

Analysis of Masticatory Function in Patients with Maxillofacial Defects

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Abstract: ***Introduction:** Maxillofacial defects affect vital organs and systems, resulting in serious impairment of masticatory function. Its restoration is a major goal of prosthetic rehabilitation. **Objective:** The aim of this literature review is to present, based on a retrospective analysis of the studies on masticatory function in maxillofacial prosthodontic patients, current investigations on this topic. **Discussion:** Prosthodontic treatment of patients with maxillofacial defects is a complex multistage process related to the solving of multiple problems. Most of them are associated with the underlying difficulties in restoring normal mastication and nutrition. The extent of occurred functional disorders depends on the size and location of the defect, as well as the presence of preserved teeth. Prosthetic rehabilitation methods occupy a central place in the complex treatment of these patients, which requires examining and analyzing the possibilities for improving masticatory function. **Conclusions:** Prosthetic rehabilitation of patients with maxillofacial defects enables satisfactory restoration of masticatory function, which contributes to the maintenance of a relatively good quality of life during the different stages of treatment.*

Keywords: mastication, maxillofacial defects, obturator, post-resection prosthesis, T SCAN

1. Introduction

Mastication is a neuro-motor activity, aimed at processing the food to a consistency suitable for swallowing [1, 2, 3]. The masticatory act is realized as a result of a sequence of mechanical and physiological processes engaging all anatomical structures in the oral cavity[4]. It can be carried out in parameters of the norm, as well as states of functional pathology of the masticatory apparatus [5, 6]. In both cases, the topic of the quality of mastication and the effectiveness of the masticatory process, while shaping the food bolus, is up-to-date and decisive for the functional life of prosthodontic constructions [7]. The extent of food mastication varies considerably between individuals [8, 9] and depends on the functional status of the masticatory apparatus [10]. Bornhorst and Singh [11] concluded that although mastication appears to be a simple process, it involves a number of factors, such as individual physiological characteristics and facial anatomy, gender, age, dental status, etc. There are various etiological factors and conditions with the potential to affect the normal masticatory act [12, 13]. Modern authors [14, 15, 16] examine the prevalence, diagnosis and importance of craniomandibular dysfunctions, in the context of the body as a whole, as a risk factor influencing the functionality of the masticatory apparatus. Dysfunctions with different etiologies are observed in maxillofacial defects as well, where masticatory function is affected in almost 100% of the cases [17]. This is the main reason for the disturbances in nutrition in patients with maxillary resection and for their reduced quality of life [18, 19]. Restoration of impaired masticatory function is a key priority for the rehabilitation of these patients [20, 21, 22, 23].

Prosthodontic methods occupy a central place in the complex treatment of patients with maxillary resection [24, 25, 26]. Most authors [25, 27, 28] apply a three-stage treatment scheme by using surgical, temporary and definitive obturators, thus facilitating nutrition and providing an acceptable quality of life of the patients.

2. Objective

The aim of this literature review is to present, based on a retrospective analysis of the studies on masticatory function in maxillofacial prosthodontic patients, current investigations on this topic.

3. Literature Survey

The literature describes numerous studies of masticatory function in patients with obturators [29, 30, 31, 32, 33, 34, 35, 36, 37]. Most of them examine the changes in masticatory efficiency and occlusal force after treatment [21, 29, 31, 33, 34, 38]. According to Matsuyama et al. [31], masticatory efficiency after obturator prosthesis is comparable to that in young people, although less occlusal force is measured. Ono et al. [21], however, believe that it is close to that in healthy subjects. Kreeft et al. [38] determine masticatory efficiency as similar to that in patients with complete dentures, but the results of Reitemeier et al. [33] found less masticatory efficiency than that achieved in patients with complete dentures.

The opinions of the factors influencing masticatory function are also controversial. According to Koyama et al. [30], the most important of these factors include the size and location of the defect and the presence of teeth. Data of Reitemeier et al. [33] confirm that masticatory function depends on the location of the defect, the number and location of preserved teeth. Ono et al. [21] demonstrated the leading role of the factors, ranked by clinical significance - size of the defect, status of mandibular distal teeth, occlusal force and mouth opening capability. The authors believe that the analysis and evaluation of these factors allow prediction of masticatory efficiency after prosthodontic treatment. Similar is the opinion of Koyama et al. [30], where it is stated that the masticatory efficiency in maxillofacial prosthodontic patients differs significantly, depending on the number of teeth and the configuration of the defect. The studies of Wedel et al. [39] found that the larger is the prosthetic site,

the more severely impaired is the patient's masticatory function. According to Kreeft et al. [38], the size of the defect does not affect the masticatory function, but the presence of natural teeth facilitates nutrition. Vergo and Chapman [35] concluded that masticatory function and the retention of the obturator are correlated and depend on the presence of teeth, bones and soft tissues, which is confirmed by our own investigations [40,41]. Tsuchiya et al. [42] found improved masticatory function in case of provided retention and stability of the obturator. In a three-dimensional study of the obturator mobility while chewing, opening and closing the mouth, the authors established different degrees of mobility, which varied widely in individual patients. Stoev and Avramov [29] confirmed these data in masticatiographic studies of masticatory efficiency by Rubinov in patients treated with prostheses without obturation segments, soft plastic obturator and obturator directly relined with such a plastic. The obtained results indicate optimal restoration of masticatory function in the last patient group, especially in the cases with preserved teeth.

An important role in the studies of masticatory function play the investigations related to the possibilities for its improvement [35]. In a similar study with a spectrophotometer, Umino et al. [34] found that restoration of occlusal contacts in the region of small and large molars significantly increases masticatory efficiency. On videofluoroscopic records, Yontchev et al. [37] visualized the leading role of premolars and molars involved in 70% of the masticatory cycle, and the negligible participation of the frontal teeth and the teeth on the side of the defect. In a similar study before and after prosthodontic treatment of patients with unilateral defects, Xing et al. [36] found a 59.98% increase of the masticatory efficiency one month after completion of the treatment. Similar results obtained Vergo et Chapman [35], who improve nutrition through even distribution of the masticatory pressure.

In a study of the impact of mastication on cerebral blood flow after obturator prosthesis, Guo et al. [43] found no disturbances in the blood supply of the middle cerebral artery.

Although that according to some authors [19,38] swallowing is a major problem in the treatment with obturator, isolated studies [44] consider its impairment as a complication of conducted radiotherapy. This is the main reason for the "leak" in swallowing, which is found in 29% of the patients with obturator prosthesis [19]. For its diagnosis and the objective assessment of swallowing, different methods are applied, as some of them use the X-ray examination - the degree of impairment is assessed by the amount of contrast agent infiltrated into the nasal cavity [45]. According to other methods, the effectiveness of prosthesis is investigated by measuring the time required for swallowing of 30 ml water [46]). The reported 8.2 ± 6.3 seconds and 5.0 ± 3.5 seconds after obturator treatment define the prosthodontic methods as optimal means to restore swallowing. These data are also confirmed in cases of obturator treatment with customizable palatal vaults [47].

The EMG studies allow objective registration of the changes in swallowing, which according to Vaiman et al. [48] are a reliable, noninvasive method, successfully used in healthy individuals. Its use in patients with complete dentures shows prolonged swallowing time [49]. Using this method of study, some authors [50, 51] found weaker muscle activity of m. masseter after complete denture treatment, while others [52, 53], its increased amplitude. Araujo et al. [54] reported a positive impact of dentures on muscle activity after a two-week adaptation, and Goiato M.C. et al. [55] believe that the time to achieve the same effect is five months. According to Karkazis and Kossioni [56], an important role in the muscle activity plays the type of food, and Grunert et al. [57] found increased amplitude of m. masseter in bilaterally balanced occlusion.

In the specialized literature, there are no detailed studies of the changes in masticatory muscles after maxillary resection and prosthodontic treatment and the impact of these changes on the masticatory function of the patients. In a comparative EMG study involving 6 patients with hollow and open obturators, Hasanreisoglu et al. [58] established better clinical results for the cupped shape of the substituting part, which is confirmed by our own studies of the changes in n. facialis after definitive prosthesis [59]. Haraguchi M. et al. [60] concluded decreased muscle activity after prosthodontic treatment in three patients with mandibular resection. Similar changes are also diagnosed in surgical treatment of facial fractures [61].

A topical contemporary method for assessing occlusion-articulation relationships in the dentition is the T-SCAN system [62]. Reza Moini et al. [63] highlighted the advantages of this method versus replicating silk ribbon. In a comparative study of Accufilm methods, "wax occlusal indicator" and the T-SCAN system, Kong et al. [64] found similar results for the position and the total number of occlusal contacts. Majithia IP et al. [65] determined the advantages of the T-SCAN 3 system in its capacity to measure the force magnitude, as well as the location of the strongest contacts of each tooth.

The results of the application of the T-SCAN system in prosthodontic patients after mandibular resection showed that the size of the defect does not affect the masticatory force, but changes the occlusal center, as asymmetry is the greatest in defects involving more than half of the mandible [66]. Asymmetry in the distribution and intensity of occlusal contacts is also found by other authors after prosthodontic treatment of patients with maxillary defects [67].

4. Discussion

Maxillofacial defects affect vital organs and systems, resulting in serious impairment of masticatory function. Its restoration is a major goal of prosthetic rehabilitation. Literature data [25, 68] show understanding and coalescence around the opinion that prosthodontic treatment of patients with maxillary resection is a complex multistage process related to the solving of multiple problems. Most of them are associated with the underlying difficulties in restoring normal mastication and nutrition [18, 19, 23, 25, 69, 70]. The opinion that the extent of occurred functional

impairment depends on the size and location of the defect, as well as the presence of preserved teeth, is predominant [35, 37, 71]. In most cases, the defects are accompanied by changes in the appearance that cause serious psychological problems [18, 19, 20]. Restoration of impaired functions and esthetics is the main goal of the treatment, in which a generally accepted therapeutic approach is the prosthetic rehabilitation with obturator prosthesis [18, 72, 73, 74]. Prosthetic rehabilitation is conducted in three stages, where surgical, temporary and definitive obturators are fabricated over different time intervals [25, 27, 28]. There are conflicting opinions on the period and duration of their use, and the need of immediate prostheses. The three-stage treatment enables complete treatment and systematic patient care, thus providing the maintenance of constant quality of life [18].

The availability of a wide variety of modern prosthodontic constructions for masticatory, swallowing and speech disorders is a convincing argument for assessing the functional outcomes after prosthodontic treatment of patients with maxillary defects [17]. Currently, most maxillofacial prosthodontists do not use the functional assessment, despite the view that it is important for the overall treatment planning and decision-making with regard to the type and material of the prosthesis [75]. Due to the specifics in the quality of life of this patient group, there are no collected comprehensive data on the functional disorders after prosthodontic treatment and a need exists for a thorough study of the reference values of all parameters of the masticatory cycle - masticatory movements, speed of mastication, shaping the food bolus, presence of infringements in the swallowing phase [76]. Changes in mastication after conducted prosthodontic treatment are insufficiently studied, and the results are controversial [21, 31, 33, 38]. The important function of swallowing is poorly understood, although this is a major problem for the patients with obturators, according to some authors [19, 38]. There are no data on the changes in masticatory muscles after maxillary resection and following prosthodontic treatment. The literature describes isolated comparative EMG studies during the treatment with various types of obturators [58], and one study on the changes in n. facialis after prosthodontic treatment of patients with maxillary defects [59]. Poorly investigated and analyzed are the possibilities for achieving optimal occlusion-articulation relationships after prosthetic rehabilitation.

5. Conclusions

Prosthetic rehabilitation of patients with maxillofacial defects enables satisfactory restoration of masticatory function, which contributes to the maintenance of a relatively good quality of life during the different stages of treatment. The specifics of this type of disorders and the difficulties in the treatment process require extensive investigations of the possibilities aimed at improving masticatory function and effectiveness in these patients.

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