●原著論文

Evaluation of HA bone graft fabricated by CAD/CAM based on CT simulation

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Abstract

It is popular in these days to use a CT simulation data to determine the bone graft volume in dental implant cases with bone defect and the precise implant placement position. However there has been no report on converting the simulation data three-dimensionally to fabricate bone augmentation materials.

In this study a HA bone graft was fabricated from a sintered HA block using a CAD/CAM technique based on the bone augmentation volume data determined by the simulation data. The HA graft was evaluated by comparing with a resin graft model fabricated by a three dimensional printing (3DP) method based on the same simulation data.

The HA bone graft by CAD/CAM and the resin bone graft by 3DP was well consistent each other in the shape , size, and adaptability.

Keywords: HA bone graft , CT simulation, CAD/CAM, 3DP

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1. Introduction

Implant treatments have greatly progressed along with the development and improvement of CT and simulation software. It is now possible to observe the three-dimensional information of the bone on the software. Flapless surgery is possible with guided surgery using surgical guide based on the simulation data. It is less invasive for the patients and makes surgery easier for the operators [1-8]. Advancement of CAD/CAM technology has brought big changes in dentistry and quite a lot of prostheses are manufactured using this technology Figure 1 shows a surgical guide designed by a simulation soft and figure 2 is an oral cavity of a guided surgery. Figure 3 is the provisional restoration after operation and figure 4 and 5 are the panorama X-ray photo, final prosthesis, respectively.

For implant cases with bone defect, bone augmentation is necessary to obtain implant placement position and aesthetical improvement. Block bone transplant using autologous bone or GBR method using granular bone substitutes and multiple membrane are commonly used bone augmentation methods. However it is difficult to recreate the ideal form because of the difficulty in predicting the absorbed amount loss of the grafting

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material over time and difficulty of the surgery itself.

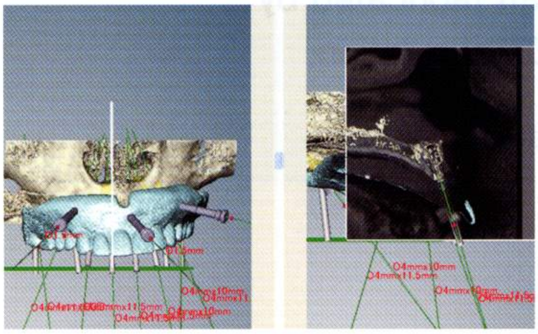

Fig. 1: Designing a surgical guide based on CT simulation software

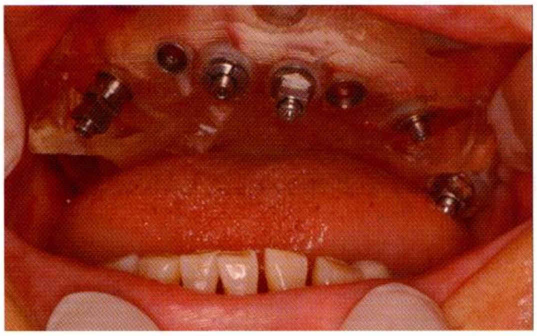

Fig. 2: Oral cavity the guided surgery using the surgical guide made by 3DP

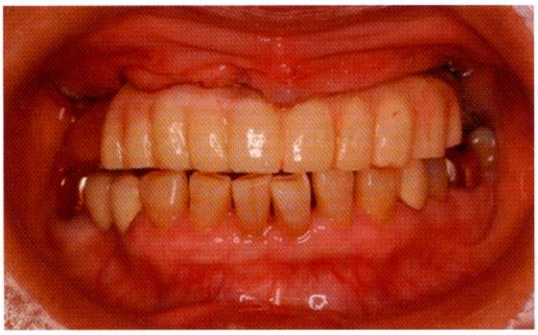

Fig. 3: Installation of provisional restoration before operation made on model material

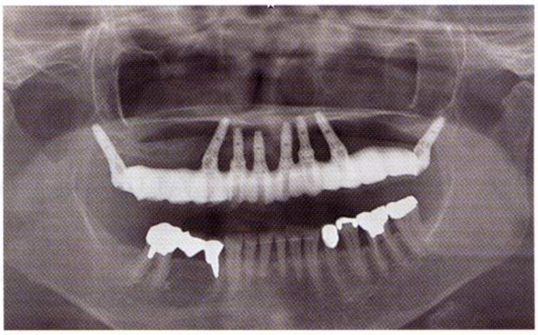

Fig. 4: Panoramic X-ray photo after installation of final prosthesis

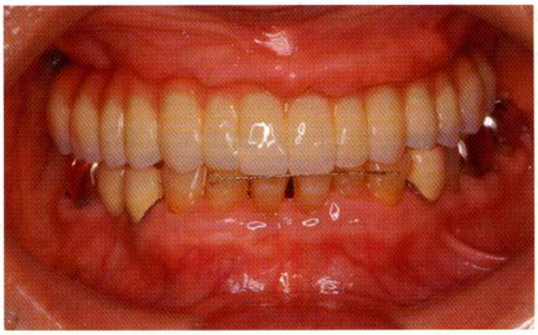

Fig. 5: Oral cavity of the final prosthesis made by CAD/CAM technology

In this study HA block was successfully made using CAD/CAM technology based on the bone augmentation volume data for the bone defect region worked out by simulation software for an implant case with bone defect in buccal #20 and #21. This paper reports its summary with accuracy validation.

2. Materials and methods

1) CT apparatus

3DX multi image micro CT (FPD8) manufactured by Morita Co. was used under the condition of diameter 60×60㎜:125μm.

2) Simulation software

SimPlant® manufactured by Materialise Dental Co. was used.