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Fully Digital Workflow with Ceramic Implants - From Planning to Prosthetic Work: A Case Report

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1. Abstract

The aim of this case report was to describe the treatment of a 25-year-old man with mobility in the upper anterior teeth due to childhood trauma with extensive root resorption. The treatment plan involved extraction of the teeth and placement of two ceramic implants in the upper central and lateral incisors. Guided surgery was used to ensure optimal implant positioning because this was an esthetic zone. Temporary crowns were fabricated using milled resin (PMMA) for immediate loading. The surgical procedure consisted of atraumatic extractions, implant placement with the aid of a surgical guide, and to preserve the soft and hard tissues, connective tissue grafting (CTG) was performed and the fresh sockets were filled with bone substitute. After a four-month healing period, final lithium disilicate crowns were cemented, and at the 24-month follow-up, the patient presented peri-implant health, preserved soft tissue volume, and no bone loss. This case demonstrates the effectiveness of ceramic implants and guided surgery in achieving functional and aesthetic results for young patients and in aesthetic areas.

2. Introduction

Currently, the placement of osseointegrated dental implants is a common procedure in dental clinical practice. However, improper positioning of dental implants is one of the main causes of future bone and/or gingival tissue loss, representing a significant challenge for rehabilitation [1]. Immediate trans-surgical complications may also occur due to inadequate planning or final positioning of a dental implant, such as nerve damage, perforation of the cortical plate, or injury to adjacent teeth [2].The digital workflow for implant surgeries, also known as guided surgery, has proven to be more accurate in transferring the planned position of the implant compared to freehand placement [3, 4]. Recent studies have shown that among the advantages of fully guided surgery, the precision of implant positioning, the possibility of flapless surgery, which consequently reduces chair time and postoperative discomfort, and the placement of provisional prostheses in immediate loading protocols with fewer adjustments stand out [5]. In contrast, despite technological advancements, the conventional non-guided protocol, also known as freehand surgery, is still widely used due to its lower treatment cost and better depth control when manually inserting the implant [6].

In addition to technological advancements for performing the surgical procedure, innovations in implant manufacturing materials have occurred over the last decades. Zirconia ceramic implants were introduced to the market in 1990 [7, 8], and the possibility of having a more aesthetic alternative with the strength to withstand masticatory forces has led to an increase in the use of these implants in recent years [9]. Despite the rise in the use of ceramic implants, long-term studies and clinical and radiographic outcomes are still scarce in current literature.

The aim of the present study was to observe the clinical and radiographic performance of two two-piece ceramic implants placed in the anterior maxilla using fully digital flow after a 24-month follow-up period.

3. Case Description

A 25-year-old man presented to the clinic complaining of mobility of the upper anterior teeth and reported being afraid of the teeth “falling out” while chewing. The clinical examination confirmed the patient’s complaint, as the upper right central incisor and right lateral incisor had significant mobility and caused discomfort to the patient (Figure 1). When talking to the patient, he mentioned that he had suffered a bicycle fall as a child, which required treatment for both teeth and the upper right central incisor; However, the latter did not show mobility. During the anamnesis, according to the patient’s self-report, he was healthy, a non-smoker, and did not use any drugs.During the imaging exam, extensive root resorption was observed in two teeth: the upper left central incisor and the left lateral incisor (Figure 2). After discussing the treatment possibilities with the patient, he opted for tooth extraction and the installation of two ceramic implants. This decision was made jointly (patient and dentist) because the patient was young, and the area was extremely aesthetically sensitive. To achieve a three-dimensional positioning as close to ideal as possible, the guided surgery treatment modality was also chosen.

4. Surgical Planning

The option for guided surgery was made so that the implants could have an adequate three-dimensional positioning and be parallel to each other. An intraoral scan was then performed (Figure3), and planning was carried out with the aid of software (Nemo Scan) (Figure 4) to create the guide (Figure 5) and two provisional crowns in milled resin (PMMA) (Figure 6) to be used as immediate provisional prostheses. The implants planned for the case were two-piece ceramic implants (Neodent Zi), one 3.75 x 11.5 mm (central incisor) and the other 3.75 x 13 mm (lateral incisor).

5. Surgical Procedure

The patient was instructed to perform antibiotic prophylaxis 1 hour beforehand with 4 tablets of Amoxicillin 500mg and rinse his mouth with 0.12% chlorhexidine for 30 seconds before receiving local anesthesia with 4% Articaine (1:100,000). The site preparation was performed as recommended by the manufacturer (Neodent – Curitiba – Brazil), and the selected implants were placed in the surgical sites using a contra-angle previously adjusted to 24 RPM and 30 Ncm (Neodent® Zi Ceramic Implant).Once anesthetized, extractions

Figure 1: The clinical examination of initial situation.

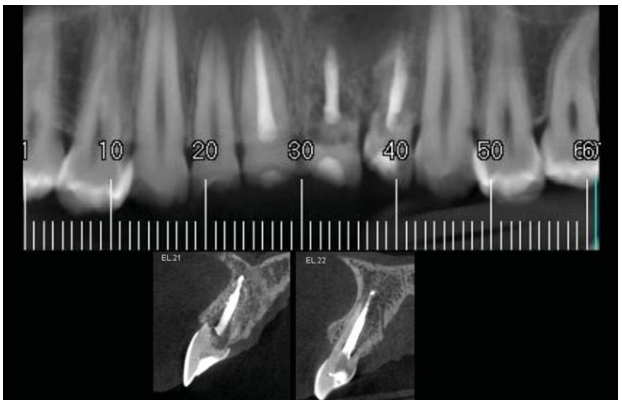


Figure 2: Imaging exam (Computerized tomography) - extensive root resorption in the upper left central incisor and the left lateral incisor.

Figure 3: Intraoral scan.

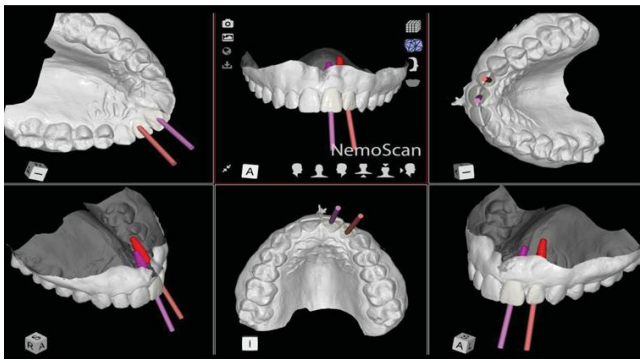


Figure 4: Planning carried out with the aid of software (Nemo Scan).

were performed atraumatically with the aid of manual periotomes and forceps (for elevation) (Figure 7). The surgical guide was positioned (Figure 8), and perforations were made according to the manufacturer's recommendations under profuse irrigation to achieve ideal primary stability (Neodent - Curitiba - Brazil). After completing all osteotomies, the selected implants (Figure 9) were placed in the surgical site using a contra-angle previously adjusted to 24 RPM and 35 Ncm so that the implants could be manually installed in their final positions (Figure 10). Two cemented prosthesis abutments were selected (CR Abutment - Neodent - Curitiba - Brazil) (figure 11) to support the provisional crowns.To capture the provisional crowns on the provisional cylinders, light-cured flow resin (Masterflow) was used, and the finishing was performed with the aid of the handpiece and polishing rubbers. After suture placement, the provisional prosthesis was relined to the abutments using light-curing resin, and immediate temporization was completed (Figures 12A & B).A connective soft tissue graft (CTG) was performed to preserve the soft tissue volume in the vestibular area. The CTG was removed from the patient's own palate using the double-blade technique (Figures

Figure 5: Surgical Guide.

Figure 6: Provisional crowns in milled resin (PMMA).

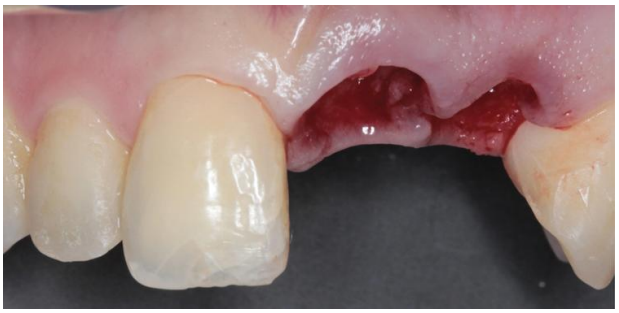


Figure 7: Fresh Sockets After an Extraction.

13A & B) and fixed with a 6/0 transparent Nylon suture (Techsuture). A bone substitute (Straumann® maxresorb® 0.5 - 1.0 mm, 0.5 cc) was used to fill the gap between the external wall of the implant and the internal surface of the buccal wall of the alveolus (Figure 14). After cementation of the provisional crowns, the suture was finalized using the "double cross" technique (Figure 15), and at the end of the surgical procedure, a periapical radiograph was taken (Figure16). The patient returned 14 days later for suture removal and received the necessary instructions. The four-month postoperative period was uneventful, and after this period, the patient returned to begin the prosthetic rehabilitation phase.

6. Prosthetic Phase

After four months, the patient returned for the final crowns to be made (Figure 17). The crowns were fabricated using the digital workflow (conventional flow) with a scan of the CR abutment selected for this case. For scanning, the Virtuo Vivo™ (Straumann) was used. Two lithium disilicate crowns (e.max®) were manufactured and cemented with dual adhesive cement (RelyXT™ U200.3M) on the prosthetic abutments (Figure 18). Occlusal adjustments were made, and at the end of the treatment, a final periapical radiograph was taken, which showed bone stability and adaptation of the prosthetic work.

7. Follow-Up

After 24 months, the patient was asked to return for a follow-up. The clinical examination showed peri-implant health and maintenance of soft tissue volume around both implants. A new radiograph was performed, which showed bone stability (no bone loss) (Figures 19A & B, respectively).

8. Discussion

This case report aimed to observe the clinical and radiographic performance of two two-piece ceramic implants placed in the anterior maxilla using fully digital flow after a 24-month follow-up period. To date, the authors of the present study are unaware of any other scientific publication describing the placement of this model of ceramic implants using fully digital flow and with a 24-month follow-up.During the 24-month follow-up, no technical or biological complications were observed, demonstrating successful clinical

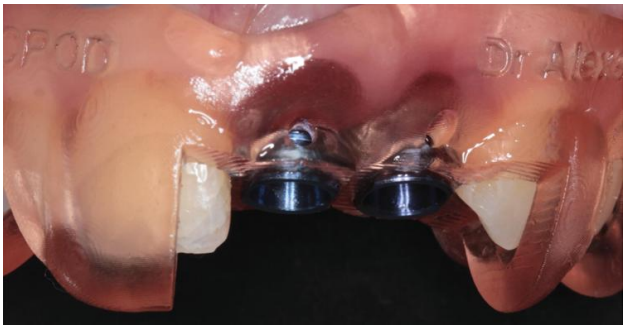


Figure 8: Guide in Position.

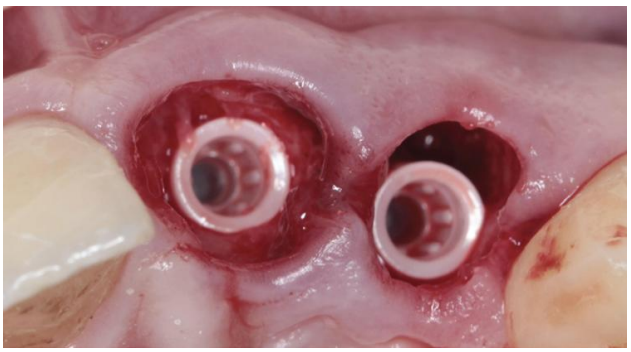


Figure 10: Oclusal View of Final Positions.

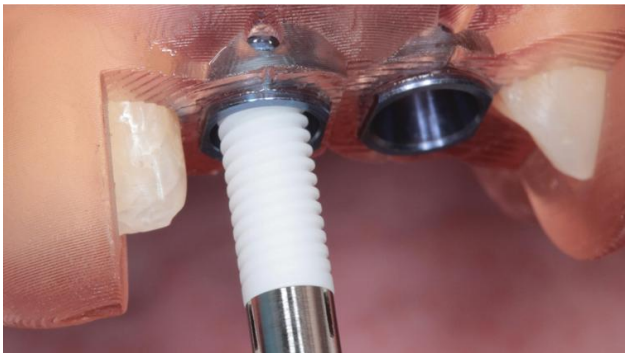
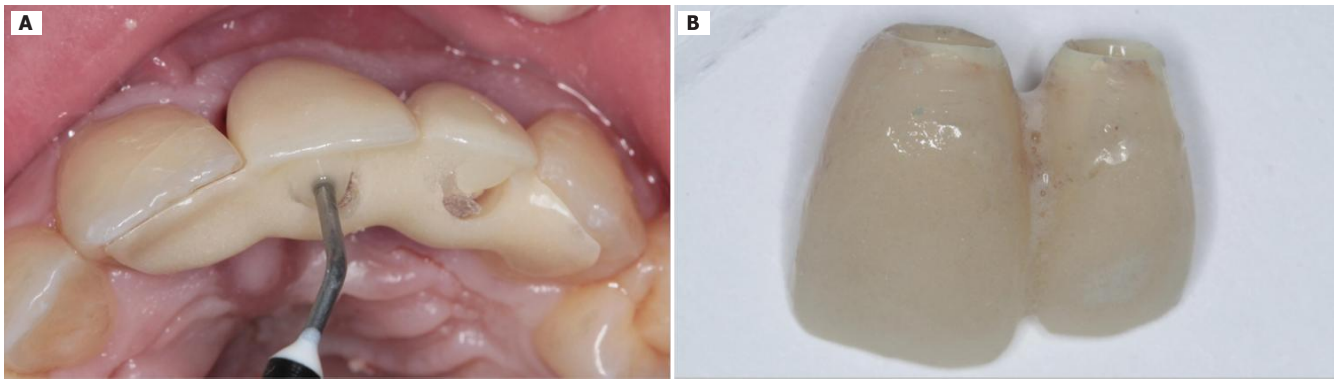


Figure 9: Neodent Zi Ceramic Implant.

Figure 11: CR Abutment (Neodent - Curitiba - Brazil).



Figures 12A & B: Capture of The Provisional Crowns with Light-Cured Flow Resin.

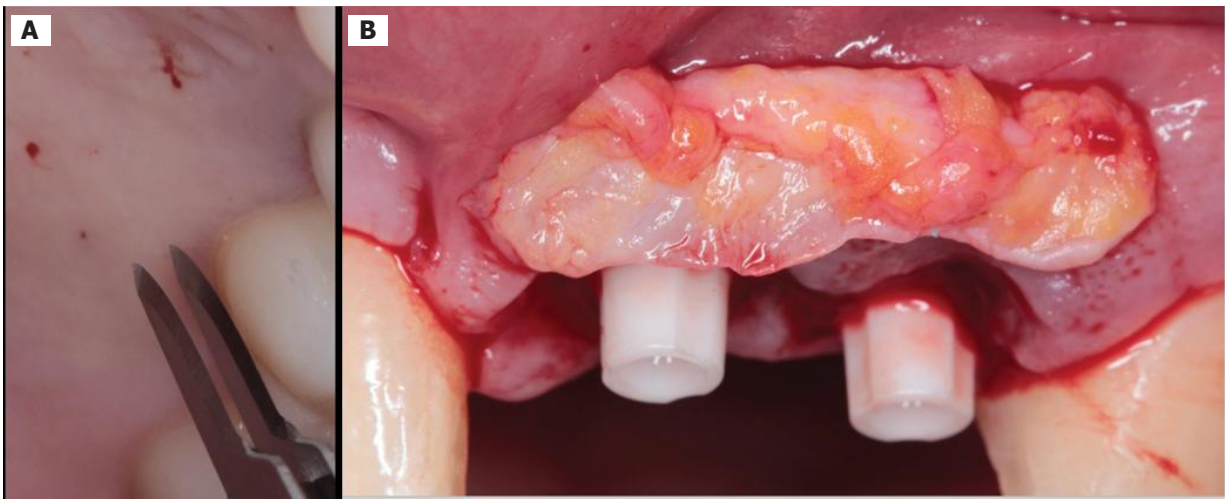


Figure 13A & B: CTG Removed from the Patient's own Palate Using the Double-Blade Technique.

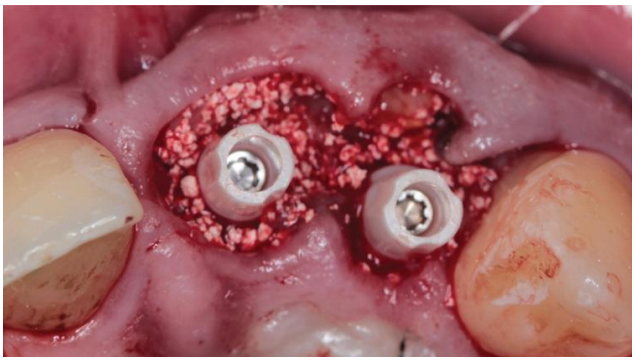


Figure 14: Oclusal View of Fresh Sockets with the Two-Peaces Ceramic Implants in Final Position Wuit CR Abutments, CTG and Bone Substitute.

Figure 15:Immediate Post-Operation with Double Cross Suture.

and radiographic osseointegration of the implants and satisfactory preservation of the shape of the soft and hard tissues, in agreement with the findings of other studies that used the same implant system, but with shorter follow-up periods than ours [10, 11]. Previous studies performed in animals have demonstrated that osseointegration of zirconia implants is reliable and safe under different loading conditions [9, 12]. As described in our study and in accordance with the current literature, both implants achieved successful osseointegration throughout the follow-up period.It is worth highlighting that Guided surgery is essential in cosmetic dentistry, especially in areas such as the anterior zone, where precision and harmony are essential. It allows for the exact positioning of implants, ensuring that they are in the ideal position in relation to the bone and soft tissue, which is crucial for a natural aesthetic result [3, 4,

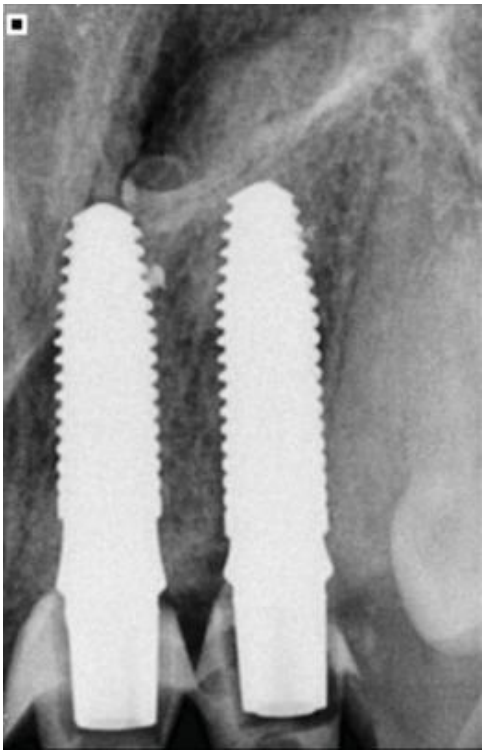


Figure 16: Immediate Post-Operative X-Ray.

Figure 17: Four Months Later, Without The Temporary Crowns and Peri-Implant Health in Both Implants.

Figure 18: Two Lithium Disilicate Crowns (e.max®) Cemented -Case Finalized.

Figure 19A & B:Respectively:Clinical Examination (Peri-Implant Health and Maintenance of Soft Tissue Volume) and X-Ray 24 Moths Latter.

13]. This technique can justify the maintenance of soft tissues and aesthetics, along with the use of a bone substitute in fresh sockets and the use of CTG on the buccal surface of the socket. In recent years, several reviews have evaluated the accuracy of flapless guided surgery; some authors [1] have concluded that computer-assisted surgery cannot be said to be superior to conventional surgery in terms of safety, outcome, and efficiency. However, as in the present study, correct three-dimensional implant placement can be observed, exactly as previously planned.Despite the limitations of the present study, success and survival of the implants were observed, both in aesthetic and biological terms, in agreement with a recent systematic review that demonstrated that implant survival obtained with the use of guided surgery presents high percentages.Despite the limitations of the present study, the success and survival of implants were observed, both in aesthetic and biological terms, in agreement with another study, which revealed that implant survival rates can be attributed to ideal prosthetic positioning with benefits for adequate oral hygiene and well-planned inter-implant distances [15].

9. Conclusion

The two-piece ceramic implant system used in the present study is promising and reliable, with results like those found with titanium implants after the same follow-up period. The guided implant placement technique proved to be an important ally in three-dimensional positioning, favoring the seating of the definitive crowns and the maintenance of the soft tissue positioning in a harmonious and aesthetic manner. The patient in the present study was advised to continue with follow-up appointments, and updates of this clinical report will be published in the future.

10. Ethical Aspects

The study protocol was submitted and approved by the Ethics Committee of the Pedro Ernesto University Hospital-UERJ, Rio de Janeiro, Brazil (HUPE-UERJ) (N. 5.598.463). The investigation was conducted in accordance with the revised principles of the Declaration of Helsinki. Written informed consent was obtained from the patient.

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