

# Plate Exposure after Mandibular Resection with Plate Reconstruction: Contributing Factors

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**Abstract:** ***Background:** Mandibular resection is one of treatment in pathological lesions that involve the mandibular bone. This procedure normally followed by the placement of plate reconstruction that often causes a facial deformity. Plate exposure is one of the complications during post-operative period and may require removal of the expose hardware or even multiple debridements. **Objective:** This article aiming to detect risk factors for plate exposure after fixation of reconstruction plate following mandibular resection. **Methods:** We performed a retrospective analysis of 72 cases of mandibular reconstruction with reconstruction plates following mandibular resection in 2016 to 2018 in Oral and Maxillofacial Department of Hasan Sadikin Hospital Bandung. Various factors such as sex, age, type of resection, diagnosis, history of systemic disease, postoperative radiation or chemotherapy and number of leukocytes were analyzed as significant risk factors for plate exposure. **Findings:** From 2016 to 2018, 72 patients underwent mandibular resection and all of them had fixation of reconstruction plate. The mean age of the study group was 38, with a predominance of female patients (65.5%). Patients with malignancy and post-operative radiation therapy and chemotherapy were more likely to have plate exposure. Plate exposure was found in 14 cases (21.8%). From 14 cases of the plate exposure, 4 cases (28.6%) underwent plate removal, 8 cases (57.1%) underwent reconstruction with flap, and 2 cases (14.3%) died. **Conclusion:** Diagnosis of malignancy and post-operative radiation therapy and chemotherapy are associated with higher rates of plate exposure. The management of plate exposure may require multiple procedures such as free flap or local flap reconstruction.*

**Keywords:** Mandibular resection, Plate exposed

## 1. Introduction

Mandibular resection is a procedure done to treat the disease or mandibular abnormality.<sup>1</sup> Mandibulectomy is indicated to eradicate disease which involves the lower jaw or mandible. This procedure can be used in various settings, including infectious etiologies (eg, osteomyelitis), osteoradionecrosis, or a benign (eg, ameloblastoma) or malignant neoplastic process (eg, invasive squamous cell carcinoma) that involves the jaw.<sup>2</sup> Discontinuity of mandible due to mandible resection leads to the loss of balance and symmetry of face. The mandible plays a central role in function and aesthetics, the loss of jaw continuity can severely impair a patient's jaw integrity, and severely affect the patient's self-perception and self-confidence.<sup>3</sup>

The goals of mandibular reconstruction are primary wound closure, improvement of phonation and deglutition, and aesthetic restoration of the lower face. There are many techniques for mandibular reconstruction, such as soft-tissue free flaps, reconstruction plates, and bone grafts.<sup>4</sup> Mandibular reconstruction plates are one of the reconstruction procedure following resection that is often used in Hasan Sadikin Hospital. Complications such as infection, plate exposure or fracture, or loosening of the fixation can occur after this procedure. This article aiming to detect risk factors for plate exposure after fixation of reconstruction plate following mandibular resection in Hasan Sadikin Bandung

## 2. Literature Survey

Mandibular resection is a procedure that is used to eradicate disease that involves the lower jaw or mandible. This procedure can be used in various settings, including<sup>2,5</sup>

- Malignant tumor invading mandible, both primary tumor in alveolar ridge and secondary tumor from tumor expansion in surrounding tissue, like the malignancy tumor in the floor of mouth.
- Mandibular benign tumor destructing most of the mandibular structure (ameloblastoma) so when the biopsy's done there will be mandibular tissue left which lead to pathological fracture .
- Osteonecrosis caused by the use of bisphosphonate
- Osteomyelitis involving most of mandibular structure
- Osteoradionecrosis caused by radiotherapy
- Severe mandibular traumatic that causes the destruction of most of mandibular structure

The most common contraindications to mandibular resection are related to medical comorbidities. Cardiovascular disorders and hemodynamic instability or other metabolic disturbances can be contraindicated to surgery. In addition, coagulopathy that cannot be corrected in patients with significant hemodynamic disorders will also be a contraindication.

In general, the technique of mandibular resection or mandibulectomy, is divided into<sup>6,7</sup> :

- a) Marginal resection or rim resection of the mandible, preserving a functional lower border of basal bone. Recommendations for a rim resection of the mandible include :

- If the depth of invasion judged from preoperative scanning is less than 5 mm
- If preoperative scanning did not reveal any evidence of mandibular invasion but periosteal stripping at the time of operation reveals mandibular invasion

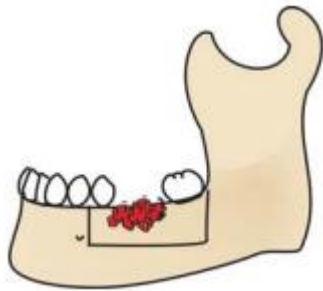


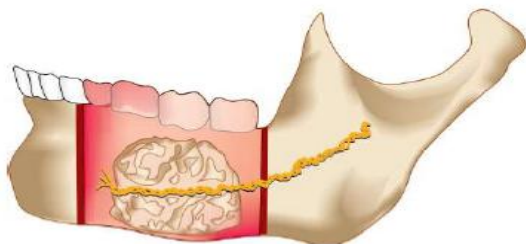
Figure 1. Marginal Resection<sup>7</sup>

b) Segmental resection, removing a segmental block of mandible, disturbing the continuity of the mandible. Recommendations for segmental resection include the following:

- Extensive invasion of the mandible as seen on preoperative radiological examination
- Extensive and deep soft tissue infiltration close to the mandible, Tumor seen to abut the whole of the height of the mandible
- When an oncologically sound rim resection would result in insufficient residual mandible to avoid pathological fracture

Segmental resection divided in two:

- Segmental resection without disarticulation of TMJ
- Segmental resection with disarticulation of TMJ (Hemimandibulectomy)



A. Without disarticulation of TMJ



B. With disarticulation of TMJ (Hemimandibulectomy)

Figure 2: Segmental resection<sup>6</sup>

c) Total Resection is the removal of entire mandibular tissue due to tumors that have invaded the entire mandibular tissue.

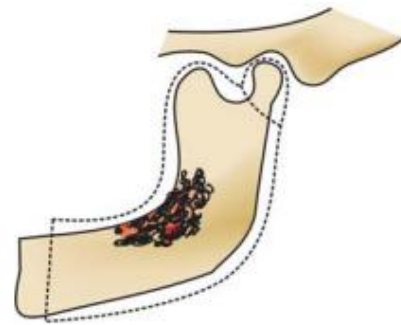


Figure 3: Total Resection<sup>6</sup>

d) Composite Resection is usually used in cases of malignancy where tumor tissue removal is required with accompanied by healthy tissue boundaries as well as a combination with the removal of surrounding soft tissue and lymph glands involved.

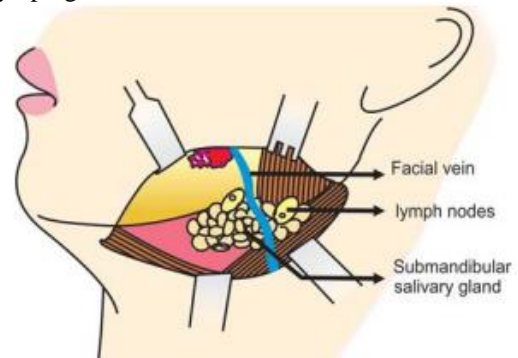


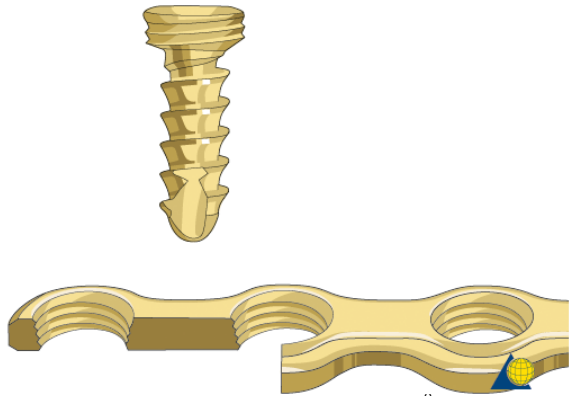
Figure 4: Composite resection<sup>6</sup>

Mandibular resection can cause disruption of mandibular movement and facial asymmetry, therefore the reconstruction is needed to: improve mandibular movement and balance; maintain the normal occlusal plane, floor of mouth, and the anatomical position of the tongue; protect vital structures; restore mastication function; restore aesthetic function; restore patient confidence in social relationships.

There are various methods used to restore defects in the mandible. This method can be classified in 3 basic categories, soft-tissue free flaps, reconstruction plates, and bone grafts.<sup>4</sup>The metallic reconstruction plates made up of titanium or stainless steel are commonly used. The plates effectively bridge the bony defect. The plates are contoured to match the facial profile and secured to the distal and proximal bony fragments with the help of the screws.<sup>7</sup>Disadvantages of the reconstruction plate are : They help only in establishing the contour, but the masticatory function cannot be restored as the fabrication of the denture is not possible; The midline reconstruction with the plates is often problematic and dehiscence of plate is a common complication; The plates can fracture due to trauma or extreme stress; The plates are liable to get loosened, infected and can evoke tissue reaction and need to be removed.

Mandibular reconstruction plates and screws (2.4 System) are the most widely used devices for mandibular reconstruction; however 2.0 plates can be used in selected cases. With the conventional fixation technique, the tightening of the screws presses the plate against the bone (load sharing). This pressure generates friction, which may

contribute to resorption of the grafted bone. However, with the locking systems (load bearing), additional threads within the screw head allows the plate to be anchored to the intraosseous screw instead of being compressed onto the bone. This reduces interference to the bone blood supply underlying the plate, prevents bone pressure necrosis and decreases the potential for plate failure at the screw-bone interface.<sup>8</sup>

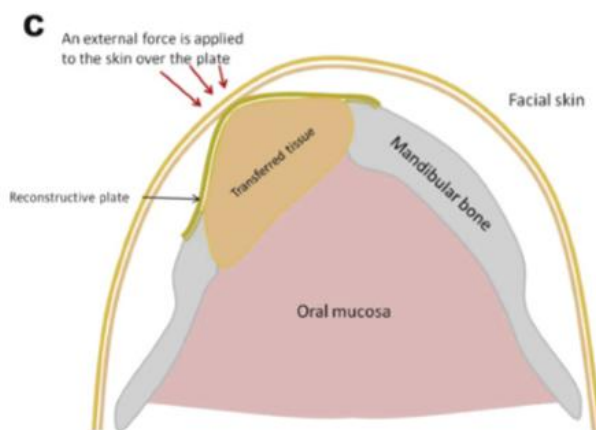


**Figure 5:** Plate and Screw<sup>8</sup>

Postoperative plate-related complications including infection, wound dehiscence, plate exposure, loosening and breakage of screws and plate fracture still occur occasionally.<sup>8</sup> Plate exposure is a postoperative complication often found in mandibular resection followed by reconstruction with fixation plate. From the literature review there are many factors that can cause plate exposure, such as<sup>9,10,11</sup>:

- 1) Persistence of dead space below the plate extent of mandibular resection
- 2) Age
- 3) Systemic disease
- 4) Malignancy
- 5) Form of the plate,
- 6) The thin soft tissue over the plate surface

A protruding part of the plate will push the covering tissue causing the plate to expose. Plate exposure can also occur due to trauma and pressure that directly hit the plate. To avoid dead space, the volume of soft tissue placed between the plate and the skin must be thick enough or graft if necessary



**Figure 6:** Soft Tissue Pressure<sup>11</sup>

- 1) Extension of resection: Mandibular resection that crosses the median line tends to cause plate exposures than when the resections that are confined to the lateral segment.
- 2) Postoperative radiotherapy and chemotherapy
- 3) Tissue necrosis around the plate
- 4) Allergy

From some of the factors mentioned above the author tries to analyze several factors that may have a strong correlation with the occurrence of plate exposure.

### Problem Definition

Plate exposure as a postoperative complication often found in mandibular resection followed by reconstruction with fixation plate. This article aiming to detect risk factors for plate exposure after fixation of reconstruction plate following mandibular resection in HasanSadikin Bandung

### 3. Methodology

We conducted an observational analytic study using a retrospective cohort method from patient data that had undergone mandibular resection surgery and reconstructed with plate reconstruction in the Oral and Maxillofacial Surgery Section of HasanSadikin Hospital.

The inclusion criteria of this study were patients who underwent mandibular resection, patients who experienced plate expose post mandibular resection in 2016 to 2018. The exclusion criteria for this study were incomplete medical records. Samples were taken by means of consecutive sampling that is taking data from medical records that match the inclusion criteria. The independent variables in this study were gender, age, type of resection, diagnosis, history of systemic disease, postoperative radiation or chemotherapy and the number of leukocytes. The dependent variable in this study is plate exposure.

### 4. Results and Discussion

From the results of data collection over the past 3 years (2016-2018) in the Oral and Maxillofacial Surgery Division of HasanSadikin Hospital Bandung, it was found that the number of patients undergoing mandibular resection procedures was 72 patients. Patients consisted of 25 men and 47 women with an age range of 13 - 74 years (mean 38 years). Patients have different diagnosis, patients with malignant and benign diagnosis were 7 and 65 consecutively. AO plates were used as reconstruction material in 72 cases.

Of the 72 cases, plate exposure were found in 14 cases. Plate exposure occurs after 2-72 months post resection (mean 11 months). Of these 14 patients, 4 patients (28.6%) had plates removal, 8 patients (57.1%) had reconstruction with flap and 2 patients (14.3%) died. The study variables according to sex, age, procedure, malignancy, comorbidities, chemotherapy or advanced radiotherapy and the number of leukocytes pre op are presented in Table 1

There was no significant correlation between age, sex of the procedure, concomitant diseases, and the number of leukocytes pre-op with the incidence rate of plate exposure.

Of the 7 variables that show a strong correlation with the occurrence of plate exposure are malignancy and chemotherapy or advanced radiotherapy variables.

**Table 1:** Characteristics of Research Samples

Variable	Characteristic	n (%)
Sex	Male	25 (34.7%)
	Female	47 (65.3%)
Age(years)	<20	8 (11.1%)
	20 – 40	35 (48.6%)
	>40	29 (40.3%)

Medical treatment procedures	Hemimandibulectomy Segmental Resection	43 (59.7%) 29 (40.3%)
Malignancy	Malignant	7 (9.7%)
	Benign	65 (90.3%)
Systemic Disease	Systemic Disease	12 (16.7 %)
	Non Systemic Disease	60 (83.3%)
Chemotherapy or advanced radiotherapy	Ada	7 (9.7%)
	Tidak	65 (90.3%)
Leukocytes Pre Op	Normal	30 (52.6%)
	Abnormal	27 (47.4%)

**Table 2:** The relationship Between Variables and Plate exposure

Variable	Characteristic	n (%)	Plate exposure		P Value
			Yes	No	
Sex	Male	25 (34.7%)	6 (24%)	19 (76%)	0.476
	Female	47 (65.3%)	8 (17%)	39 (80%)	
Age(years)	<20	8 (11.1%)	0 (0%)	8 (100%)	0.082
	20 – 40	35 (48.6%)	5 (14.3%)	30 (85.7%)	
	>40	29 (40.3%)	9 (31%)	20 (69%)	
Medical treatment procedures	Hemimandibulectomy	43 (59.7%)	8 (18.6%)	35 (81.4%)	0.826
	Segmental Resection	29 (40.3%)	6 (20.7%)	23 (79.3%)	
Malignancy	Malignant	7 (9.7%)	4 (57.1%)	3 (42.9%)	0.008
	Benign	65 (90.3%)	10 (15.4%)	55 (84.6%)	
Systemic Disease	Systemic Disease	12 (16.7 %)	4 (33.3%)	8 (66.7%)	0.183
	Non Systemic Disease	60 (83.3%)	10 (16.7%)	52 (83.3%)	
Chemotherapy or advanced radiotherapy	Yes	7 (9.7%)	4 (57.1%)	3 (42.9%)	0.008
	No	65 (90.3%)	10 (15.4%)	55 (84.6%)	

**Table 3:** The Relationship Between Pre Op Leukocyte Variable Variables with plate exposure

Variable	Characteristic	n (%)	Plate exposure		P value
			Yes	No	
Leukocyte	Normal	32 (52.6%)	6 (18.8%)	26 (81.3%)	0.741
	Leukocytosis	27 (47.4%)	6 (22.2%)	21 (77.8%)	

The success rate of mandibular reconstruction has increased as a result of advances in plate and material design. However, complications of plate exposure post mandibular reconstruction with plate fixation is still common. There are several factors that have been thought previously to be related to plate exposure. In this study, we examined the variables of sex, age, type of resection, diagnosis, history of systemic disease, postoperative radiation or chemotherapy and the number of leukocytes as factors associated with plate exposure. In our population, thenon-surgical risk factors associated with plate exposure such as systemic disease, pre-op leukocyte counts are not significantly related to plate exposure. Although no significance was found with the occurrence of plate exposure the significance of these risk factors cannot be discounted given the biological process by which these factors can interfere the wound healing.

The extension of excision is another potential factor that may be associated with plate exposure. However, in this study we have not yet discussed in detail the extension of excision, we only analyzed according to the category of segmental resection and hemimandibulectomy, and we did not find a significant correlation with plate exposure.

In this study we found a strong correlation between malignancy and chemotherapy or advanced radiotherapy with the occurrence of plate exposure. In previous studies were also found a significant relationship between the presence or absence of graft variables with plate exposure. Some research also states that the wide excision, diagnosis of malignancy and thickness of soft tissue covering the plate have a significant relationship with the incidence of plate exposure.



**Figure 7:** Plate exposure with fistula at right mandible



**Figure 8:** Plate exposure with orocutaneous fistula at left mandible follow with masseter and pterygoid muscle contracture

## 5. Conclusion

Mandibular reconstruction remains a challenging procedure in head and neck reconstruction. Malignancy and advanced therapy can indicate a greater risk of plate exposure. Many factors must be reviewed cautiously and considered to prevent the complication of plate exposure. We have to make good treatment plan during preoperative period, by optimizing the patient's condition before surgery, using 3D models to make appropriate plan for plate placement, form as well as adjust the shape of the plate, and estimating the necessity of graft placement.

## 6. Future Scope

For future study we will conduct research involving more specific variables such as the extension of excision, type of flap and the presence or absence of a graft and bending time.

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