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USE OF AN RPA CLASP, PLANNING, AND VIRTUAL FABRICATION OF A REMOVABLE PARTIAL DENTURE METAL FRAMEWORK

USO DO GRAMPO RPA, PLANEJAMENTO E FABRICAÇÃO DIGITAL DE ESTRUTURA METÁLICA PARA PRÓTESE PARCIAL REMOVÍVEL

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Resumo

Objetivo: O presente artigo teve como objetivo descrever uma técnica de confecção de uma Prótese Parcial Removível (PPR) classe I de Kennedy com grampo RPA (nicho, placa proximal, grampo de Akers) no arco mandibular usando o sistema CAD-CAM (Computer-Aided Design and Computer-Aided Manufacturin technology). **Materiais e Métodos:** Um scanner de bancada (3Shape®, Copenhagen, Dinamarca) capturou a imagem do modelo de gesso e o software (Exocad DentalCAD®, Darmstadt, Alemanha) realizou o processamento das imagens. Todo o planejamento inicial foi realizado; porém, com a análise através do fluxo digital e a obtenção do modelo impresso, o desenho da armação metálica foi alterado devido à necessidade de modificação do grampo de retenção nos dentes pilares. As demais etapas clínicas para instalação da prótese parcial removível foram seguidas em laboratório para obtenção de resultados estéticos e funcionais satisfatórios. **Resultado e Conclusão:** Com esta técnica e utilizando a odontologia digital, observou-se a otimização do fluxo de trabalho na reabilitação protética, maior facilidade no planejamento do trabalho envolvendo a equipe clínica e o técnico em prótese dentária e o restabelecimento da função mastigatória e estética ao paciente.

Palavras-Chave: Desenho Assistido por Computador; Tecnologia Odontológica, Planejamento de Prótese Dentária.

Abstract

Objective: A technique is described for selecting the RPA clasp (rest, proximal plate, Aker’s clasp) and making a Kennedy class I removable partial denture in the mandibular arch using the computer-aided design and computer-aided manufacturing technology. **Materials and Methods:** A benchtop scanner (3Shape®, Copenhagen, Denmark) captures the stone cast image, which is processed by a (Exocad DentalCAD®, Darmstadt, Germany). All the initial planning was carried out; however, because of the digital flow analysis to obtain the printed cast, the design of the metallic framework was changed due to the need of modifying retentive clasp on the abutment teeth. The other clinical steps for the installation of the removable partial denture were followed in the laboratory to obtain satisfactory aesthetic and functional results. **Results and Conclusion:** With this technique using the digital medium, the optimization of the workflow in dental prosthetic rehabilitation, easier work planning involving the clinical team and the dental technician, and the return of the masticatory function and aesthetics to the patient were observed.

Keywords: Computer-Aided Design; Technology Dental; Dental Prosthesis Design.

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Introduction

Technological advances in dentistry have been constantly increasing, thus making it possible to manufacture dental prostheses through digital media. The progress in computer-aided design and computer-aided manufacturing (CAD-CAM) design and fabrication has led to the production of more precisely fitted milled restorations[1] and the extensive use of digital workflow to produce dental prostheses.[2] In addition to minimizing molding failures and casting steps, this method has emerged as a viable alternative to reduce clinical and laboratory time.[3]

In the field of removable partial dentures (RPDs), use of dental applications using digital technology are is increasing.[4] Sophisticated printing software programs have been implied to manufacture the RPD components.[5] However, despite these advances in dentistry, careful planning is necessary, especially in patients with extensive edentulous spaces.[6] A precise fit is a key component of removable dentures.[7] In addition, inadequate fitting can promote tooth movement and discomfort, with poor adaptation being one of the main reasons RPDs are not used.[8] Other harmful effects, such as caries (especially root caries), periodontitis, oral candidiasis, denture stomatitis, and halitosis, can arise from the biofilm that accumulates around the components of an RPD.[9]

In situations of extensive edentulous spaces, the component selection that increases the adaptation of the RPD is fundamental, which consequently reduces the adverse effects caused by inadequate planning.[6] In these specific situations, the RPA clasp becomes the most suitable choice because it has a mesial rest, smaller connector, proximal plate, and Akers clasp retentive arm. In this type of clasp, the rest provides a good resistance to occlusal displacement, covering a minimal structure, and, in most situations, it has less metal than other clasps.[10] Therefore, the choice of the RPA clasp, associated with virtual planning of the RPD, can be an excellent option in partially edentulous individuals' treatment. Based on the above and the advantages presented by the precision of milling using digital flow,[11,12,13,14] this study proposes to report a precise and fast technique, through CAD-CAM technology, combined with planning using the RPA-type clasp for making RPDs.

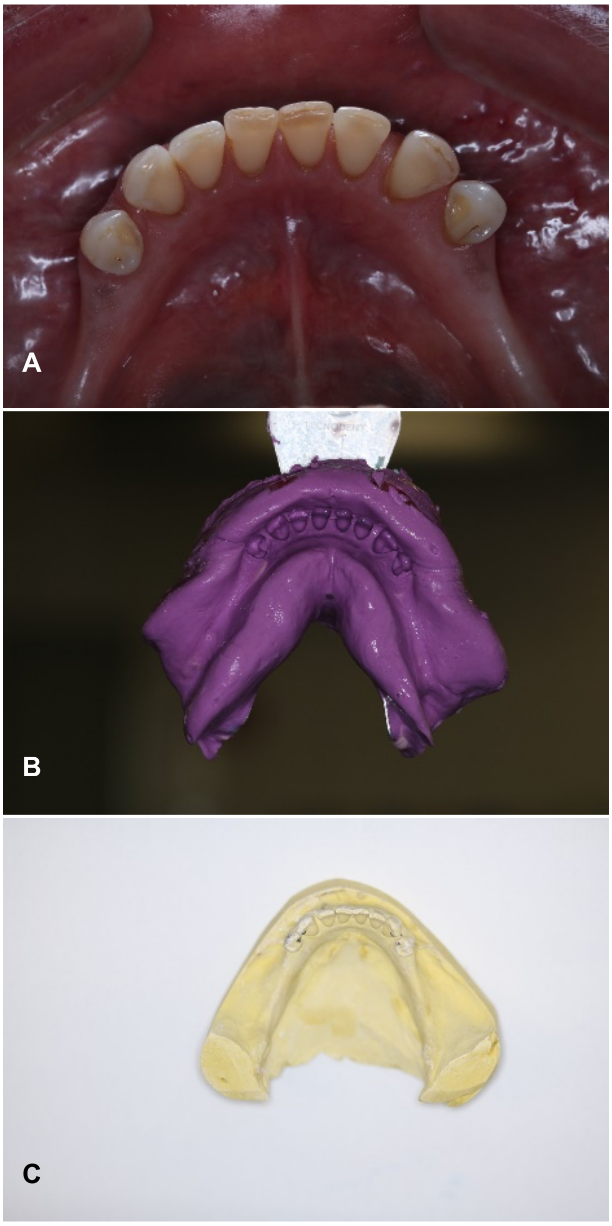


Figure 1. a) Kennedy class I partially edentulous arch; b) impression with Hydrogum® alginate; c) working cast.

Technique

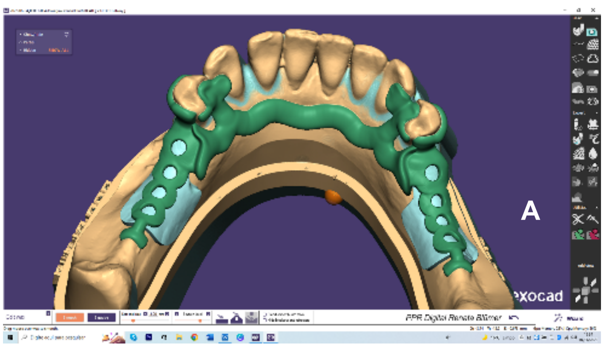
1. In a Kennedy Class I patient (Fig. 1a), make the impression with alginate (Hydrogum®; Zhermack, Badia Polesine, Italy) (Fig. 1b) to make a working cast (Fig. 1c).

2. Scan the working cast and export digital file (Fig. 2). Key steps for scanning a model for a digital RPD using the 3Shape scanner: a) ensure the model is clean and dry; b) turn on the 3Shape scanner and ensure it's calibrated; c) place the model on the scanning platform securely and level it for accurate results. d) choose the appropriate scan type for a removable partial denture (RPD) in the 3Shape software; e) initiate the scanning process and move the scanner smoothly around the model to capture all surfaces and details; f) verify that all areas of the model are captured accurately during scanning. Repeat or adjust if necessary; g) let the software process the scan data to create a digital 3D model

of the physical model; h) make any necessary adjustments or edits to the digital model, such as removing unwanted areas or correcting imperfections; i) proceed to design the RPD within the software, including support structures, retainers, connectors, and other specific features; j) carefully review the design for accuracy and quality. Make final adjustments and then finalize the design.

Figure 2. scanning process on 3Shape scanner®.

3. Design the infrastructure in software (Exocad DentalCAD®; Darmstadt, Germany) (Fig. 3a). Represent the retentive (in red) and expulsive (in blue) areas (Fig. 3b) to indicate the best option for using the RPA clasp due to the small space between the gingival margin of the abutment tooth and the bottom of the vestibule. Highlight the RPA clasp drawing (Fig. 3c).



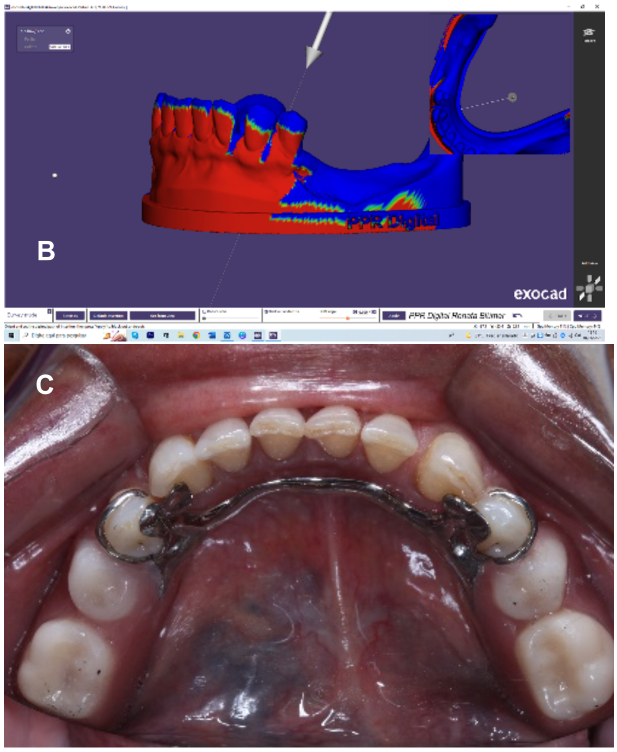


Figure 3. a) Design the infrastructure; b) Represent the retentive (in red) and expulsive (in blue) areas; c) RPA clasp drawing.

4. 3-D print the cast with the infrastructure design (Fig. 4a). Adapt the finished metallic framework (Co-Cr) to the printed cast (Fig. 4b).

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Figure 4. a) The cast with the infrastructure design; b) Adaptation the finished metallic framework (Co-Cr).

5. Place the metal frame in the mouth to test its fit (Fig. 5).

Figure 5. Framework try-in in the mouth.

6. Fabricate the record base for interocclusal registration. Isolate the cast with Cel-Lac® (SS White Duflex; São Cristovão, Brazil) (Fig. 6a). Relieve the cast with wax 7 (Fig. 6b) to place the colorless self-cure acrylic resin (Fig. 6c). Subsequently, create the posterior wax plane (Fig. 6d) to complete the procedure (Fig. 6e).

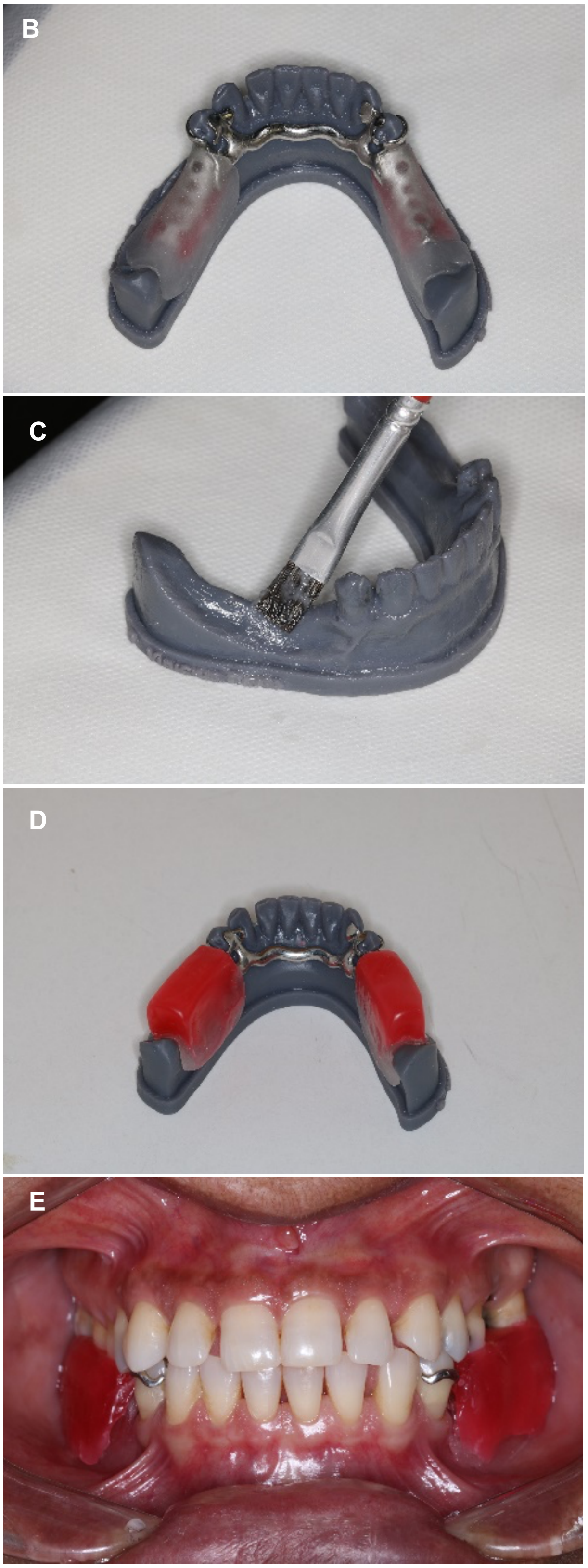


Figure 6. a) Isolation of the cast with Cel-Lac®; b) relief the cast with wax 7; c) colorless self-cure acrylic resin placed; d) posterior wax rim; e) procedure completed.

7. Select the shade (Trilux scale; VIPI, Pirassununga, Brazil) for artificial teeth (Fig. 7a), try-in wax-mounted teeth, and make a functional impression with polyether for altered cast fabrication (Impregum®; 3M, Sumare, Brazil) (Fig. 7b).

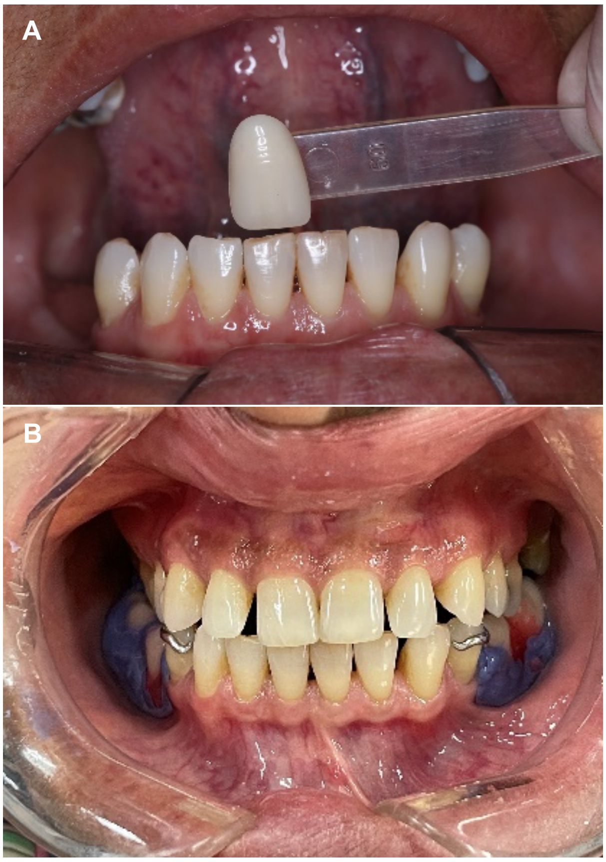
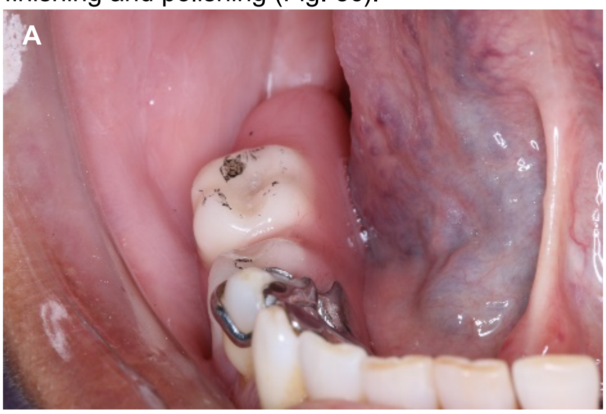


Figure 7. a) Selection the shade for artificial teeth; b) functional impression with polyether Impregum®.

8. Deliver the RPD after occlusal adjustment (Fig. 8a), identifying the pressure spots (Fig. 8b), and finishing and polishing (Fig. 8c).



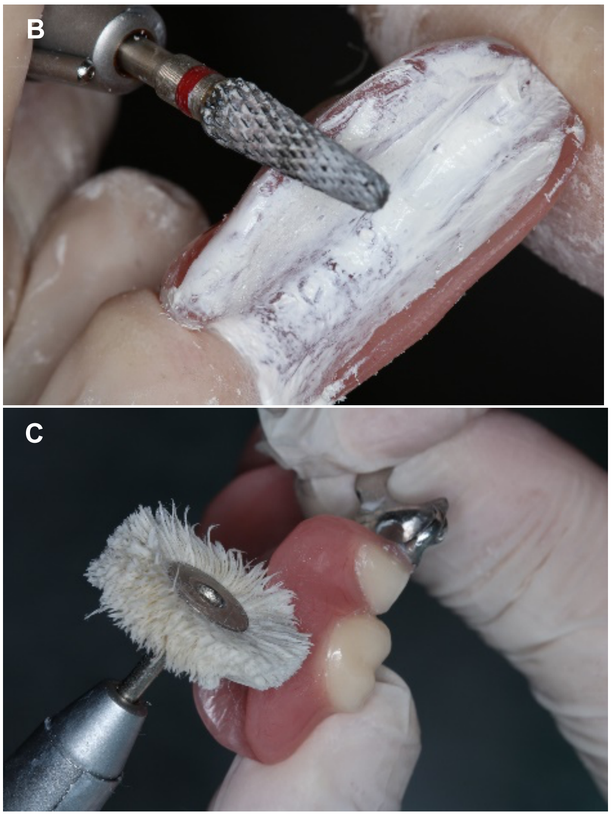


Figure 8. a) Occlusal adjustment; b) identification of compressive areas; c) finish and polish.

9. The RPD Kennedy Class I finished

Figure 9. Kennedy class I removable partial denture finished.

Discussion

Currently, the application of CAD/CAM technologies can reduce the errors found in traditional laboratory steps during the manufacturing of RPDs, which suggests the manufacture of a metallic structure with better adaptation.[15] The technique differs from the conventional one by scanning the mold or working cast and digital planning and obtaining a 3-D model (print) of the metallic frame previously in resin. This facilitates the analysis of the material thickness control, the definition of the clasp, communication with the responsible clinical professional, as well as speed in the execution of the treatment.

Ozawa et al. (2015) showed that analog workflows are laborious and can provide unsatisfactory results compared to digital workflows.[16] Another advantage was the cost of installing the software. Regardless, the limitations of using this digital technique include the initial learning curve for professionals involved in using CAD as it is necessary to develop a different dental workflow, which can be time-consuming and challenging for new software users[17].

Furthermore, the components manufactured for RPDs must satisfy functional and biomechanical needs, such as retention, stability, support, reciprocity, and passivity.[18] Usually, T- or I-bar action clasps are indicated at the free ends; however, when the direct abutment tooth adjacent to the free end has a gingival recession, a retentive area is created between the clasp and the buccal surface, which results in greater food accumulation. Another situation refers to marked bone loss in the abutment tooth region, resulting in vestibular fundus reduction, rendering the use of bar action clasps unfavorable.

In this situation, the RPA clasp is the most suitable choice. In addition to the advantages already mentioned, the great advantage of the RPA clamp is in two specific clinical cases: 1) When the abutment tooth has gingival recession and 2) when there is little space between the gingival margin of the abutment tooth and the bottom of the vestibule. The RPA clasp is also contraindicated in patients with substantial tissue and bone loss, requiring 3 mm of distance from the gingival margin on the buccal side for its correct seating.[10]

The use of virtual planning helps in the professional evaluation of the distance from the soft tissue to the dental pillar and allows the visualization of undercut areas that would pose a risk of accumulation of microorganisms and development of biofilm, which is one of the indications for the use of the RPA clamp. In addition, it facilitates treatment planning with the dental technician and makes the procurement process faster, thus representing a viable option for oral rehabilitation with less number of RPDs.

Therefore, regardless of the chosen technique in the RPD manufacture, a careful framework design that minimizes the biofilm accumulation and has favorable biomechanical forces is necessary. In addition, occlusal adjustment correction, continuous maintenance, and excellent oral hygiene are indispensable factors for the long-term survival of the RPD, abutment teeth, and periodontium.[19]

Conclusion

A dental technique that uses CAD-CAM technology for planning, selecting the clasp assembly, and obtaining RPDs is presented in this study. The technique represents an accurate and rapid method that can minimize errors arising from laboratory processes and/or clinical planning. The indication of the RPA clasp can represent an alternative to the traditional bar action clasps used in free ends, facilitated by a virtual analysis of its processing.

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