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International Journal of Prosthodontic Rehabilitation

Mini Review

Dynamics of Mastication in Dental Implants: From Brain to Bridge-A review

Apoorva Singh[1], Varun Wadhwani[2], Vaishnavi Rajaraman [3]

[1] *Department of Prosthodontics, All India Institute of Medical Sciences, New Delhi* -110029

[2]*Department of Prosthodontics, Maulana Azad Institute of Dental Sciences, New Delhi -110 002*

[3]*Department of Prosthodontics, Bharati Vidyapeeth Dental College and Hospital, Mumbai* - 400614

How to cite: *Apoorva S et al.Dynamics of Mastication in Dental Implants: From Brain to Bridge-A review. Int J Prostho Rehabil 2022; 3: 1:12-16.* *https://doi.org/10.56501/intjprosthorehab.v3i1.267*

ABSTRACT

The introduction of osseointegrated dental implants has led to a tremendous development in oral rehabilitation during the last decades. Masticatory function is an important aspect in oral rehabilitation. It should aim to provide or restore appropriate and adequate function. An area that has experienced an impressive growth in knowledge is oral neuroscience. Various efforts have been made to compile this knowledge and understand management of mastication in patients with dental implants. The aim has always been to provide an insight into the various aspects related to masticatory function (including quality of life) and rehabilitation with dental implants. While there are many reviews on the same, this write up shall throw light on the technical aspects and the functional aspects, which have received relatively little focus. This innovative review is an attempt in that direction, that aims to bring oral neuroscience and implant dentistry closer together -'from brain to bridge'.Particularly, the somatosensory and motor functions of the masticatory system have been studied extensively. To be able to better understand and further develop the functional aspects of dental implant therapies, it is imperative to take advantage of this knowledge.

Keywords: Mastication, Dental implants, Perception, Somatosensory

Address for Correspondence:

Dr Varun Wadhwani
Student,
Maulana Azad Institute of Dental Sciences
New Delhi-110 002
Email Id - varunw020595@gmail.com

Introduction

An increasing number of older individuals retain dentition throughout life. Many have gone through oral rehabilitation with various dental constructions—often with the purpose of securing relevant chewing and masticatory function that has been shown to be one of the most important oral health factors associated with the quality of life in older individuals. Chewing and masticatory function constitutes one of the most important oral health factors that affect quality of life, especially in older individuals. Little consensus currently exists regarding ways to objectively assess clinical masticatory performance (in this context, performance refers to an individual's objective ability to mix or comminute food bolus).

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Masticatory muscle dynamics are responsible for the amount of force exerted on the implant system. Several criteria are included under this heading: patient size, gender, age, and skeletal position.[1–4] The size of the patient can influence the amount of bite force. Large, athletic men can generate greater forces; patients of weak physical condition often develop less force than athletic patients.

Dental implants are increasingly used to replace missing teeth and studies have shown masticatory improvements in implant-supported overdenture wearers [5–7]. However, the effect of implant therapy is unclear in partially edentulous patients' chewing, which was the aim of this review. That said many methods were developed to assess masticatory performance. Consequently, review of the literature would be of great value when it comes to identifying various methods for assessing clinical masticatory performance.

Mastication Differences in Gender and Age

In general the forces recorded in women are approximately 20 lb less than those in men. In a clinical report by van Steenberghe et al.[8] partially edentulous men have a 13% implant failure rate compared with 77% for women. In a report by Wyatt and Zarb,[9] first-year radiograph bone loss was positively correlated with male sex, younger age, and implants supporting a distal extension prosthesis. Older patients record lower bite forces than young adults. In addition, the younger patient lives longer and requires the additional implant sup- port for the prosthesis for a longer time. (An 80-year-old patient will need implant support for far fewer years than a 20-year-old, all other factors being equal.)

Influence of Skeletal Position in Mastication

The skeletal arch position may influence the amount of maximum bite force. The brachiocephalic, with a stout head shape, may generate three times the bite force compared with a regular head shape. This is especially noteworthy when accompanied by moderate-to-severe bruxism or clenching. The maximum bite force decreases as muscle atrophy progresses throughout years of edentulism. A maximum occlusal force of 5 psi may be the result of 15 years without teeth.[10] This force may increase 300% in the 3 years after implant placement.[11,12] Therefore sex, muscle mass, exercise, diet, state of the dentition, physical status, and age all influence muscle strength, masticatory dynamics, and maximum bite force. The skeletal Class III patient is primarily a vertical chewer and generates vertical forces with little excursive movement. How- ever, some patients appear "pseudo-Class III" as a result of anterior bone resorption or loss of posterior support and collapse of the vertical dimension with an anterior rotation of the mandible. These patients do exhibit lateral excursive movements when the incisal edge position is restored to its initial position.

Evaluation of Mastication

Several methods have been used to evaluate mastication, including occlusal force measurements[13,14], color- changeable gum test[15–17], and muscle thickness evaluation[18–20]. In addition, correlations among bite force, chewing performance, and masticatory muscle thickness have been established, and it is known that

Masticatory muscle action is influenced by occlusal factors, such as partial edentulism. Thus, masticatory muscle function can be reduced by severe tooth loss or soft diet consumption, as typically selected by edentulous patients, leading to muscle atrophy.

The most common approach to evaluating masticatory performance has been to sieve comminuted food and determine the degree of food breakdown[21–23]. For example, one study indicated that a multiple sieve method was more reliable in determining masticatory performance than a single sieve method. Edlund et al. developed a masticatory efficiency index that could be used in these types of comminution tests, but it also required five separate test sessions to be reliable. Optical scanning of chewed food particles was used in comminution studies—in lieu of sieving. Comminution tests were used to evaluate masticatory performance after implant treatments or to assess masticatory performance in patients with conventional dentures.

Another common masticatory performance assessment method involves mixing ability tests. One study indicated that a mixing ability test discriminates better (between groups of individuals with compromised masticatory performance) than comminution tests[24,25]. In another study, two colored chewing gums were used as test food. Determining the degree of mixing of the two colors assessed mixing ability[26–28]. Optical/scanning methods or visual inspection enable the assessment[29]. Multicolored paraffin wax, which is mixed during chewing, can be used as test food for determining masticatory performance; this method demonstrated validity and reliability in individuals with normal and compromised dentition. While comminution and mixing tests are common methods when quantifying masticatory performance, others were also developed. Some studies used color-changing chewing gums here, color change was assessed with a colorimeter or spectrophotometer and was used as a way of quantifying masticatory performance.

For practitioners and researchers, it would be interesting to find out if these methods could be used to evaluatemasticatory ability before dental treatment. For research studies that develop and test interventions to enhance masticatory performance need exists for reliable, valid methods that objectively evaluate clinical masticatory performance. While most of these tests were used in laboratory studies, no established method for evaluating a patient's objective masticatory performance is available within clinical practice, and the clinician must rely on masticatory performance assessments via oral status appraisals, existing dentition, or patients' subjective experiences.

Conclusion

As a general rule the implant treatment plan should reduce other force magnifiers when masticatory musculature dynamics increase. For example, a cantilever length should be reduced in cases of elevated masticatory dynamics. A crown height may be reduced by bone augmentation. The prosthesis may be made removable so nocturnal bruxism is reduced (if they do not wear their prosthesis). The implant number, size, and design may also be increased to increase the surface area of load.

Authors Contribution

Apoorva S: Manuscript editing, Literature search, data collection

Varun W: Manuscript grammar and drafting

Vaishnavi R: Data Analysis, manuscript drafting

Acknowledgement

The authors would thank the dental institutions for the support

Conflict of interest

The authors have nothing to disclose or any conflicts of interest.

Source of funding- None

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