

COMPLETE REMOVABLE PROSTHETIC REHABILITATION USING THE PIEZOGRAPHY TECHNIQUE

Neada Hysenaj^{1,2*}, Endrit Paparisto¹, Tedi Verçani¹, Edit Xhajanka^{1*}, Edlira Mulo¹, Alketa Qafmolla¹, Blerta Lila¹

¹Faculty of Dental Medicine, University of Medicine, Tirana, Albania.

²University Dental Clinic, Tirana, Albania. neada.hysenaj@umed.edu.al

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ABSTRACT

Edentulism is a concern worldwide, where the main focus remains restoring the function, phonetics, and proper aesthetics in edentulous patients. This is a case report of a totally edentulous patient who came to the University Dental Clinic, Tirana, intending to replace the old dentures with new ones. The patient was unsatisfied with the existing dentures, which she had worn for 7 years. She also had TMJ discomfort and TMJ clicking. Complete removable dentures using the piezography technique and with adjusted vertical dimension were constructed. The patient completed the OHIP EDENT questionnaire before and after the new dentures. The OHIP EDENT questionnaire was translated into Albanian using the forward and backward translation. A clinical examination was also conducted to evaluate the parameters of the new dentures. Based on the results of the completed OHIP EDENT questionnaires, before and after new dentures, and based on the clinical examination, an improvement in retention, function, comfort, social and psychological aspects, phonetics, and aesthetics was observed. After the new denture delivery, an improvement in the quality of life of the patient was observed. TMJ symptoms were also relieved. This is a clinical case report where the advantages of the piezography impression are identified. This technique is especially important in complex clinical cases with severe resorption of the residual ridge, in post-surgical conditions, and in patients with neuro-muscular diseases.

Key words: Total removable denture, Piezography, Neutral zone, Third impression, OHIP EDENT, Questionnaire.

Introduction

Although there has been development in the field of implantology, the proportion of fully edentulous patients receiving implant-supported prosthetic restorations remains low [1]. Complete removable dentures remain an important treatment for the rehabilitation of edentulous patients. It is also important that clinicians have adequate experience in prosthodontic treatment to achieve maximal results [2]. Among the advantages the total removable dentures have, the main disadvantage is the lack of necessary stability and retention of these prosthetic restorations, especially in the lower jaw [3]. Several methods and materials have been used to overcome these disadvantages [4-8]. One of the techniques is through the third impression or piezography impression. It was Fish *et al.* [9] who primarily introduced the concept of the neutral zone. After teeth extraction, the organs that surround this area are called peri-prosthetic organs. If the denture fulfills the neutral zone, the musculature around the denture supports it, instead of dislodging it. In this area, there is an equilibrium of forces: the forces applied from inside toward outside, mainly from the tongue muscles, are neutralized by the forces applied from outside in the inner direction, by the lips and cheeks. The neutral zone evolves with time, perhaps as a result of bone resorption and muscular adaptation. The most challenging cases are the clinical cases with severe resorption of the residual ridge. The highest grade of resorption occurs in the first years, but continues in a progressive way through the years [10]. Bhorgonde *et al.*

conducted a clinical study where the neutral zone in the mandibular crest is, in many cases, lingually [11]. This is a clinical case, where we have described the detailed clinical steps, and also the OHIP EDENT in the Albanian language has been used as an assessment, along with the clinical examination, to determine the outcomes of the new total removable dentures.

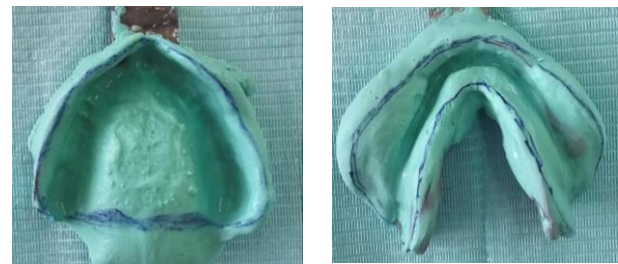
Materials and Methods

A 68-year-old totally edentulous patient came to the University Dental Clinic, Tirana. She had had old dentures for seven years. Her main complaints are poor denture stability, esthetic issues, and TMJ discomfort. The patient reported a clear clicking sound in the right temporomandibular joint and mild discomfort, particularly during chewing and wide mouth opening. On clinical examination, the click was consistently detected during both opening and closing phases of mandibular movement, and accompanied by a reciprocal sound during closing. The clicking was reproducible across several consecutive opening-closing cycles, confirming its persistence. Maximum unassisted mouth opening was 38 mm. A slight deviation of the mandible to the right was observed during early opening, which corrected itself after the click. No pain was provoked during mandibular function, although the patient described occasional mild discomfort. Palpation of the joints and chewing muscles did not cause significant pain or tenderness. Based on these findings, the condition was diagnosed as disc displacement with reduction of the

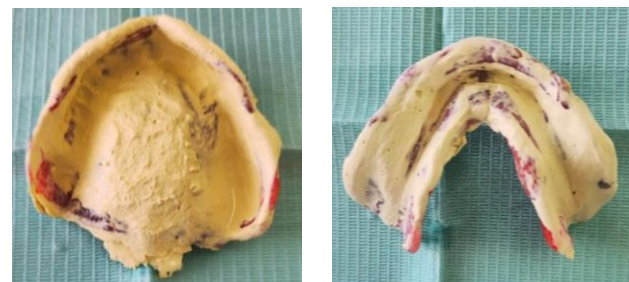
right TMJ, based on DC/TMD criteria [12]. The case was categorised as a patient with minor TMJ alterations according to the Bader classification [13].

During the examination of the existing dentures, the following were detected: decreased height of vertical dimension in centric occlusion, lack of stability and retention, and compromised aesthetics. In the extraoral examination, the following was found: reduced vertical height of the lower third of the face, emphasized nasolabial folds and wrinkles, and lack of lip support, all features that are characteristic of edentulous patients. No signs of discoloration or asymmetry were observed. During the intraoral examination, in the upper arch, based on Atwood classification [14], a Class III Atwood is observed, with a well-rounded residual ridge, a well-defined shape of the palate, factors which predict a good prognosis for the upper denture. In the lower arch, Class IV Atwood was noticed. The tongue was enlarged, and the floor of the mouth relatively high. All these factors contribute to a poor prognosis regarding the stability of the lower denture. The patient did not accept surgical intervention for implant prosthetic fixed or implant-supported dentures. New removable dentures were constructed, this time using the piezography technique. The primary impression was made with alginate (**Figure 1**). The final impression was made with zinc oxide eugenol, with individual trays constructed with photo-polymerizing resin (**Figure 2**). Jaw relation records were recorded, determining and registering all three parameters: occlusal plane, the vertical dimension of centric occlusion, and the centric relation position. New dentures with a vertical dimension 3mm higher compared to the old dentures were constructed, based upon the measurements made with different techniques. The aim was to restore function properly and improve TMD symptoms as well, by improving the quality of life of the patient in general. The face bow was used to record the maxilla's location in relation to the intercondylar axis. Individual data registered with the face bow were used to determine the location of the upper cast on the Bioart articulator. The centric relation was then registered once more and ultimately determined. The lower cast was mounted in the Bioart articulator, based on the recorded occlusion. The piezography impression (**Figure 3**) was made in the centric relation record stage with KERR wax, instructing the patient to smile, whistle, swallow, and to pronounce: SIS, TO, M, D, P, V several times until the material was set. During this procedure, the periprosthetic musculature left its impression. After the procedure, an index of silicone putty was made (**Figure 4**). The KERR wax was replaced with liquid wax, and the artificial teeth were arranged in the registered neutral zone (**Figure 5**). The selection of the teeth was made through the facial indicator and the measurement of the ala-nose distance, identifying the size and shape of the artificial teeth. The color of the teeth was determined based on the color of the face and hair, and based on the preferences of the patient. The artificial teeth were aligned, ensuring bilateral balanced occlusion. In the try-in stage, the centric relation, phonetic, and aesthetic

were controlled. Some minor aesthetic adjustments were made. Then, the flasking and polymerization cycle was done. In the insertion stage (**Figure 6**), the centric occlusion was again checked, and the interferences were eliminated. The patient was rescheduled the day after, after one week, 2 weeks, 4 weeks, 12 weeks, and after 6 months. The patient fulfilled the OHIP-EDENT [15] questionnaire in the Albanian language related to the parameters of the denture and the overall satisfaction [16-23].



a) b)
Figure 1. Primary impressions



a) b)
Figure 2. Final impressions



Figure 3. Piezographic impression



Figure 4. Silicone putty



Figure 5. Artificial teeth in the neutral zone



Figure 6. Insertion stage

Results and Discussion

After 4 weeks of evaluation, TMJ symptoms were relieved. The patient fulfilled the OHIP-EDENT questionnaire for the old and new dentures, with the possible answers: Never (0), hardly ever (1), occasionally (2), fairly often (3), very often (4).

The patient's total OHIP-EDENT score before treatment was 64 points, which decreased to 14 after treatment (**Table 1**), corresponding to a 78,1 % reduction in the negative impact on oral health-related quality of life (OHRQoL). Based on the patient's answers, the following results are obtained: significant improvement in comfort, stability, and retention, as well as an enhanced psychological aspect, social life, and well-being, all of which contribute to increasing the patient's quality of life. The patient also reported the absence of TMJ clicking. The above parameters were also confirmed clinically.

Table 1. The mean domain score of OHIP EDENT before and after denture replacement

Domain	Mean Before (Old Dentures)	Mean After (New Dentures)
Functional Limitation	3.5	1.0
Physical Pain	3.0	0.5
Psychological Discomfort	3.5	1.5
Physical Disability	4.0	1.67
Psychological Disability	3.67	0.67
Social Disability	2.33	0.0

Handicap

3.5

0.5

OHIP EDENT [15] is a short form of the full OHIP [24] and contains 19 questions. It has shown a similar reliability to full OHIP-49, but it is simpler and easier to use in edentulous patients. El Osta *et al.* [25] made a comparison between the three instruments, as measuring components for edentulous patients: OHIP EDENT, GOHAI [26], OHIP-14 [27]. In the study of El Osta *et al.* 2021 edentulous patients were included, and based on the statistical evaluations, OHIP EDENT was concluded to be the more accurate instrument in determining oral and denture problems in edentulous patients. Iwaki *et al.* [28] used two instruments to compare traditional dentures vs 3D printed dentures: the OHIP EDENT and the VAS scale to express the general satisfaction of the patient. In our study, the OHIP EDENT questionnaire was translated into Albanian with the forward and backward translation. This is a case of total removable prosthetic rehabilitation of an edentulous patient. One of the factors that causes TMJ clicking might be the decrease in the vertical dimension over the years, due to a lack of occlusal support and jaw overload. The adjusted vertical dimension has been one of the factors that might relieve TMD symptoms, which has also been analyzed in literature [29]. The neutral zone is a zone that is often neglected while constructing total removable dentures [30]. Piezography can be applied during the try-in phase, centric relation, or functional impression phase. When using a functional impression, a base is typically made of photopolymerizing resin, and the impression material is placed over the base of each individual tray with mechanical retention, indicating the location of the artificial teeth and the occlusal rims. If it is registered in the centric relation stage, the impression material is positioned over the base constructed over the master cast, as in our study. After a pattern of silicone or plaster is constructed to keep the registration. The impression material is removed, and generally it is replaced with melted wax to make the occlusal rims. When it is done in the try-in stage, in order to record the external surface, the material is positioned on the outside surface of wax dentures, the vestibular and oral area. The pattern is created to record the obtained impression. During the piezography procedure, functional movements are instructed to the patient and phonetic exercises [31-33]. During these movements, the periprosthetic musculature leaves its impression. The materials that are used should harden slowly, so there is enough time for the necessary movements, and should not be excessively fluid. In literature, the most used materials for the third impression are: condensation, additional silicone, elastic resin, tissue conditioner, and Kerr wax. In the literature, there is a lack of data related to the impact on the quality of life of complete removable dentures constructed with the piezography technique, compared with the traditional complete denture. Geerts *et al.* [34] conducted a study where 35 patients received two types of dentures: traditional dentures and dentures constructed with the third impression. The authors used OHIP EDENT for both groups. A

significant difference in oral health-related quality of life was observed before and after treatment, while a small difference found between the two groups. Soliman *et al.* [35] conducted a study with 12 patients, each of whom received a CAD-CAM denture with the normal workflow and dentures constructed with the third impression technique incorporated. A significant difference was found between the two groups related to patient satisfaction. Also, a significant difference was found between the anatomy of the two types of dentures. Medit compare software was used to evaluate the three-dimensional comparison of the teeth position and denture borders. Choi *et al.* [36] presented a case report in which the neutral zone technique was registered with CAD-CAM record bases for the construction of removable dentures in an edentulous patient with severely resorbed alveolar ridges, resulting in fact in a stable neutral zone registration, accurate jaw relation, and also an improved denture stability through optimal arrangement of the artificial teeth and polished surfaces as well. Birtles *et al.* [37] made a study, where they analyzed whether the presence or the absence of the upper denture in situ influences the outcome of the mandibular neutral zone, exactly the anterior neutral zone of the lower denture. They concluded that the presence or absence of the upper denture did not affect the location of the labiolingual mandibular neutral zone. The piezography impression is especially indicated in the clinical cases with severe resorption of the residual ridge, flabby ridges [38], unfavorable anatomic features, and patients after surgical conditions such as partial glossectomy [39], patients with neuromuscular disorders, Parkinson's disease [40, 41], or damage to the motor nerves.

In the review of Limpuangthip *et al.* [42], the existing literature supports the fact that the patients' preference is higher when treated with complete dentures with piezography impression compared to traditional dentures. Also, in the review of Masumi *et al.* [43], the authors concluded that the registration of the neutral zone, in difficult prosthetic clinical cases, increases retention and stability. Although the evidence is low, further research is suggested in this regard.

Conclusion

This is a case report that emphasizes the effectiveness of using the piezography technique in the construction of complete removable dentures, especially in clinical cases with total edentulism and with severe resorption of the residual ridge, where the prognosis of traditional total removable dentures is predicted to be low. Based on current evidence, the piezography technique increases the dentures' stability, retention, patient comfort, and improves the social and psychological aspects and patient quality of life. Further research is suggested to evaluate and compare the efficacy with traditional dentures.

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Conflict of interest: None

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Ethics statement: This case report is part of a larger project, which has received approval from the Ethical Board of the University of Medicine, Tirana, Nr. 28, date 29.08.2024. Written informed consent has been obtained from the patient.

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