but can occur at any skeletal site. The clinical manifestations of spinal fractures include loss of height, increased scoliosis or kyphosis, significant back pain and limited range of motion. The dental manifestations includes: the cortex at the mandibular angle gets distinctly thinner and cannot be seen well at the anterior margin of ramus and in the maxilla it is minimal along the alveolar crest[6].

Risk factors: Various risk factors for osteoporosis are grossly categorized into modifiable and non-modifiable factors. Habits like smoking, sedentary life style, intestinal disorders which lead

to inadequate absorption of Ca, P, deficiency of Vitamin-D and renal disorders can be modified to reduce the risk of osteoporosis. Whereas non-modifiable risk factors include age, gender, familial history, menopausal status & ethnicity[7-9].

Dental screening of osteoporosis: Bone density may be assessed by a prosthodontist using linear measurements (morphometric analysis) or by measuring optical density of bone (densitometric analysis), though it is undeniable that qualitative assessment of bone density by simple radiographs is affected by the degree of penetration of the X-rays used (e.g., higher energy X-rays make bone appear less dense). Morphometric analysis includes the Mental Index, which measures the mean width of the inferior cortex below the two mental foramina. Devlin and Horner suggested that such a measurement could be an accurate osteoporotic measure[10].

Densitometric analysis is carried out with the help of an optical densitometer, comparing the light passing through bone with a reference material "step wedge" of known density. Significant differences in densitometrically derived measurements between osteoporotic and non-osteoporotic patients have been noted, though these did not correlate with the mandibular Bone Mineral Density measurements (BMD) by DEXA (Dual Energy X-ray Absorptiometry). Ledgerton et al., stated that bone density measurements of the mandible using Dual Energy X-ray Absorptiometry, could be ideal for screening osteoporosis because of high correlation coefficient, greater sensitivity and specificity. However, Klemetti pointed out that this measurement provided information about the basal rather than alveolar portion of the mandible, therefore the results would be reflective of the impact of muscle attachments rather than that of osteoporosis. Other researchers raised doubts about delineating the effects of osteoporosis from that of local diseases on mandibular BMD measurements[11-13].

Computer Assisted Densitometric Image Analysis (CADIA): It is a practical method to measure the change in bone density of alveolar crest. It is the comparison of two serial images that are acquired with standardized projection geometry and equalized for the density differences in the images, which gives depth of lesion in the buccolingual direction. Thus, it represents the volumetric description of the density change[14].

Oral bone loss assessment: The cortical part of mandible is more dependent on general bone loss than the trabecular portion or the remaining height of the alveolar process. The buccal cortex in the region distal to the mental foramen has been reported to correlate better with skeletal mineral density values than the lingual cortex. Oral signs of osteoporosis might be manifested by excessive alveolar ridge resorption, tooth loss, chronic destructive periodontal disease, referred maxillary sinus pain, or fracture. Resorption of alveolar bone is influenced by the severity of underlying periodontal disease and quality of the denture if the patient is a denture wearer. Dental panoramic radiographs are routinely used in the screening of dental diseases. The incidental findings detected on panoramic radiographs may be used to identify women who have no awareness of their low BMD. A number of mandibular cortical indices, including the mandibular cortical index (MCI) and panoramic mandibular index (PMI), have been developed to assess the quality of mandibular bone mass and to observe signs of resorption on panoramic radiographs for identification of osteopenia[15-18].

Dental considerations in osteoporosis: Some studies have experimentally concluded that in post menopausal women BMD is related to interproximal bone loss and pointed at osteopenia as a possible risk factor for periodontal disease. Women with low BMD & high calculus apposition had greater clinical gingival attachment loss than in women with normal BMD & similar calculus apposition. Serum estroidal supplementation reduces gingival inflammation and attachment loss which is the cause for early loss of teeth in early menopausal osteoporotic women. Taguchi et al., suggested that the loss of posterior teeth may be with a decrease not only in alveolar bone height, but also alveolar BMD[19].

Residual ridge resorption in complete denture patients is a biological phenomenon which results as a decrease in biomechanical loading on bone which reduces the stresses within and on the periosteal surface of the bone leading to resorption. Literature review of last 15 years demonstrates the relationship between Residual Ridge Resorption and BMC. Hirai T et al., indicated that osteoporosis strongly affects reduction of the residual ridge in edentulous patients. Several other studies also concluded a significant mandibular ridge height and local or systemic bone loss[20].

Osteoporosis and Residual Ridge Resorption (RRR): RRR after tooth loss is a well described biological reaction. A decrease in biomechanical loading on bone reduces the stresses within the bone and results in resorption within the bone and its periosteal surface. The single case control study seems to indicate that the BMC status in the jaws is lower in patients with symptomatic osteoporosis than in healthy age and menopausal age-matched females and that osteoporosis may produce a risk factor for severe resorption of the maxillary residual ridge, while this relationship is not clear cut in the mandible. Based upon several studies, it was concluded that-

1. Post-insertion complaints would be greater in osteoporotic patients as a result of increased RRR and lower masticatory function.
2. Osteoporosis should be routinely screened while planning rehabilitation of edentulous patients.
3. Osteoporotic edentulous patients require more frequent post-denture insertion appointments and denture remakes[21].

Osteoporosis and implant supported overdentures: implant treatment with overdentures seems to minimize mandibular bone loss. However, the presence of mandibular osteoporosis may be a risk factor for loss of bone height around the implants. Therefore, an assessment of osteoporosis in the jaws prior to implant treatment is recommended, so that special care of the risk group can be taken concerning the maximal level of oral hygiene and the exclusion of the factors which may lead to loss of bone height. However, this implant treatment can be recommended also in osteoporotic persons with a high chance of good long-term results, provided the right precautions are taken[22].

Prosthodontic management: Humphries et al., conducted a study on bone resorption of mandibular alveolar bone in elderly edentulous adults and they concluded that women above 50 years with osteoporosis required new dentures three times more frequently than women of same age. Reducing the stresses on the bone by modifying the treatment plan with specific precautions is considered in these patients[23-24]. Curtis et al., reported that largest amount of resorption has been shown to occur in the mid lateral aspects of the body of the mandible, while less resorption

occurred anteriorly. It was also reported that the clinical height of the region distal to the mental foramen was more closely correlated with the general bone loss status than the anterior region[25].

While fabricating the removable dentures the main area of focus should be on reduction of the forces on residual ridge. Mucostatic or open mouth impression techniques, selective pressure impression technique, should be employed to reduce mechanical forces while impression making, semi anatomic or non anatomic teeth with narrow buccolingual width should be selected. Optimal use of soft liners, extended tissue intervals by keeping the dentures out of mouth for 10 hours a day can be advised. While fabricating fixed partial denture in periodontally compromised abutments it may accelerate the bone loss in osteoporotic patients. So, the fabrication of FPD should follow treatment of osteoporosis rather than preceding it.

Established systemic osteoporosis does not imply that a jaw bone is unsuitable for osseous integration nor is it an absolute contraindication to implant therapy. Dao et al., and Becker et al., in studying the association between pre-menopausal and post-menopausal women and implant failure, did not find a higher failure rate for implants placed in women older than 50 as compared with women younger than 50 or between women and men older than 50[29,16]. Augat P et al., found more number of maxillary implant failures than mandibular implants in post menopausal women[15]. They found that postmenopausal women not taking hormone replacements had the highest failure rates. They reasoned that because osteoporosis affects trabecular bone more than cortical bone and the maxilla has more trabecular bone content than the mandible, the maxilla is more susceptible to the effects of systemic osteoporosis. During dental implant therapy, it may be wise to be cautious with maxillary implant treatment planning. Reduced bone density does affect the treatment planning surgical approach, length of healing, necessitates need of progressive bone loading and hydroxyapatite coating on implants. Daily calcium uptake should be up to 1500 mg/day pre and post surgically[43,44,45,41].

Clinical Relevance: Osteoporosis is a health condition that greatly affects the bones, weakens them and makes them capable of fracture easily. Besides hampering overall health and well being, osteoporosis also has a direct relationship on oral and dental health. One should realize

that the disease can hamper jawbones. It also triggers dental and oral health issues, including gum or periodontal diseases and loss of teeth.

The dental and oral effects of osteoporosis tend to affect more women than men. It should also be noted that even if someone has no teeth and does not wear dentures, the effects of osteoporosis can still affect dental and oral health. Bone weakness and loss may also affect the body ridges that hold dentures in the proper position, resulting in poor-fitting dentures. Studies also show that sufferers of the disease are at risk of requiring new dentures more often than those who have strong, healthy bones.[26]

Osteoporosis has a major impact on the part of the jawbone supporting the teeth, which is most likely to cause tooth loss or mobility. Low bone density in the jaw triggered by osteoporosis can also lead to other dental issues. For instance, women suffering from osteoporosis are most likely to experience difficulties linked to ill-fitting or loose dentures. The results of various oral and dental surgical procedures are also less than desirable for these women.[14-20]

Osteoporosis has been suggested as a risk factor in dental implant failure, but data supporting such a link are limited[28].

Randomized clinical studies reported implant failure in patients with osteoporosis after menopause. Studies that contraindicate the use of implants in patients with osteoporosis infer that the impaired bone metabolism led to reduction of bone healing around the implants. Other authors believe that the presence of osteoporosis is not a definitive condition to contraindicate the therapy with dental implants. In osteoporotic patients, the dentist should perform a proper treatment planning, modifying the implant geometry, and use larger implant diameter and with surface treatment. Thus, osteoporosis is not a contraindication for implant surgery because an accurate analysis of bone quality by means tomography is performed.[28-31]

The best way to handle this problem is to avoid delaying or postponing dental treatments. Regular dental visits are essential in correcting problems in oral and dental health caused by weak bones. A healthy lifestyle is necessary in strengthening and maintaining good bone health.

CONCLUSION

Osteoporosis has potential prosthodontic implications with associated bone loss, tooth loss and TMJ pathology. Though the question of the most suitable screening option is unresolved, the jaw could be a suitable option because of the frequency of dental radiographs and the presence of decipherable radiographic features of osteoporosis. The Prosthodontist, by identifying these features routinely, would be at an advantage of being in a position to refer the patient for management of the condition and also, modify his treatment plan accordingly[32,33]. The continuous advancement of digital imaging in dentistry has made the development of a dental radiographic module to analyse and diagnose osteoporosis, a plausible prospect[42].

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