"The Influence of Different Artificial Tooth Material on the Supporting Structure of Lower Kennedy Class I Partial Denture"

(In vivo study)

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Introduction

Patients rehabilitated with maxillary complete denture opposing mandibular bilateral distal extension partial denture are vulnerable to trauma leading to destructive changes in both the maxillary and mandibular ridges. It was referred to such changes as combination syndrome in which early bone loss from the anterior maxillary jaw is the triggering factor for such retrograde changes. Five features of this condition were described, they included loss of bone in anterior part of maxillary ridge, overgrowth of the tuberosities, papillary hyperplasia of the hard palate, over eruption of lower anterior teeth, and loss of bone beneath the removable partial denture bases. Six additional changes associated with combination syndrome. They included loss of occlusal vertical dimension, occlusal plane discrepancy, anterior spatial repositioning of the mandible, poor adaptation of the prostheses, epulis fissuratum and periodontal changes. [1,2]

Many aspects of the prosthesis design have been suggested in an attempt to overcome the detrimental hard and soft tissue changes that are frequently observed in patients rehabilitated with a maxillary complete denture opposing distal extension removable partial denture. A rigid removable partial design that provides positive occlusal support, maximum stability and maximum basal coverage beneath the distal extension bases is highly recommended. A basic principle is to develop an occlusal scheme that would reduce or eliminate excessive occlusal pressure on edentulous ridges. Balanced occlusal scheme with no anterior contact in centric and

light contact during excursive mandibular movements to avoid over loading to premaxillary region should be established.

Studies showed that many of the problems encountered by conventional upper complete denture could be eliminated when maxillary overdentures were used. Maxillary implant retained overdenture has been advocated as a preventive line of treatment to offer resistance to the anterior force that cause ridge resorption. [3,4]

Acrylic and composite resins were chosen as it was claimed that resilient occlusal materials protect the abutments from occlusal trauma. A question now arises; which of these resins is better and more protective for the supporting structures?

Review of literature

I.Edentulism

Edentulism is defined as. "The final outcome of a multifactorial process including biological processes (caries, periodontal disease and trauma) as well as non-biological factors related to dental procedures (access to care, patient preferences, third party payments for selected procedures, treatment options, etc.)". [1,2]

The incidence of Edentulism has shown a decline, and the demand for treatment may be different than what it was several decades ago. Although the beneficial improvement in the oral health and the decrease in the rate of the edentulous condition, still we have a number of complete denture wearers among elderly people. The number of edentulous elderly persons may increase because of the expansion of the oldest segment of the population. [3-5]

Tooth loss has a big influence on biological, social and psychological levels of the oral health quality of life. The prevalence of tooth loss has declined in various countries. Tooth loss appears to have an important role in the loss of esthetics and mastication. It was observed tooth loss across all ages; he found that the main cause of tooth loss was dental caries (83%) followed by periodontal disease (17%). Decrease in edentulous patient number is considered to be a reflection of the improvement in the oral health of the population. It is also considered to be a sign of the success of preventive measures by the health care system. [6-8]

Esthetically and functionally successful prosthetic rehabilitation requires careful attention and meticulous treatment planning. Rehabilitation of partially edentulous arch can be challenging when it is a

distal extension situation classified under Kennedy's class I and class II situations. [9,10]

There are more than 65000 of possible combination of partial edentulous pattern of both the maxillary and mandibular arches, That, it makes it easier to classify edentulous arches with common characteristics to facilitate communication between dental staff. Different classifications have been used to classify partially edentulous arches to determine different possible combinations of teeth to ridges. Now, Kennedy's classification is considered the most relied on classification for partially edentulous arches. Kennedy's classification offers immediate visualization and assessment of removable partial denture cases. Study of incidence of various classes of partial edentulism provides clinically useful information. The main aim in using a classification for removable partial dentures (RPDs) is to facilitate the description of partially edentulous cases. Kennedy classification was selected because it makes the description of partially edentulous cases and to apply the basic principles of partial denture design in a simple way. [11]

It was reported that mandibular removable partial dentures (RPDs) are more common than maxillary removable partial dentures, and that the class I mandibular RPD is the most prevalent type of RPD. Some studies were initiated to assess the prevalence of partial edentulism among dental patients. The findings of these studies showed that the frequency of partial edentulism in the mandibular arch is higher than that of the maxillary arch. The pattern of loss has been assessed in different populations in various countries. [12,13]

II. Residual ridge reduction (RRR)

Residual ridge is a term used to describe the shape of the clinical alveolar ridge after healing of bone and soft tissue. After extraction inflammatory reactions are immediately activated, and the socket is closed temporarily by the blood clot. Epithelial tissue begins its proliferation and migration within the first week and the disrupted tissue integrity is quickly restored. Histologic evidence of active bone formation in the bottom of the socket is seen as early as 2 weeks after the extraction and the socket is progressively filled with newly formed bone in about 6 months. (13)

After healing, the alveolar bone starts a catabolic remodeling. The size of the residual ridge decreases most rapidly in the first 6 months, but bone resorption of the residual ridge continues throughout the life at slower rate, resulting in removal of a large amount of jaw structure. (13,14)

Classic studies on the longitudinal loss of the residual ridge height have demonstrated that once the teeth are extracted bone loss is a continuing process, and that the mandibular edentulous ridge may be resorbed four times the rate of the maxillary edentulous ridge. (15,16)

Factors affecting residual ridge resorption

Factors responsible for residual ridge resorption have been reported as either local factors or systemic factors. Local factors include the length of time edentulous, the size of edentulous ridges, the amount of occlusal stress transmitted through removable prostheses to the underlying hard and soft tissues, the number of dentures previously worn, 24-hour wearing of dentures, and a previous history of wearing removable partial dentures. Systemic factors include age and gender, presence of asthma, reduced

calcium intake, osteoporosis, thyroid disease, smoking, obesity, and others. [17]

Prosthodontic factors affecting complete dentures

Complete dentures are foreign objects that are accepted and tolerated by the oral tissue to a certain degree. A study conducted on patients prior to and after insertion of complete dentures for 3 months the underlying mucosa showed an increased amount of keratinization. However, wearing well adapted dentures is not harmful to the epithelium as they can stimulate rather than irritate the underlying mucosa. [18]

Disuse atrophy of the residual ridge was of significant importance, implying that good quality dentures should prevent resorption of the residual ridge as lack of dentures would lead to increase in bone loss. Clinical studies showed that denture-wearing jaws lose more bone than those without dentures. [19,20]

Trauma to the denture wearing tissues may be caused by many factors as ill-fitting dentures, deflective occlusion, and unfavorable loading. In cross sectional studies, elderly people show an average more resorbed ridge than younger individuals. But this may be due to the longer period of edentulism in the elder people. In prospective studies age hasn't been a prove to be important when confounding factors such as, length of edentulism and osteoporosis were controlled. [21,22]

III. Combination syndrome

The seventh edition of the **Glossary of Prosthodontic Terms** defines **Combination Syndrome** (CS) as "the characteristic features that occur when an edentulous maxilla is opposed by natural mandibular anterior

teeth, including loss of bone from the anterior portion of the maxillary ridge, overgrowth of the tuberosities, papillary hyperplasia of the hard palate's mucosa, extrusion of the lower anterior teeth, and loss of alveolar bone and ridge height beneath the mandibular removable partial denture bases—also called anterior hyper-function syndrome. This matches the findings of Kelly on the pattern of residual ridge resorption as observed in a group of patients completely wearing maxillary dentures opposing distal extension removable partial dentures (RPD). [23]

Kelly [8] was the first person used the term "combination syndrome". It was added to the description of the combination syndrome by including destructive changes such as loss of occlusal vertical dimension, occlusal plane discrepancy, anterior spatial repositioning of the mandible, poor adaptation of the prosthesis, epulis fissuratum and periodontal changes. [24]

In 2003 a study concluded that combination syndrome doesn't qualify to be a medical syndrome and there was no evidence to believe that resorption of anterior maxilla was related to the presence of natural anterior teeth in the opposing arch. [25]

a) <u>Pathogenesis of combination syndrome</u>

It was stated that "to prevent bone resorption, mechanical factors must be distributed over a large area of the basal seat as possible, and denture must be with minimal movement as possible against its basal seat. These factors are interconnected with the lower anterior teeth causing trauma and bone loss from anterior part of maxilla, and with the movement of denture base on its foundation area more and more will cause a very destructive condition. [26]

The changes produced in patients wearing maxillary complete denture with some natural anterior mandibular teeth, with removable partial denture. These changes were attributed to several factors. As the presence of lower anterior teeth, patients tend to favor these teeth to produce maximum forces. Patients will tend to produce excessive anterior functional and parafunctional forces, especially when not counter balanced posteriorly in excursive movements. [8]

Another theory stated that patients with maxillary complete denture and mandibular bilateral distal extension partial denture gradually loose bone in the posterior mandibular ridge. The lower denture base sinks and posterior open bite developes. In these patients, a fulcrum axis is established in the complete upper denture at first premolar, producing a positive pressure in the premaxilla and negative pressure in the posterior part. [27,28]

An adverse continuous pressure is generated by lower anterior teeth against upper anterior position of the unsupported maxillary denture. This continuous force causes a considerable resorption of the premaxillary alveolar bone. Heavy function in the anterior regions of the jaws is known as anterior hyperfunction. [29]

i.Sequence of changes associated with combination syndrome

The early loss of bone from the anterior region of maxillary jaw is first step to the other changes of the combination syndrome. With the anterior loss of bone, a flabby hyperplastic connective tissue makes up the anterior part of the ridge. The second important sign in combination syndrome is posterior maxillary hypertrophy and enlargement of maxillary tuberosity [21].

It was suggested that its origin from a "negative pressure" from underneath the denture related to the presence of posterior palatal seal, negative pressure is produced posterior to the fulcrum line. This negative pressure may cause enlargement of the tuberosities and the papillary hyperplasia. (2)

Enlargement of maxillary tuberosities is a result of slow resorption of the mandibular bone, with progressive reduction of the height of alveolar ridge and progressive shrinkage of the mandibular partial denture. The posterior open bite seems to be the cause of posterior maxillary alveolar bone hypertrophy as the tuberosities in an attempt to preserve the vertical occlusal functional relationship. Most of the clinical cases with a lack of opposing dentition, both the teeth and the bone will react simultaneously. As teeth will over erupt and bone will develop hypertrophy. Patients with Kelly syndrome, this feature is unique and may develop in both posterior and anterior segment of the ridge. In the anterior segments of the ridge, lack of maxillary anterior teeth leads to over eruption of the mandibular anterior teeth and in posterior segment of the jaw over growth of the maxillary tuberosities will occur. (30)

Disuse atrophy of the mandibular edentulous bone and increase in posterior open bite is the cause of posterior hypertrophy of the maxillary alveolar bone and super eruption of mandibular teeth. This over growth of the maxillary tuberosities is usually made up of fibrous tissue, but some cases there is an increase in the height of the bone. (31)

iii.Occlusal problems in combination syndrome

Bone resorption that occurs in both anterior maxillary and posterior mandibular alveolar ridge will lead to reduction in the vertical dimension of occlusion. The mandible will move forward. lead to a relative mandibular prognathism. The mandibular natural teeth will migrate upward, the upper denture anterior teeth will disappear by patient's lip, and both dentures will migrate downward posteriorly. Patients will have poor esthetics showing none of their maxillary anterior teeth and excessive showing of their mandibular anterior teeth, and the occlusal plane will drop down posteriorly and denture will move up anteriorly. [7,32]

Over protruded, up rotated chin and reduced lower facial height are associated with altered facial esthetics seen in severe combination syndrome cases. Two main symptoms that are present and differentiate combination syndrome cases from any other dental condition are resorption of anterior maxillary alveolar ridge and posterior open bite. [30]

The upper denture may form a void "suction chamber", or other form of negative pressure which may be the cause of inflammatory papillary hyperplasia of the palate. Microscopic examination of the hyperplastic tissue in the anterior ridge and the fibrous tissue that develops over the maxillary tuberosity shows that both has dense bundles of collagen fibers, few cellular elements, with few inflammatory cells. It is avascular with overlying epithelium that seems to be almost normal but has some hyperplasia. [33]

It is the same microscopic feature of epulis fissuratum if we reduce the ulcerative area caused the denture borders. But there is a difference as the hyperplastic tissue in anterior ridge is free while fibrous tissue over the

tuberosity is hard. However, all three conditions (flabby ridge, the fibrous tuberosity, and epulis fissuratum) as a result of prolonged trauma from denture base. Therefore, the fact that the tissue response is the same is logic. The difference in consistency of the fibrous tuberosities and flabby ridge anteriorly may be explained mechanically, as the anterior ridge has been disappeared and the connective tissue that is formed is not supported, on the other hand, the fibrous tissue covers tuberosity is supported by a broad bone beneath it. (34)

The upward tipping movement of the anterior portion of the maxillary denture and the simultaneous downward movement of the posterior portion will decrease antagonistic forces on the mandibular anterior teeth and lead to their Supra-eruption. Eventually, an occlusal plane discrepancy will occur and the patient may have a loss of vertical dimension of occlusion. In addition, the chronic stress and movement of the denture will often result in an ill-fitting prosthesis and contribute to the formation of palatal hyperplasia. (35)

b) Prevalence of combination syndrome

The prevalence of combination syndrome in patients with maxillary complete dentures was investigated and found that the previous changes most commonly in patients with maxillary complete denture and mandibular natural teeth and is about 24% of the patients. This is about five times greater than in patients with complete maxillary and mandibular dentures. However, patients who had even one lower molar didn't have combination syndrome. (36)

This proves what was stated that loss of occlusal posterior support is the main factor in the development of combination syndrome and it was

noted an associated loss of vertical dimension of occlusion, occlusal plane discrepancy, anterior repositioning of the mandible, poor adaptation of the prostheses, epulis fissuratum, and periodontal changes. [24]

The early bone loss in the anterior maxilla was considered to be the key to the other changes and noted that as resorption of the premaxilla progressed, further tissue damage and denture instability followed proportionately. [8]

c) Prevention of combination syndrome

Prevention of destructive changes that complete maxillary dentures opposing class I mandibular partial dentures may be possible through proper treatment planning. It was emphasized that prevention is the best possible treatment. It was stated that the clinician should do every possible thing to prevent the un-favorable combination of removable dental prostheses that include a maxillary complete opposing distal extension mandibular partial denture. The frequent relining slow down doesn't prevent the development of combination syndrome. Treatment should restore a stable posterior occlusion, decreasing the occlusal pressure on the anterior maxilla. [37] it includes:

i. Maxillary overdenture prosthesis

Every effort should be done to prevent destructive occlusal forces result from combination syndrome on maxillary anterior ridge. Therefore, when complete denture is contemplated, endodontic treatment, periodontics treatment should be done to preserve root of maxillary anterior teeth to preserve the bone of the anterior maxilla. Also, the