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Orthodontic consideration in bone disorders

[1]Mahasweta Dasgupta, Senior Lecturer, KSD Jain Dental college, Department of Orthodontics and Dentofacial Orthopaedics.

[2]Madhuparnee Choudhary, Reader, KSD Jain Dental College, Department of Orthodontics and Dentofacial Orthopaedics.

Corresponding Author: Mahasweta Dasgupta, Senior Lecturer, KSD Jain Dental college, Department of Orthodontics and dentofacial Orthopaedics.

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Abstract

Orthodontics is now no longer a specialiality that only encompass the Pediatric population, but nowadays increasing amount of adult patients are seeking treatment for cosmetic as well as prosthetic reasons. Therefore, it becomes imperative to evaluate the bone as well as systemic disorders that commonly plague the adult population, as well as others that are present since birth. Such cases have been reported in few numbers, and many clinicians may find orthodontic treatment may not be viable. This article presents a systematic review of orthodontic management of such rare and complex bone disorders which may serve as clinical guide.

Keywords: Orthodontics, Metabolic, Physiologic.

Introduction

The physiologic basis of Orthodontics & dentofacial Orthopaedics is the bio mechanical manipulation of bone.

The metabolic status of the patient may influence bio mechanical response to the altered function & applied loads and bone disorders may provide a challenging situation.

Diagnosis and management of patient suffering from bone disorders which may affect facial form and aesthetics is a intricate task, but proper multidisciplinary approach can provide proper satisfactory final results.[1]

Bone disorders can be categorized as: -

Non-neoplastic diseases of bone

a. Fibrous dysplasia
b. Paget disease of bone
c. Cherubism
d. Arthritis
e. Marfan syndrome

Metabolic bone disease: -

f. Thyroid Disease
g. Renal osteodystrophy
h. Postmenopausal osteoporosis

i. Hyper parathyroidism

Fibrous dysplasia

Fibro-osseous lesion in which normal medullary bone is eventually replaced by an abnormal fibrous connective tissue mass Normal trabeculae of bone undergo osteo clastic resorption to make room for the expanding cellular proliferation. Some of the growing fibroblasts undergo metaplasia to become osteoblasts Thus new bone is formed within the cellular mass which is abnormal and consists of small and highly irregularly shaped trabeculae of embryonic origin "woven" bone. Thus, there is tumor-like enlargement of the affected bone that is weakened and vulnerable to pathologic fracture.

The disease may occur in single bone(monostotic) or multiple bones (polyostotic), or in combination with endocrinopathies and pigmentation in Mc Cune – Albright Syndrome.[2]

Radiographic feature

Bone trabeculae are small and curvilinear shapes, which have been described as "CHINESE LETTER" arrange Ment. (₣ ₤ ₪ ŧ ₩ ¥ ⊐ ⊐̋) Jaw lesions might undergo maturation, but long bone lesions do not show any maturation even in older aged individual

Orthodontic Consideration

Patient with craniofacial fibrous dysplasia have predis position to malocclusion.[3]

- Treatment is difficult, result should be delayed till skeletal maturity.
- Risk of relapse, use of bonded retainer suggested.
- Cosmetic reshaping after certain age with titanium screw fixation (after the growth has stopped)[4]
- Osteomies and maxillary down fracture should be performed with care, in case maxillary sinus has been obliterate or extensive skull base disease[5]
- Orthognathic surgery combination with orthodontic treatment can also be performed.[4,5]
- Radiation therapy is contraindicated, as it carries the risk of development of post-radiation Osteosar coma.
- Prior to instituting therapy, it is important to find out that disease has burned out.

It is done through consolation with patients' physician, that the condition has not been active since last 10 years.

Paget's disease (Osteitis Deformans)

- Paget disease is a chronic progressive disease of the bone characterized by abnormal resorption & deposition of bone, resulting in distortion & weakening of the affected bones. Disease principally affects older individuals (rarely below 40 yrs of age).
- It may affect a single bone (monostotic form) or multiple bones (polyostotic form).[6] Relatively asymptomatic, but severe bone pain is a common complaint. Pelvis, skull & femur are the most commonly affected bones. Jaw involvement is seen in about 10% - 15% of cases. Facial disfigurement may be consequence of enlargement of maxilla or mandible.

Maxilla is affected more than mandible in ratio 2:1. Bones affected by Paget's disease becomes thickened, enlarged & weakened. The alveolar ridge tend to become grossly enlarged (symmetrically).[6] In severe cases lip closure is difficult or impossible. Dentulous patients – chief complaint is spacing of teeth whereas in edentulous patients chief complaint is non-fitting dentures or retainer (as the jaw is enlarging)

Radiographic features

Depends on the stage of the disease (osteoclastic & osteoblastic). Early stages reveal a decreased radio density– slight radio lucency with alteration in trabecular pattern. During later stages of (osteo blastic) disease there is haphazardly formed patchy areas of radio-

opacities (bone formation) – giving it a "Cotton wool" appearance.

Dental changes seen are hyper cementos is of roots, loss of lamina dura, obliteration of PDL space & resorption of roots

Lab findings

Important information is provided.

- Serum Calcium & Phosphate levels are within normal limits.
- Serum Alka line phosphatase levels are markedly elevated. Normal value in adult: 1.5 – 5.0 (Bodan sky units) where as in Paget's disease: 50 – 250 (Bodan sky units)

Orthodontic consideration

- No treatment is required for mild cases
- Use of parathyroid hormone antagonist, such as calcitonin or bio phosphonates can reduce bone turn over

Dental

- Difficulty in extraction is encountered (hypercementosis) - edentulous patients may require periodic new & larger dentures.[7]
- Take good medical history.
- Obtain consent after explaining risks and side effects of bisphosphonate therapy.
- Assess risk level for orthodontic treatment and osteoradionecrosis.
- Consider morning fasting serum test for C-terminal telopeptide test prior to invasive surgical procedures
- Take preventive measures against osteonecrosis
- Avoid invasive dental procedures in orthodontic treatment plan
- Consider alternative dental treatment plan
- Ensure retainers are passive with no pressure on the bone covering soft tissues.

Cherubism

Cherubism is a rare hereditary disease that frequently manifests as a painless enlargement of mandible or maxilla. The disease usually progresses rapidly during first and second decades of life but is self-limiting and often regresses.[1]

Radiographic appearance

The radio graphic appearance shows multi locular, bilateral, radio lucent area within jaw bones giving a soap bubble appearance.

Orthodontic consideration

Reports on orthodontic treatment for cherubism are sparse .it may be undertaken in those affected by cherubism, even with pre-existing idiopathic root resorption, but patient need to be informed and consented.

Orthodontic treatment anterior to the lesion was successful in two cases,[8]

Cases of orthodontic extrusion of lower molars have been undertaken.[9]

Eruption of teeth may be delayed but not impossible[10]

Orthodontic alignment plus osseous recontouring to provide ideal facial aesthetics

Orthognathic surgery may be performed after growth caesation to correct severe skeletal deformities of jaws.

However procedure technically difficult as screw placing zones may be hard to locate adjacent to ostetomy lines in patient with concurrent osteolytic zones.

Arthritis

- 1. Rheumatoid arthritis
- 2. Osteoarthritis
- Rheumatoid arthritis- starts before midlife. It affects multiple symmetrical small joints of the body
- Osteoarthritis-it affects older people Degenerative joint disease. On inflammatory Adjunctive treatment

Affect of drugs used in arthritis

1. N saids

2. Steroids

Juvenile rheumatoid arthritis

Juvenile rheumatoid arthritis (JRA) is an autoimmune inflammatory arthritis occurring before the age of 16 years. The process involves an inflammatory response of the capsule around the joints secondary to swelling of synovial cells, excess synovial fluid, and the develop Ment of fibrous tissue (pannus) in the synovium. The pathology of the disease process often leads to the destruction of articular cartilage and ankylosis of the joints. Temporo mandibular joint (TMJ) can be damaged up to complete bony ankylosis, leading to development of mandibular hypoplasia and retrognathism. Typical dental presentation with skeletal class II and open bite. In JRA with unilateral TMJ involvement, craniofacial asymmetry may occur.

Signs and symptoms

- Rheumatoid arthritis typically manifests with signs of inflammation, with the affected joints being swollen, warm, painful and stiff, particularly early in the morning on waking or following prolonged inactivity.
- Increased stiffness early in the morning is often a prominent feature of the disease and typically lasts for more than an hour.
- Gentle movements may relieve symptoms in early stages of the disease.
- Classic signs of rheumatic destruction of the TMJ include condylar flattening and a large joint space.

Orthodontic considerations

- Regarding load on TMJ in rheumatoid arthritis patients receiving orthodontic treatment, there are different opinions. Profit et al have suggested that orthodontic procedures that place stress on the TMJ, such as functional appliances and heavy class It elastics, should be avoided if TMJ is involved in rheumatoid art ritis[13]. Burden et al considered use of headgear in moderate mandi bular deficiency patients[11] On the other hand, Kjellberg et al suggested that functional appliances may unload the affected condyle and act as a "joint pro tector',[15]
- When predis posing patient factors are not present, occlusal treatment (orthodontics, orthognathic surgery, prosthesis) normally result in functioning remodelling.[12]
- It has been suggested that in cases of severe mandibular deficiency, mandibular surgery should be avoided and a more conservative approach using maxillary surgery and genioplasty should be conside red[14]
- Orthopaedic chin cups should be avoided as they load the TMJ.[14]

If the wrist joints are affected these patients have difficulty with tooth brushing.

- Regular professional scaling
- Recommend use of an electric toothbrush
- Sugar-free medicines should be preferred to minimize caries.

Osteoarthritis

With the increasing amount of adult patient seeking treatment, more than 30%, it becomes imperative to know the effects of degenerative joint disease like osteoarthritis on treatment consideration.

Typical symptoms include crepitus, temporo mandibular joint pain, restriction of mandibular movement.

Orthodontic consideration

Morphologic collapse of the joint by TMJ-OA causes decrease in ramus height, and subsequent clockwise rotation of mandible and open bite. All these causes TMJ stress during loading.

Kuroda reported that molar intrusion using implant anchorage was quite useful to improve both occlusion and facial esthetics in severe anterior open bite with skeletal class II jaw relationship, causes mandi Bula

counter clock wise rotation and forward mandi bulbar movement.[16]

Orthognathic surgery in patient resulted in skeletal relapse related to condylar remodelling and resorption, so its not strongly recommended.

Marfan syndrome

Marfan syndrome is a heritable disorder of connective tissue that can affect the heart, blood vessels, lungs, eyes, bones, and ligaments. Individuals affected by the syndrome routinely seek orthodontic treatment to correct the orofacial manifestations.

It may be classified as type I or type II.

Type I, or classic Marfan syndrome, is the most common presentation of the disorder. Males and females are equally affected. Mutations in the FBN1 gene located on chromosome 15 cause type I Marfan syndrome. The fibrillin-1 glyco protein encoded by the FBN1 gene is required for the formation of elastic fibers in connective tissue. A mutation in the gene can decrease the quantity and quality of fibrillin-1. This in turn can lead to weakened structural support, especially in areas where elastic fibers are found in abundance. Consequently, the aorta, ligaments, and ocular muscles are among the most frequently affected parts of the body.[17]

Type II Marfan syndrome is less common and is due to a mutation in the gene that encodes transforming growth factor- receptor 2 (TGFBR2).6 The protein synthesized by this gene transmits signals from the cell surface to the nucleus, thereby affecting cell division and growth.

The clinical presentation of type II Marfan syndrome resembles that of classic Marfan syndrome, with the exception that the ocular system usually is not involved [17]

Orthodontic consideration

- Constriction of the maxilla and a high-arched palate are important from an orthodontic standpoint, as are concomitant crowding and posterior cross-bite. Maxillary vertical excess and mandi bulbar retrognathism combined with a high and narrow palatal vault are commonly seen
- A dolichofacial face type and skeletal Class II malocclusion are commonly noted. However, dental and orthodontic treatment objectives in individuals with Marfan syndrome do not differ from those in healthy counterparts. Prophylactic antibiotics might be required prior to exodontia or banding of teeth, to reduce the risks of bacteraemia and subsequent endocarditis.[17]
- Stringent maintenance of oral hygiene also assumes special importance in minimizing the need for scaling and root planning.
- Children with Marfan syndrome require orthodontic treatment to correct the malocclusion and associated orofacial anomalies.
- Additionally, ortho gnathic surgery may be indicated in patients with severe jaw and bite ab normalities. [18]
- The challenge before the orthodontist is to establish the correctability mandi bulbar relationship while achieving retention and stability.
- The treating orthodontist may be apprehensive of including a surgical procedure in the treatment plan because of potential complications related to surgery. However, surgeons work closely with the patients' cardio logists when planning treatment.
- Cases treated required Orthognathic surgical procedures; neither delayed bone healing following surgery nor abnormal tooth movement was observed.

Thyroid disorders

After diabetes mellitus, thyroid disease is the most common endocrine problem. Thyroid diseases occur more often in women and most often in women older than 30 years of age.

Orthodontic considerations

Orthodontic therapy requires minimal alterations in the patient with adequately managed thyroid disease.

- In hyperthyroidism enlarged tongue may pose problem during treatment.
- The bone turnover can influence orthodontic treatment. High bone turnover (i.e., hyper thyroidism) can increase the amount of tooth movement compared with the normal or low bone turnover state in adult patients.
- Low bone turnover (i.e., hypothyroidism) can result more root resorption, suggesting that in subjects where a decreased bone turnover rate is expected, the risk of root resorption could be increased.

Renal osteodystrophy

- The most common renal condition to present to the orthodontist is chronic renal failure. Chronic renal failure is a progressive and irreversible decline in renal function. the number of functional units of the kidney or nephrons diminishes, the glomerular filtration rate falls, while serum levels of urea rise. Up to 90% of patients with renal insufficiency show oral signs and symptoms in soft and hard tissues, some of them being a cause of the disease itself and others deriving from the treatment. Initially treatment is conservative with dietary restriction of sodium, potassium and protein. As the disease progresses dialysis or trans plantation are required. Many patients are prescribed steroids to either combat renal disease or to avoid transplant rejection.[19]

Because of its component of secondary hyper para thyroidism and impaired vitamin D metabolism, kidney disease may result in poor bone quality, a condition often referred to as renal osteodystrophy.

- Absorption from the small intestine is the primary source of exogenous calcium and phosphate.
- Phosphate is passively absorbed and rarely deficient.
- Optimal calcium uptake on the other hand required an active absorption mechanism.

Orthodontic considerations

Extraction should be done cautiously in such patients. Abnormal bone healing after extraction can result due to alterations in calcium and phosphors metabolism and secondary hyper para thyroidism which result in bone demineralization.

- Due to the increase in circulating para thyroid hormone. It has been suggested that orthodontic treatment forces should be reduced and the forces re-adjusted at shorter intervals.
- A patient with impaired renal function often is at a high risk for osseous manipulative procedures such as end osseous implants or orthognathic surgery. [20]

Osteoporosis

Osteoporosis is chronic, systemic, degenerative disease characterized by decreased bone mass, a micro Architectural deterioration of the bone and consequent increase in bone fragility.

Group of diseases in which bone resorption occurs at a faster rate than bone deposition.

Bone mass drops and bones become increasingly porous. Compression fractures of the vertebrae and fractures of the femur are common.

Often seen in post Meno pausal women because they experience a rapid decline in Estrogen secretion; Estro gen stimulates osteoblast and inhibits osteoclast activity.

Risk factors that cannot be altered include advanced age, being female, Estrogen deficiency after menopause.

Potentially modifiable risk factors include excessive alcohol intake, vitamin D deficiency, and smoking. Drugs most commonly used in treatment of osteoporosis are bisphosphonate (BP), Estrogen, and calcitonins.

Classification of Osteoporosis

Osteoporosis can be classified as:

- Localized osteoporosis
- Generalized osteoporosis – This can further be classified as Primary osteoporosis, Secondary osteoporosis

Primary osteoporosis: -is the most common form and is diagnosed when other disorders known to cause osteoporosis are not present.

It can be classified according to age as

1. Juvenile osteoporosis - It affects pre-pubescent boys and girls
2. Idiopathic osteoporosis - It affects young adults
3. Post-menopausal - It affects ladies 15-20 years after menopause
4. Senile - It affects elderly patients.

- Secondary osteoporosis - It is diagnosed when the condition is related to another illness, nutritional complications or as a side effect of medications.

Orthodontic considerations

Orthodontic treatment, therefore, must include the consideration of problems such as bone loss, retention instability, and tempo roman dibular dysfunction.

Problem associated with medication must also be given consideration. Estrogen decreases the rate of tooth movement.

If these drugs are used during orthodontic treatment in patients with osteo porosis, resorption of alveolar bone and possibly tooth roots could occur.

Use of Bisphosphonates can affect orthodontic treatment by -delaying tooth eruption, inhibited tooth movement, impaired bone healing, and by causing Bisphosphonates-induced Osteo radio necrosis of the jaws. Bishops phonates inhibits osteoclasts, decreases micro circulation and thus impedes tooth movement.

Extraction protocol and use of temporary ancho rage devices should be avoided.

- Assess periodontal condition.
- Refer for periodontal treatment.
- Enforce regular periodontal recalls during orthodontic treatment.
- Discuss with patient's physician eventual temporary cessation of corticosteroid therapy.
- Discuss with patient's physician eventual temporary cessation of Estrogen supplement.
- Adjust forces according to alveolar bone height.
- Apply lighter and controlled forces.
- Ensure less extensive treatment plan.
- Ensure prolonged retention and effective retention regimen.

Orthodontic tooth movement may have a high tendency to relapse in patients with osteoporosis, regardless of whether it is of the postmenopausal or senile type.

Hyperparathyroidism

Parathyroid hormone regulates the metabolism of calcium and phosphorus, so influences the mineralization of bone and teeth. Common oral manifestation in patient with hyperparathyroidism are loss of bone density, soft tissue calcification and dental abnormalities like loosening and drifting of teeth, spacing, period ontal ligament widening, partial loss of lamina dura.[21]

Radiographically it is described as loss of medullary trabecular pattern, Jaw appears finely radio-opaque as clear ground glass appearance.

Orthodontic consideration

Orthognathic surgery should be avoided as there is risk of pathological fracture as bony healing is impaired.

Excessively forces should be avoided as tooth are loose with loss of lamina dura.[22]

Conclusion

- Orthodontic tooth movement needs simultaneous bone formation and resorption. Patients with high risk of bone resorption (osteo porosis), due to systemic

problems, may have a deleterious effect on tooth move Ment.

• With increased adults seeking orthodontic treatment, the number of such patients seeking orthodontic treatment have increased in last few decades. It so has become of prime importance for an orthodontist to diagnose such patients and take necessary actions.

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