Application of Digital Flow Associated with 3D Printing of Anatomical Posts

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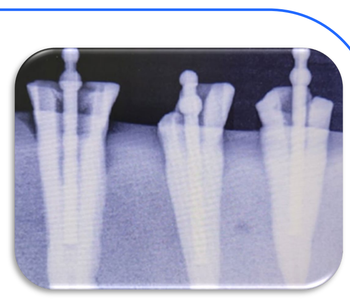
INTRODUCTION

Endopost placement provides intraradicular retention to the final restoration of severely destroyed endodontically treated teeth. The anatomic post, customized to the canal shape by reline of a prefabricated fiber post with composite resin, has been shown to provide a better fit to the prepared root canal walls, especially in those with conical and wide shapes, however, this can present bond failures in the post-composite interface. The fabrication of a single material anatomical post by 3D printing, could be a restorative alternative that allows to enhance the possibilities of clinical intervention.

STRATEGIES

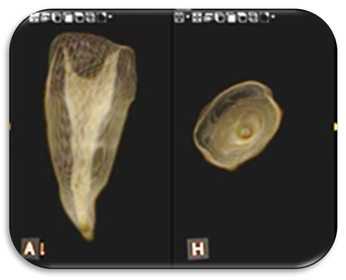
Even though there are a variety of prefabricated posts designed with different sizes and shapes, in the search for a better adaptation and cement layer thickness reduction, the presence of wide conducts, both because of the anatomical natural shape or by excessive instrumentation, sometimes it is not possible to achieve a good fit of a prefabricated post to the canal walls, mainly in the cervical portion of the conduct, which is the area where greatest tensions occur.

Within the restorative strategies for these cases, the anatomic post, developed as a substitute for the cast post, whose stiffness represents a high risk of radicular fracture, is the one that achieves a better adaptation to the dental surface, nevertheless, due to masticatory forces to which the tooth is subjected, a break in the bond between post and composite resin is possible, leading to treatment failure.



OBJECTIVE

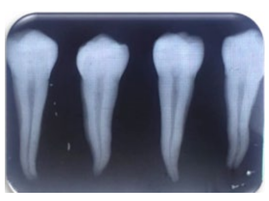
Digital flow application to obtain 3D printing anatomical posts, through a computerized aided design, by information transferred from Cone Beam computed tomography (CBCT) of the prepared tooth.

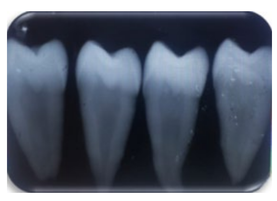


METHODS & MATERIAL

SAMPLE SELECTION AND PREPARATION

- Uniradicular teeth with single conduct. Upper central incisors, upper lateral incisors, lower premolars and upper premolars.



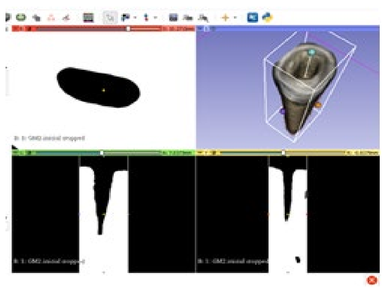


- Endodontic access and instrumentation up to #45 file with NaCL 1.25% irrigation solution (*high speed carbide round bur#5; K-File 25mm Dentsply, EEUU*).
- Post space preparation at 12mm length (*Pesso Largo 32mm, Dentsply, EEUU*).
- Conduct widening #4.5 Parapost drill (*Parapost Fiber White, Coltene Whaledent, Swiss*).

IMAGING, DESIGN AND 3D PRINTING

- Cone Beam Computed Tomography *(Cone Beam Carestream Cs9200c. Field of vision 10x5).*

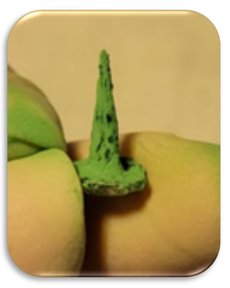
- Transfer of information from DICOM file to the design program and conversion to STL format *(3D Slicer Image Computing Platform).*

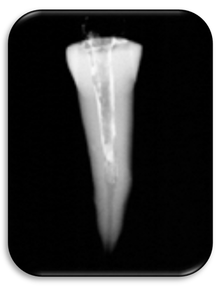


- Anatomical post "prototype" 3D printing with polylactic acid (Makerbot PLA) by fused deposition modelling (FDM) *(MakerBot replicator Extruder 3D).*

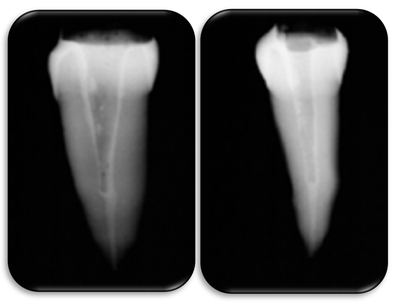
CEMENTATION, PROCESSING AND EVALUATION

- Interference identification, adjustment and radiographic evaluation applying a mixture of liquid glycerin and amalgam powder on the post surface *(Occlude Spray Green, Pascal CO)*

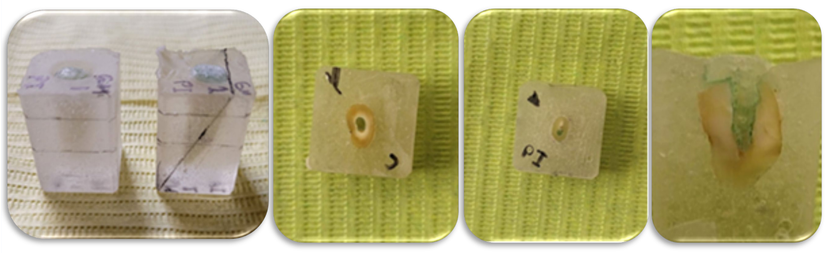




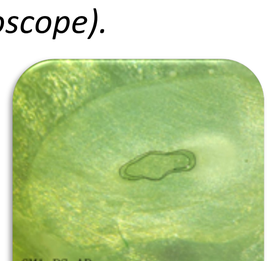
- Posts cementation with adhesive protocol *(U200 3M™Relyx™ Clicker, 3M ESPE, EEUU).*



- Sample processing in acrylic resin blocks. Diagonal cuts at cervical level and cross cuts both at cervical and apical levels were made.



- Microphotography for adaptation and density defects evaluation *(Carl Zeiss OPMI® Pico Dental Microscope).*



- To provide quantitative values, microphotography images where sectioned into a grid.

RESULTS

- Squares were selected, when at least 50% of its area was occupied by the post as by the root canal. Adaptation percentage in cervical and apical thirds were determined separately for each tooth.

Graphic 1. 3D printing posts adaptation percentage on cervical and apical thirds of each tooth.

- Adaptation mean for each teeth group was then calculated. The mean value of 3D printing posts adaptation is 81.83%.

Tooth	Adaptation %	Mean value	Density defects
CI	87.35632184	81.83222201	Yes
LI	83.0952381		Yes
LP	78.19767442		Yes
UP	78.67965368		Yes

- All 3D posts presented little defects of density, however, its dimensions and the amount found, do not represent a significant risk of failure.

CONCLUSION

Within the limitation of this study, CBCT provides sharp images with precise dimensions to use for digital design of small structures as posts.

3D printing of single material posts eliminates the risk of bond failure between fiber post end composite resin of conventional anatomical post method.

As a continuation to the project, it is necessary to try other 3D printing methods, work in the digital design protocol improvement, and the development of a 3D printing biomaterial that meets the requirements for a functional restoration.

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