The usefulness Cone Beam CT image analysis for identifying available bone volume during planning implant placement: Case report.

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I. Introduction

Recently, implant has become an important field in dental clinic. Radiologic examination is essential for successful implant surgery. To make an pre-surgical planning, we can use radiologic examination such as periapical radiograph, panoramic radiograph, conventional tomography, CT(computed tomography) scan images. Panoramic radiograph is widely used by many dentists for preoperative evaluation in dental implantation surgery. however, it has some disadvantages, such as variable magnification from 10%-30%, image distortion and invisibility in the facio-lingual dimension.10 Facio-lingual aspect evaluation can not be accepted to all of radiographs except CT scan and tomography.

In some cases clinical examination provide sufficient information or properly plan for the surgical approach; in others, a combination of various 2-D radiographic images and clinical examination may be adequate. For many patients, however, the additional information obtained from 3-D imaging is invaluable in planning an effective surgical procedure that minimizes the risk of damage to contiguous vital structures.7 The large field of view and 3-D image set offered by CBCT creates the opportunity for the clinician to adequately assess the implant site, look at the opposing occlusion, TMJs, and other factors that may associated with the total success of implant-based rehabilitation of the patient’s occlusion.6

Despite its advantages, until now, the use of CT for implant surgery is restricted. In recently years, 3-D volumetric scan imaging has been developed specifically for dentistry in addition to the advantages of CT, these technologies offers reduced cost relative to medical CT and significantly reduced radiation expose.
Kobayashi et al.8 reported there is no different between cadeva measurements and LCBCT(limited CBCT), so it is relatively precise.
This study is to evaluate the usefulness of CT scan for implant surgery.

II. Materials and Methods

2 Patients involved in this study were aged 71, 48 years (all men). All patients had been routinely examined clinically, and by using conventional panoramic radiographic machine. It revealed significant information about bone graft implant sites. For the precise diagnosis, CBCT scan was taken of the patient. The radiation condition was 120kvp, 3-8mA, 40s, 0.4mm voxel size. After that, we reconstructed the images with software (Simplant, Materialise, Belgium). Bone width and depth were measured on the computer monitor. We measured the shortest distance between alveolar crest to upper border of mandibular canal to decide the implant length after consideration of implant direction. To decide the implant diameter, we measured the distance of alveolar bone width and bucco-lingual width in accordance with implant direction, too.
(Case 1) #47 implantation

**Fig.1** panoramic view (pre-operation)

**Fig.2** #47 Cr. is removed.

**Fig.3** Panoramic view. tracing was done. Depth (from alveolar crest to mandibular canal): 20mm. Width: 8.7mm

**Fig.4** #47 Cross-sectional view. Remaining bone with depth was measured. Orange color shows mandibular canal.

**Fig.5** #47 Axial view.

**Fig.6** 3D image

**Bone width**: about 10.2mm  
(remaining buccal, lingual bone wall is about 1mm.)

**Root diameter**: about 7.5mm  
→ Ø 6.0mm implant was selected.

**Depth**: about 17.7mm  
(from alveolar crest to upper border of mandibular canal.)

**Root length**: about 7.1mm.

**Implant diameter**: Ø 6.0mm  
**length**: 11.5mm
(Case 2) #45,46,47 implantation

![Panoramic view](image1)

![Tracing was done](image2)

![Intra-oral view](image3)

#47–45 Br. was removed before surgery.

**Fig. 7. a. panoramic view, b. tracing was done**

**Fig. 8. Intra-oral view.**

**Table:**

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Depth (from alveolar crest to mandibular canal)</th>
<th>Bone width</th>
<th>From alveolar crest to mandibular canal</th>
<th>Implant diameter</th>
<th>Implant length</th>
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<tr>
<td>#45</td>
<td>14.0mm</td>
<td>about 5.7mm</td>
<td>about 12.6mm</td>
<td>3.7mm</td>
<td>11.5mm</td>
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<td>#46</td>
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<td>13.3mm</td>
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<tr>
<td>#46</td>
<td>10mm</td>
<td></td>
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**Fig. 9. #45 Cross-sectional view.**

**Fig. 10. #46 Cross-sectional view.**
Implant surgery simulation was done with diameter 4.7mm, length 11.5mm implant.
Bone width: If implant is inserted to septal bone remaining bone (buccal, lingual wall) is about 2mm.
Implant diameter: Ø 4.7mm, length: 11.5mm

Bone width: about 7.0mm (1.4mm below alveolar crest.)
From alveolar crest to mandibular canal: about 11.3mm (1.4mm below alveolar crest.)
Implant diameter: Ø 4.7mm length: 10mm

Root rest is extracted gently.
III. Result

Both cases were evaluated that bone graft was necessary as a result of clinical and panoramic examination. But CT image analysis showed bone graft was not necessary. We checked bone width after root rest extraction during implant surgery, bone graft was not necessary.

IV. Discussion

CT is very useful diagnostic equipment. The presurgical assessment of proposed implant sites requires very specific and accurate data. Eom et al.\(^1\) reported that in transaxial CT data of human dry skull, in case of 3mm slice thickness rapid prototyping model, we could not distinguish anatomical structure clearly than 1-2mm slice thickness. It is not possible to measure between anatomical structure in case of 4mm slice thickness. In this case we used slice thickness 0.4mm, and to distinguish anatomical structure is so easy. To distinguish between anatomical structure was easy, too.

Personal view of point can be effected the result, but Lee et al.\(^2\) reported that the measurements which is measured by different person in same area and same person in same area is statistically equal. Cavalcanti et al.\(^3\) reported that multiplanar reconstructed CT image error is 0.25mm and 0.6mm in Choi et al.\(^4\) 0.5mm slice thickness status and the measurement is precise. But some reports shows that between reconstructed CT images and real bone length reveals discrepancy about 0.4mm-0.5mm, So 1-2mm safety margin is necessary. In this case, we used Simplant (Materialise, Belgium) software. At least 0.5mm safety margin considered because of multiplanar reconstructed CT image error.

V. Conclusion

The introduction of CBCT creates the opportunity for clinicians to acquire the highest quality of diagnostic images. More precise diagnosis by using CT scan is available. To evaluate whether bone graft is necessary or not at the proposed implant site is also available.

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Abstract

임프란트 식립시 CBCT를 이용한 가용 골량 확인

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Purpose: 임프란트 식립 시 CT로 진단하고 이를 활용하여 임프란트를 식립한 후 CT의 효용성을 알아보았다.

Materials and Methods: 임프란트 식립 전 CT (I-CATTM, Imaging Sciences International, USA)로 120kvp, 3-8mA, 40s, 0.4voxel의 조사 조건으로 촬영한 후 software (Simplant, Materialise, Belgium)로 상을 재구성하여 골폭을 측정하고 치조로 하약관 까지의 길이를 측정하였다.

Result: 임상 검사와 파노라마 사진을 통하여 진단을 한 후 골이식이 필요한 것으로 판단되었으나 CT 촬영시 골이식이 필요하지 않은 것으로 진단되었고, 실제 식립시 확인한 결과 골이식이 필요하지 않았다.

Conclusion: 다른 방사선 사진들 보다 CT로 진단한 경우 골이식이 필요하지 않으니에 대한 명확한 진단을 할 수 있었다.