

THE INFLUENCE OF MANDIBULAR RIDGE ANATOMY ON TREATMENT OUTCOME WITH CONVENTIONAL COMPLETE DENTURES

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ABSTRACT

Since prognostic indicators are likely to take on increasing importance as a diagnostic tool for selection of patients for implant provision, this study investigated the influence of the shape and resiliency of the mandibular alveolar ridge on the retention and stability of conventional complete dentures. Ninety-three edentulous patients wearing both maxillary and mandibular conventional complete dentures composed the sample. Data were collected regarding shape and resiliency of the mandibular residual ridge. Dentures were assessed for retention and stability using an objective and reproducible tool. The asso-

ciations between the clinical characteristics of the mandibular alveolar ridge and denture retention and stability were analyzed using chi-square and Fisher exact tests ($\alpha = 0.05$). A significant association between ridge shape and denture stability ($p < 0.05$) was found, while ridge resiliency was significantly associated to denture retention ($p < 0.001$). Based on the results, mandibular ridge shape and resiliency influenced the retention and stability of conventional complete dentures.

Key words: complete denture; denture retention; patient satisfaction

INFLUÊNCIA DA ANATOMIA DO REBORDO MANDIBULAR NO TRATAMENTO COM PRÓTESES TOTAIS CONVENCIONAIS

RESUMO

Visto que indicadores de prognóstico são uma ferramenta importante para a seleção de pacientes a serem tratados com prótese total, este estudo investigou a influência da forma e da resiliência do rebordo alveolar mandibular sobre a retenção e estabilidade de próteses totais convencionais. Noventa e três pacientes edentados portadores de próteses totais superior e inferior compuseram a amostra. Os dados foram coletados quanto a forma e resiliência do rebordo mandibular. As próteses foram avaliadas para a retenção e estabilidade utilizando-se uma ferramenta objetiva e reproduzível. As associações entre as características clínicas

do rebordo alveolar mandibular e retenção e estabilidade das próteses foram analisados por meio dos testes qui-quadrado e exato de Fisher ($\alpha = 0.05$). Observou-se associação significativa entre a forma do rebordo e a estabilidade da prótese ($p < 0,05$), enquanto que a resiliência foi associada significativamente com a retenção ($p < 0,001$). Baseando-se nos resultados, a resiliência e forma do rebordo mandibular influenciaram, respectivamente, a retenção e estabilidade de próteses totais convencionais.

Palavras-chave: prótese total; retenção em prótese total; satisfação do paciente

INTRODUCTION

Successful treatment with conventional complete dentures depends to a great extent on the patient's ability to use the denture. The problem is how to identify, through oral examination, which patients have suitable conditions for denture use¹. Denture stability is defined the resistance of a denture to movement on its tissue foundation, especially to lateral forces as opposed to vertical displacement (termed denture retention)². Patients usually complain less about comfort and retention of the maxillary than of the mandibular denture^{2,3}. The maxillary residual ridge often has a more favorable shape, and

is less resorbed and resilient than its mandibular counterpart. According to Baat et al.,⁴ patient's adaptation to complete dentures is strongly related to the prosthetic condition, which combines denture quality and residual ridge characteristics. Thus, the discrepancy between the dentist's evaluation of denture quality and the patient's subjective judgment may result from inappropriate assessment of the quality of the denture-bearing surfaces⁴. After attending 723 patients seeking complete denture treatment, Fenlon's group concluded that the shape of the residual edentulous ridge influences patients' satisfaction and the use of new dentures^{5,6}.

In another study, denture satisfaction correlated to submandibular/sublingual salivary flow rate, oral musculature characteristics and mandibular ridge shape⁷. Mandibular ridge shape has also been related to masticatory efficiency⁸ and ability⁹. It seems obvious that better ridge shape will result in a more stable and retentive denture, and consequently better patient acceptance. However, some studies have found that residual ridge form has no influence on patient satisfaction^{10,11}. According to a recent review of the literature, studies on this area are equivocal and lack standardized methodologies for direct comparison². Since prognostic indicators are likely to take on increasing importance as a diagnostic tool for selection of patients for implant provision, the need for further research in this area has never been higher². Therefore, the purpose of this study was to investigate whether the shape and resiliency of the mandibular alveolar ridge are related to denture retention and stability using a standardized and reproducible methodology. The research hypothesis is that mandibular ridge anatomy may influence treatment outcome with conventional complete dentures.

MATERIAL AND METHODS

The study was approved by the institution's Research Ethics Committee. All edentulous patients treated at the Prosthodontics Clinic between 2004 and 2009

were invited to participate in this cross-sectional study. After a preliminary examination, patients were excluded if they exhibited xerostomia, severe oral manifestations of systemic diseases or psychological or psychiatric conditions that could influence data collection. In addition, dentures were evaluated by an experienced prosthodontist and patients were excluded if at least one of the following features was inappropriate: extension of the denture base in relation to the optimal available denture bearing area, peripheral seal, border extension, tissue fit, and balanced occlusion in retruded contact position. The sample was composed of 93 edentulous patients (18 male, 75 female), mean age 65.6 years (SD \pm 9,2) wearing both mandibular and maxillary dentures for at least two months and less than 5 years. After providing informed consent, patients answered a personal information questionnaire (name, address, phone number, age, gender). Data were collected regarding shape (Cawood and Howell classification¹²) and resiliency⁷ of the mandibular residual ridge (Table 1). The factors and criteria for evaluation of retention and stability of the mandibular denture were set up according to Sato et al.¹³ (Table 1). Data were collected by a single examiner to avoid inter-examiner variability. Prior to the clinical examinations, the examiner participated in the calibration process, which was divided into theoretical

Table 1: Clinical assessment of the oral condition and denture quality.

| Parameter | Classification | Description |
|--|------------------------------|---|
| Ridge shape (Cawood and Howell classification) ^{5-7,12} | Class I | Dentate |
| | Class II | Immediately post extraction |
| | Class III | Well-rounded ridge form, adequate in height and width |
| | Class IV | Knife-edge ridge form, adequate in height and inadequate in width |
| | Class V | Flat ridge form, inadequate in height and width |
| | Class VI | Depressed ridge form, with some basal loss evident |
| Ridge resiliency ⁶⁻¹¹ | Resilient | Firm, attached mucosa resistant to palpation |
| | Flabby | Mobility of ridge crest on palpation |
| Denture retention ¹³ | Displacement with difficulty | Does the denture dislodge with vertical pulling on central incisors after these are dried with gauze? |
| | Easily displaced | |
| Denture stability ¹³ | Normal tissue displacement | Is there movement induced by index and middle finger pressure on the molar teeth? (First, a direct pressure is applied equally on both sides; then a direct pressure is applied first on one side and then on the other; and then a rotational force is applied.) |
| | Some instability | |
| | Shifted | |

discussions of codes and criteria for the study, as well as practical activities. Data were processed with SPSS software (V 17.0 for Windows, SPSS Inc, Chicago, IL, USA). The associations between the clinical characteristics of the mandibular alveolar ridge and denture retention and stability were analyzed using chi-square and Fisher exact tests. Confidence level was set at 95%.

RESULTS

The ridge resiliency was classified as flabby in 62 patients (63.3%) and resilient in 31 patients (31.6%). According to Cawood and Howell's classification¹², seventy ridges were Class III (75.3%), 15 were Class IV (16.1%), and 8 were Class V (8.6%). Seventy-three mandibular dentures were easily displaced (78.5%), while 20 were displaced with difficulty (21.5%). Regarding denture stability, 43 were within normal tissue pattern (46.2%), 27 had some instability (29%), and 23 shifted (24.7%). Mandibular ridge shape was significantly associated to denture stability ($p < 0.05$), but did not influence denture retention (Table 2). Ridge resiliency was significantly associated to denture retention ($p < 0.001$), but not to denture stability (Table 3).

DISCUSSION

The results of this study support the research hypothesis that mandibular ridge anatomy may influence treatment outcome with conventional complete dentures. Mandibular ridge shape was significantly associated to denture stability ($p < 0.05$). Eighty-two percent of the dentures that shifted during the stability test were associated to a flat ridge (Class V). In addition, ridge resiliency was associated to denture retention ($p < 0.001$). Direct comparison of these results to other studies was not possible because no study with the same purpose was identified. However, these results corroborate previous findings regarding the influence of ridge shape on patient satisfaction^{6,7} and the use of new dentures⁵. Fenlon's group observed a strong influence of ridge shape on mandibular denture stability and security which in turn strongly influenced jaw relations^{5,6}. This was shown to have a significant influence on usage of and satisfaction with new dentures^{5,6}.

It was expected that the shape and resiliency of the mandibular ridge would influence both denture retention and stability. However, ridge shape was associated only to denture stability ($p < 0.05$), but not to retention. In addition, ridge resiliency was

Table 2: Relationship between the shape of the mandibular ridge and denture stability and retention.

| Ridge shape | Denture stability* | | | | | | Denture retention | | | |
|-------------|----------------------------|----------------|------------------|----------------|------------|----------------|------------------------------|----------------|---------------------|----------------|
| | Normal tissue displacement | Expected count | Some instability | Expected count | Shifted | Expected count | Displacement with difficulty | Expected count | Easily displacement | Expected count |
| Class III | 12 (12.9%) | 10.2 | 6 (6.4%) | 4.8 | 2 (2.2%) | 5 | 13 (14%) | 15.1 | 57 (61.3%) | 54.9 |
| Class IV | 14 (15.1%) | 13.4 | 5 (5.3%) | 2.6 | 2 (2.2%) | 5 | 4 (4.3%) | 3.2 | 11 (11.8%) | 11.8 |
| Class V | 17 (18.3%) | 18.1 | 16 (17.2%) | 15.7 | 19 (20.4%) | 18.2 | 3 (3.2%) | 1.7 | 5 (5.4%) | 6.3 |
| Total | 100% | | | | | | 100% | | | |

* Significantly associated to ridge shape ($p < 0.05$)

Table 3: Relationship between the resiliency of the mandibular ridge and denture retention and stability.

| Ridge resiliency | Denture retention* | | | | | Denture stability | | | | |
|------------------|------------------------------|----------------|------------------|----------------|----------------------------|-------------------|------------------|----------------|------------|----------------|
| | Displacement with difficulty | Expected count | Easily displaced | Expected count | Normal tissue displacement | Expected count | Some instability | Expected count | Shifted | Expected count |
| Resilient | 17 (85%) | 15.7 | 14 (19.2%) | 15.3 | 27 (29%) | 28.7 | 21 (22.6%) | 18 | 14 (15.1%) | 15.3 |
| Flabby | 3 (15%) | 5 | 59 (80.8%) | 57 | 16 (17.2%) | 14.3 | 6 (6.5%) | 9 | 9 (9.7%) | 7.7 |
| Total | 100% | | | | | 100% | | | | |

* Significantly associated to ridge resiliency ($p < 0.05$)

associated to retention ($p < 0.001$), but not stability. These results may be related to the factors and criteria for evaluation of retention and stability. It is possible that the height and width of the alveolar ridge may be more relevant to prevent denture dislodgement under rotational forces, while a resilient ridge prevents dislodgement under vertical forces.

It seems logical to assume that better ridge shape would promote improved retention and stability, and consequently better patient acceptance². However, some studies have found contradictory results^{10,11}. Celebic et al.¹⁰ concluded that patients rated as having the best mandibular ridge shapes were the least satisfied with their new lower denture, and those given the best rating for maxillary ridge shape were more satisfied with their upper denture¹⁰. Another study examined a sample of 130 patients and found no influence of physical condition of the mouth on patients' satisfaction¹¹. These contrasting results may be related to differences in the methodologies used to assess retention and stability, as well as the criteria adopted for ridge shape classification. Our study used clear, direct criteria for objective assessment of the functional factors of a dental prosthesis¹³. The method proposed by Sato et al.¹³ has been shown to be broad, trustworthy, reliable and reproducible¹³. Assessment of the ridge shape followed the classification proposed by Cawood and Howell.¹² This ridge classification system has been used in previous studies which reported similar results⁵⁻⁷.

According to Batt et al.,⁴ successful treatment with conventional complete dentures depends on both denture quality and oral conditions. Thus, it is reasonable to conclude that patients' rating of technically appropriate dentures may be low due to their residual ridge characteristics. The American College of Prosthodontists has developed a classification system for complete edentulism that is based on specific diagnostic criteria, such as mandibular bone height, morphologic features of the maxil-

lary residual ridge, mandibular muscle attachment and maxillomandibular relationship. Edentulism is divided into 4 levels of difficulty or complexity, and the highest level designates patients who require the most difficult degree or complexity of treatment¹⁴.

Several factors other than a patient's oral conditions may also influence denture retention and stability. Stability can be further improved with precise linear centric occlusion¹⁵. Denture instability may be caused by oblique forces during functional and parafunctional activities as well as errors during the recording of maxillo-mandibular relations^{1,5}. Inadequate intermaxillary relationship may have a negative impact on denture retention¹⁶. In addition to the dentist's technical skills and clinical expertise, the patient's psychological profile may influence treatment outcome¹⁶. Psychological evaluation should be carried out to determine patient's attitudes regarding denture use². Patients with a negative opinion of their dentures are often less satisfied.¹¹ In addition, subjects with no previous experience of dentures are less satisfied than those who have already worn one or more pairs of dentures².

To summarize, using a standardized and reproducible methodology, this study showed that mandibular ridge anatomy may influence treatment outcome with conventional complete dentures. The shape of the mandibular ridge may influence denture stability, while ridge resiliency may influence denture retention. Prognostic indicators are likely to take on increasing importance as a diagnostic tool for selection of patients for implant provision. Previous studies done in this area are equivocal and lack standardized methodologies for direct comparison². However, it must be emphasized that successful prosthodontic therapy is likely to be multifactorial, and the clinical characteristics of alveolar ridges alone may not predict treatment outcomes⁴.

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