

# Swallowing function after segmental mandibulectomy and reconstruction using a CAD/CAM system



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# *Background*



# Back ground 1

After segmental mandibulectomy for surgical treatment of advanced oral cancer, **reconstruction using a free flap with bony tissue has many benefits**, such as;

- Decrease a risk of destructions of reconstruction plate
- Possible bite-reconstruction using dental prosthesis and implant materials
- Cosmetic improvement
- Better functional outcome in terms of biting and swallowing

However, the procedure requires;

- A long operation time
- Well-trained surgical staff
- Sometimes the outcome may not be optimal for the patient

# Back ground 2

For the efficiency of the process and better outcomes, several papers have been reported concerning;

- A virtual operation planning
- Model and surgical guide for reconstruction
- using CAD/CAM (computer aided design and computer aided manufacturing) system

However, most of those depend on the outsourcing from the hospital.

The cost, time, and regional problems limit the diffusion of CAD/CAM clinical use in Japan.

**We have started to use CAD/CAM system within the hospital (self-sourcing).**

# *Procedure*



# Procedure

**Diagnosis and surgical indication are conducted in Head and Neck Cancer Board (every Thursday evening)**



**Otolaryngologists, Radiologist, Dentists, Plastic Surgeons, Medical staffs**

# Procedure

**Preoperative CT → DICOM data**

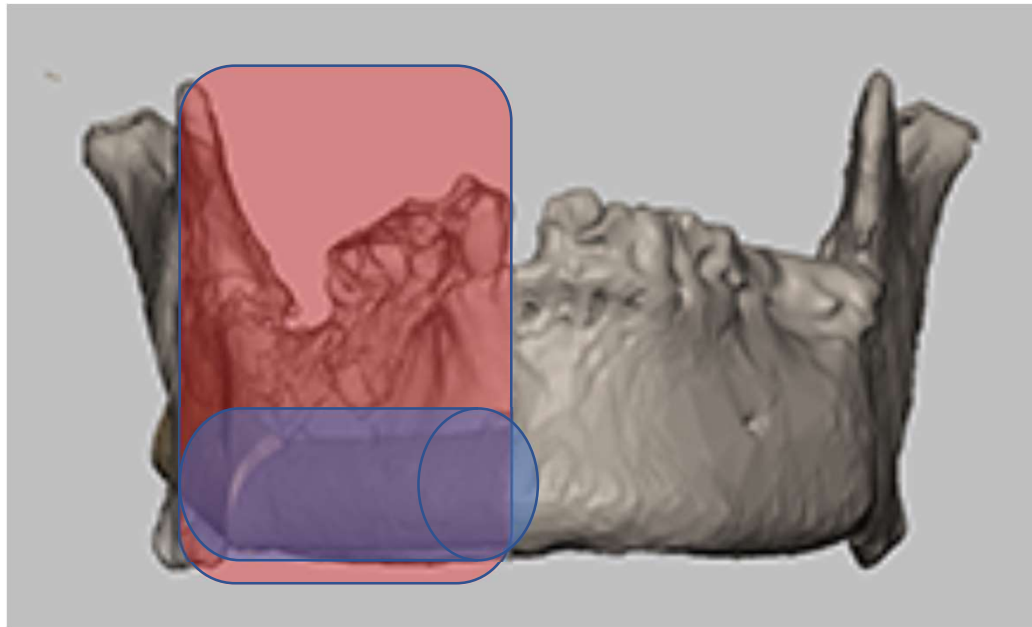
→ **STL (standard triangulated language)**

→ **Adapted by the CAD software**

→ Creating a virtual model with a 3D printer.

→ Planning the surgical margin and collection of the most appropriate osteocutaneous flap

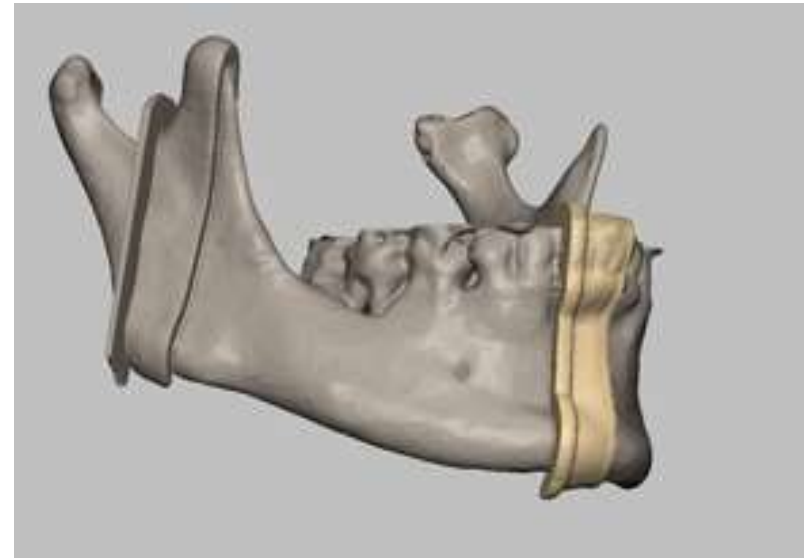
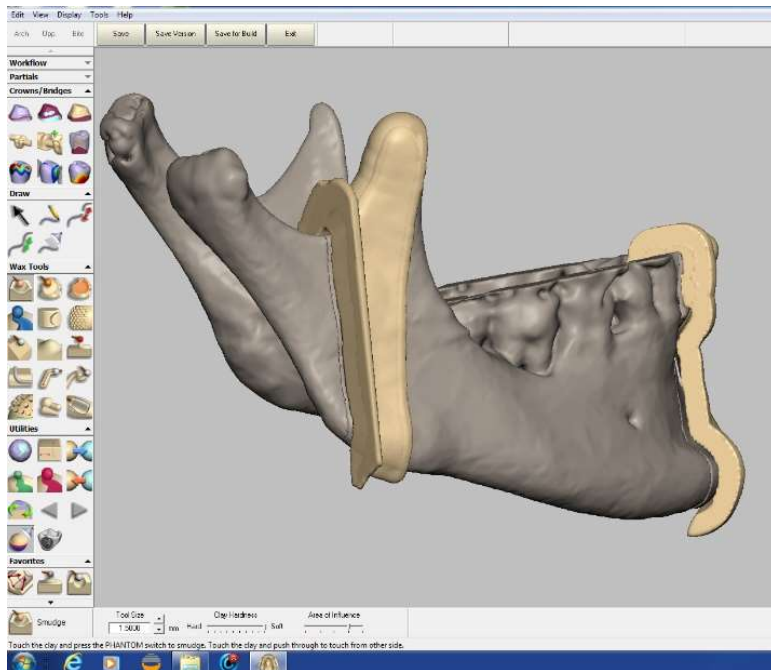
**Resected Portion**



**Expected Reconstruction**

# Procedure

- Preoperative CT → DICOM data
- STL (standard triangulated language)
- Adapted by the CAD software
- Creating a virtual model with a 3D printer.
- Planning the surgical margin and collection of the most appropriate osteocutaneous flap



Planning of Resection and Guide



# Procedure

- Preoperative CT → DICOM data
- STL (standard triangulated language)
- Adapted by the CAD software
- **Creating a virtual model with a 3D printer.**
- **Planning the surgical margin** and collection of the most appropriate osteocutaneous flap

**Lateral margin**



**Medial margin**



**Making Guide for Resection using 3D-model**

# Procedure

- **Creating a virtual model with a 3D printer.**
- **Planning the surgical margin and collection of the most appropriate osteocutaneous flap**

Reconstruction models of fibular osteocutaneous flap and plate



**Guide for collection of osteocutaneous flap**

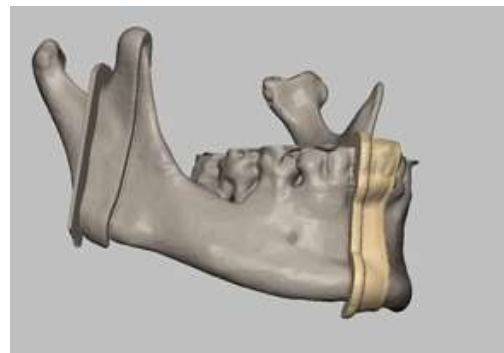
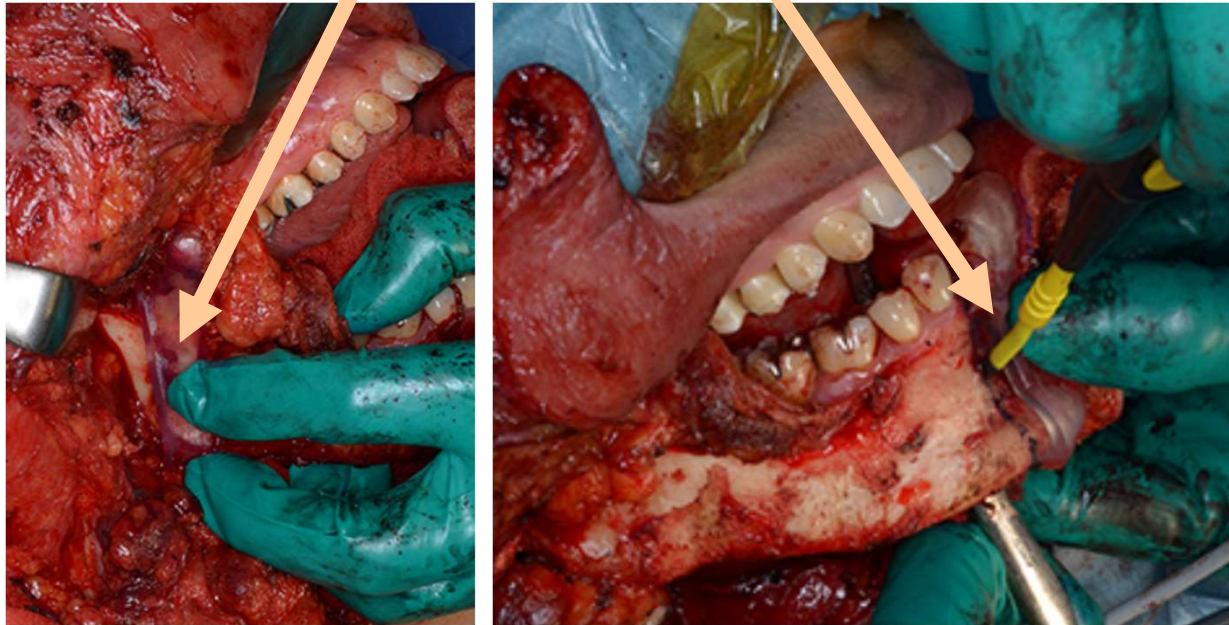
# *Surgical application*



# Segmental mandibulectomy

Finally applied for the surgical procedure...

**Guide for resection**

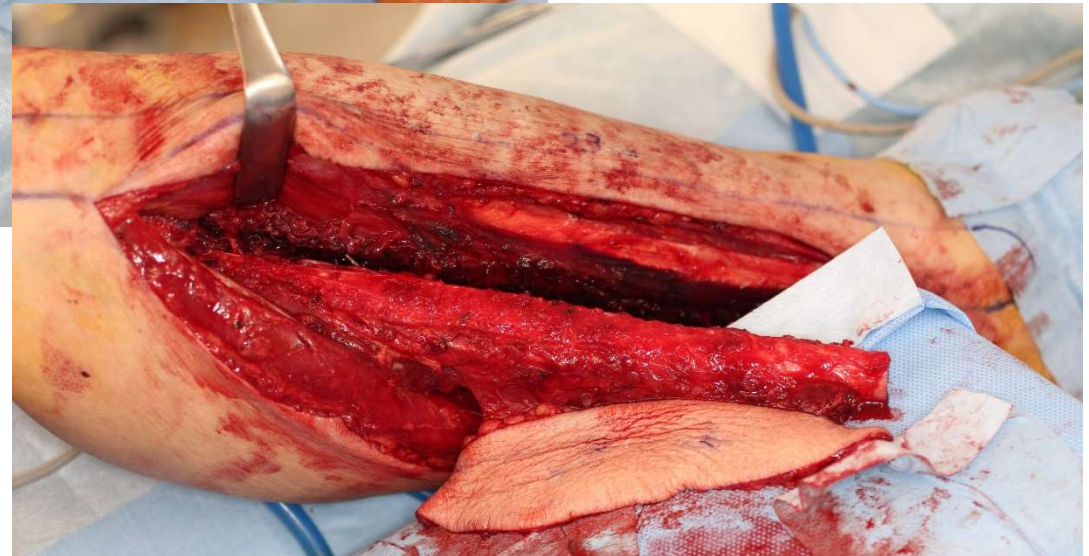
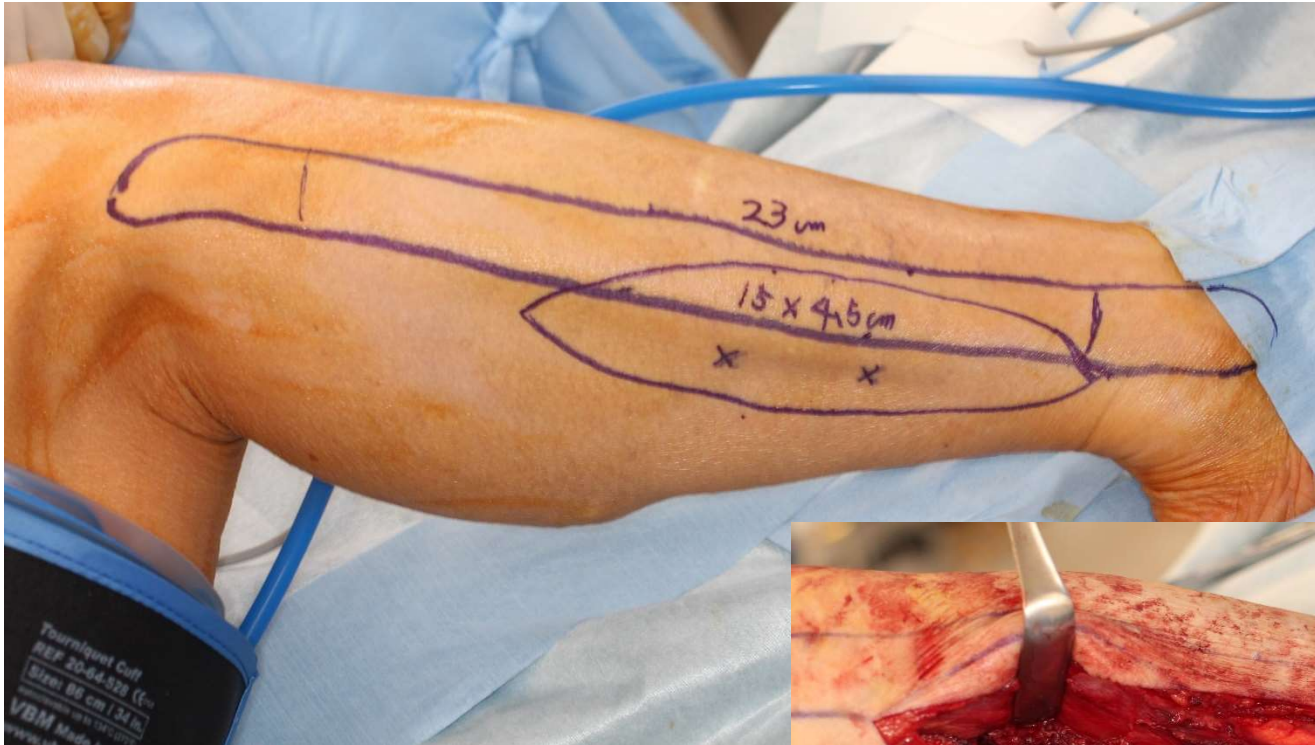


Head and Neck  
surgeon



# Collecting fibula osteocutaneous flap

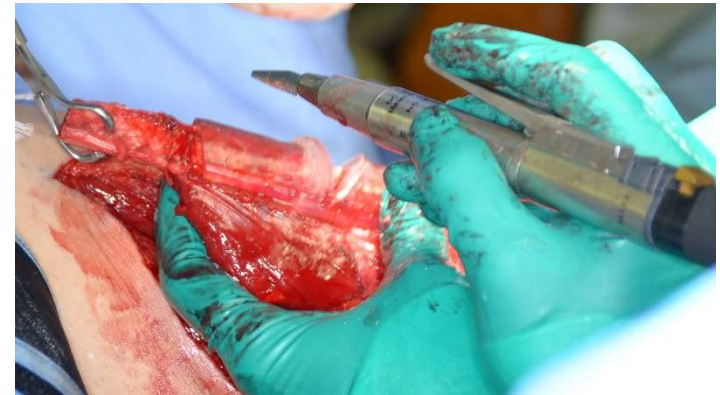
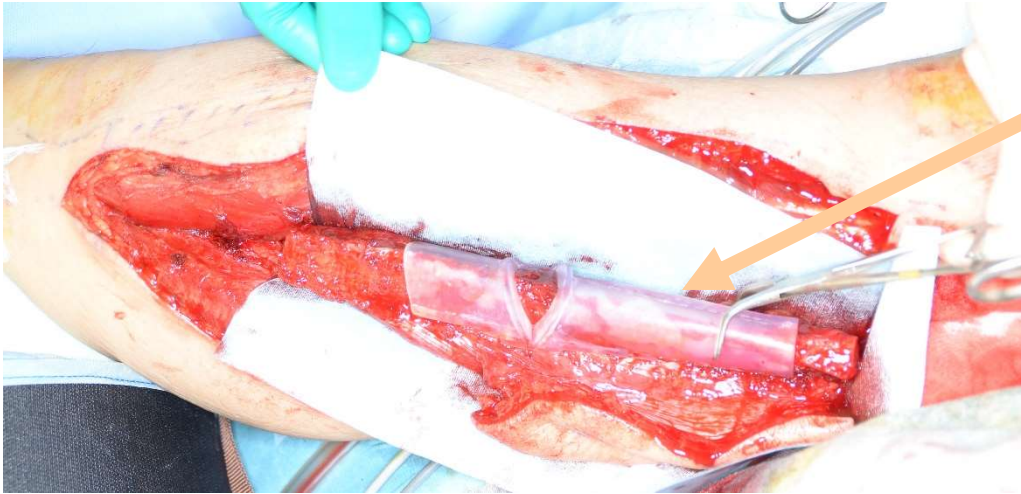
Collect the fibula osteocutaneous flap under the guide, confirming blood flow using ICG fluorescence image



Plastic surgeon

# Collecting fibula osteochoaneous flap

## Guide for collection



Plastic surgeon

# Fixation bone and flap

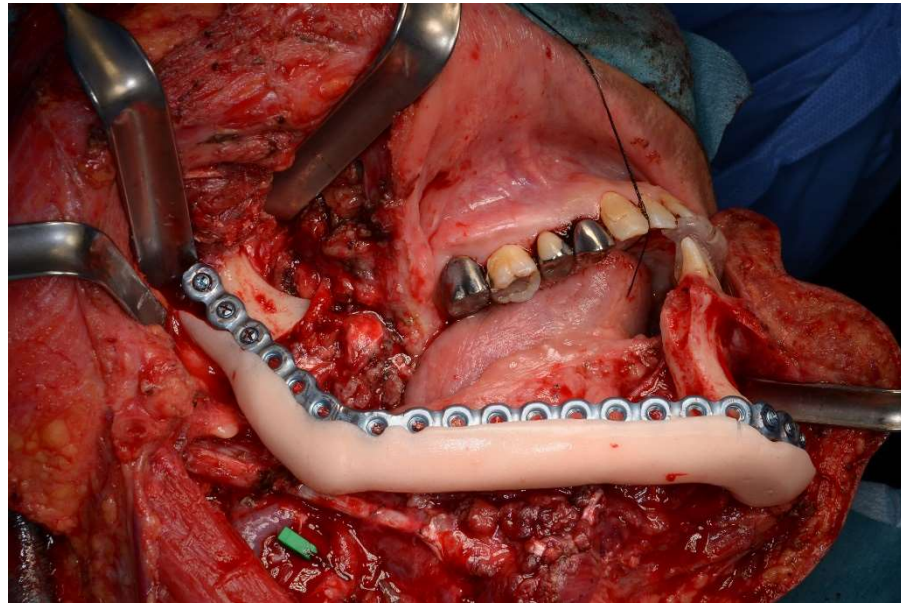
Fixation between the  
upper and lower  
jaws



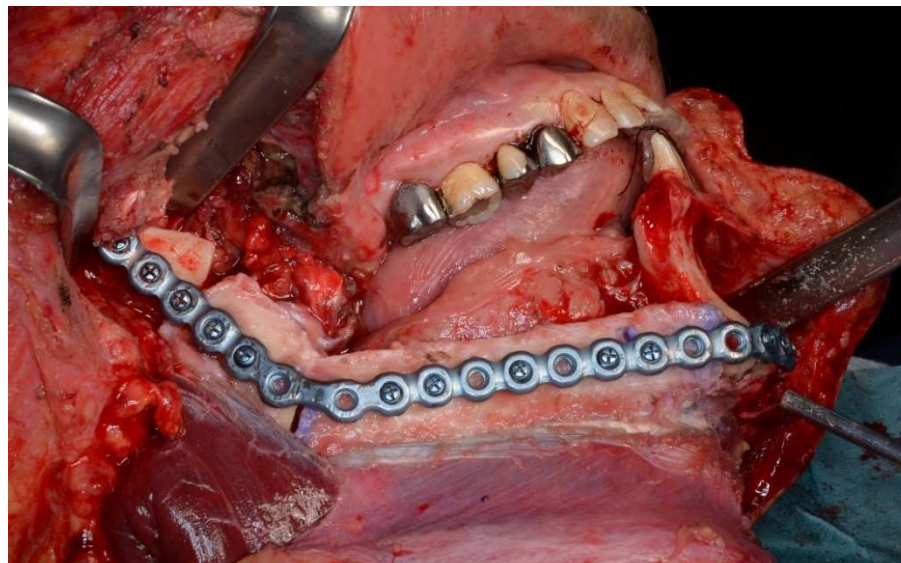
Setting plate



Fixation bone and  
flap

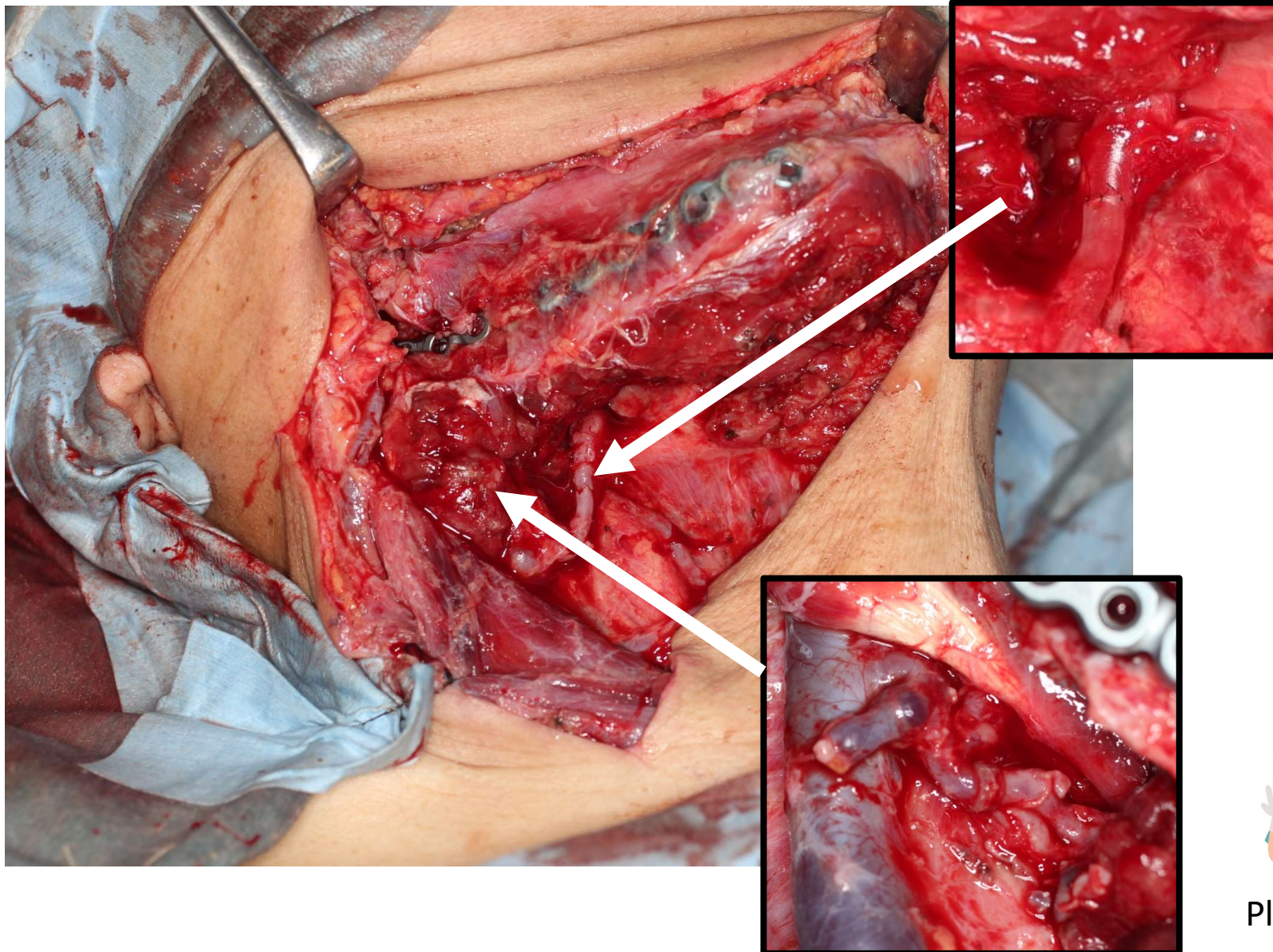


Dentist  
(Oral surgeon)



Plastic surgeon

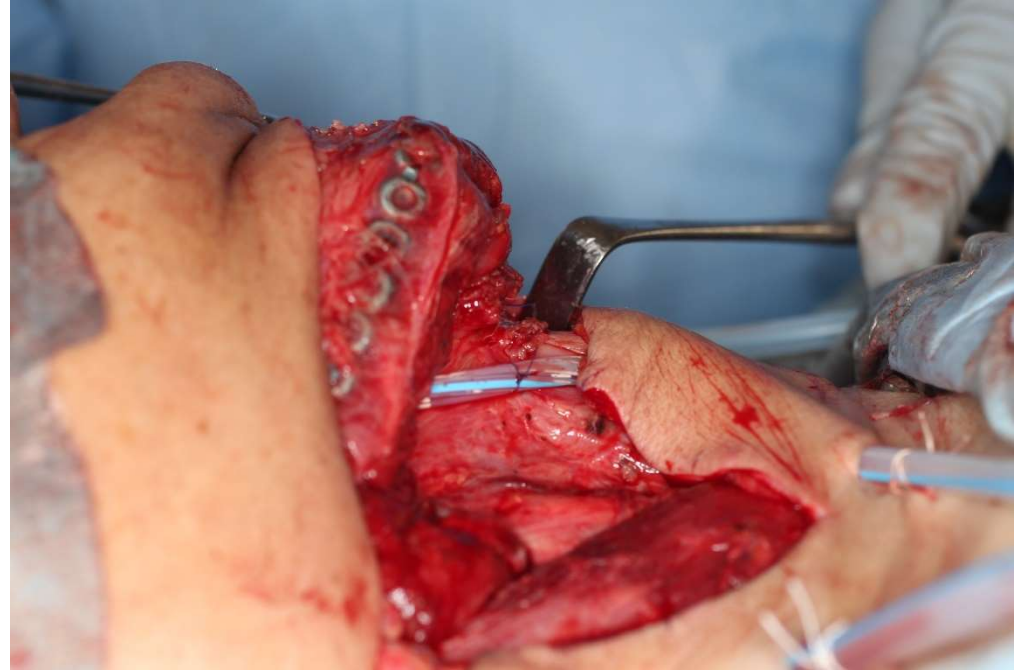
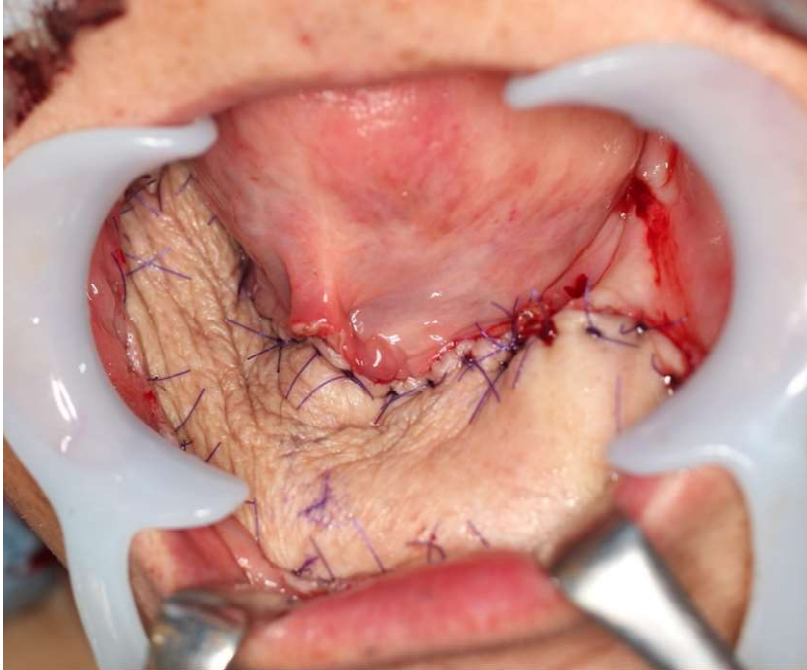
# Vascular anastomosis



Plastic surgeon



# Reconstruction by flap

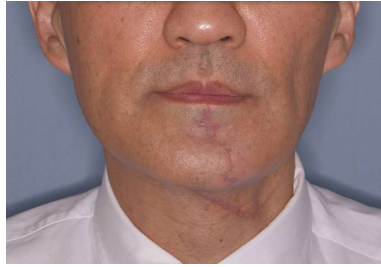


# *Outcome*



# Cosmetic outcome

Case 1



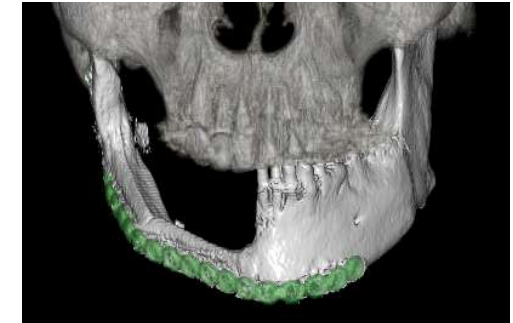
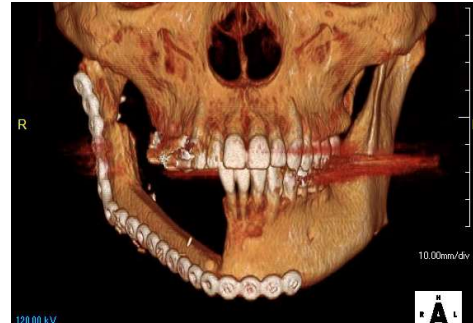
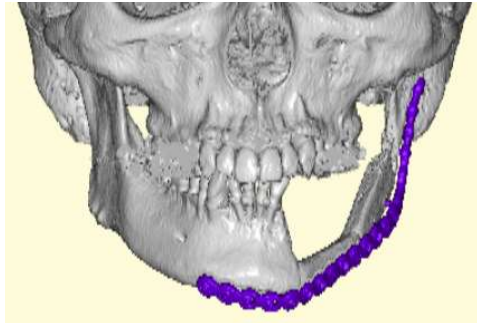
Case 2



Case 3



Reconstructed  
mandible  
(3D-CT)



**Good adjustment between reconstructed plate,  
fibula and mandible**

# Conversational and eating outcome

After 3 weeks from the surgery, speech and bite training have progressed well.

A day after this video, he discharged hospital.

VTR  
(with permit of the patient)



# Our cases 2016-2019 (n=19)

No.	age	sex	primary site	T	N	operation time (min)	Brown	ND	laryngeal suspension
1	49	M	lower gingiva	4a	2b	786	II	hemi	-
2	71	M	lower gingiva	4a	2b	751	II	hemi	-
3	60	M	lower gingiva	4a	1	755	II	hemi	-
4	71	F	lower gingiva	4a	1	575	II	hemi	-
5	52	M	lower gingiva	4a	0	593	II	hemi	-
6	68	F	lower gingiva	4a	1	575	II	hemi	-
7	68	F	lower gingiva	4a	2b	507	II	hemi	-
8	59	M	lower gingiva	4a	1	683	II	hemi	-
9	68	M	lower gingiva	4a	0	917	II	hemi	-
10	68	M	lower gingiva	r1	0	714	II	blt	-
11	74	M	lower gingiva	4b	2b	758	II	hemi	-
12	69	M	buccal mucosa	4a	2b	666	II	hemi	-
13	70	F	lower gingiva	4a	0	803	IV	hemi	-
14	75	M	lower gingiva	4a	2b	509	IV	hemi	+
15	56	M	lower gingiva	4a	2b	786	IV	hemi	+
16	65	F	lower gingiva	4a	2c	544	IV	blt	+
17	67	M	lower gingiva	4a	1	883	IV	blt	+
18	68	M	lower gingiva	4a	0	795	IV	hemi	-
19	64	M	oral floor	4a	2c	1052	IV	blt	+

# Our cases 2016-2019 (n=19)

No.	age	sex	primary site	T	N	operation time (min)	Brown	ND	laryngeal suspension
1	49	M	lower gingiva	4a	2b	786	II	hemi	-
2	71	M	lower gingiva	4a	2b	751	II	hemi	-
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15	56	M	lower gingiva	4a	2b	786	IV	hemi	+
16	65	F	lower gingiva	4a	2c	544	IV	blt	+
17	67	M	lower gingiva	4a	1	883	IV	blt	+
18	68	M	lower gingiva	4a	0	795	IV	hemi	-
19	64	M	oral floor	4a	2c	1052	IV	blt	+

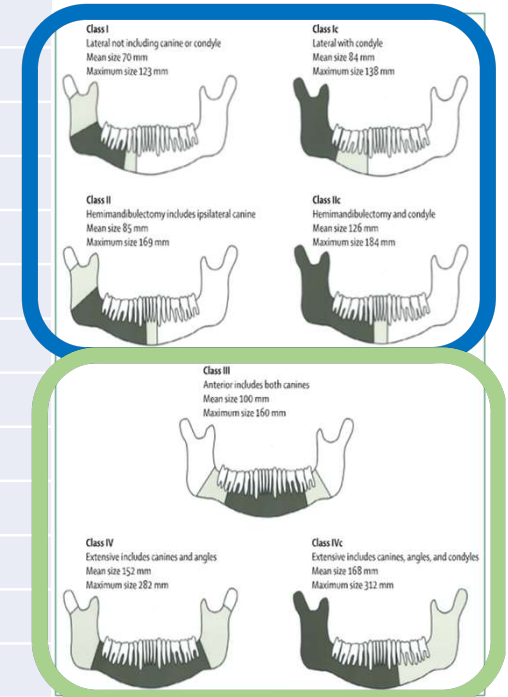


Figure 2: Proposed classification of mandibular defects  
Mean defect size (dark shading); total extent of mandibular defect (light shading).

classifications for  
mandibular defects

(Brown et al. Lancet Oncol 2016)

# Our cases 2016-2019 (n=19)

No.	age	sex	primary site	T	N	operation time (min)	Brown	ND	laryngeal suspension	conversation function	FOIS
1	49	M	lower gingiva	4a	2b	786	II	hemi	-	excellent	5
2	71	M	lower gingiva	4a	2b	751	II	hemi	-	excellent	6
3	60	M	lower gingiva	4a	1	755	II	hemi	-	excellent	7
4	71	F	lower gingiva	4a	1	575	II	hemi	-	excellent	7
5	52	M	lower gingiva	4a	0	593	II	hemi	-	excellent	6
6	68	F	lower gingiva	4a	1	575	II	hemi	-	excellent	5
7	68	F	lower gingiva	4a	2b	507	II	hemi	-	excellent	6
8	59	M	lower gingiva	4a	1	683	II	hemi	-	excellent	7
9	68	M	lower gingiva	4a	0	917	II	hemi	-	excellent	7
10	68	M	lower gingiva	r1	0	714	II	blt	-	excellent	7
11	74	M	lower gingiva	4b	2b	758	II	hemi	-	excellent	6
12	69	M	buccal mucosa	4a	2b	666	II	hemi	-	excellent	6
13	70	F	lower gingiva	4a	0	803	IV	hemi	-	excellent	6
14	75	M	lower gingiva	4a	2b	509	IV	hemi	+	excellent	6
15	56	M	lower gingiva	4a	2b	786	IV	hemi	+	excellent	5
16	65	F	lower gingiva	4a	2c	544	IV	blt	+	excellent	6
17	67	M	lower gingiva	4a	1	883	IV	blt	+	moderate	5
18	68	M	lower gingiva	4a	0	795	IV	hemi	-	excellent	7
19	64	M	oral floor	4a	2c	1052	IV	blt	+	poor	4

# Conversation function

- Hirose Classification -

CAD-CAM	Poor	Moderate	Excellent
Without (2005-2014)	4 (10.3%)	14 (35.9%)	21 (53.8%)
With (2015-2019)	1 (5.3%)	1 (5.3%)	17 (89.5%)



# Eating function

- FOIS Score-

CAD-CAM	Tube dependent (1~3)	Total oral diet with limitation (4~5)	Excellent (6~7)
Without (2005-2014)	9 (23.1%)	9 (20.1%)	21 (53.8%)
With (2015-2019)	0	6?	13?

Brown class I-II と III-IV の比較

# *Summary*



# Summary

**We start to use CAD/CAM system within the hospital (self-sourcing).**

**Currently, 19 cases have been treated, this system could facilitate the precise reconstruction, thus aiding rehabilitation of biting and swallowing function and improving the cosmetic outcome.**

**We can expect better function for conversation and eating.**

**Further experiences are expected.**

# Thank you!



Head and Neck Surgeon



Prosthodontist



Plastic Surgeon



Speech Therapist



Dental Surgeon



Radiologist



Nurse