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Clinical case

Oral Rehabilitation in a Patient with Decreased Vertical Dimension, Integrating CAD/CAM Technology. Case Report

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ABSTRACT

Introduction: The vertical dimension is the distance between two anatomical points, taking as reference, in this particular case, the tip of the nose and the chin. On the other hand, the vertical dimension of occlusion and the vertical dimension at rest are measurements in a vertical sense taking into account the frontal plane that constitutes the relationship between the maxilla and the mandible. **Objective:** To describe the case of oral rehabilitation of a patient with decreased vertical dimension who obtained the restoration of the proper functions of the stomatognathic system through different treatments. **Case presentation:** A 73-year-old female patient, ASA II classification, controlled diabetic, with the reason for consultation: "I want you to make a prosthesis for me." The patient presented partial edentulism in both arches, coupled with a decrease in the vertical dimension. An analysis of the increase in occlusal and resting vertical dimension

with upper and lower bases and rollers was completed, to subsequently perform a diagnostic wax-up on teeth 14, 15, 24, 34, 35, 44, 45 and 31 to 43 and to be able to propose the following treatment plan: monolithic zirconia crowns on premolars, injected resin veneers on mandibular anterior and upper and lower acrylic partial prostheses. **Conclusions:** Understanding the concept of vertical dimension and knowing its limitations and competencies allows us to offer the best treatment to the patients according to their needs. Besides, current digital technology brings multiple benefits to restorative dentistry, in addition to providing greater accuracy and precision to the work performed.

Keywords: vertical dimension, Computer-Aided Design, silicone elastomers, oral rehabilitation, composite, removable partial denture.

INTRODUCTION

The vertical dimension (VD) is the distance between two anatomical points, taking as reference, in this particular case, the tip of the nose and the chin[1]. Simultaneously, the vertical dimension of occlusion (VDO) and the vertical dimension at rest (VDR) are measurements in a vertical sense taking into account the frontal plane that constitutes the relationship between the maxilla and the mandible[2]. Therefore, the calculation and determination of both allows for a good diagnosis to offer an appropriate treatment plan, when rehabilitating a patient who has lost most of the dental structure, coupled with a loss of vertical dimension. This way, sufficient prosthetic space is obtained, as required for the restoration material, achieving biofunctional, biomechanical and dentofacial aesthetic success of the treatment[1].

VDR is determined when the muscle tone is in relaxation of the mandible, unlike VDO, when the teeth are in contact. Alterations, wear and absences directly affect this measurement and, in this sense, subsequent dental loss is one of the main causes of the decrease in the vertical dimension, causing facial, functional and aesthetic alterations and affecting the patient's lifestyle[1]. Unfortunately, there is no scientifically proven method to accurately record VDO[2]. Since each patient is different with respect to musculature, function, and anatomic structure, it is important to consider the patient's extraoral and intraoral factors when considering the alteration of the VDO[3].

Other methods have been presented to obtain VDO among the most accepted are the swallowing technique and facial, morphological, phonetic and cephalometric proportions; taking into account that these methods require their joint application to guarantee greater precision, according to the patient's needs[4]. Thus, in the evaluation of facial proportions to record the VDO, the use of bases and rollers is indispensable, and once placed in the mouth, there must be harmony between the facial segments[2]. Regarding temporomandibular joint disorders associated with an increase or decrease in the VDO, it can be stated that there is no scientific evidence over time to support this[5]. Additionally, it is known that the stomatognathic system is sufficiently capable to adapt to moderate occlusal changes resulting from changes in the VDO[5]. Thus, most patients accept the changes positively, considering that an increase of up to 5 mm is a safe procedure with a low rate of future complications[3]. Similarly, there are various techniques to recover the vertical dimension; one of them is through provisional restorations, with the intention of adapting the patient to the new occlusion and subsequently placing the

definitive restorations. It is recommended that the adaptation period be approximately one month, however, some authors mention that it is not necessary and that the time it takes to prepare the final restorations by the dental laboratory is sufficient[6].

It is worth highlighting that digital work has developed significantly in oral rehabilitation, being part of both diagnosis and treatment. Fundamentally, the skills of the dentist are essential during conventional impression taking of dental preparations for crowns, because marginal defects increase the failure of the restoration over time. Digital intraoral impressions allow for instant analysis of the finishing line, the shape of the dental stump and the quality of the impression[7]. Intraoral scanners allow you to work more efficiently and accurately, creating digital impressions that facilitate sending models to the dental laboratory via digital platforms or email, reducing time and work. Likewise, Computer-Aided Design & Computer-Aided Manufacturing (CAD/CAM) technology, through robotic devices, creates a 3D image that is sent to a milling machine to obtain the crowns[8].

CLINICAL CASE PRESENTATION

A 73-year-old female patient from *Monterrey*, *Nuevo León*, ASA II classification, controlled diabetes, attended the Dental Prevention Clinic of the Universidad de Monterrey, whose reason for consultation was "I want you to make a prosthesis for me".

Extraoral examination revealed a mesocephalic skull, mesofacial surface, temporomandibular joint with no clinical pathological data and a concave profile. Intraorally, the following were found: hydrated mucous membranes, well-inserted frenulums, hard palate with present palatal rugae and smooth soft palate, patent oropharynx and airways, hydrated and vascularised floor of the mouth, liquid salivation, fissured tongue, gums without inflammation or periodontal pockets. Radiographically, good bone support and no signs of apparent pathology were observed.

The patient presented partial edentulism in both arches, coupled with a decrease in the vertical dimension. The Kennedy classification was used, with class I, modification 3 in the maxilla and class II, modification 1 in the mandible (Figure 1A). For that reason, an analysis of the increase in occlusal and resting vertical dimension of +4 mm with upper and lower bases and rollers was performed. Subsequently, type IV plaster models were mounted on a semi-adjustable articulator (Axiomath® Articulador dental, Vamasa Health Innovation, Monterrey, Mexico) and a diagnostic wax-up was conducted on teeth 14, 15, 24, 34, 35, 44, 45 and 31 to 43 (Figure 1B), where the occlusal plane and incisal plane were evaluated. The following treatment plan was proposed: monolithic zirconia crowns on premolars, injected resin veneers on mandibular anteriors, and upper and lower acrylic partial dentures.

As soon as the patient accepted the treatment plan, complete rehabilitation was fulfilled through four phases. In the first phase, preparation for monolithic zirconia crowns on premolars was done, based on the principles of tooth preparation of Shillingburg, developing a rounded shoulder chamfer finish line together with the support of milling keys. Likewise, the dental stumps were reconstructed with fluid resin (Brilliant™ Flow, Coltène/Whaledent AG, Altstätten, Switzerland) and A2 shade composite (Brilliant™ NG, Coltène/Whaledent AG, Altstätten, Switzerland). Once the dental preparations were ready, the scanner (Primescan, Dentsply Sirona Inc., Charlotte, NC, USA) was used to scan both arches following the manufacturer's protocol. To take the bite record, provisional teeth were removed from the right side, leaving provisional teeth on the left side as a reference for vertical dimensions, and then the same was done for

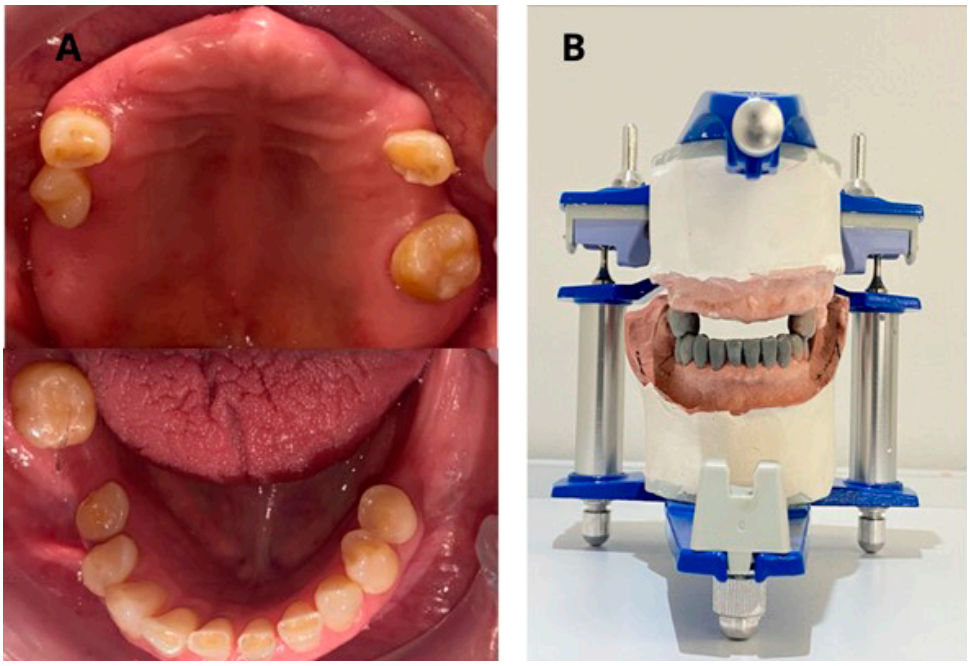

Figure 1. Initial photographs. A. Maxillary and mandibular arches. B. Diagnostic wax-up.

the opposite side. The software matched the scanned images (Figure 2), leaving the vertical dimension planned for the subsequent restorations. As it was a completely digital procedure, we avoided utilising a semi-adjustable articulator, increasing the precision in the size of the crowns to be placed. The A2 shade was selected from the colorimeter (Vita classical A1-D4® shade guide, Vita Zahnfabrik, Bad Säckingen, Germany) and then sent to the digital laboratory of the same university clinic for processing. Through a digital design with InLab CAM software (Dentsply Sirona Inc., Charlotte, NC, USA), the occlusion, interproximal contacts, preparations and finishing lines were analysed. Once the design was finished, it was sent to a milling machine (inLab MC X5, Dentsply Sirona Inc., Charlotte, NC, USA) for the production of crowns, to be sintered in the oven (inFire HTC speed, Dentsply Sirona Inc., Charlotte, NC, USA). Then they were glazed and pigmented in a conventional oven for dental ceramics and finally sandblasted at 30 Bar with 30-50 micron aluminium oxide. The temporary restorations were then achieved with rapid acrylic, which were checked with articulating paper, achieving a stable and balanced occlusion. In this phase, the adaptation period with the acrylic provisional restorations was carried out.

In the second phase, injected resin veneers were made using a silicone key that was performed the day before the appointment, with light silicone (Elite Transparent, Zhermack SpA, Badia Polesine, Italy), with which the waxing was duplicated. Holes were done on the key on the incisal side with a #2 ball bur, to allow the entry and exit of the A2 shade resin (3M™ Filtek™ Supreme Flowable Restorative, 3M, Saint Paul, MN, USA), from the cervical side to the incisal side of the tip, allowing for full distribution of the material. The procedure was accomplished individually on each tooth, isolating the adjacent teeth with Teflon tape and preparing each tooth to be treated for the adhesion process. For contouring and polishing, interproximal sandpaper and polishing rubbers, resins (TDV Dental Ltda., Pomerode, Brazil), discs (3M™ Sof-Lex™ Contouring and Polishing Discs Kit, 3M Espe Deutschland GmbH, Germany) and polishing paste (Ultradent™ Diamond Polish Mint, Ultradent Products Inc., South Jordan, UT, USA) were used (Figure 3).

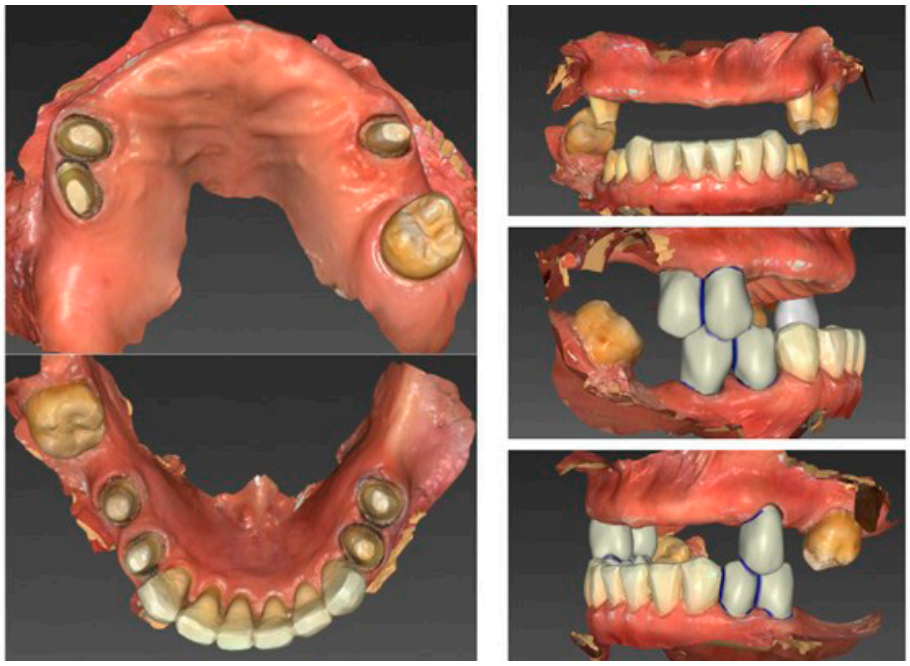

Figure 2. Scanning of dental preparations and digital design.

Figure 3. Preparation of injected resin veneers.

In the third phase, after the adaptation period with the provisional teeth, the phonetics, absence of joint symptoms, occlusion and comfort of the patient were evaluated. The crowns, previously sandblasted by the laboratory, were tested, verifying that they sat properly and the occlusion was checked with articulating paper. To proceed with the cementation of the monolithic zirconia crowns, they were disinfected with a cleaning gel (ZirClean™, Bisco Inc., Schaumburg, IL, USA) for 20 seconds. Then, we conditioned with a primer (Z-Prime™ Plus, Bisco

Inc., Schaumburg, IL, USA) applying two layers for adhesion. In addition to the above, we continued with the conditioning of the dental substrate, disinfecting with 2% chlorhexidine and placing universal adhesive (All-Bond Universal®, Bisco Inc., Schaumburg, IL, USA), light-curing it for 20 seconds. The dual-cure resin cement (3M™ RelyX™ U200, 3M Espe Deutschland GmbH, Germany) was then mixed, cemented, and any excess was removed with a non-absorbent fibre applicator (Microbrush®, Microbrush International, Young Innovations Inc., Algonquin, IL, USA) and dental floss, so that each crown could be light-cured after cementing. Immediately afterward, oral hygiene instructions were given to the patient.

In the fourth phase, the treatment of the upper and lower acrylic partial prosthesis was conducted. Using an individual spoon, both edge rectifications were made with addition silicone putty and a functional impression was taken with light addition silicone (Coltène/Whaledent AG, Altstätten, Switzerland), to subsequently obtain the type III plaster working models. The bases and rollers were utilised to test the orientation of the occlusal planes and record the occlusion. The patient was asked to bite, marking the anterior maxillary area, midline, canine line and smile line. The working models were mounted together with the bases and rollers on a hinge articulator, to be sent to the laboratory for fitting, taking as a reference the A2 shade of the VITA classical A1-D4® colorimeter. The fitting test was carried out, in which the patient was satisfied with the tone, occlusion and morphology, so, the prostheses were sent to the laboratory to be acrylated for production. The patient was provided with her upper and lower acrylic partial dentures (Figure 4A). Both were tried in to ensure proper seating, nevertheless, undercut areas were noted, which were reduced with a low-speed handpiece and metal bur, and the occlusion was checked. The patient was given instructions on how to clean and care for the prostheses. Finally, a control phase was performed at different periods, at 24 hours, at one week and at one month, and clinically no alteration was observed in mucous membranes, supporting tissues or teeth (Figure 4B).

Figure 4. Follow-up. A. Before oral rehabilitation showing loss of vertical dimension. B. Final rehabilitation.

DISCUSSION

The diagnosis and treatment for the rehabilitation of a partially edentulous patient, coupled with a decrease in VDO, depends largely on the patient's adaptation mechanisms; that is, whether he or she manages to balance or eliminate the emergence of counterproductive signs and symptoms. For this reason, if the patient requires an increase in VDO and additionally has dysfunction in the temporomandibular joint, it is indicated to treat the joint condition prior to treatment[9].

Pairazaman[10] mentions that oral rehabilitation with metal-ceramic crowns combined with removable partial prostheses is a treatment of choice for the desired increase in VDO, achieving a stable and balanced occlusion according to the patient's physiology. The design of the prosthesis hooks does not detract from aesthetics, especially in patients with long lips, which provides an excellent alternative for patients for whom, for health or financial reasons, the use of tooth-supported implants is not possible. This is how it becomes an appropriate treatment, with satisfactory and long-lasting results[10].

Traditionally, porcelain-metal crowns were the main choice for fixed partial prostheses, though, fractures or chipping of the crowns have been commonly found, considering it a frequent complication in the posterior sector. Nonetheless, the boom in dental aesthetics has led to the introduction of metal-free materials, such as monolithic zirconia, which, due to its high hardness and resistance, provides very good mechanical and aesthetic properties[11]. Similarly, thanks to the advancement of digital technology, the use of intraoral scanners and CAD/CAM technology is becoming more common, which facilitates and speeds up treatment, and improves communication between dentist, technician and patient[8]. Zirconia is a material compatible with CAD/CAM technology, minimizing fractures and chipping of crowns[12].

One of the many benefits of digital impressions is that the quality of the impression can be verified immediately, which allows it to be repeated at the same appointment in case of an error. Also, it provides long-term dimensional stability and is exempt from decontamination issues, which can happen with conventional printing materials[7]. Salgueiro *et al*.[13] conducted a systematic review comparing the precision and accuracy of several intraoral scanners of the most recognised brands against conventional impressions. Among the scanners they evaluated, the Primescan stood out for its superior precision and accuracy compared to the other scanners.

On the other hand, Eng & Ulloa[14] mention that, along with dental aesthetics, minimally invasive treatments are also sought, avoiding excessive wear of healthy tissue. In this sense, porcelain veneers have been the first choice for the rehabilitation of anterior teeth. Nevertheless, the evolution of resins over the years has improved their mechanical and aesthetic properties, as well as their ease of polishing and adhesion. This provides cost-benefit to the patient and allows for a more conservative and less abrasive treatment alternative for the teeth[15]. Treatment with injected resin veneers, which is fulfilled with fluid resin with a high concentration of nanofiller particles, is a direct/indirect technique that, by means of a diagnostic wax-up and a transparent polyvinyl siloxane impression key, can replicate the anatomical morphology of the wax-up and transfer the resin through the impression. Another advantage is that they can be accomplished without dental preparation, achieving the procedure in the enamel area, where adhesion is greater and the patient is less vulnerable to sensitivity[14]. Notwithstanding, compared to porcelain veneers that maintain their shine over time, injected resin veneers can change colour depending on the patient's habits, which is why annual polishing is suggested[15].

CONCLUSIONS

Understanding the concept of vertical dimension and knowing its limitations and competencies will allow us to offer the best treatment according to the patient's needs. In other ways, digital technology today brings multiple benefits to restorative dentistry, in addition to providing greater accuracy and precision to the work produced. In this context, our patient was satisfied with her complete oral rehabilitation treatment, thus achieving the objective of restoring the proper functions of the stomatognathic system, achieving aesthetic, dentofacial, biofunctional and biomechanical success.

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