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Review article

Effectiveness of denture space recording method in the prosthetic treatment of edentulous patients

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Abstract

Purpose: To present a clinical rationale for the effectiveness of denture space recording methods for the prosthetic treatment of edentulous patients through a review of the literature.

Study selection: A total of 3167 studies were extracted from a search of four terms, namely denture space, neutral zone technique, flange technique, and piezography using PubMed and J-STAGE databases. A total of 57 documents that matched the inclusion and exclusion criteria were selected.

Results: From the extracted articles, the clinical application of denture space recording methods was found to be effective in edentulous patients with severe ridge resorption. The relationship between the labiolingual and buccolingual pressure in patients with neuromuscular problems or with mandibular or lingual defects differs from those without it, so a stable prosthesis can be easily fabricated by locating the neutral zone using denture space recording methods.

Conclusions: The literature on denture space recording methods suggests that its application on challenging cases of edentulous patients is useful in providing prostheses with improved retention and stability.

Keywords: Denture space recording method, Neutral zone technique, Flange technique, Piezography, Edentulous patient

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1. Introduction

The proportion of older people worldwide is increasing. By 2050, global projections indicate that there will be more than twice as many persons over 65 as those under 5, and that the former will surpass the number of those aged 15 to 24 years [1]. It has been estimated that 7%–69% of the adult population worldwide will be completely edentulous [2]. It is recognized that the absorption of the residual ridge in edentulous patients progresses over time. The fabrication of complete dentures for edentulous patients with a high degree of residual ridge absorption can be clinically difficult. There is an increasing possibility of encountering such challenging cases in daily dental practice due to our unprecedented super-aging society [6, 7].

Denture space recording methods are effective for complete denture construction in edentulous patients with a high degree of residual ridge resorption [8–12]. However, there is a worldwide need to review this method for the treatment of such cases [13, 14]. Gahan et al. [13] described this method as an alternative approach for the construction of lower complete dentures and it is the most effective method for dentures

with a highly atrophic ridge and a history of instability. This technique is by no means new; however, it remains valuable. Cagna et al. [14] reported that providing complete denture therapy to patients with atrophic residual alveolar ridges is challenging because, physiologically, optimal denture contours and appropriate denture tooth arrangement should be accomplished to maximize prosthesis stability, comfort, and function. Denture-space recording methods are effective in addressing these problems. Such methods include the neutral zone technique developed by Beresin et al. [15] to record the neutral zone reported by Lammie [9], the flange technique developed by Lott et al. [16] based on the principle of Fish [8], and piezography developed by Klein [17].

The purpose of this study is to present a clinical rationale for the effectiveness of denture space recording methods in the prosthetic treatment of edentulous patients through a review of literature.

2. Methods

In this study, PubMed and J-STAGE databases were used to search the literature. The search terms were denture space recording, neutral zone technique, flange technique, and piezography. The inclusion criteria were articles published in English related to edentulousness. The exclusion criteria were non-English articles with irrelevant content.

The results are discussed in three sections: literature search, research on denture space recording, and clinical applications.

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3. Results

3.1. Searching of the literature

Figure 1 displays a flowchart of the literature search. A total of 2302 articles were extracted by searching for four terms in PubMed: denture space recording (108 articles), neutral zone technique (1341 articles), flange technique (823 articles), and piezography (30 articles). A total of 865 articles were extracted by searching the four terms in J-STAGE: denture space recording (83 articles), neutral zone technique (14 articles), flange technique (755 articles), and piezography (13 articles). As this study focuses on edentulous patients, the literature was researched by adding the term "edentulous" to the literature extracted from these four terms. A total of 151 articles were extracted from PubMed: denture space recording (54 articles), neutral zone technique (47 articles), flange technique (43 articles), and piezography (7 articles). A total of 94 articles were extracted from J-STAGE: denture space recording (42 articles), neutral zone technique (13 articles), flange technique (34 articles), and piezography (5 articles). After applying the exclusion criteria for all 245 documents, a total of 55 articles were extracted from PubMed: denture space recording (10 articles), neutral zone technique (40 articles), flange technique (2 articles), and piezography (3 articles). A total of eight articles were extracted by searching the four terms in J-STAGE: denture space recording (2 articles), neutral zone technique (3 articles), flange technique (3 articles), and piezography (0 articles). Finally, 57 articles, excluding 6 duplicate articles from a total of 63, were determined to be appropriate for this research.

3.2. Research regarding denture space recording

3.2.1. Reproducibility of the denture space

Many studies on denture spaces have been conducted [18–34]. Karlsson et al. [18] reported that differences in the flange form measurements and the distances between the impressions were small. Reproducibility was considered clinically acceptable. However, there were significant differences in the flange form of measurement regarding the distances between the various materials and the methods of application of the materials. Morikawa et al. [19] evaluated the reproducibility of the area and morphology of the denture space. They concluded that the reproducibility of repeated recordings by the same dentist was remarkably high. Consequently, the buccolingual central line was located on the labiobuccal side of the ridge crest in most cases. Masumi et al. [20] examined the reproducibility of denture spaces using wax which they reported was inferior, unless the temperature was properly controlled.

3.2.2. Position of the denture space

There are several reports related to the central line of the denture space and ridge crest line [21–27]. Demirel et al. [21] evaluated the relationship between tooth arrangement according to the neutral zone principles and the ridge crest. They reported that the lower molars were positioned slightly closer to the lingual side of the ridge crest, and the premolars were positioned either close to or coincided with the ridge crest. Raja et al. [22] stated that denture space may lingually shift in relation to the alveolar ridge crest in patients with prolonged edentulousness. Jain et al. [23] also reported that as edentulousness increases, there is more lingual positioning of the neutral zone at the molar region of both sides of the arch. There was no change in the position of the neutral zone in the premolar region. In contrast, Ikebe et al. [24] reported that the buccolingual central line of the denture space was located on the buccal side of the alveolar ridge crest. Birtles et al. [26] evaluated the anterior mandibular labiolingual neutral zone position in edentulous patients with and without their maxillary dentures in situ. They concluded that the presence of the maxillary denture led to no statistically significant mean difference in the labiolingual position of the mandibular denture space. Porwal et al. [27] stated that the distance and direction of denture space in relation to the residual ridge crest in edentulous patients had no significant relationship with factors such as age, sex, or period of edentulism.

Fig. 1. Study flowchart: extracting the literatures.

3.2.3. Comparison of dentures fabricated using various methods

Makzoumé [28] morphologically compared the phonetic denture space with the swallowing denture space and found that the latter was located lingually to the former. Ladha et al. [29] evaluated the electromyographical (EMG) activity of the orbicularis oris and buccinator muscles in patients wearing complete dentures, which were fabricated using the swallowing and phonetic denture spaces. They reported that both muscles' activities did not differ significantly, irrespective of the technique used for complete denture fabrication. Ladha et al. [30] also evaluated patient satisfaction with complete dentures fabricated using the swallowing and phonetic denture spaces. They confirmed that the dentures fabricated using the swallowing denture spaces were preferred by patients in terms of esthetics, stability, comfort, and mastication. Geerts [31, 32] examined the quality of life of patients using dentures fabricated using the conventional method and the denture space recording method. The results showed that there was no difference between the two dentures. Rehmann et al. [33] investigated speech sound production with dentures fabricated using the conventional method and the denture space recording method. They concluded that there was no difference between the two dentures. Al-Magaleh et al. [34] compared patient satisfaction with dentures fabricated using the conventional method and the denture space recording method. They found that the latter offered significantly higher levels of patient satisfaction than the former in terms of all function (retention, stability, mastication, and speech), as well as comfort and appearance.

3.3. Clinical applications

3.3.1. Applicable cases of denture space recording

There have been many studies on the application of denture space recording methods. The majority of these reported that they are highly effective in providing denture stability [35–54]. The clinical applications of denture space recording methods were classified into those related to unstable complete dentures [35–40], neuromuscular problems [41–44], and maxillofacial defects [45–54] (Table 1).

3.3.2. Materials and alternative techniques for denture space recordings

Traditionally, modeling compounds [14], zinc oxide eugenol impression materials [14], wax [15], and soft impression materials [16] have been used as materials for denture space recordings. Kursoglu et al. [55] used a dynamic impression material, Shanker et al. [56] used a hydrocolloid impression material, and Agrawal et al. [57] used an elastomeric impression material to record the denture space.

Romero et al. [58] stated that it was better to reduce the wax-rim thickness when the denture space was recorded using phonetics as the conventional wax-rim made it difficult to pronounce words. Koli et al. [59] used transcutaneous electrical nerve stimulation to record the denture space. Ohkubo et al. [60] described denture fabrication methods that combined piezography with CAD/CAM.

Table 1. Clinical application of denture space recording methods.

Application	Author
Related to unstable complete denture	
severe mandibular ridge resorption	Lynch [35], Chandra [36], Rehmann [37], Ladha [38]
oral submucous fibrosis	Afroz [39]
mandibular fracture	Shinohara [40]
Related to neuromuscular problems	
neurological disorders	Karkazis [41]
Parkinson's disease	Makzoum [42]
neuromuscular incoordination	Sadighpour [43], Saravanakumar [44]
Related to maxillofacial defects	
maxillary defects	Masumi [45], Wee [46], Makiyara [47]
mandibulectomy	Masumi [48], Pekkan [49], Patil [50], Halim [51]
glossectomy	Ichikawa [52], Ohkubo [53], Awuti [54]

4. Discussion

4.1. Searching of the literature

Regarding the literature search, we first searched for four terms: denture space recording, neutral zone technique, flange technique, and piezography. As the neutral zone technique, flange technique, and piezography were all included in denture space recording, we initially considered summarizing the results of each technique. However (Fig. 1), we altered our strategy because there are very few studies related to the flange technique and piezography. Furthermore, the evidence of this review article is low as most of the extracted literature were case reports.

4.2. Research regarding denture space recording

Denture space recording can be classified into three research areas related to the: reproducibility of denture space, position of denture space, and functional movements. The morphology obtained by this method is affected by the materials used, the function to be adapted, and the pressure required. According to this review, it was assumed that the duplicability of the denture space was substantially reproducible when the same dentist applied the same material. However, reproducibility was reduced when other materials were applied, even for the same dentist [18, 19]. In addition, according to a study on the relationship between the central line of the denture space and the crest of the ridge line, there was no significant difference between the anterior teeth and the premolars. However, among the molars, the denture space was different from that of the crest of the ridge line: one on the lingual side, one on the buccal side, and so on [21–27]. The purpose of denture space recording is to increase the retention of the denture by reducing the lateral pressure applied on the denture from the surrounding tissues as much as possible. Therefore, the reason for the variation in the central line of the denture space may be that the labial, buccal, and lingual pressures differ from patient to patient. Furthermore, the functional movements applied during denture space recording are different. It has also been reported that dentures fabricated using this method have a high patient satisfaction rating [31, 32, 34].

4.3. Clinical applications

From several articles on clinical applications, the denture space recording method can be considered a highly effective method for fabricating dentures for edentulous patients with severe ridge resorption [35–38]. The relationship between the labiolingual and buccolingual pressure differs in patients with neuromuscular problems [41–44] or with mandibular or lingual defects [45–54], so a stable prosthesis can be easily fabricated by locating the neutral zone using denture space recording method.

5. Conclusion

In this study, we reviewed the literature on the effectiveness of denture space recording methods for the prosthetic treatment of edentulous patients. It has been clinically supported that adding a denture space recording method to the conventional denture fabrication process can improve retention, stability, and patient satisfaction in edentulous patients with a high degree of alveolar resorption and ill-defined alveolar ridge crest. Additionally, applying this method to patients with neuromuscular problems and maxillofacial defects, which are challenging cases that are expected to increase in the future, leads to a significantly positive result by providing a prosthesis with improved retention and stability. Future studies are needed to elucidate the effectiveness of denture space recording methods in the prosthetic treatment of edentulous patients.

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Conflict of Interest

The authors declare no conflict of interest.

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