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Application of CAD/CAM dental implant surgical templates in immediate implant surgery in esthetic area : A case report

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ABSTRACT

CAD/CAM (Computer-aided design/Computer-aided manufacturing) dental implant surgical templates applied in the immediate implant surgery in esthetic area, is beneficial to acquire appropriate three-dimensional position, realize the transformation that from virtual plan to practical surgery, from traditional surgery depended on experience to digital and accurate surgery, improve predictability, accuracy and safety of the surgery. This article gives a report for application of CAD/CAM dental implant surgical templates in immediate implant surgery in esthetic area.

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KEYWORDS

CAD/CAM;
Surgical template;
Immediate implant;
Esthetic area.

INTRODUCTION

In 1970s, the dentist named Francois Duret^[1] in France introduced the concept and technique of CAD/CAM in industry into design and manufacture of dental restorations. In 1986, the first dental commercialized CAD/CAM system came out, which ushered in the digital dental age based on computer technique. Nowadays, the concept and technique of CAD/CAM and RP (Rapid Prototyping) has been accepted widely. Digital dental implant surgical templates have been introduced to the area of dental implant.

CAD/CAM dental implant surgical templates were designed according to the following steps images obtained from CT (computed tomography), imported to

the guide software, analyzed bone volume and simulated the implant surgery. Based on the information of the implant including location, direction and depth, manufacture the surgical templates. Application of the templates showed great advantages in the cases of insufficient bone volume, high esthetic requirement, immediate restoration demand, even edentulous jaw, especially in the case of immediate implant surgery in esthetic area. More and more attention has been paid to dental implant surgical templates, because they can transfer the three-dimensional position from simulate design in the computer pre-operation to practical implant surgery, easy to realize the purpose of MIS (minimal invasive surgery), high efficiency, safety and accuracy.

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CASE PRESENTATION

A 35-year-old female presented with undesirable restorations of bilateral central incisors in maxilla (Figure 1). CBCT (cone beam computed tomography, Planmeca ProMax 3D) showed that root apex of bilateral maxilla central incisors were absorbed, and round shadow around the root apex (Figure 2). According to his statement, he had no systemic disease or surgery



Figure 1: Undesirable restorations of bilateral central incisors in maxilla

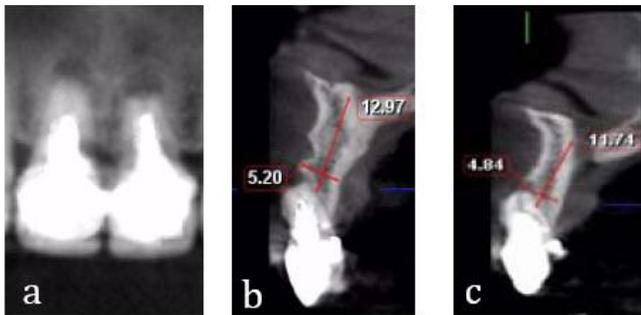


Figure 2 : (a)CBCT images of bilateral central incisors in maxilla; (b) sagittal image of right central incisors in maxilla; (c) sagittal image of left central incisors in maxilla.

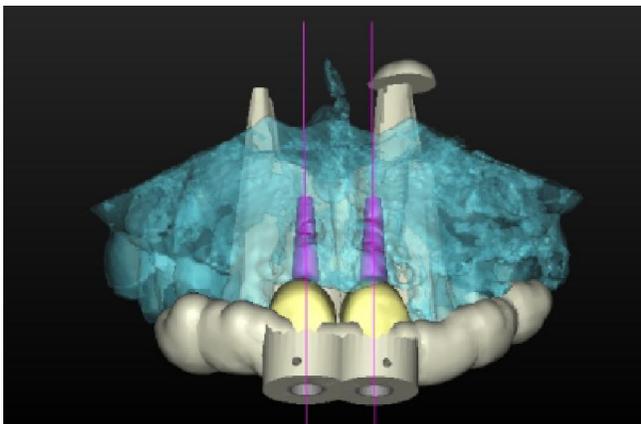


Figure 3 : three dimensional position of the simulate implants

contraindication. Applied Simplant software to extract the teeth, simulated final restorations, based on bone volume and position of final restorations, designed three dimensional position of the implants (Figure 3), and manufactured the surgical template (Figure 4) pre-operation. Articaine Hydrochloride and Epinephrine Tartrate Injection was used for oral local anesthetics, and minimally invasive extract the teeth (Figure 5). Applied CAD/CAM surgical template to guide the preparation of the implant hole. During this procedure, made sure the template guiding in the whole preparation by exchanging the sleeves (Figure 6). Implanted two implants (Nobel Replace 3.5×11 mm) in the hole (Figure 7). Using guided bone regeneration to cover labial bone defect. Finally, sutured the wound with free-tension. CBCT examination post-operation showed that three dimension position of the implant were excellent (Figure 8). Six months later, second-stage surgery was per-



Figure 4 : CAD/CAM dental implant surgical template



Figure 5 : minimally invasive extraction of bilateral central incisors in maxilla

formed, and healing abutments were placed on the implants (Figure 9). Two weeks later, took dental impression. One week later, placed individual all-ceramic abutment

(Figure 10), and bonded ceramic crowns (Figure 11). Applied Mimics 11.0 to compare three dimensional positions between simulate pre-operation and practical post-operation (Figure 12, TABLE 1).

DISCUSSION

Research, application and development of dental

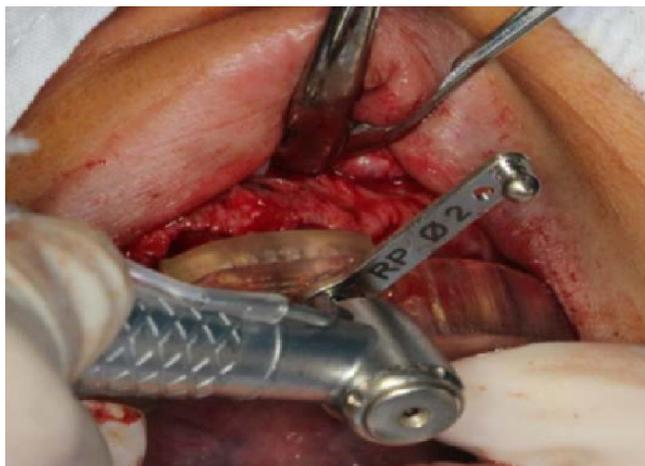


Figure 6 : Applied CAD/CAM surgical template to guide the preparation of the implant hole.

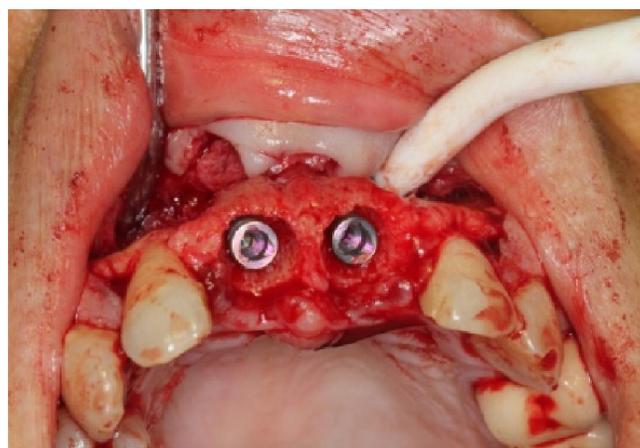


Figure 7 : Implanted two implants.

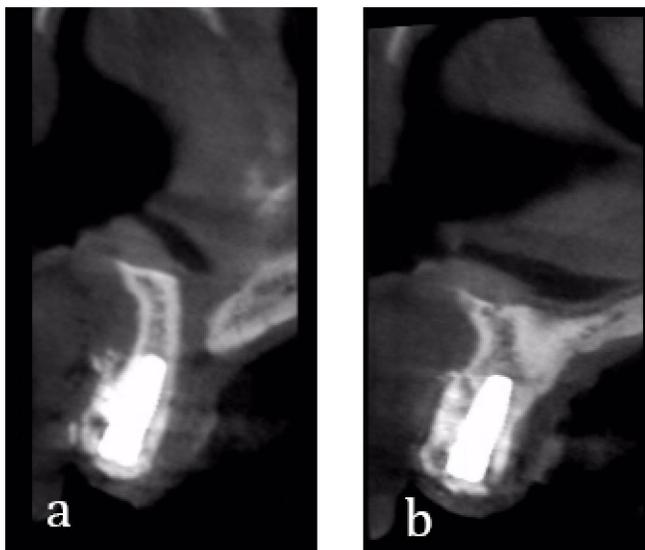


Figure 8 : sagittal images of the two implsnts



Figure 9 : Placed the healing abutments.



Figure 10 : all-ceramic abutment



Figure 11 : ceramic crowns

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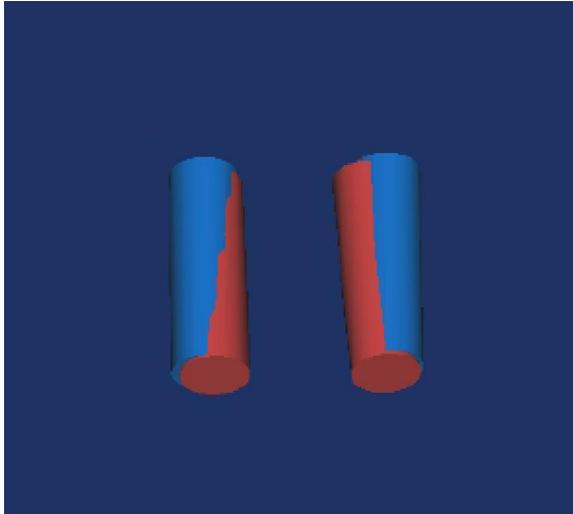


Figure 12 : compare three dimensional positions (red cylinder represented simulate implant pre-operation, blue cylinder represented practical implant post-operation)

TABLE 1 : Deviation analysis of three dimensional position

Implant site	11	21
Distance deviation at entry (mm)	0.62	0.62
Distance deviation at apex (mm)	1.31	0.69
Angle deviation ($^{\circ}$)	1.58	1.62

implant surgical templates is a hot topic of implantology nowadays. A great many clinical and scientific research^[2-13] demonstrated that, application of CAD/CAM surgical templates, could transferred simulate implant position to practical implant surgery, had better reliability, accuracy and predictability, especially in immediate implant surgery in esthetic area. In addition, it is possible for surgeons to perform flapless surgery because of the templates, and carry out the concept of MIS. Templates is meaningful to realize the purpose of accurate implant and immediate restoration.

Application of CAD/CAM technique in the area of implantology improves the accuracy of implant surgery. However, some clinical and scientific research^[3-7] indicated that deviation of templates exists. Statistics of the third EAO (European Association Organization) in 2012 showed that, mean distance deviation at entry was 1.09mm, mean distance deviation at apex was 1.28mm, mean angle deviation was 3.9° in the guided implant surgery^[14]. In this case, distance deviation of the two implants at entry was 0.62mm, distance deviation at apex were 1.31mm and 0.69mm, angle deviation were

1.58° and 1.62° . Source of the deviation were: metallic artefacts from CBCT scanned, transformation during Images transmission and processing, expansion and shrinkage during preparing plaster molds, mechanical tolerance between template holes and sleeves, and so on. The reason above may have a negative effect to the accuracy of the templates. It needs further scientific and clinical research to improve the accuracy of CAD/CAM dental implant surgical templates.

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