

# DOES AN IN-HOUSE CAD/CAM APPROACH CONTRIBUTE TO ACCURACY AND TIME SHORTENING IN MANDIBULAR RECONSTRUCTION?

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## Introduction

The CAD/CAM reconstruction system is commercially available in only limited regions and is not available in our country. Therefore, we perform mandibular reconstruction using a CAD/CAM procedure with free software and a conventional 3D printer.

The purpose of this study is to clarify, among patients with mandibular reconstruction with free fibular flaps, whether the use of in-house CAD/CAM method, when compared with conventional free-hand treating control group, increase the accuracy level of reconstruction and shorten the time of surgery?

## Patients and methods

This is a retrospective study. Patients were divided into two groups; CAD/CAM treated group and conventional free-hand treated group. The primary predictor variable is the reconstructive technique (CAD/CAM vs conventional), and the outcome variables are accuracy, operative time, and ischemic time. Other variables are age, gender, HCL classification of defects, average deviation, percentile of reconstructed points which are within 1,2,and 3mm deviations, the number of fibular segments used, prior surgery, and prior irradiation.

In the CAD/CAM group, we used free software (The Blender; The Blender Foundation, Amsterdam, The Netherlands) for the virtual planning and designing of the cutting guides. To manufacture the virtual cutting guides, the Replicator 5th (MakerBot Industries, New York City, NY, USA) was used for 3D printing. These procedures were performed by our surgeons themselves according to Numajiri methods [1,2]. Titanium plates (Synthes, West Chester, PA, USA) for the fixations were prebent in the model surgery procedures and disinfected before the actual surgery.

In the conventional group, the defect size was clarified after the ablation of the mandible, and the any pre-bending of the plates and pre-cutting of the fibula were not performed.

At least six months after the surgery, free software, Cloud-Compare (<http://www.danielgm.net/cc/>), was used to measure deviations.

## RESULTS

In the CAD/CAM group (9 patients), eight of nine cases were judged as accurate. The average deviation after reconstruction was 0.492 mm (0.07-1.21). The average percentages within 1, 2 mm and 3 mm deviations were 59.0% (27.4-80.4), 81.5% (49-96.7), and 90.5% (63.5-99.1), respectively. The average ischemic time and total operating time were 147 minutes, and 16 hours and 52 minutes, respectively. In the conventional group (10 patients), four of ten cases were judged as accurate. The average deviation after reconstruction was 0.370 mm (0.01-0.87). The average percentages within 1,2 mm and 3 mm deviations were 42.3% (2.78-73.0), 68.7% (52.6-92) and 82.2% (66.1-97.2), respectively. The average ischemic time and total operating time were 183 minutes, and 15 hours and 11 minutes, respectively.

Accuracy was obtained in CAD/CAM group (n=8, 88.9%) and conventional group (n=4, 40%). Reconstructive points within 1mm deviation ( $p = 0.04$ ), within 2mm deviation ( $p = 0.03$ ), and shorter flap ischemic time ( $p = 0.03$ ) were significantly observed in CAD/CAM group than conventional group.

Method	CAD/CAM	Conventional
n	9	10
Age	68.7	57.9
Average (mm)	0.49	0.37
Standard Deviation	1.64	2.21
Within 1 mm (%)	59.0	42.3*
Within 2 mm (%)	81.5	68.7*
Within 3 mm (%)	90.5	82.2
Fibular Segments	2.2	2.4
Time Total Operation (minutes)	1012	911.3
Time Ischemia (minutes)	146.9	183.1*

\*:  $p$  value < 0.05

Table 1

## Case Report 1 CAD/CAM

A 74-year-old patient with gingival cancer T4aN2 was treated. Hemi-mandible, and both the oral mucosa and the mental skin were to be excised. Neck dissection was also necessary. Immediate reconstruction with a free fibular flap was planned (Figure 1). The virtual mandibular cutting guide was designed (Figure 2). The ischemic time was 172 minutes. The total surgery time was 16 hours and 16 minutes. The postoperative course was uneventful. Occlusion of the remaining teeth did not cause any problems, although a flattened facial contour was notable because of the lack of thickness of the fibular skin paddle (Figure 3). The average deviation was 0.07 mm, 80% of the reconstructed points were within 1 mm deviation against the virtual plan, and >95% of the reconstructed points were within 2 mm deviation. Because the facial outer surface was also replaced with the fibular thin skin flap, the final esthetic outcome was not satisfactory.

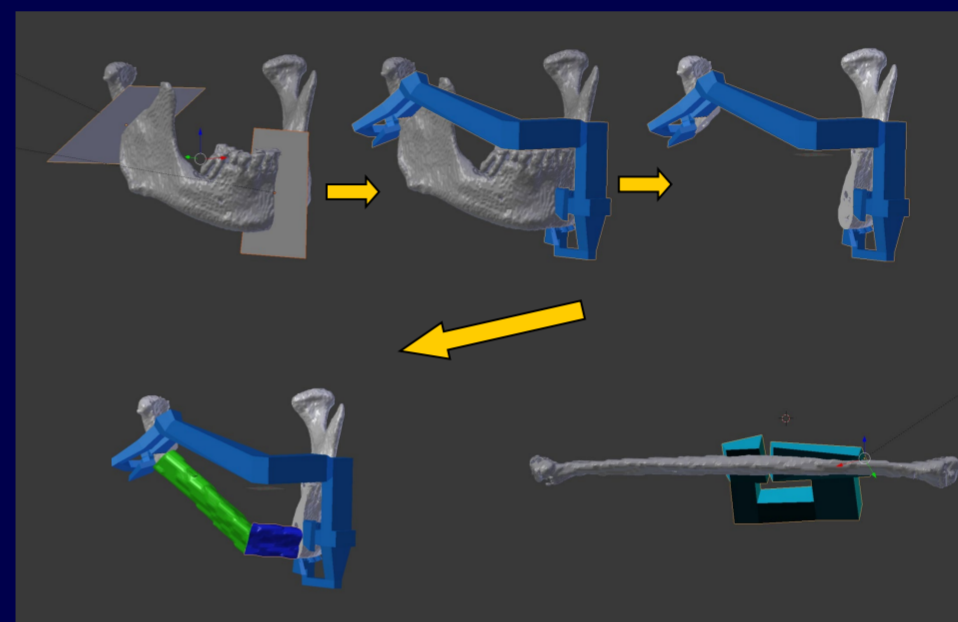


Figure 1

This guide was also designed as an external fixator to maintain the positions of the remaining bones after removal of the bone. In this case, only the mental tubercle is reconstructed to shorten the op-time and make the surgery simple. The mandibular angle was not to be reconstructed.



Figure 2.

After the mandibulectomy, the positions of the remaining mandible were maintained by the cutting guide. The external fixator also worked as a retractor in the cranial direction.

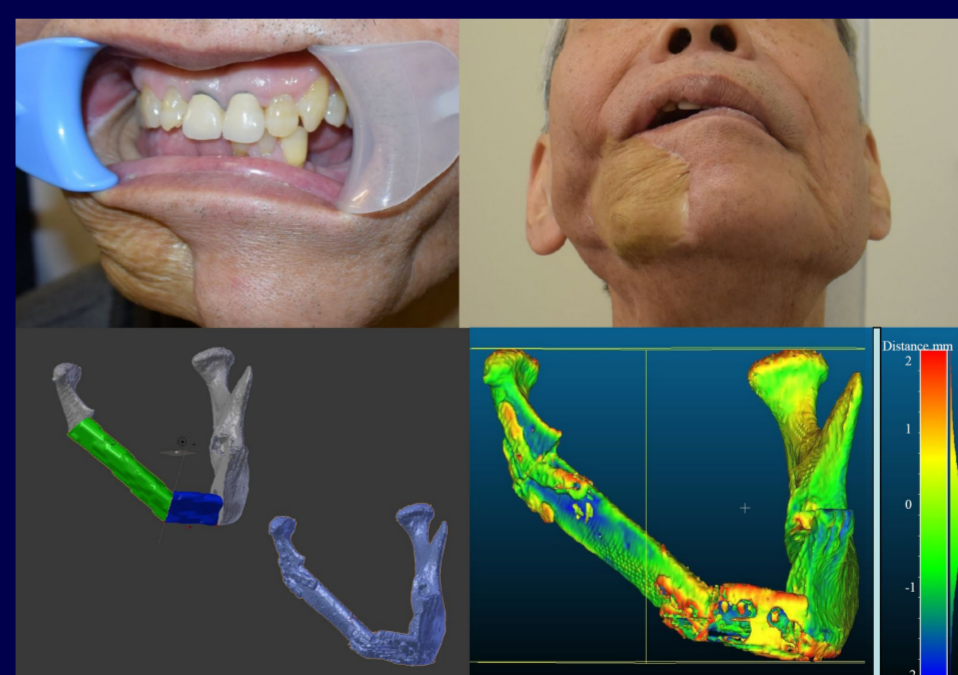


Figure 3.

The occlusion was maintained by the remaining teeth. Because the fibular skin was thin, the contour was flattened. The angle was not reconstructed. Compared with the plan, about 96% of the reconstructed points were within 2 mm deviation.

## CONCLUSIONS

In-house approach CAD/CAM results in superior accuracy to the conventional method especially within 1 mm and 2 mm deviations. The ischemic time was shorter in the CAD.CAM group, however total surgery time was similar. Use of the In-house CAD/CAM guides might be an option where commercial guides are not available.

## REFERENCES

- Numajiri T. et al. Plast Reconstr Surg Glob Open. 2016;4:e805.
- Numajiri T. et al. JPRAS Open. 2017;12:1-8.