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Is Computer Assisted Surgical Extraction being resisted by Dentists?

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Abstract

Surgical tooth extraction show a high level of difficulty in practice such as inadequate visualization, improper instrumentation, or other factors related to the targeted tooth Methods. The concept of computer-assisted surgical guide made by 3D printing of plastics and hybrid outcome materials in addition to the conventional surgical cutting tools is modified with a number of stoppers adjusted to avoid any excessive drilling that could harm bone or other vital structures. The present outcome could provide a minimally invasive technique to overcome the routine complications facing dental surgeons in surgical extraction procedures.

Keywords: 3D Printing; Stereolithography; Surgical Extraction; Teeth

Introduction

Surgical extraction of decayed teeth which includes root sectioning and bone cutting is routinely done practice through conventional technique. Ideally, it requires periapical radiographs which include for evaluation of root curvature, angulation, or root fracture, intraoperative radiograph to check the accuracy of the extraction procedure and a postoperative one to confirm complete removal of any remaining tooth structure **[1]**.

Given the broad scope of 3D bioprinting, its application is being increasingly adopted in multiple disciplines, including maxillofacial prosthodontics, otolaryngology, and plastic and reconstructive surgery **[2]**.

Three-dimensional (3D) technologies can allow the user to design a prosthesis using CAD/ CAM software and then fabricate a complex restoration using the desired material type **[3]** This technique still possesses some limitations which includes excessive bone cutting could lead to bone necrosis in the related area. Also, the technique is considerably invasive in areas related to vital structures (e.g., nerves and maxillary sinuses) when applied on teeth with fused or angled roots **[4]**. It also has a relatively prolonged operative time and could be not applicable in patients with limited mouth opening or noncompliant patients **[5]**.

Surgical Guide Fabrication

For a patient undergoing surgical extraction a model is firstly done by impression taking and gypsum pouring before proceeding with the surgical procedure. Then, the patient is directed to perform digital radiograph (CT or CBCT). The 3D images are firstly segmented so that teeth, bone, and other structures are differentiated **[6]**.

Treatment planning includes accurate determination of the position, alignment, and inclination of teeth/roots. Also, bone density overall and in targeted areas could be determined from 3D radiographs. Finally, vital structures such as nerves and sinuses adjacent to the proposed tooth/teeth for extraction are located **[6]**.

The planning is done to provide cutting slots for the surgical burs to reach the roots, bone, and root-bone interface in optimal orientation. These cutting slots are designed to allow the drills to pass exactly and accurately in the weak areas between the roots as could be obtained from the 3D radiographs **[7]**.

The cutting slots are designed as empty lines, points, or areas on the virtual stent corresponding to the cutting areas. The designing could be done by specifying the areas to be fabricated of metals and the rest of the stent to be fabricated of plastics. The surgical guide is designed with assuring the stability and extension of the stent and involvement of required areas as well as smoothening of its margins to avoid injury of the soft tissue due to friction **[6]**.

The design of the surgical guide has two separate parts which account for internal structures, as well as include considerations for methods of fastening (jointing) the parts together into a single component.The final design of the surgical guide is converted to Stereolithography, which are, transferred to special 3D printer that is capable of printing plastics, milling metal, and fusing metal and plastic material into one object.

The surgical guide is adapted onto the master model while the cutting stent is fixed onto the patient's maxillary or mandibular arch by either pins, screws, or engagement into the dental or bone undercuts. Cutting could be done within the cutting slots by dental drills or burs with the depth stoppers and tooth extraction could be completed safely by normal curved forceps or elevators.

Discussion

The evolution of 3D printing technology which merged metallic and nonmetallic materials aimed not only to ease surgical extraction procedure for dentists/oral surgeons but to reduce the pain that is associated with such procedure through planning the cutting direction, depth, and inclination on computer. Also transferring these data into templates and instrumentation can avoid the unreasonable bone cuttings done in the procedures. The method is similar to fabricating the surgical guides routinely used for dental implants, as digital treatment plan is firstly performed with the data acquired from CT scan; a master model is created with extraction site determined prior to planning; segmentation of bone, teeth, and soft tissues is done on the digital scan.

However, the procedure is met with resistance due to the following reasons:

Time

The long duration taken to make digital or conventional impressions and work-up of the planned restoration with a diagnostic wax-up or digital image of the planned for the surgical removal. Also the time taken to fabricate a radiographic template for the patient to wear while having a CT/CBCT scan and importing data into software and eventually planning the case. Hence training is required to prepare the surgical guide, and learn the techniques and equipment needed to perform surgery through a surgical template.

Money

The added costs to fabricate the radiographic scan prosthesis, the CT/CBCT scan, and the fabrication of the surgical guide. For the surgeon possible upgradation of the computer hardware, and new software programs and as well as armamentarium

Fear of the unknown

The surgeon will have to learn new, unfamiliar technologies and techniques that can have complicated multiple-step workflows that may be difficult to integrate into practice.

Patient's fears and questions.

The pain, swelling, and recuperation time many guided surgery software products have embedded tools that can help clinicians educate patients about "virtual" technologies in a visual manner during consultation.

Other Apprehensions

Virtual treatment plan has been done prior to printing the splint and has to be discussed with the surgeon performing the extraction procedure. However, modifying the treatment plan to simulate the tooth extractions or bone modifications should be done priorly. Optionally, the surgical guide could be manufactured based on the master model; but, the master model is used only for validating the final outcome **[7]**.

However, the advancing CAD/CAM and imaging technologies have enabled clinicians to analyse patient's anatomy and to manipulate areas that need skeletal reconstruction **[9]**. The use of CT scanning and stereolithography has produced accurate and predictable results and enhanced the outcome of dental implant procedures **[10]**.Considering the accuracy of cutting the surgical guide can provide less soft tissue injury due to trauma, laceration, or excessive drilling, using this technique could compensate for the long time for achieving CT scans as well as designing and fabricating the cutting guide to complete the procedure.

Competing Interests: The author declares that he has no competing interests

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