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Markers for Implant Placement in CBCT: A Technical Overview

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Abstract - *Cone beam computer tomography (CBCT) is becoming a more accessible modality of imaging within dentistry. It has particular application in the diagnostic treatment planning for dental implant placement. The use of radiographic surgical stents with CBCT can help to provide important information about bone position and therefore placement of implants and final restorations. This article looks at a novel technique, which allows a variety of different marker positions that can be quickly and easily placed and removed. It allows the use of a current prosthesis that can be adapted to act as a surgical stent during CBCT.*

KEY WORDS: Implant markers, Dental CBCT, Placement of implants.

INTRODUCTION

This article describes a practical method of marking prosthesis to help orientate possible implant placement with relation to tooth location and soft tissue depth. This technique could help with placement of markers when radiographic stents are not available.

CBCT is becoming a more accessible modality for pre operative assessment on suitable cases[1]. This is due to the fact that the dose of CBCT, relative to multi-site CT, is reduced and the quality of the images remains high [2]. CBCT machines are smaller and more affordable and are regularly being used in Hospital and Practice environments. Many centres with access to these facilities also accept referrals from surrounding practitioners for scans.

In cases where a CBCT is needed for better treatment planning, it seems sensible to use these images to try and gain as much information as we can [3]. Radiographic stents can help to show the ideal placement of the crown of the final restoration in relation to bone availability [4]. This information can greatly change the treatment plan and restoration choice. This is particularity relevant for patients whose treatment is in the aesthetic zone or those who require full arch reconstruction.

Radiographic stents are a useful tool in patients where treatment options are questionable and CBCT is deemed necessary to provide extra information [5]. The original markers used in stents were small ball bearings embedded into prosthesis, sliver foil or gutta percha which can cause unwanted artefacts and can be difficult to place correctly [6]. New developments such as the use of barium sulphate in denture base acrylic and prosthetic teeth in different ratios can aid planning. This technique allows one to ascertain how much soft tissue replacement may be required relative to tooth position [7]. This method requires a new prosthesis, clinical and technical skill in its construction and has cost and time implications.

Most patients with missing teeth will have a diagnostic removable or resin retained prosthesis as a replacement during the stages of implant treatment.. Ideally this would have been made to replicate the appearance of the final prosthesis. It would therefore be ideal if this removable prosthesis could be used as a radiographic stent. This would have to be done in a reversible way, the material would need to be radiopaque without unwanted artefact on CBCT, be quick to apply and remove, be of low cost and successfully provide additional information.

Here we describe a reversible method for marking prosthesis, which can easily be carried out in primary, secondary and tertiary care settings. We have found the use of flowable composite resin such as X-Flow™ shown in figure 1, has all the qualities required for this technique. This material is visible on a CBCT with little unwanted artefact. It is cheap and readily available, easily placed and removed without damage to the prosthesis. In cases where the prosthesis is not an ideal shape or angulation it can be used to adjust the positioning. The material can also be placed in different locations on the prosthesis depending on the information required.

The case below highlights the effective use of this technique and demonstrates two different application methods:

APPLICATION

A 64 year old male patient was seen within a hospital setting who had been referred due to denture intolerance and a strong gag reflex. Following an initial assessment this lead to consideration of the possible use of dental implant fixtures. A CBCT was prescribed for further planning. As the patient had a satisfactory denture with teeth in function, good occlusion and aesthetics it was decided this would be suitable to use for the placement of markers. Location markers were placed in 11, 13, 15 and 21, 23, 25 regions.

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Figure 1. A cartridge of X-Flow™ composite resin used as the marking material.

Figure 3. Placement of flowable composite onto the fit surface of a full upper denture.

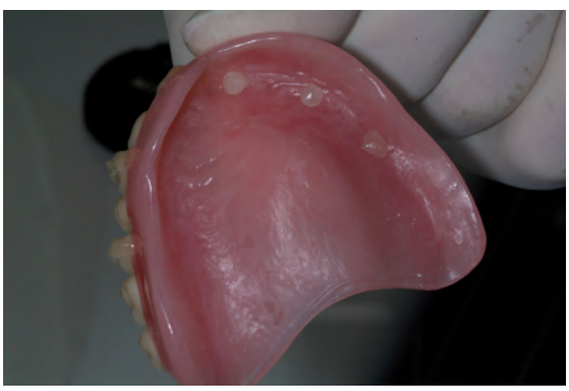

Figure 2. Placement of flowable composite on the buccal surfaces of an upper full denture.

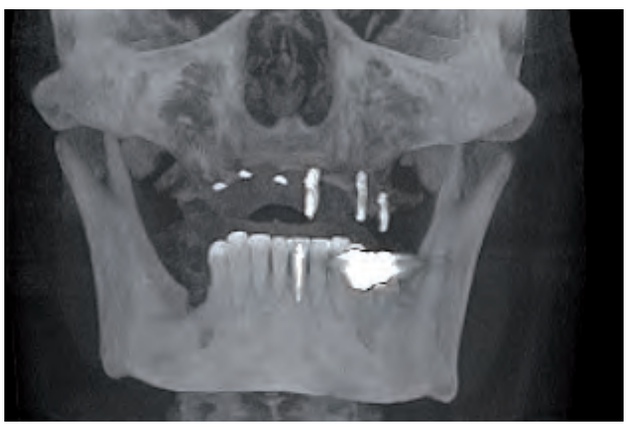

Figure 4. Original CBCT frontal coronal view.

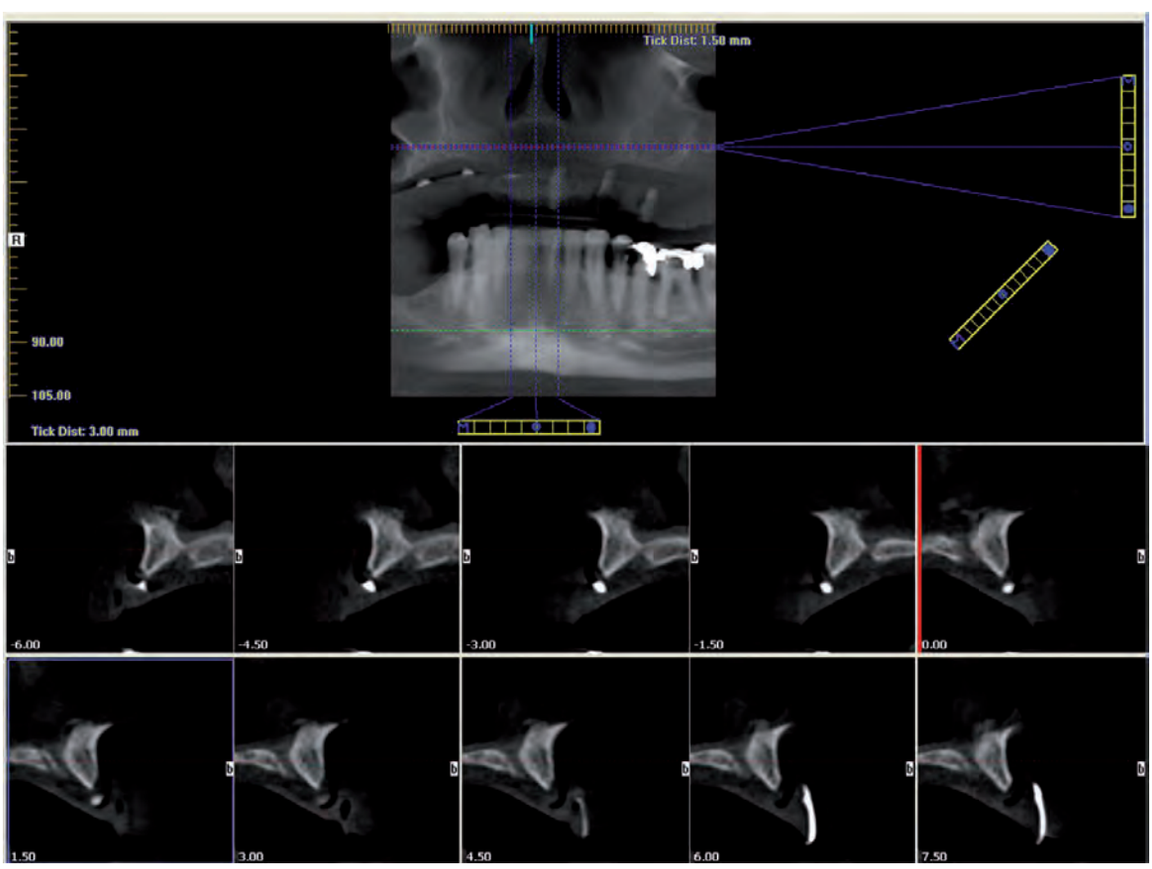

Figure 5. Slices of 1.5mm though CBCT image shown either side of the midline.

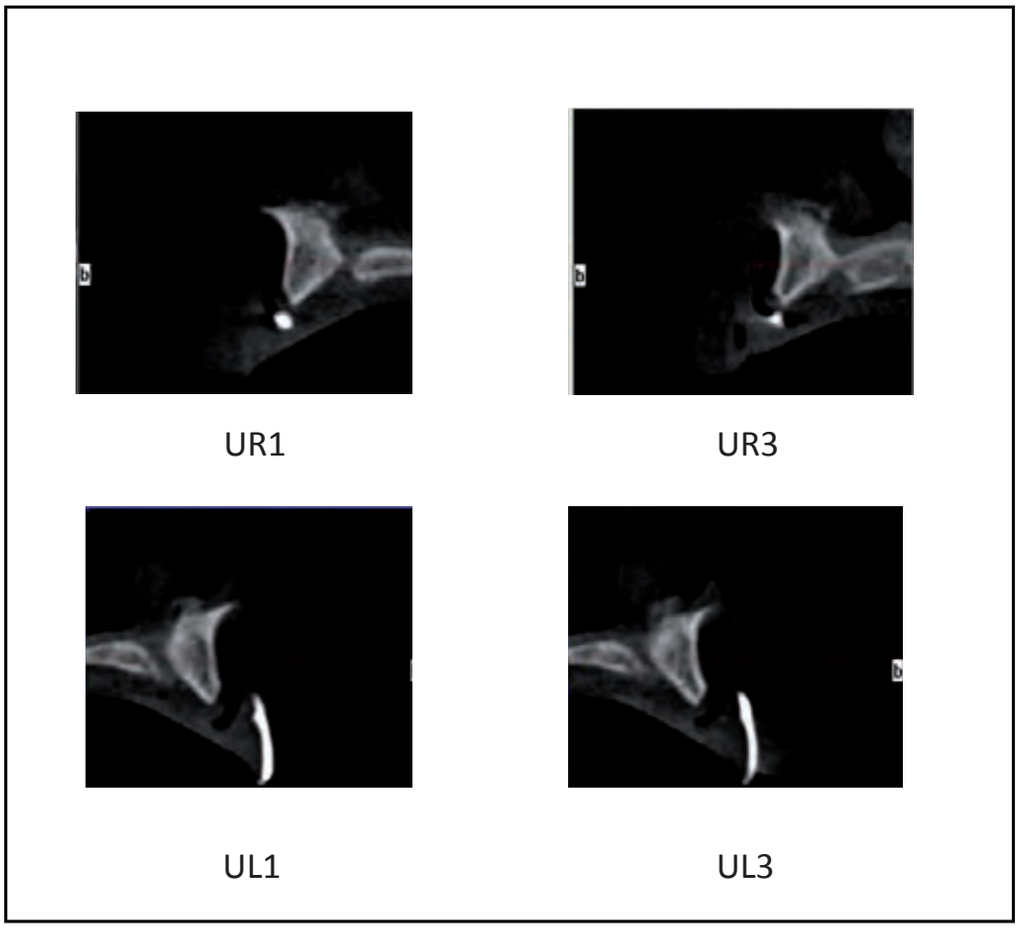

Figure 6. Selective slices of CBCT showing the markers in the UL1 UL3 UR1 UR3 regions.

Small round discs of composite resin were placed on the fit surface of the denture in the locations of interest Figure 2.

The composite resin was placed on the buccal surface of these teeth Figure 3.

In this example a split denture design was used to show the difference between the two application methods. Markers would commonly be placed on the fit and the buccal surfaces. The application of the flowable composite can be done in a linear fashion, as a cross design, along the insical edge, cervically on the tooth, on the tooth cingulum, over possible screw locations or over the whole buccal/palatal surface. These different methods of application can give more or less information about individual tooth location and angulations as required.

The CBCT is then taken with the patients' denture in situ. The associated image can then be manipulated. This image can then provide additional information utilising the markers on the CBCT. The patient's denture can be returned to them and the composite resin can easily be removed leaving their prosthesis undamaged.

Not only does the CBCT image give detail for the clinician but the three dimensional reconstruction, Figure 4, can help to educate the patient [8]. The markers are used to identify the placement of the final prosthesis in relation to the available bone and soft tissue. By placing markers on the fit surface it also allows an assessment of the soft tissue depth.

The software now available can use the raw CBCT image, and create slices of different sizes through this image, Figure 5.

In Figure 6 1.5mm slices have been taken either side of the midline through the CBCT image. A red line represents the midline point. The different markers can be seen either side of this line. Four of the six locations are shown in Figure 6. From these images the bone quality in the marked regions can be examined.

In these locations more accurate measurements can then be taken to decide if implant placement is possible and what suitable components would be required [9]. All the additional information will help with further planning and with the decision for final implant placement.

CONCLUSION

This simple yet effective method has multiple advantages. It increases the information gained from a CBCT which helps to justify the increased exposure and makes the images more interpretable. Compared to other radiographic stents or adaptations to prosthesis it is very low cost, little time and technical input is required, there is no damage to the prosthesis and it is completed using easily accessible materials. The extra information gained can be invaluable and gives clinicians a better ability to assess potential problems and to plan treatment more effectively.

MANUFACTURE DETAILS

X-Flow™ DENTSPLY, 221 W. Philadelphia Street, P.O. Box 872 USA.

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REFERENCES

1. Tyndall DA, Brooks SL. Selection criteria for dental implant site imaging: a position paper of the American Academy of Oral and Maxillofacial radiology. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics* 2000;**89**(5):630-7.
2. Tsiklakis K, Donta C, Gavala S, Karayianni K, Kamenopoulou V, Hourdakis CJ. Dose reduction in maxillofacial imaging using low dose Cone Beam CT. *European journal of radiology* 2005;**56**(3):413-7.
3. radiology Ead. Radiation Protection. CBCT fr dental and maxillofacial radiology EB guidlines: SEDENTEXCT; 2009.
4. Van Assche N, van Steenberghe D, Guerrero ME, Hirsch E, Schutyser F, Quirynen M, et al. Accuracy of implant placement based on pre-surgical planning of three-dimensional cone-beam images: a pilot study. *Journal of Clinical Periodontology* 2007;**34**(9):816-21.
5. Ku YC, Shen YF. Fabrication of a radiographic and surgical stent for implants with a vacuum former. *The Journal of prosthetic dentistry* 2000;**83**(2):252-3.
6. Peter Floyd PP, Richard Palmer. Dental Implants: Radiographic techniques. *British Dental Journal* 1999;**187**:359-65.
7. Basten CH, Kois JC. The use of barium sulfate for implant templates. *The Journal of prosthetic dentistry* 1996;**76**(4):451-4.
8. Kau CH, Richmond S, Palomo JM, Hans MG. Three-dimensional cone beam computerized tomography in orthodontics. *Journal of orthodontics* 2005;**32**(4):282-93.
9. Peltola JS. A panoramatomographic study of the teeth and jaws of Finnish university students. *Community Dent Oral Epidemiol* 1993;**21**(1):36-39.

All illustrative photos were taken by C Forbes-Haley.
In figure 1 image of packaging was sourced from:

http://www.dentsplymea.com/products/restorative/composites/x-flow.