

Electromyographic activity in patient with an inferior implant/ tooth-supported overdenture: clinical report

Atividade eletromiográfica de um paciente com prótese inferior implantodontossuportada: Relato de caso clínico

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ABSTRACT

Clinicians can find patients with one mandibular remaining tooth, and it is difficult to decide if the tooth has to be removed. When a clinician decides to maintain the tooth, it is common to question the masticatory load distribution divided between the tooth and implant. This paper reports a clinical case of patient with an implant/tooth-supported overdenture and elucidates the masticatory efficiency by electromyography activity analysis. The objective of this case report was to describe a clinical case of a patient with an implant/tooth-supported overdenture and to discuss the muscle response to this treatment. Electrical activities of the masseter and anterior temporal surfaces at maximum voluntary contraction were evaluated by electromyography during pre-treatment, immediately post-treatment, 15 and 60 days after installation. When patient has one remaining tooth in good condition, the implant/tooth-supported overdenture can be recommended, to preserve the periodontal ligament and proprioception, and to minimize bone loss. Electromyography analysis showed that implant/tooth-supported overdenture is a viable treatment alternative, in muscular standpoint, when the patient has a remaining tooth with good osseous support.

KEYWORDS

Dental prosthesis, implanted supported; Dental implants; Denture.

RESUMO

Os dentistas podem encontrar casos em que o paciente possui apenas um dente mandibular remanescente, sendo difícil decidir se o dente deverá ser extraído. Quando o clínico decide manter este dente, é comum surgirem dúvidas sobre como ocorre a distribuição da carga mastigatória em próteses suportadas por dente e implante. Este artigo relata a resposta muscular por meio de atividade eletromiográfica de um paciente reabilitado com uma prótese inferior implantodontossuportada. O objetivo deste artigo foi descrever este caso clínico e discutir a resposta muscular neste tipo de tratamento. As atividades eletromiográficas dos músculos masseter e temporal anterior superficial foram avaliadas durante o pré-tratamento, imediatamente após a instalação da prótese, 15 e 60 dias pós-tratamento. Foi verificado que quando o paciente tem um dente remanescente em condição de ser mantido, a prótese implantodontossuportada pode ser recomendada como tratamento, para preservação do ligamento periodontal e da propriocepção, e para minimizar a perda óssea. A análise eletromiográfica demonstrou que a prótese implantodontossuportada é uma alternativa viável de tratamento, do ponto de vista muscular, quando o paciente possui um dente remanescente com suporte ósseo adequado.

PALAVRAS-CHAVE

Implantação de prótese dentária; Implantação dentária; Prótese.

INTRODUCTION

Today's elderly population is particularly susceptible to tooth loss and must often use some kind of prosthesis to guarantee adequate food ingestion and, consequently, maintain a satisfactory state of nutritional health and quality of life [1,2].

The classic treatment for edentulous patients could be the use of maxillary and mandibular complete removable dentures. This treatment is relatively inexpensive in comparison with the use of implant-supported prostheses. However, when the regional ridge shape is inadequate, the denture may be unstable or poorly retained, leaving the patient dissatisfied with the final treatment result[3]. Therefore, numerous prosthetic designs associated with implant prostheses are usual in clinical situations. Complete dentures can be stabilized by the placement of implant-retained overdentures[1], leading to higher bite force values[4]and improved patient satisfaction compared with that achieved with conventional complete dentures [3-5].

The Glossary of Prosthodontics Terms[6] defines an overdenture as "any removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants; a dental prosthesis that covers and is partially supported by natural teeth, natural tooth roots, and/or dental implants".

Some new designs with different means of support have emerged in response to the specific clinical conditions of the edentulous mandible provided with implants [1], but the literature on the use of an implant/tooth-supported overdentures is sparse. The objective of this case report was to describe a clinical case of a patient with an implant/tooth-supported overdenture and to discuss the muscle response to this treatment.

DESCRIPTION OF CASE

Patient A.G.A., a 68-year-old male with an edentulous maxilla and partially edentulous mandible, presented at the Extension Project of Complete Dentures (ICT, São José dos Campos, UNESP – Univ Estadual Paulista, Brasil). After clinical and radiographic examination, it was observed that the patient's left canine presented satisfactory endodontic treatment, and there was an implant on the right side (in the canine region). However, there was significant horizontal elevation between the tooth and the implant, which had hindered previous attempts at prosthetic resolution.

The proposed treatment was a new mandibular overdenture. A metallic core was first prepared for the remaining tooth, with a reduced crown portion to be used only for denture support, not just as a retainer. An O-ring system (Titanium Fix, São José dos Campos, Brazil) was installed on the external hexagonal regular platform implant (Figure 1).



Figure 1 - Front view showing the difference between the tooth and the implant that hindered prosthetic resolution.

The old maxillary complete denture appeared to be in good condition and was not replaced. For preparation of the mandibular overdenture, the conventional treatment steps were performed, with impressions in alginate (preliminary) and a functional mercaptan mold (subsequent). The maxillo-mandibular

relationship (vertical dimension and centric occlusion) was determined by wax guidance.

For assembly of the semi-adjustable articulator, the facebow measurement was taken with the maxillary denture in place. The assembly of the inferior model was made after registration of the centric relationship in the mandibular guidance plan. After the artificial teeth were mounted and tested, the overdenture was subjected to the application of an acrylic resin.

When the overdenture was installed, the abutment O-ring implant was inserted and fixed with a chemically activated acrylic resin (Figure 2).



Figure 2 - Internal surface of overdenture.

The electrical activities of the masseter and anterior temporal surfaces at maximum voluntary contraction (isometric), were evaluated by electromyography during pre-treatment (with the patient using the old overdenture), immediately post-treatment (at

the time of installation of the new overdenture), and 15 and 60 days after installation.

Electromyographic recordings were made with an electromyograph (EMG-800C model, EMG System, São José dos Campos, Brazil). Six input channels with active electrodes with 20X amplification gain were used to record the signals.

The collection protocol followed the recommendations of SENIAM (surface electromyography for non-invasive assessment of muscles) and the ISEK (International Society of Electrophysiology and Kinesiology).

The collection of electromyographic recordings started by cleaning the skin with 70% alcohol to reduce skin impedance and to allow proper placement of surface electrodes guided by the direction of the muscle fibers.

Electromyographic recordings began with the superficial masseter and anterior temporal muscles at maximum voluntary contraction, with a sampling time of 10 s, three times in succession, with an interval of one minute between recordings. Throughout the collection of electromyographic signals, made by a single calibrated operator, the patient and the electromyograph were monitored. Patient data were recorded on computer files and converted in the EMGLab V1.1 software system (EMG System do Brazil, São José dos Campos, Brazil) in a binary-specific language, providing all mathematical and statistical information.

There were some changes in the electromyographic profiles of the muscles after overdenture installation (Table 1).

Table 1 - Electrical activity measurements (μV) at rest and at maximum voluntary contraction (isometry) during the rehabilitation treatment (mean \pm standard deviation)

Period	Right Masseter	Right Temporal	Left Masseter	Left Temporal
At rest				
Initial	19.56 \pm 1.54	75.87 \pm 1.89	19,32 \pm 0,10	151.22 \pm 3.11
Immediate	19.85 \pm 0.67	71.75 \pm 3.00	20,91 \pm 0,61	158.16 \pm 6.67
15 days	31.78 \pm 0.29	216.47 \pm 8.44	36,17 \pm 0,29	213.45 \pm 3.46
60 days	62.30 \pm 0.26	209.10 \pm 1.84	31,88 \pm 1,06	90.83 \pm 0.42
Isometry				
Initial	45.61 \pm 9.03	140.36 \pm 29.57	79.97 \pm 8.79	186.29 \pm 15.01
Immediate	65.62 \pm 2.08	87.49 \pm 9.26	49.72 \pm 2.34	215.46 \pm 11.38
15 days	41.82 \pm 7.97	227.22 \pm 1.71	40.18 \pm 2.40	227.31 \pm 3.63
60 days	75.90 \pm 4.89	245.91 \pm 4.51	64.55 \pm 5.52	232.01 \pm 10.98

DISCUSSION

After 60 days, the patient was satisfied with the treatment. The decision by the clinician and patient to retain or remove teeth should be based on a thorough assessment of information related to risk factors affecting the long-term prognosis for endodontic and dental implant treatment. The clinician should consider several factors when determining whether to save a tooth through endodontic therapy or extract it and place an implant. These factors pertain to the patient's health status, the condition of the tooth and periodontium, and treatment-related considerations[7]. In this case, the patient had a functional tooth without loss of periodontal support and with satisfactory endodontic treatment. If the treatment choice had been to extract the tooth and 'level' the bone, considerable bone removal would have been required. This treatment does not preserve tooth and bone.

In the electromyographic analyses, there are muscular activity changes patterns immediately after overdenture installation. When new dentures were installed, there was a tendency toward lower mean electrical activity values of muscles when compared with those of the old complete dentures[8]. Further, these muscle behaviors could be associated with

functional adjustments induced by implant-supported rehabilitation, modulated by the dynamic aging process[2]. Additionally, patients with mandibular implant-supported prostheses showed a higher pattern of muscular activity because of difficulty in the associated use of complete maxillary dentures[9,10], which limit the performance of postural functions[9].

It could be seen that, 15 days after mandibular overdenture installation, there was an ideal balance in muscle activity between the right and left sides of masseter and temporal muscles. However, after 60 days, the muscular activity on the implant side (right) appeared to be higher than that on the tooth side (left). The electromyographic activity in patients with implant-supported overdentures tended to be higher than that in those with tooth-supported overdentures [11]. This occurred because of the absence of periodontal ligament mechanoreceptors and hence the loss of inhibitory reflexes with their specific functions, resulting in considerable alterations in oral sensory perception skills [5]. Periodontal receptors are involved in the fine motor control of biting and chewing [12] and in neuromuscular coordination [13], and thus are important for the precise control of the low forces used during the intraoral manipulation of

food [12]. The reduced tactile function could lead to the impaired control of the maximum biting force, which is reflected in the high muscular activity [5].

After 60 days, at maximum voluntary contraction, the activities of muscles analyzed were higher and more stable than initial period. The increase in muscular effort can also occur immediately after denture stabilization, rather than over the long term [10]. Patients who have been edentulous for over 10 years, and who have adapted to unsatisfactory prostheses, may need extra time to re-establish musculature after the prosthesis is changed [14]. It must be emphasized that when the patient's muscular activity was evaluated, all muscles were in equilibrium, demonstrating that the dentures had balanced occlusion.

Implant-supported overdentures are undoubtedly more stable than conventional dentures, with a high degree of patient satisfaction [10]. Moreover, the mandibular implant-retained overdenture is a relatively simple and low-cost treatment [5]. Therefore, when the patient has a remaining tooth in good condition, the implant-retained overdenture can be recommended.

Furthermore, the following of bone condition around the implant and tooth can be another long-term success sign, but at the first sight, it can be stated that electromyography consisted an important tool to evaluate the muscle response in the proposed treatment.

In conclusion, the electromyography analysis showed that implant/tooth-supported overdenture is a viable treatment alternative, in muscular standpoint, when the patient has a remaining tooth with good osseous support. This treatment avoids tooth extraction and

preserves the tooth and the alveolar bone ridge. The preservation of periodontal ligament mechanoreceptors is important for adequate muscular function.

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