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Case Report

Digital Workflow Rehabilitation in Short Implants Associated with Gingival Grafts

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Abstract

The success of rehabilitation with implants depends on a global planning, involving procedures in soft and hard tissues that aim at the possibility of performing a prosthetic rehabilitation with good aesthetic and functional results. This case is intended to report a clinical case of oral rehabilitation on short implants, in the posterior region of the mandible, associated with the Digital Work Flow and alteration of the gingival phenotype with Free Gingival Grafts on the right side and Subepithelial Connective Tissue Graft on the left side. The association between the use of short implants, change in gingival phenotype and digital flow proved to be favorable procedures in the rehabilitation of the posterior region of the mandible, resulting in increased predictability of the result and satisfaction with the treatment.

Keywords: *Computer Assisted Design; CAD CAM; Work Flow; Dental Implants; Connective Tissue; Tissue Graft; Dental Prosthesis, Implant-Supported*

Introduction

The rehabilitation of partially edentulous patients is considerably complex and must combine high predictability and low morbidity, in addition to reaching the patient's expectations [1]. The pattern of bone loss after tooth extraction in the posterior region of the upper and lower arches is quite distinct. In the mandible, this loss occurs mainly in the vertical direction [2]. Due to this, and the presence of noble anatomical areas, planning for rehabilitation of the posterior region of the atrophic arches usually requires specific treatment alternatives [3].

When the residual bone height over the mandibular canal is reduced, studies [3-6] consider short implants as a preferable option due to the reduction in treatment time, cost and morbidity in the face of reconstructive and/or more complex surgical procedures. Currently, those with ≤ 6 mm are defined as short implants [7,8]. However, the importance of maintaining bone tissue in rehabilitation with this type of implant is highlighted, since its impairment can lead to a relatively greater impact on support when compared to marginal bone loss in implants of greater length [2]. In this scenario, attention is focused on procedures aimed at the integrity of peri-implant tissues. Currently, attention to the gingival phenotype is evidenced in the literature, considering the quality and quantity of keratinized tissue around the implants and possible needs for surgical procedures for manipulation of peri-implant tissues, preferably in pre or trans-surgical stages of installation of the implants, aiming at tissue stability and treatment longevity [9-13].

In addition to the development of successful surgical processes, it is essential to search for technological advances that favor a quality rehabilitative result, which deliver safety and predictability for both the professional and the patient, in order to obtain satisfaction with the treatment [14,15]. In this context, the use of Digital Flow processes is emphasized, which is becoming more and more present in the clinical routine [15,16]. CAD/CAM (Computer-aided-design/Computer-aided-manufacturing) systems offer an alternative to the processing of indirect dental restorations and fixed dental prostheses. The use of digitized prints eliminates a series of clinical and laboratory steps, leading to fast and effective delivery of the final personalized device [14].

Objective of the Study

The objective of this work is to report a clinical case of oral rehabilitation on short implants, in the posterior region of the mandible, associated with the Digital Flow and alteration of the gingival phenotype.

Case Report

A 56-year-old woman, ASA II, attended the clinic of Master in Dentistry at Latin American Dental Research and Teaching Institute - ILAPEO - (Curitiba, PR, Brazil), with an indication of prosthetic rehabilitation on implants.

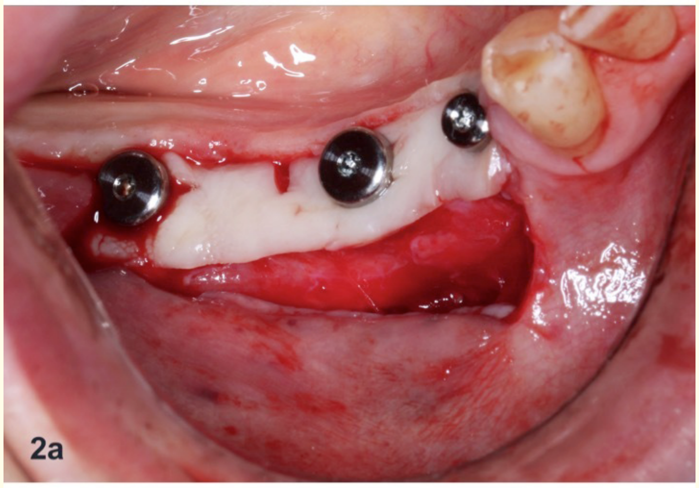
Upon clinical examination and evaluation of the imaging exams of the lower arch, Morse Cone (CM) type implants (NEODENT™, Curitiba, PR, Brazil) were observed, installed in the regions of the teeth 35 (TITAMAX® CM Cortical 3.5 x 7 mm) and 36 (TITAMAX WS® CM Cortical 5 x 5 mm), on which NEODENT™ gingival healers were installed; 44 (TITAMAX® CM Cortical, 3.5 x 7 mm), 46 (TITAMAX WS® CM Cortical 4 x 5 mm) and 47 (TITAMAX WS® CM Cortical 5 x 5 mm). Implants 44, 46 and 47 were submerged. Also noteworthy was the presence of a thin periodontal phenotype with a predominance of alveolar mucosa in the right (Figure 1a) and left (Figure 1b) edentulous regions of the lower arch.

Figure 1: *(a) Right side: thin periodontal phenotype and submerged lower implants. (b) Left side: thin periodontal phenotype and implants with installed gingival healers.*

Figure 1: *(a) Right side: thin periodontal phenotype and submerged lower implants. (b) Left side: thin periodontal phenotype and implants with installed gingival healers.*

Through the Diagnostic Planning process, using the assembly of the arch models in a semi-adjustable articulator, the prosthetic rehabilitation of the lower arch was defined through the construction of prostheses on bilateral implants, made of metal-ceramic material, by a screwed system, through CAD-CAM digital flow. Clinically, the need to change the periodontal phenotype (autogenous gingival grafts) in the regions of pre-existing lower implants was identified. For the upper arch, we opted for rehabilitation through prosthesis over dento-gingival implants of the hybrid type, screwed.

Periodontal surgeries, performed in different stages, were defined according to the clinical indications on each side of the arch. For the right side (region 44 to 47), where the implants were submerged, the Free Gingival Graft (FGG) was indicated due to the need to increase the attached gingival band. In the FGG procedure, it was decided to perform the trans-operative selection of gingival healers, using them as an auxiliary means of fixation and immobilization of the grafted tissue. After obtaining the tissue from the palate, with width and length defined by a surgical map and about 2 mm thick, it was transported to the recipient area previously prepared in a divided flap. Blades 15c were used for both incisions. The position of the implants was marked in the transplanted tissue before fixation, through perforations, and in this place, "X" incisions were made to adapt the gingival healers. Small relaxing incisions were made on the margins to facilitate the extension and adaptation of the tissue and the gingival healers on the implants. After the healers were positioned in the tissue, the set was fixed on the implants and additional stabilization sutures were performed (Figure 2a and 2b). After 10 days, the sutures were removed and 60 days after the operation, an increase in the keratinized gingiva band was observed (Figure 2c).



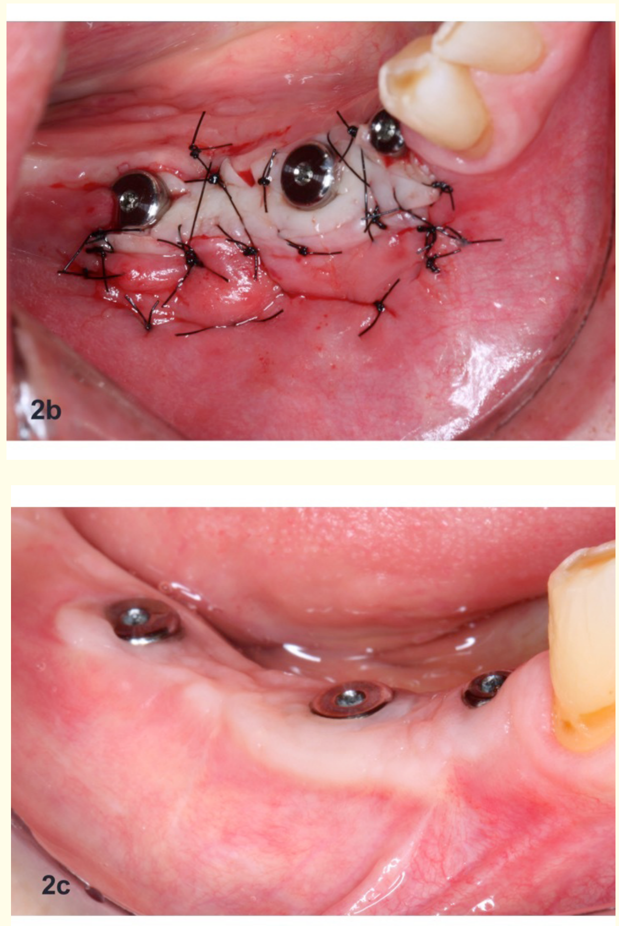


Figure 2: *(a) Gingival tissue from the palate, transfixed by the gingival healers and fixed over the connective tissue of the ridge. Small marginal relaxing incisions facilitate the positioning of the transplanted tissue on the recipient bed. (b) Additional fixation of the transplanted tissue by sutures. (c) 60 days after surgery. Note the increase in the width of the keratinized gingiva band.*

For the left side (region 35 and 36), where the gingival healers were already installed, with the presence of a keratinized gingiva band of 2 mm width and 1.5 mm thickness, the Subepithelial Connective Tissue Graft (SCTG) was indicated with the aim of increasing tissue thickness. In the SCTG procedure, it was decided to obtain connective tissue using a double-blade scalpel, with two 15c blades. The donor area chosen was the region of the alveolar crest of the upper border, on the left side. The upper part of the graft was not de-epithelialized, with the keratinized gingiva band maintained and juxtaposed to the gingival healers, and the connective tissue positioned in the recipient area previously prepared by a flap divided and stabilized by sutures (Figure 3a and 3b). After 10 days, the sutures were removed and 60 days after the operation, there was a gain in keratinized tissue and a slight increase in tissue volume (Figure 3c).

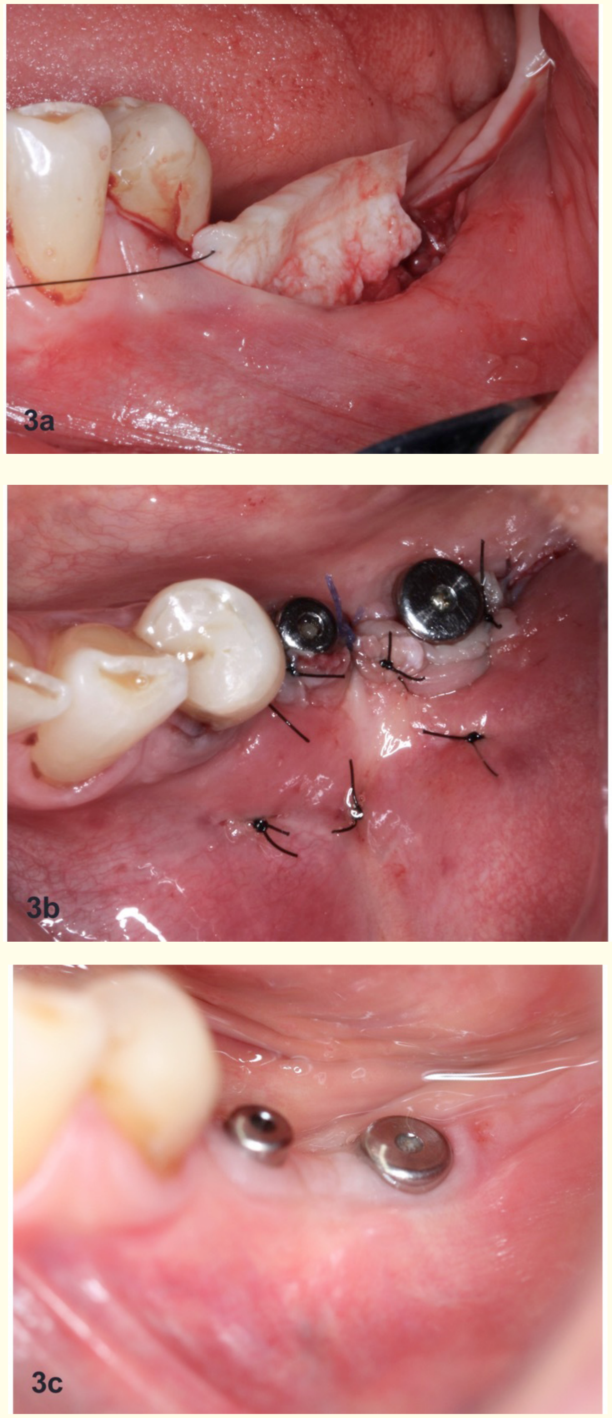


Figure 3: *(a) Adaptation of non-de-epithelialized connective tissue, originating from the alveolar ridge and removed with a double-bladed scalpel, in the receiving bed prepared by a split-flap. (b) Fixation of the transplanted tissue by sutures. (c) 60 days after surgery. There is an increase in the width of the keratinized gingiva band and a slight increase in the thickness of the connective tissue.*

In both surgical techniques, the gingival healers were maintained for at least 60 days, before prosthetic rehabilitation began. To make the provisionals, the gingival healers were removed and the NEODENT™ prosthetic abutments were selected and installed (35 and 44 CM micro abutments); (36, 46 and 47 WS conical mini abutments). Subsequently, NEODENT™ intraoral scan or scan body transfers, specific for each type of abutment, were installed (35 and 44 transfer for CM micro abutments); (36, 46 and 47 transfers for CM mini-abutments), to obtain images.

The scanning for making the provisionals was carried out using the TRIOS® intraoral scanner (3Shape™, Copenhagen, Denmark), obtaining the "STL" type image of the lower arch (with emphasis on the peri-implant gingiva and prosthetic pillars), lower arch with scan-bodies in position (Figure 4a), upper arch and, finally, recording of the occlusion. The files were sent to the digital prosthesis laboratory for digital planning and making provisional prostheses in milled resin, with four elements joined on the right side (44-45-46-47) (Figure 4b) and two elements joined on the left side (35-36). The crowns received were repackaged in the mouth on titanium cylinders, keeping the screw opening with Teflon protection. After being attached to the cylinders, the crowns were screwed over the micro and mini-abutments. At the time of fitting the provisionals, the upper arch had already been rehabilitated with a full arch prosthesis on implants

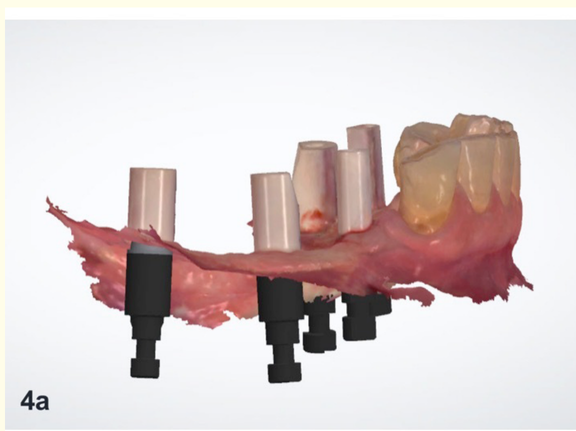
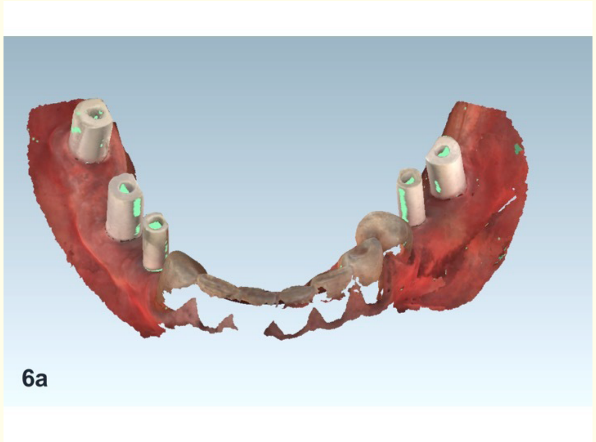


Figure 4: *(a) Digital image for planning temporary crowns, obtained by TRIOS® Scanner, with scan-bodies in position. The abutments analogs are digitally inserted in the Prosthesis Laboratory, through planning software. (b) Digitally planned prostheses, with the determination of occlusion.*

Figure 5: *(a) Temporary prostheses from elements 44 to 47, made by milling, already installed in the mouth, in occlusion with the upper prosthesis. Note the change in the gingival phenotype obtained by the EGL surgery. (b) Milled provisional prostheses from elements 35 and 36 were installed in the mouth, in occlusion with the upper prosthesis. Note the change in the gingival phenotype obtained by ECSE*

(Figure 5a and 5b).

A new intra-oral scan and a new digital occlusion record were made for the construction of the final prosthesis using the VIRTUO VIVO® Scanner (Dental Wings™, Montreal, Canada), through the steps of scanning the lower arch with the provisional prostheses; removal of provisionals and scanning of the gingival profile, installation and scanning of scan bodies (Figure 6a), followed by scanning the upper arch and occlusion (with provisionals in position) (Figure 6b). The digital files were sent to the digital prosthesis laboratory for the planning and execution of the definitive elements, made of metal-ceramic. The CrCo metal infrastructures were carried out using the milling technique (Figure 7) and tested in the mouth. The settlement was verified by periapical radiographs on both the left side (Figure 8a) and the right side (Figure 8b) and the parts were sent to the laboratory for the preparation and application of feldspathic ceramics. The definitive prostheses were screwed with 10 N/cm torques on each screw, determined by a Torquimeter ratchet (NEODENT™). Periapical radiographs were taken to analyze the settlement adaptation and Panoramic radiography for final documentation (Figure 9) and finally, the access holes were isolated with Teflon and closed with a temporary light-curing restorative. The follow-up of the patient was carried out for two months, after which the restoration of the access holes in photopolymerizable resin and clinical discharge was performed, with satisfactory functional and aesthetic results (Figure 10a and 10b).



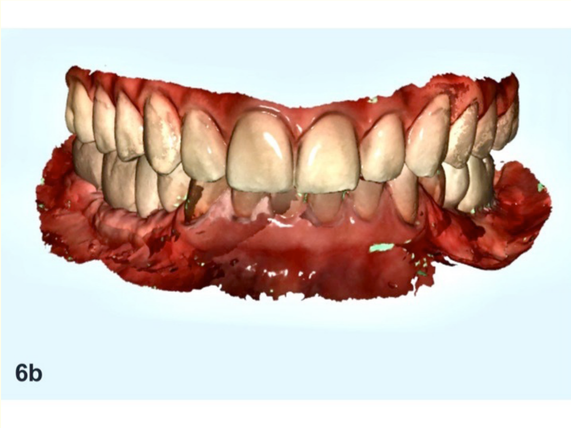


Figure 6: *(a) Digital scanning for making metal-ceramic prostheses. Scan-bodies in position to determine the exact position of the abutments. (b) Scan with provisionals in position, with the determination of occlusion with the upper arch.*

Figure 7: *Infrastructure of permanent CrCo prostheses, made by milling, adapted on the model obtained through 3D printing of the digital scanning file.*

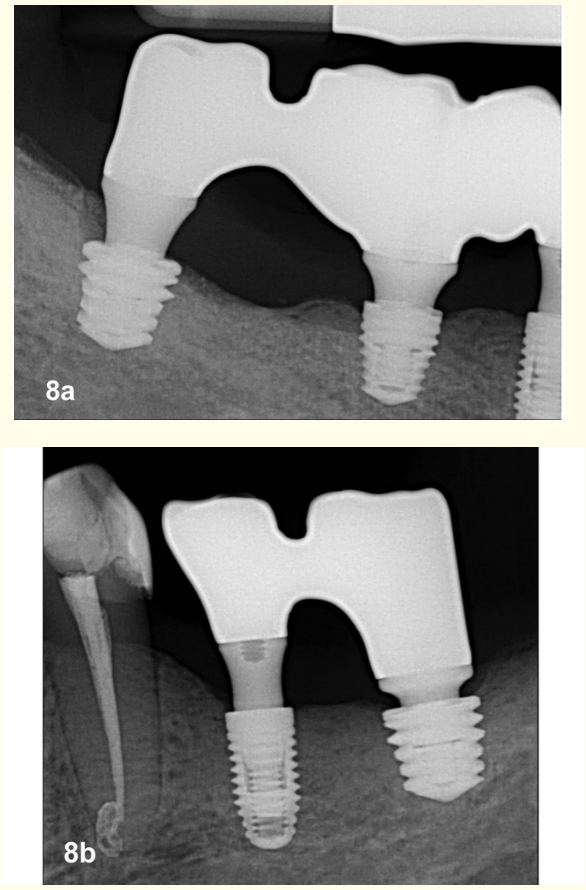


Figure 8: *(a) Verification of the settlement of the infrastructures on the right side through periapical radiography. (b) Verification of the settlement of the infrastructures on the left side through periapical radiography. Note the preservation of peri-implant bone tissue.*

Figure 9: *Final Panoramic Radiograph, after installation of the prostheses.*

Figure 10: *Right (a) and left (b) metal-ceramic prostheses installed. Final evaluation after two months of installation.*

Discussion

The clinical occurrence of patients seeking rehabilitation in the posterior areas of the jaws due to early tooth loss is a reality present in daily clinical practice. The absence of the tooth in the alveolus triggers a cascade of biological bone remodeling events [2,17,18] and readaptation of specialized soft tissues [19]. In the first three months after extraction, bone remodeling is characterized by a more pronounced structural loss in the buccolingual direction [18]. When related to the posterior region of the lower arch, as in the present report, the presence of the condition clinical diagnosis of bone loss in height and the predominance of oral mucosa in substitution to the keratinized gingiva is frequent. This condition has considerable influences on dental rehabilitation, especially when it involves planning implants and implant-supported prostheses [20].

The technological evolution of short implants in macro and microstructure seeking greater primary stability, and the growing demand for procedures with fast, predictable resolution and lower morbidity and cost, contribute to this type of implant being a predominant choice compared to reconstructive procedures for rehabilitation in atrophic arches [2,7,8,21,22].

Specific conditions must be respected when choosing to use short implants, with a view to tissue preservation and treatment (longevity), such as the observation of bone and soft tissue quality. In this case, the presence of type II bone was observed, with a thin gingival phenotype and a predominance of the alveolar mucosa over the mandibular ridge. The use of surgical burs with high cutting power, the performance of precise surgical technique and the use of implants with large diameters (≥ 4 mm) are also important specific conditions to achieve the mentioned objectives, in addition to considering the systemic conditions of the patient [2,7], which in this case was favorable, without restrictions, with an ASA II classification.

Prostheses on short implants usually result in long teeth, so conditions that promote prosthetic stability should be sought. The occlusal crown table on short implants should preferably be reduced, with maximum harmonic contact points, shallow grooves and low cusps, with an axial distribution of forces. Multiple prostheses are preferably indicated and they must be joined. In addition, the use of intermediate pillars at least 1.5 mm in height from the transmucosal, when feasible, contribuites to the stability of the peri-implant tissue, preventing marginal bone loss, by favoring the restoration of a biological space in the peri-implant gingival sulcus [2]. The conditions mentioned were applied in the case in question, as the objective of optimizing the biomechanical results.

Still paying attention to the maintenance of bone tissue and peri-implant soft tissues, authors [13,23] emphasize that the presence of keratinized mucosa with a minimum width and thickness of 2 mm around the prostheses favors biological stability against the evolution of inflammatory processes and possible tissue recessions, consequently contributing to aesthetics and better conditions for peri-implant hygiene. Therefore, in view of the unfavorable gingival clinical feature found in this case, the need to change the phenotype was considered. The manipulation of soft tissues, such as FGG and SCTG surgeries are the most frequently indicated for this purpose [24] these being the surgical techniques applied in this case. The determination of the type of soft tissue graft to be used depends on the location and extent of the recipient area and the gingival phenotype.

Subepithelial connective tissue is considered the gold standard for procedures to increase tissue thickness around implants and for aesthetic areas, however, it is limited by the extension of the recipient area, since obtaining extensive bands of connective tissue is often not feasible [25]. In the case presented, the SCTG technique was applied on the left side, as it is less extensive and requires an increase in peri-implant tissue thickness. FGG promotes an increase in the width of the keratinized gingiva band, replacing the alveolar mucosa. This procedure results in a change in the color of the gingiva, which may compromise aesthetics, and is therefore avoided in anterior regions [25,26]. This technique was applied on the right side of the lower arch, where the demand for gingival extension was greater.

Currently, the use of technological resources is emphasized, in order to increase the predictability, dynamics, quality and precision of prostheses on implants [16,27,28]. The digital flow for prosthesis execution involves the use of an intraoral scanner, which depends on a learning curve [28] or a bench scanner, the latter being used for a digital copy of the model instead of the intraoral digital copy. The images obtained are transferred to planning software, which allows the virtual design of the elements necessary for prosthetic rehabilitation (CAD), reconfiguring form and function with extreme precision. The virtual planning is then carried out in the laboratory (CAM), digitally, through a printer (provisional crowns, guides and models), or a milling machine (structures in feldspar ceramic, zirconia, lithium disilicate or silicate, titanium, chromium/cobalt and resins, depending on the structure to be milled and its purpose). In this case, we opted for the milled infrastructure in CrCo metal, overlapped by feldspathic ceramics, as these materials are highly resistant, durable and result in better adaptation and a smaller marginal gap when compared to the conventional technique [29,30] in addition to requiring less cost compared to the all-ceramic prosthesis.

The CAD-CAM system connects a scanner, software, printer and milling machine for the rehabilitation of the patient in a fast, resistant and precise way, even allowing the personalization of intermediaries. Therefore, it can be said that the digital flow brings advantages to the oral rehabilitation process, allowing the execution of cases with benefits, such as visual and dynamic planning, high level of adaptation of the pieces performed and greater agility of consultations, leading to a superior treatment outcome.

Conclusion

The association between the use of short implants, change in the gingival phenotype and digital workflow proved to be favorable procedures in the rehabilitation of the posterior region of the mandible, resulting in increased predictability of the result and satisfaction with the treatment.

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