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Application of piezography in the treatment of total mandibular edentulism in the elderly: case report

Zastosowanie piezografii w leczeniu całkowitego bezzębia żuchwy u osób starszych: opis przypadku

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Summary

The treatment of a completely toothless mandibular arch represents a big challenge in the field of dentistry, especially when bone resorption is considered in the case of patients who remained without oral rehabilitation for a long period.

The fabrication of a complete denture which would meet the requirements of prosthetic stability retention and comfort is often difficult. Even in the era of dental implantology, piezographic technique (impression and registration) remains an excellent option to overcome prosthetic instability due to the inevitable narrowing of the prosthetic corridor. The use of the neutral zone by piezographic recording leads to obtaining a complete denture respecting the physiology of the paraprosthetic organs and a better organization of the prosthetic teeth.

The aim of this clinical report was to present, according to a didactic approach, the

Streszczenie

Leczenie całkowicie bezzębnego łuku żuchwy stanowi duże wyzwanie w dziedzinie stomatologii, zwłaszcza gdy bierzemy pod uwagę resorpcję kości u pacjentów długotrwale pozbawionych rehabilitacji jamy ustnej.

Wykonanie protezy całkowitej spełniającej wymagania w zakresie retencji i stabilizacji oraz komfortu użytkowania jest często trudne. Nawet w dobie implantologii stomatologicznej technika piezograficzna (wycisk i rejestracja) pozostaje doskonałą metodą przezwyciężenia tych problemów, spowodowanych nieuniknioną resorpcją kości. Wykorzystanie strefy neutralnej poprzez zapis piezograficzny pozwoliło uzyskać protezę całkowitą wydolną funkcjonalnie.

Celem niniejszego doniesienia klinicznego było przedstawienie, w ujęciu dydaktycznym, etapów protetycznych wykonania protezy całkowitej rekonstruującej resorbowany bezzębny łuk

prosthetic steps to fabricate a complete denture rehabilitating a resorbed toothless mandibular arch, using the piezographic impression and recording techniques.

żuchwy, z wykorzystaniem wycisku piezograficznego i technik rejestracji.

Introduction

Human aging is a slow, progressive, inevitable physiological phenomenon that leads to a weakening of the organism. It affects all body tissues, including the orofacial sphere. This progressive involution of structures and functions is aggravated by the presence of local and/or general pathologies. Bone tissue is strongly subject to the effects of senescence, with the onset of bone resorption phenomena.[1]

The treatment of a completely toothless arch represents a challenge in the field of dentistry, especially when bone resorption is considered such as the maxillary and mandibular Sangiuolo Class III and mainly the mandibular Sangiuolo Class IV.[2]

Stable prosthesis that restores the various manducatory functions (phonation, mastication and swallowing) requires specific and meticulous management during all the clinical and laboratory prosthetic stages. Unlike the maxilla, in the mandible a large support surface is reduced not only by the presence of the tongue, but also the resorption, which is amplified with age by the migration of the insertions of the surrounding muscles following edentulism. Hence the interest in piezography at the mandibular level.[3]

Piezography consists in recording the neutral space, a space that the muscles remember even after tooth loss. The literature on neutral space registration techniques has concluded that their application results in more stable dentures.[4,5] However, a few case reports have presented the practical modality of this piezographic registration in a didactic way.

The aim of this article was to present, according to a didactic approach, the prosthetic steps to fabricate a complete denture rehabilitating a resorbed toothless mandibular arch, using the piezographic technique.

Case presentation

A 64-year-old female patient, hypertensive and diabetic, was referred to the department of removable prosthodontics at the Dental Clinic of Monastir for a prosthetic rehabilitation. Her main chief complaint was functional with chewing disability and phonation difficulties. The patient reported that she had never had a removable denture.

Endobuccal examination revealed a Class II Kennedy Appelgate partial edentulism in the maxilla bordered by the left second premolar. The edentulous ridges were moderately high and covered by thin, adherent fibromucosa. The mandible was completely edentulous, with Sangiuolo Class III (Fig. 1).

Radiological examination showed that the radiological crown to root ratio was moderately favourable (RC/RR=1) in the maxilla (Fig. 2).

After discussion with the patient, who expressed financial limitations and a wish to have stable prostheses, the prosthetic decision was to make a maxillary metallic removable partial denture and a mandibular complete denture. Piezographic technique was used to fabricate the lower prosthesis in order to optimize the stability of the mandibular prosthesis and to satisfy the patient's requirements.

The prosthetic steps started with the fabrication of a lead wire on a model derived

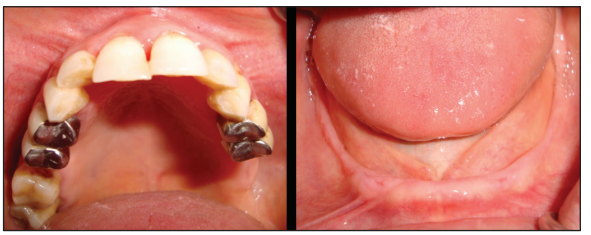

Fig. 1. Oral condition at consultation.

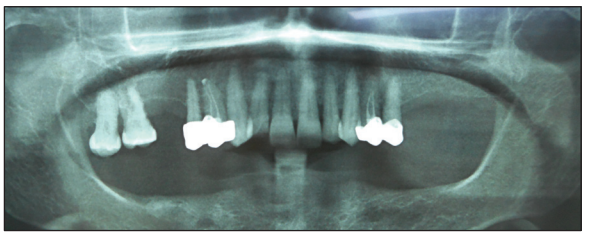

Fig. 2. Panoramic radiography.

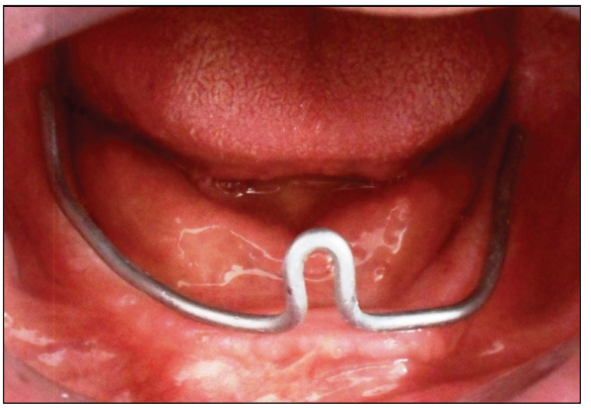

Fig. 3. Fitting of a shaped lead wire adapted to the edentulous ridge.

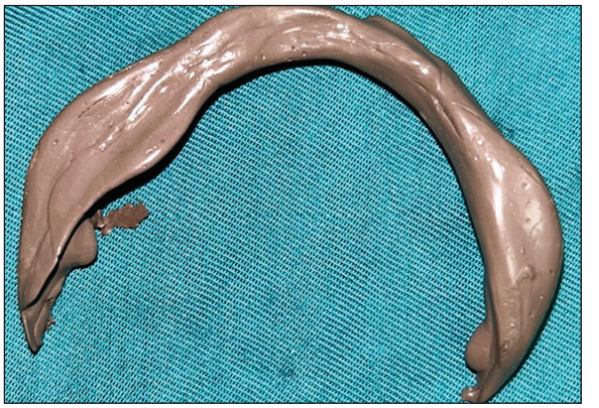

Fig. 4. Final piezographic impression.

Fig. 5. The model obtained by casting the piezographic impression.

Fig. 6.The secondary impression.

from a preliminary alginate impression. This wire was then adjusted in the mouth, to fit the shape of the edentulous ridge and be in intimate contact with it. An anterior grasping loop was created. This must not come into contact with the peripheral elements, so as not to destabilize the wire. The fit of the two posterior loops on the eminences was checked to ensure that the material was well supported and to record the bearing surface at this level (Fig. 3).

The piezographic impression was made as follows.First, the wire was coated with the polysulfide on the eminences, using maximum opening, swallowing and tongue mobilization movements. Then, the patient was asked to swallow and to pronounce the posterior modelling phonemes ‘sis’ and ‘so’. The anterior sector was modelled by pronouncing the phonemes ‘se’, ‘te’ and ‘de’ and by swallowing. To have a better registration of the bearing

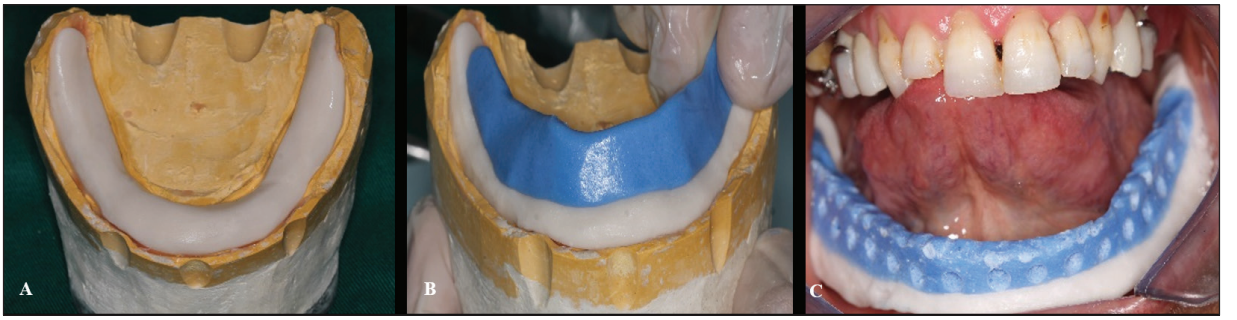

Fig. 7. The steps of making the piezographic recording. A – The resin base; B – The piezographic wall; C: Making retention mean for the piezography material.

Fig. 8. Phonetic piezography recording.

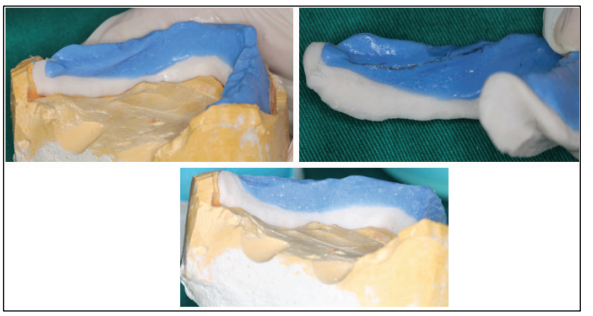

Fig. 9. Determination of the piezographic occlusion plane.

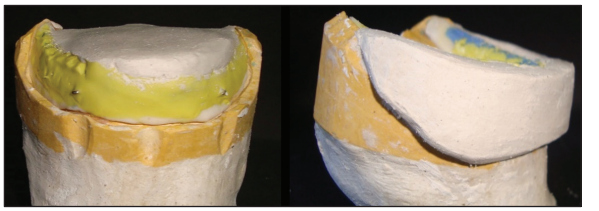

Fig. 10. Making vestibular and lingual plaster keys.

surfaces, the entire recording was surfaced with polysulfide, performing all the movements executed in the previous steps. Thus, the piezographic impression was obtained (Fig. 4).

Casting this piezographic impression produced a piezographic model (Fig. 5) on which an individual impression tray with acrylic base was made and fitted in the mouth. The latter was used as the support for a secondary impression: a peripheral seal sector by sector was done. Then it was followed by taking the proper impression with polysulfide (Fig. 4).

The support for piezographic recording of the prosthetic corridor consists of a resin base which supports a thin, perforated wall passing through the middle ridgeline; it was made on the model resulting from the casting of the secondary impression (Fig. 6). This wall was coated with catalyst-free heavy silicone which was supported by the holes. The same movements performed during the piezographic impression were performed again during this recording. The patient was also asked to smile, so that the modiolus impression could be recorded on the vestibular side of this piezogram (Fig. 8).

This recording also made it possible to locate the level of the occlusion plane located in the most sloping part of the lingual impression (Fig. 9).

After making precision grooves in the vestibular and lingual areas of the secondary cast, two plaster keys were made, one vestibular and one lingual (Fig. 10).

Fig. 11. Tooth mounting using the vestibular and lingual keys.

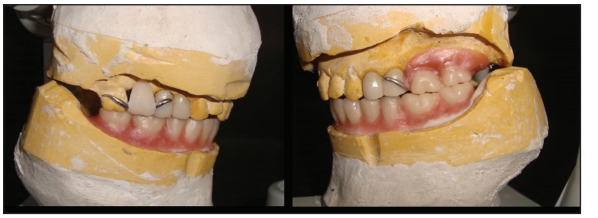

Fig. 12. Maxillary prosthetic teeth mounting.

Fig. 13. Mouth fitting.

Fig. 14. Final prostheses in the mouth.

These two keys delimited the piezographic prosthetic space, and the prosthetic teeth were mounted with reference to these keys (Fig. 11).

The assembly of the maxillary prosthetic teeth was then undertaken (Fig. 12). It should be noted that when recording the occlusion, only the maxillary occlusal rim was modified, given that the occlusion plane was marked during the mandibular piezographic recording.

After fitting the teeth on wax (Fig. 13), the prostheses were polymerized then placed in the mouth with a minimum of edge trimming and occlusal balancing (Fig. 14).

The patient was satisfied with the result. A post-prosthetic maintenance program was then set following consultation with the patient.

Discussion

In the oral cavity, the aging process is most often accompanied by a narrowing of the prosthetic corridor, in line with the extent of bone resorption and the invasion of peripheral elements. In fact, the situation becomes unfavourable for prosthetic rehabilitation with conventional removable prosthetic techniques, which calls for other procedures to improve prosthetic stability.[6,7]

In the case of significant bone resorption in patients who have remained for a long time without prosthetic restoration and when the option of implantology is impossible; the fabrication of a complete denture which would meet the requirements of stability and retention is very difficult. The involvement of piezographic techniques is considerable in these situations since the integrity and stability of the prosthesis are obtained following the recordings of the prosthetic space. This recording will guide the practitioner in prosthetic construction. A well-designed and well-fitted prosthesis also reduces the bone resorption rate.[8]

The neutral space is the area between the muscles of the buccinator-labial strap and the tongue, where the forces exerted by the latter are neutralized and where the prosthesis finds the maximum of stability and retention.[9]

Klein defines piezography as "a technique that allows the molding of a plastic mass by intrinsic pressures, generated by the periprosthetic muscle masses."[12,14]

According to *Nabid* et al., piezography is a technique that offers the three-dimensional reproduction of the mandibular prosthetic space for the totally edentulous patient by using a piezographic model, and that highlights the specific oral muscle tone of the individual.[10]

Piezography is used for both prosthetic and analytical purposes. The prosthetic piezography consists of the techniques used in different stages of treatment: during the impression or the recording of the neutral space. It was the piezography technique that was used in this case.

The fabrication of a mandibular denture, using the prosthetic piezographic technique, begins with a preliminary alginate impression with a Schreinmaker impression tray, the casting of which will produce a preliminary model. On this model, a lead wire will be shaped to support the primary piezographic impression. This technique enables precise registration of the osteomucosal support structures, guided by peripheral muscle dynamics, and therefore prevents compression of these elements, leading to prosthetic overextention and subsequent prosthetic instability.[3] Once the primary piezographic impression has been cast, an acrylic base is applied to the cast for the secondary impression.

The piezographic impression could be taken with different materials such as elastomers (especially medium viscosity polysulfides), silicones, polyether or eugenol zinc oxide.[11]

Klein invented the phonetic piezographic technique by pronouncing the phonemes 'sis' and 'so' in the posterior sector; then the phonemes 'se', 'te' and 'de' in the anterior sector. However, the mixed technique with additional swallowing movements results in stable prostheses by stabilizing and centering the impression. Other movements can be used during this recording according to certain authors such as chewing, sucking, lip pinching, laughing and smiling.[12,13] It is therefore preferable to combine all these techniques to obtain a more stable denture when performing all manducatory functions.[12,13]

Afterwards, an individual impression tray is made on the model resulting from the secondary impression. However, although the secondary impression records the fields of action of the peripheral elements, it does not necessarily include a total peripheral seal, but rather in the areas where there is space, since the prosthetic space has generally been recorded by the primary piezographic impression.

The next step is the piezographic registration. It consists in recording the dental corridor, the corridor in which the teeth will be placed, a space modelled according to the memory of the oral muscles where the teeth will be stable, thus resulting in a stable denture. This requires a base plate made on the secondary model, topped at the ridge line by a thin resin wall or Brill blade bead. The latter will be coated with a heavy silicone without catalyst, sector by sector, preferably with the mixed technique.[11-14] When recording the piezographic prosthetic corridor using the phonetic and swallowing method, the tongue marks its imprint on the inner surface of the piezographic wall, creating a depression in line with the morphology of the lingual margin. In a dentate patient, the occlusion plane is at the same level as the tongue. The dental corridor is thus modelled, and the prosthetic occlusal plane corresponds to the line passing through the most declining points of the registration.[12] However, a classical occlusion registration step is performed. Classically, the maxillary occlusal plane is located and oriented anteriorly and posteriorly. The vertical dimension of the occlusion is measured and the occlusion is recorded. The two models were mounted on an articulator. Besides, two mandibular models were made: one standard with the occlusion plane recorded parallel to the Camper's plane. The other piezographic with the dental space modelled in the mouth and the piezographic occlusion plane.

Masumi et al.[15] conducted a systematic review 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, as well as patient's satisfaction in cases of edentulism with a high degree of alveolar resorption and ill-defined alveolar ridge crest.

Concerning the analytical piezography, it can be used during the wax fitting or on polymerized prosthesis. A material will be modelled on the prosthetic extrados to check the prosthetic and dental positioning in relation to the physiological prosthetic and dental corridor: the areas where there is an excess of material will be filled in, the areas where the material has a low or zero thickness will be reduced. Analytical piezography will also serve as a reliable means of pre-implant study: the choice of implant positions must be included in this physiological corridor in order to obtain stable and functional implant-borne prostheses. By examining the effect of the addition of impression material on the prosthetic space using piezographic registration, it was concluded that it regulated the prosthetic space, which was located slightly on the buccal side of the alveolar ridge.[16]

Additionally, the application of this method to patients with neuromuscular problems and maxillofacial defects, which are challenging cases that are expected to increase in number in the future, leads to a significantly positive result by providing a prosthesis with improved retention and stability

It is important to mention that piezography, whether prosthetic or analytical, requires the cooperation of the patient and technical skills of the practitioner and the laboratory technician.

The past two decades have seen an unprecedented revolution in the field of dental technology. Computer-aided design and computer-aided manufacturing (CAD/CAM) complete dentures have been shown to have superior fit and material strength to conventionally fabricated dentures.[17]

In challenging clinical situation, such as severe ridge resorption, some authors combined piezography and CAD-CAM for the manufacturing of a complete denture In a recent report, authors recorded the denture space using the piezography technique. After that, the piezographic space was scanned, a virtual tooth arrangement and festooning were performed within the space using computer-aided design software. The denture bases were milled from a polymethylmethacrylate resin block using computer-aided manufacturing, and commercially available denture teeth were bonded with resin adhesive.[18]

Conclusion

When bone resorption is significant, as generally noted in elderly patients, prosthetic piezography can be used to optimize the future complete denture as far as possible. This technique enables functional stability and facilitates adaptation to the new prosthesis. It is also strongly recommended to use this technique even when implants will be added to the overdentures, in order to combine stability and retention.

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