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CASE REPORT

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# Peri-implant bone level assessment of early loaded dental implants submitted to different prosthetic protocols: a case report

Avaliação do nível ósseo peri-implantar de implantes dentários com carregamento antecipado submetidos a protocolos protéticos diferentes: relato de caso

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## ABSTRACT

**Aim:** The present split-mouth case report aims to describe the clinical and radiographic long-term outcomes of the implant rehabilitation of two mandibular premolars in which the digital workflow was used to apply different prosthetic protocols. **Case description:** A female 42-year-old patient with the absence of both mandibular second premolars was submitted to guided surgery for the placement of platform-switching Grand Morse connection implants. Digital workflow was used for implant and prosthetic planning, applying early loading protocol 21 days after surgery. The implant on the right side received the final abutment at the time of surgery (without loading), whereas the implant on the left side had a healing abutment placed, which was replaced by a temporary abutment and then by a final abutment. Two months after surgery, both implants had final ceramic restorations delivered. The patient was followed clinically and radiographically for 30 months, presenting excellent hard and soft tissue outcomes, with bone level changes lower than 2mm for both implants. **Conclusion:** The use of digital workflow and early loading, made the present implant-supported rehabilitation predictable, safe and time-efficient, resulting in total patient satisfaction. Peri-implant bone level was observed to be stable after early loading protocol for both platform-switching connection implants inserted, despite the prosthetic protocol applied.

## KEYWORDS

Dental implants; Prosthesis; Computer-aided design; Platform-switching; Bone loss; Patient satisfaction.

## RESUMO

**Objetivo:** O presente relato de caso de boca dividida tem como objetivo descrever os resultados clínicos e radiográficos a longo prazo da reabilitação com implante de dois pré-molares inferiores em que o fluxo de trabalho digital foi usado para aplicar os conceitos de "*one abutment-one time*" em uma das reabilitações e troca de componente no outro. **Descrição do caso:** Paciente do sexo feminino, 42 anos, com ausência de ambos os segundos pré-molares inferiores, foi submetida à cirurgia guiada para colocação de implantes de conexão Grand Morse plataforma-switching. Foi utilizado fluxo de trabalho digital para planejamento de implante e prótese, aplicando protocolo de carga antecipada 21 dias após a cirurgia. O implante do lado direito recebeu o componente protético definitivo no momento da cirurgia (sem carga), enquanto o implante do lado esquerdo recebeu um cicatrizador, que foi substituído por um pilar provisório e depois por um componente definitivo. Dois meses após a cirurgia, ambos os implantes tiveram restaurações cerâmicas finais entregues. A paciente foi acompanhada clínica e radiograficamente por 30 meses, apresentando excelentes resultados de tecidos duros e

moles, com alterações do nível ósseo inferiores a 2mm para ambos os implantes. **Conclusão:** O fluxo de trabalho digital e carregamento precoce, tornou a presente reabilitação implantossuportada previsível, segura e eficiente em termos de tempo, resultando em total satisfação do paciente. O nível ósseo peri-implantar foi observado como estável após o protocolo de carregamento inicial para ambos os implantes de conexão plataforma-switching inseridos, independente do protocolo protético aplicado.

## PALAVRAS-CHAVE

Implantes dentários; Próteses; Desenho assistido por computador; Plataforma-switching; Perda óssea; Satisfação do paciente.

## INTRODUCTION

The use of the CAD-CAM technology in the field of implant dentistry provides consistent accuracy and reproducible outcomes by means of digital designs and computer-aided production of surgical guides and restorations [1,2]. Reduced intraoperative discomfort as well as postoperative morbidity are some benefits that have been associated with guided implant surgery. This technique uses Cone Bean Computed Tomography (CBCT), intraoral scanning and virtual treatment planning to achieve optimal implant positioning, regarding anatomical and prosthetic parameters [3]. Moreover, this system can be very helpful to reduce the time between implant placement and loading, since it provides better surgical predictability [4].

Another factor that reduces treatment time is the immediate or early loading of implants, that have been applied especially in cases of good bone quality, providing enhanced esthetics and function, with high implant survival rates. The insertion of a prosthesis within 72 hours of implant placement defines the immediate loading protocol [5] whereas when implants are put into function between 1 and 8 weeks after surgery, it defines early loading [6].The reduction of the healing period is not expected to result in increased marginal bone loss or implant failure, as reported in several studies [7,8].

Regarding marginal bone loss preservation, the use of implants with platform-switching configuration has already been reported as an ally to achieve better long-term results [9]. Moreover, the one abutment one time concept has been introduced to avoid repeated dis/reconnection of abutments - which can jeopardize peri-implant tissue stability - thus maintaining all the platform-switching advantages [10]. However, it is still not clear if different prosthetic protocols really have clinical significance.

Therefore, the present split-mouth case report aims to describe the clinical and radiographic long-term outcomes of the implant rehabilitation of two mandibular premolars in which the digital workflow was used to apply the concept of early loading of dental implants while applying the concept of one abutment at one time in one of the rehabilitation and abutment removal in the other.

## CASE DESCRIPTION

### Surgical and prosthetic procedures

A female, 42-year-old patient, referred to Ilapeo College (Curitiba, Brazil) with the absence of both mandibular second premolars, ASA 1, wishing for implant-supported prosthesis rehabilitation (Figure 1). The patient gave written consent, and the study was approved by the local ethics committee (CAAE: 11965719.6.0000.5218) under the protocol 3.367.313. Pre-operatory intraoral scans and CBCT were obtained. The ".stl" and DICOM files were then sent for virtual planning on coDiagnosticX Software (Dental Wings GmbH, Chemnitz, Germany) (Figure 2) and, after surgeon´s approval, the surgical guide was printed (Rapid Shape GmbH, Heimsheim, Germany). Before surgery, the guide was tried-in to verify its adequate seating (Figure 3).

Surgical procedure was performed by a single operator and carried out under local anesthesia (mepivacaine 2% with epinephrine 1:100.000) in order to avoid inferior alveolar nerve lesion and to keep patient´s partial sensibility. Stabilizing pins were screwed through the sleeves into the implant connection with the specific Guided Surgery Surgical kit for Helix GM implants (Neodent, Curitiba, Brazil) to increase guide stability. Each site was prepared following the drill sequence recommended by the manufacturer and 3.75x10mm platform-switching Grand Morse connection implants (GM

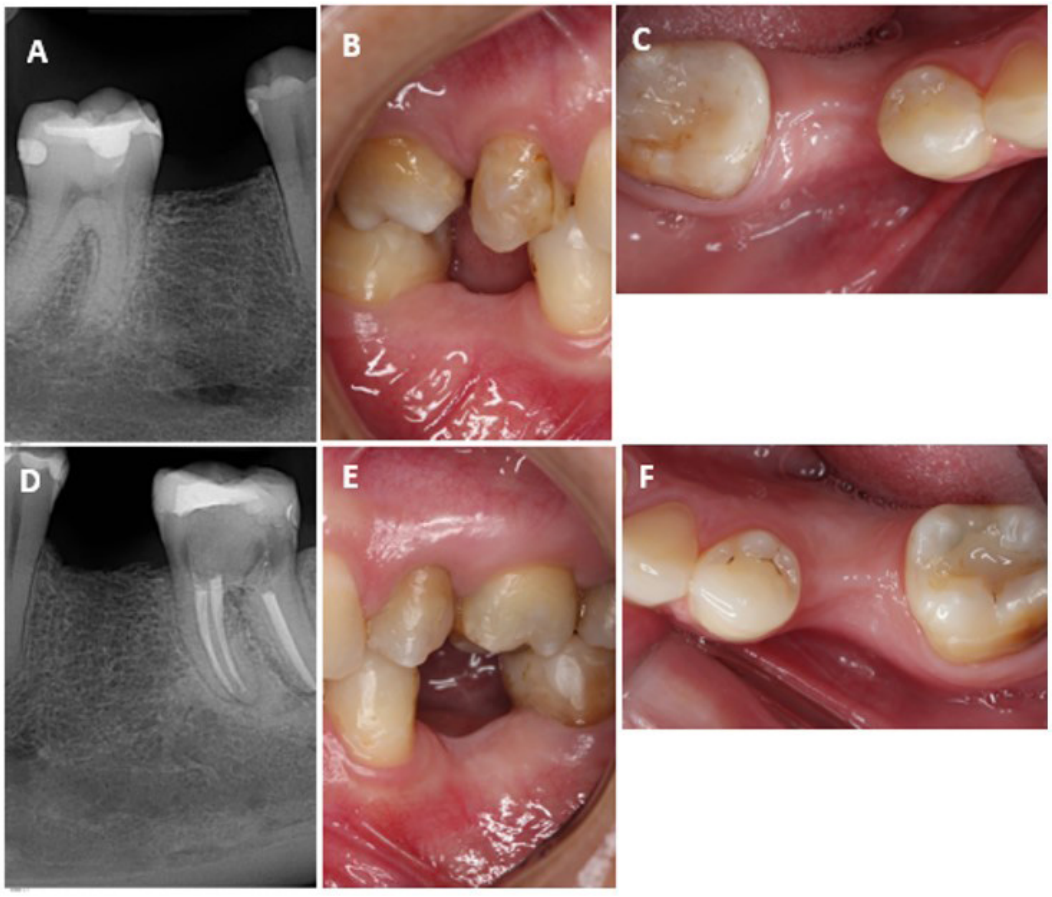


**Figure 1 -** Patient´s initial aspects. A) Periapical x-ray, B) lateral and C) occlusal view showing the absence of teeth 35. D) Periapical x-ray, E) lateral and F) occlusal view showing the absence of teeth 45.

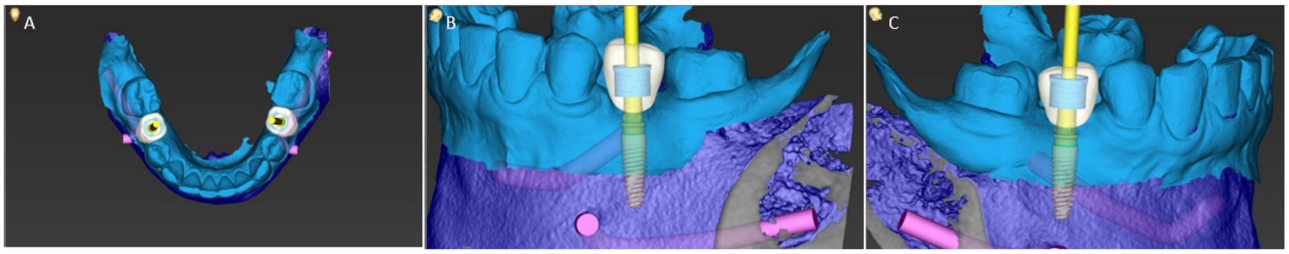


**Figure 2 -** Implant and prosthetic digital planning on CoDiagnosticX Software. A) Occlusal view of digital planning. B) and C) lateral views of digital planning.

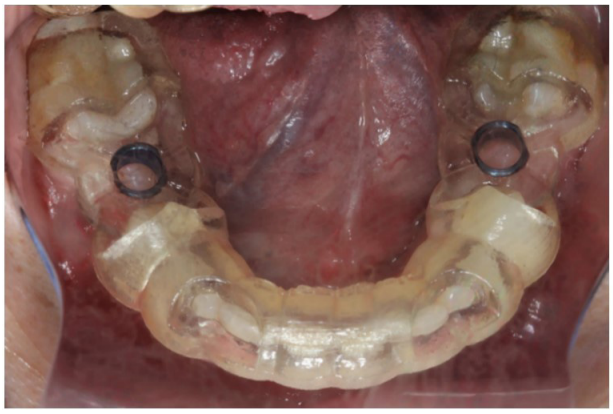

**Figure 3 -** Surgical guide try-in to check adequate seating on adjacent teeth.

Helix Acqua, Neodent, Curitiba, Brazil) were inserted in both, with a final toque of 35 N.cm. In order to evaluate peri-implant bone level alterations regarding the one abutment one time concept, the following protocol was applied: on the implant of the left side, a GM Customizable Healing Abutment (Neodent, Curitiba, Brazil) was inserted and, on the one on the right side, a 3.5x6x1.5mm Titanium Base (Neodent, Curitiba, Brazil) was placed and protected with a cement-retained Zirconia Coping that had been planned and milled previously to the surgery, without loading (Figure 4). Antibiotics (Amoxicilin

875mg) and pain relief medication (Ibuprophen 600mg) were prescribed.

Nineteen days thereafter, the GM Customizable Healing Abutment of implant #35 was removed and conventional impressions were obtained of both regions, at implant (#35) and abutment level (#45). After that, the healing abutment was placed back on implant #35. At the 21st day after surgery, early loading was applied on both implants by means of insertion of Polymethyl methacrylate (PMMA) acrylic resin prostheses – with centric and eccentric occlusal contacts. For that, a 5.5x4.5mm Pro Peek Abutment was inserted on implant #35 and the Titanium Base maintained in place on implant #45 (Figure 5).

Two months after surgery, a new intraoral scanning was performed for the confection of a printed model and final prostheses planning (Figure 6). A 3.5.x6x1.5mm titanium base was selected in order to replace the Pro Peek Abutment on region #35 and a Zirconia coping was drilled. Final prostheses were then delivered, and periapical x-rays were taken (Figure 7). Prosthetic procedures were performed by another clinician. A summary of procedures sequence is shown on Figure 8.

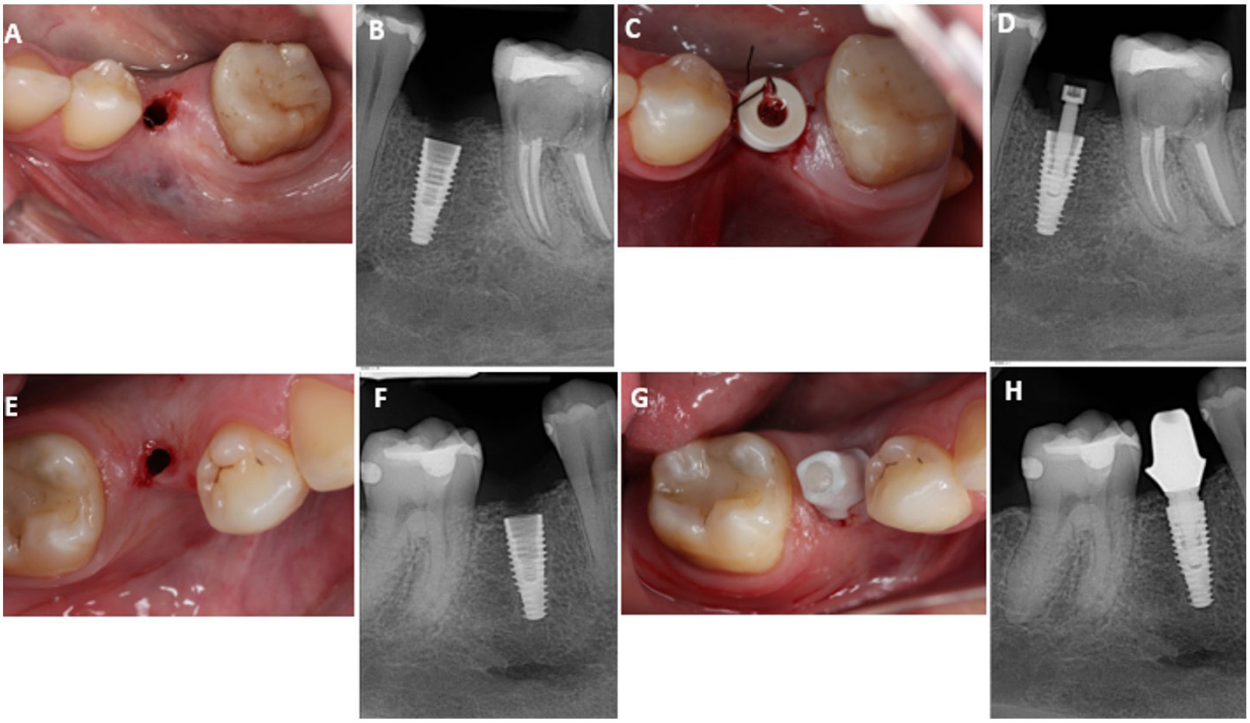


**Figure 4 -** A) to D) Immediate clinical and radiographic conditions after implants and abutments insertion on region 35. E) to H) Immediate clinical and radiographic conditions after implants and abutments insertion on region 45.

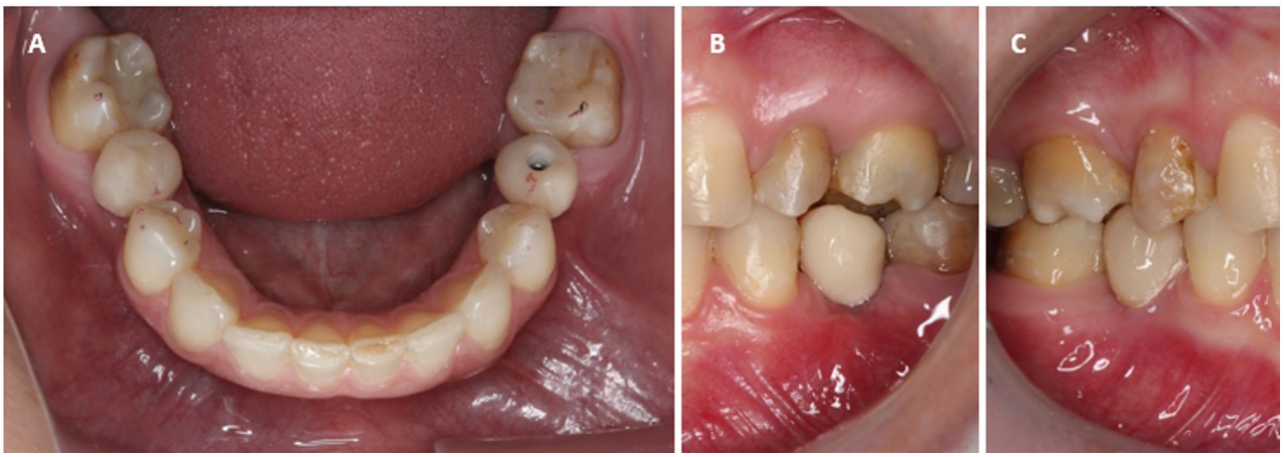


**Figure 5 -** A) View of prostheses occlusal points. B) and C) Lateral view of acrylic resin provisional rehabilitation on regions 35 and 45.

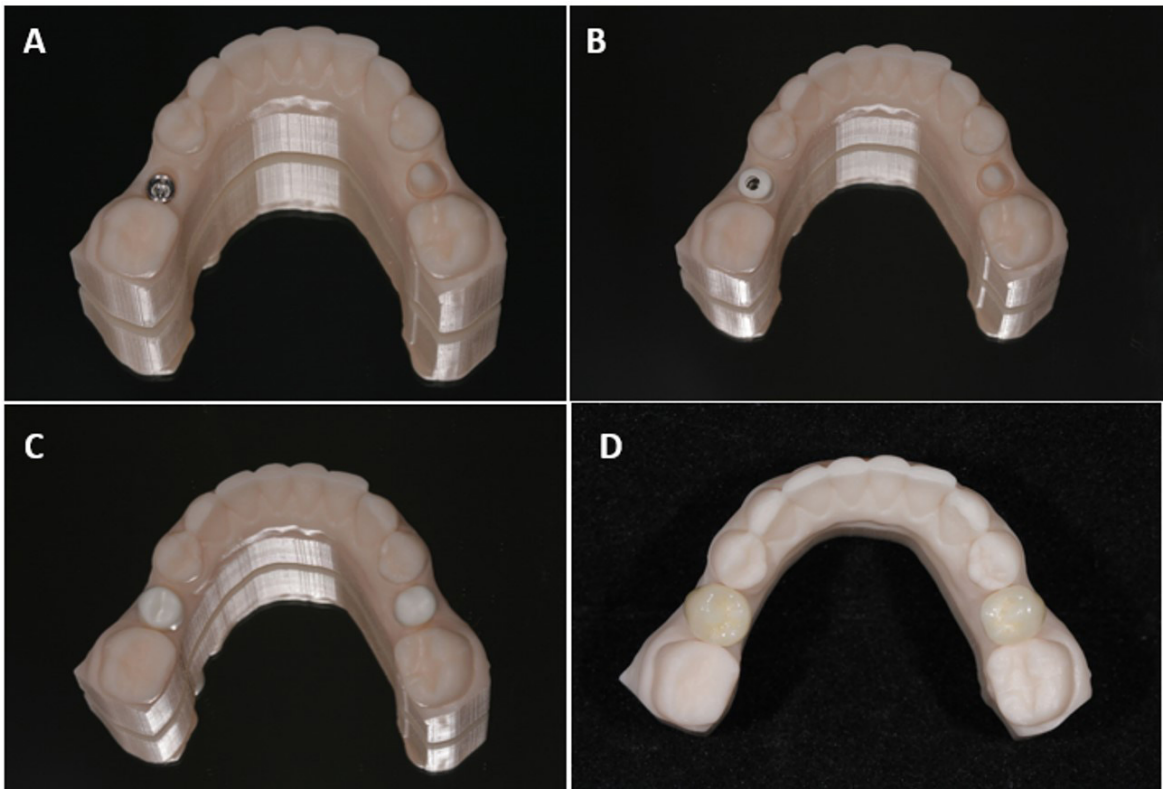


**Figure 6 -** A) Printed model with analogue of implant 35. B) Customized zirconia coping on Tibase of region 35. C) Drilled copings of #35 and #45. D) Final zirconia-ceramic crowns.

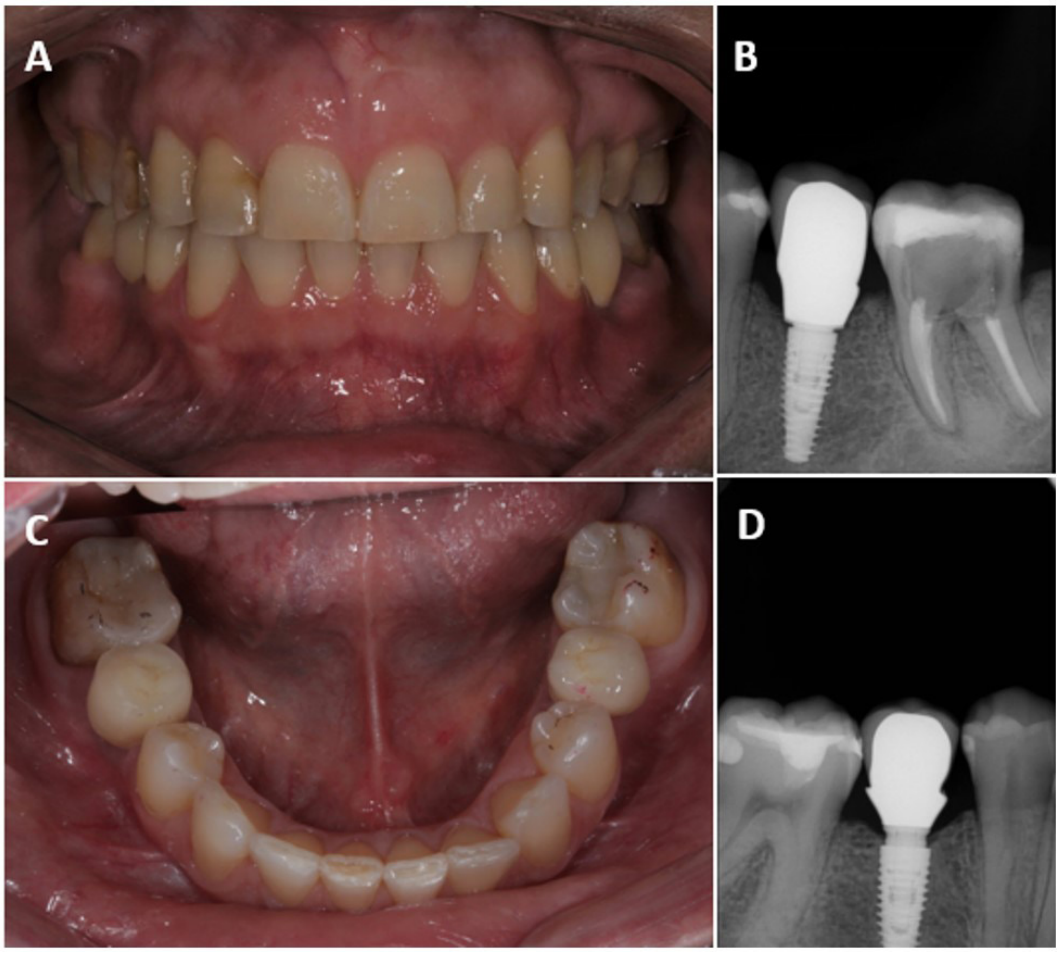


**Figure 7 -** A) and C) Frontal and occlusal view of final protheses. B) and D) Periapical x-rays of rehabilitation of #35 and #45.

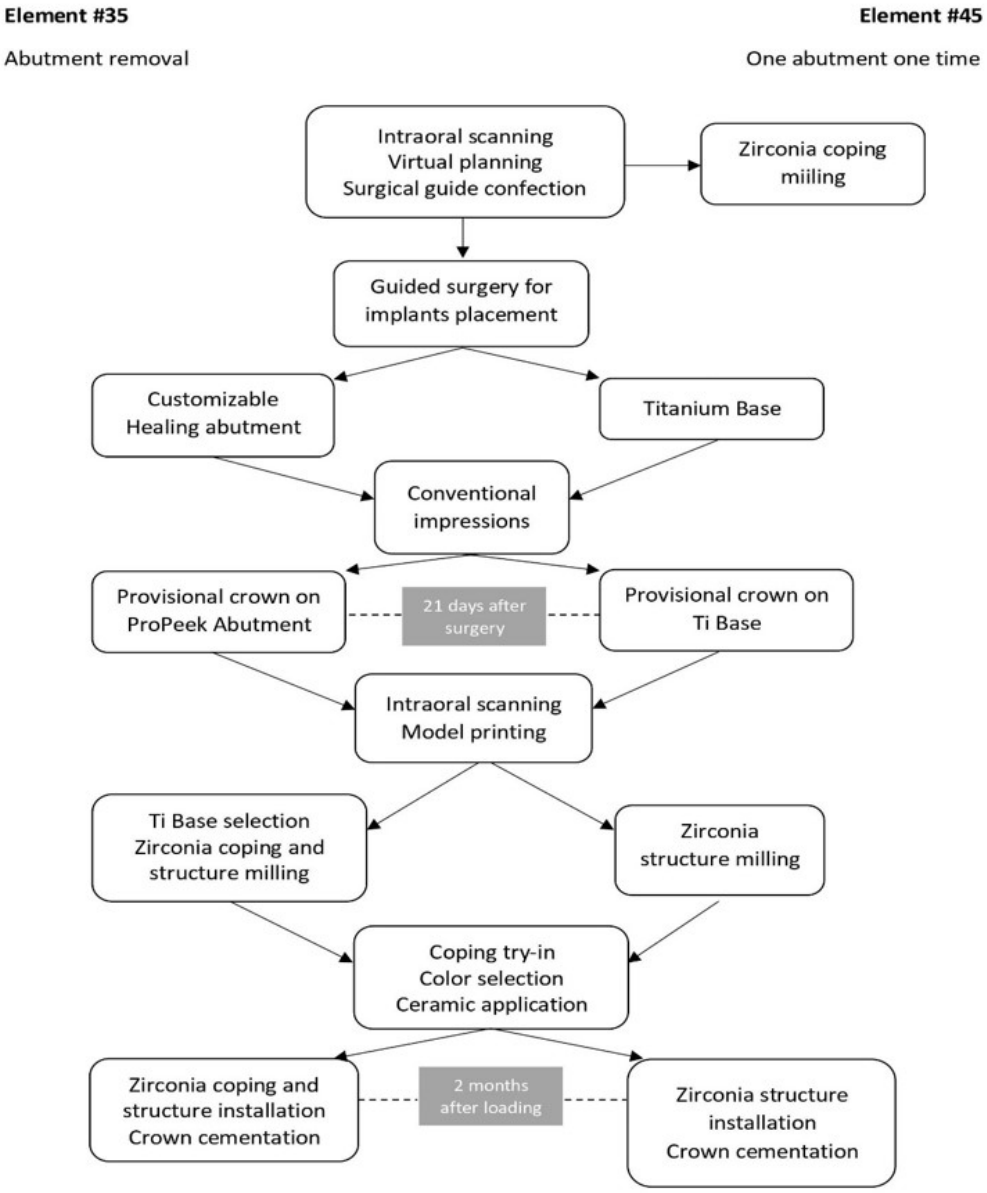


**Figure 8 -** Summary of surgical and prosthetic procedures.

## Follow-up and outcomes

The patient was followed-up with visits at 6 ,12 (Figure 9) and 30 months (Figure 10) after loading. Keratinized tissue width measurement with a graded periodontal probe was performed [11], and photographs were obtained by a third clinician. Digital periapical x-rays were obtained (Heliodent Plus, Dentsply Sirona, USA), using the parallelism radiography technique to standardize the images.

No complications were observed during the follow-up period and both implants presented clinical and radiographic success by means of implant stability, absence of signs of peri-implantitis, complete implant osseointegration [12]. Regarding peri-implant bone level, it was measured at mesial and distal peri-implant bone levels closest to the implant platform [13], using Sidexis XG version 2.6 software (Sirona, Bensheim, Germany). Mild changes could be observed after loading, with region 35 (abutment removal) presenting mean bone loss of 1.8 mm and region 45 (one abutment-one time) only 0.3 mm after 30 months. Soft tissue evaluation revealed good outcomes [14] with keratinized gingiva width of 1mm after definitive prostheses placement and increasing to 2mm at the 30-month follow-up visit. In addition, very good soft-tissue esthetic outcomes were achieved in the long-term, by means of maintenance of harmonic interdental papillae shape and natural form of gingiva margin [15].

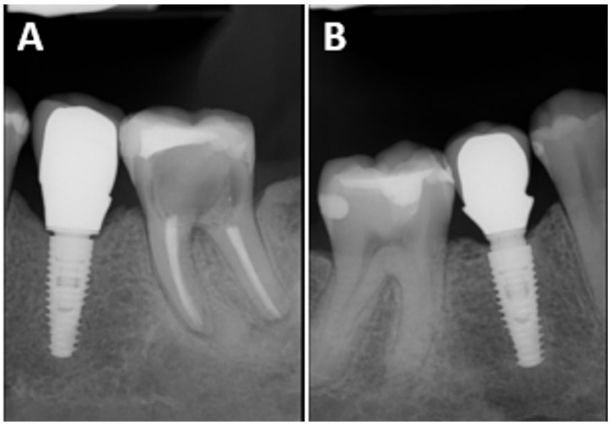


**Figure 9 -** A) and B) Periapical x-rays of regions 35 and 45 at the one-year follow-up.

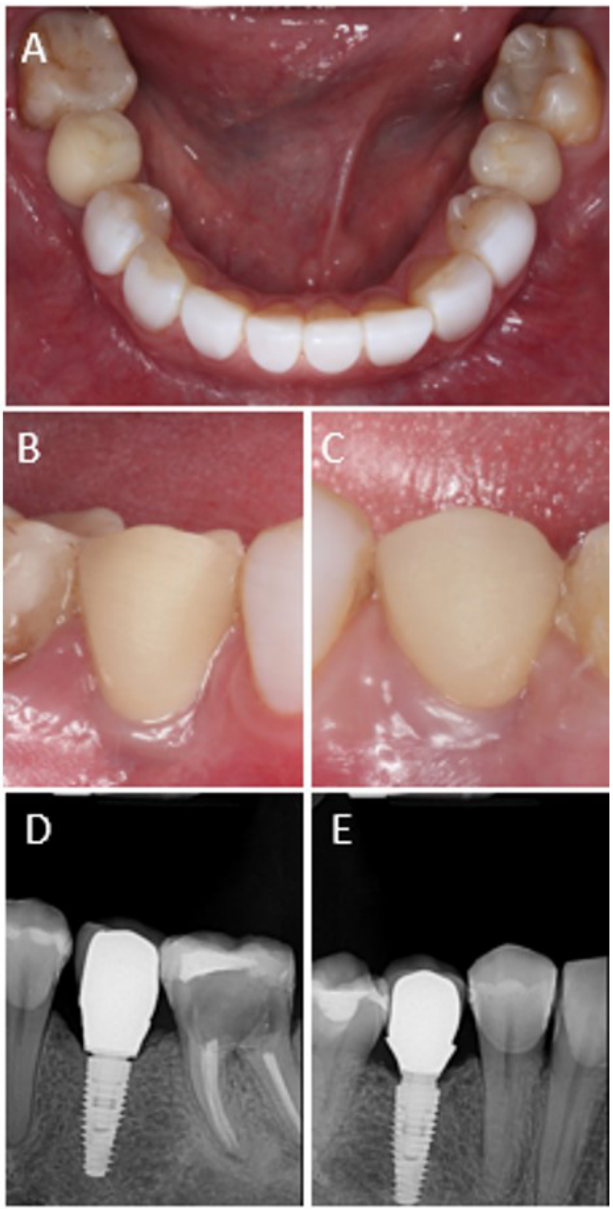


**Figure 10 -** Clinical and radiographic aspects at 30-month follow-up visit. A), B) and C) Occlusal and lateral view of regions 35 and 45. D) and E) Periapical x-rays of #35 and #45.

### Patient satisfaction

The Portuguese translation of OHIP–14 (Oral Health Impact Profile) questionnaire [16] was applied during screening visit, and the patient reported she very often had trouble eating, relaxing, felt self-conscious and that life was less satisfying in general, because of her teeth problems. All that resulted in an OHIP-14 score of 15.7, revealing how unsatisfied she was with her initial oral conditions. However, at the 12-month follow-up, OHIP-14 score decreased to 0, showing patient´s great satisfaction with treatment outcomes, which remained at the 30-month follow-up.

## DISCUSSION

New technologies and different approaches are continuously applied in the dentistry field to obtain accurate, predictable, and time-efficient diagnosis, planning and treatment [17]. In the present case report, digital workflow, guided surgery, platform-switching, and one abutment-one time concepts were combined along with early loading to provide an efficient treatment to the patient and evaluate differences regarding bone loss.

The guided surgery based on CBCT images allows the ideal placement of implants according to the planned restoration, surrounding anatomy and principles of implant positioning and spacing. This is known to enhance safety and predictability when compared to freehand technique, preventing undesiring adverse events and reducing patient´s morbidity [4]. In the present case, no adverse events such as excessive bleeding, edema or pain was reported in the intra or post-operative period.

Another factor that should be considered when using surgical guides is the possibility of overheating during implant site preparation, that can culminate in bone loss. This phenomenon can happen due to reduced access for adequate irrigation [18]. In the post-operative periapical images of the presented case, no signs of overheating as early bone loss [19] can be observed, since adequate drilling protocol and irrigation were followed.

Regarding loading protocol, PMMA acrylic provisional prostheses were inserted 21 days after surgery, characterizing early loading, since both implants achieved primary stability (35 N.cm) [20]. It has been reported that immediate or early loading can only be successful when protheses are

delivered without centric and eccentric occlusal contacts [21]. In the present case, however, provisional prostheses were inserted with occlusal forces and osseointegration and, thus, implant survival was not jeopardized. Furthermore, PMMA presents durability, strength, high impact toughness and resistance to the environment [22]. For the final prostheses, zirconia was the chosen material, since used it has been reported to be successful for posterior restorations [23].

The soft tissue health was also evaluated and presented good outcomes, which might be related to the zirconia-based restoration that does not affect soft tissues, corroborating with other authors [24].

Another concern when applying immediate or early loading, is extensive bone loss [25]. Thus, platform-switched implants have been introduced as a great alternative as they may present reduced marginal bone loss even in one-stage procedures, when compared to platform-matched implants [26]. Moreover, the non-removal of the abutment placed at the time of implant insertion, known as one abutment one time concept, has been reported to help in maintaining peri-implant bone level [9,10]. This could be observed in the present case, since the region in which the final abutment was inserted at the time of implant placement surgery presented less bone loss than implant in which abutment removal was performed during temporary and final prostheses confection process.

Nevertheless, neither implants presented extensive bone loss and both were considered successful, with bone level changes lower than 2mm, at the 30-month follow-up. Therefore, although applying the one abutment one time protocol seems beneficial regarding bone level, it may not be clinically relevant to the clinician nor to the patient, as discussed by other authors [9]. Likewise, the need to replace the abutments may not be critical to the stability of peri-implant bone level, when implants with platform-switching taper connection are used, corroborating with previous results [8].

Regarding patient´s satisfaction with treatment, the OHIP-14 questionnaire score showed that the patient´s quality of life was initially affected by her teeth problems, as reported in the literature [27]. That, however, was completely resolved with the implant-supported rehabilitation, improving her quality of life in the long-term. The difference regarding the prosthetic protocols seemed to not affect patient´s perception.

Since this is a report of a single case, there is a lack of ability to generalize the outcomes, further controlled studies with larger samples and blinded procedures are needed to provide better evidence.

## CONCLUSION

The use of digital workflow and early loading, made the present implant-supported rehabilitation predictable, safe and time-efficient, resulting in complete patient satisfaction. Peri-implant bone level was observed to be stable both with and without abutment removal. Therefore, platform-switching connection implants seem to be able to prevent extensive bone loss, despite of the prosthetic protocol, of early loaded implants. The present rehabilitation showed success, with excellent hard and soft tissue outcomes in the long-term.

### Author's Contributions

RHY, CAC, SRB: Investigation. CPV: Writing – Original Draft Preparation. WC: Writing – Review & Editing LCT: Project administration and Funding Acquisition. RMF: Conceptualization and supervision.

### Conflict of Interests

The authors C.A.C., C.P.V., W.C., S.R.B., and L.T.C. work for the company that provided the devices. The authors R. H.Y. and R.M.F. declare that they have no conflict of interest.

### Funding

The devices used in this case report was provided by Neodent.

### Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of Local Human Research and Ethics Committee.

The approval code for this study is 3.367.313.

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