CASE REPORT

Titanium Reconstruction Plate Exposure Following Mandibular Reconstruction in Malignancy – A Case Report and Review of Literature

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ABSTRACT

Mandibular reconstruction with titanium reconstruction plate is modality whose main advantage lies in its cost effectiveness and lack of secondary morbidity. It is thus still in widespread use, in spite of the availability of large number of other more successful reconstructive options. However, it is also associated with large number of complications. Plate exposure is not an uncommon complication, necessitating plate removal. A case of carcinoma of the anterior alveolus of the mandible is treated with supraomohyoid neck dissection, and segmental resection of mandible on the left side, followed by reconstruction of the mandible with titanium reconstruction plate and nasolabial flap. Patient developed infection in surgical site and exposure of titanium reconstruction plate on 20th post-operative day. Subsequently, the reconstruction plate was removed under general anesthesia, and infection was treated with antibiotics based on culture and sensitivity. Post-operative recovery following plate removal was uneventful. The present case report discusses the complication of an infected plate following a major head-and-neck surgery and a review of literature of titanium plate reconstruction.

Key words: Etiology, prevention of infection, titanium plate exposure.

INTRODUCTION

The mandible plays a central part in the function and esthetics in the oromaxillofacial region. Mandibular continuity may be lost as a result of trauma, tumor, or inflammation. Subsequently, the airways may be obstructed, eating disturbed, insufficient saliva retained, speech impaired, and the face disfigured. Alloplastic reconstruction of the mandible is usually chosen for the treatment of patients with malignant tumors, both temporarily and permanently.[1]

Since the early 1980s, the standard of care for the restoration of mandibular continuity has been the placement of rigid reconstruction plates combined with simultaneous or delayed osseous reconstruction.[2] Recently, the effectiveness of osteosynthesis has improved with the use of titanium reconstruction plates, which provide better biocompatibility and locking screws for biomechanical improvement. With these improvements, modern reconstruction plates can provide excellent anchorage and rigid fixation.[3]

However, the use of reconstruction plates for mandibular reconstruction is often criticized because reported rates of post-operative plate exposures have been extremely high such as the 46.15% reported by Wei *et al.*[4] Exposure is the

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most serious complication of plate reconstruction and necessitates a fundamental review of the therapeutic plan, including plate removal.[5]

The present case report discusses the complication of an infected plate following a major head-and-neck surgery and a review of literature of titanium plate reconstruction.

CASE REPORT

A 49-year-old male patient underwent a segmental mandibular resection and supraomohyoid neck dissection for squamous cell carcinoma of mandibular alveolus in the left premolar region. The mandible was reconstructed with titanium reconstruction plate of approximately 10-cm length (extending from right body region to left angle of the mandible) after contouring the plate over the outer surface of the resected mandible. The nasolabial flap was harvested by marking the medial border of the flap on the nasolabial groove and extending the tip up to 15 mm below the medial canthus of the eye. The flap's width-to-length ratio of 1:3 was maintained. The skin incision was carried out through the dermis and subcutaneous fat to the level of underlying musculature. The flap was elevated following blunt dissection. The flap was then tunneled through the buccal space and placed in the mandibular defect region. His initial post-operative course was uneventful, and a feeding tube was removed. The patient eventually began eating and speaking without difficulty.

Twenty days post-operatively, the patient developed dehiscence of the wound and exposure of the titanium reconstruction plate associated with pus discharge on the right mental region was noted [Figure 1]. After thorough clinical examination and investigations, surgery was planned for the removal of plate under general anesthesia (GA).

The patient was treated under GA after following standard sterilization protocol. Incision was given on pre-exciting incision line starting from the midline of the lower lip involving the lower border of the symphysis region and extending to the corner of the mouth on the left side. Soft tissue was reflected, and the titanium reconstruction plate was exposed completely [Figure 2]. The reconstruction plate was removed along with the screws [Figure 3]. The nasolabial flap which was previously placed in the mandibular defect was advanced by extending the incision line posteriorly over the cheek region, repostioned anteriorly on the floor of the mouth and

Figure 1: Clinical picture showing post-operative plate exposure

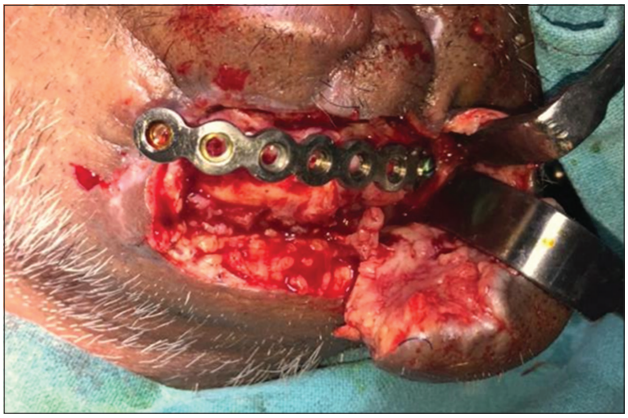

Figure 2: Clinical picture showing elevation of flap and plate exposure

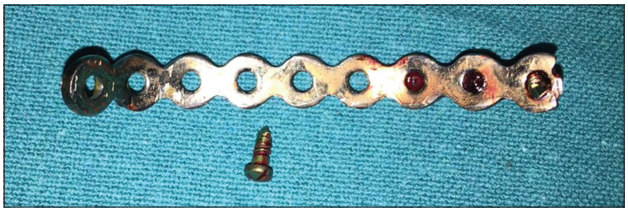

Figure 3: Clinical picture showing titanium reconstruction plate that was removed

secured to the adjacent tissue [Figure 4]. The chin incision was closed in a layer-wise manner. The extended incision of nasolabial flap was closed by primary closure [Figure 5].

Patient follow-up was done after 1 month post-operatively to check for any complications [Figure 6]. Further follow-up was done after 2 months, and it was found that healing was satisfactory without any complications [Figure 7].

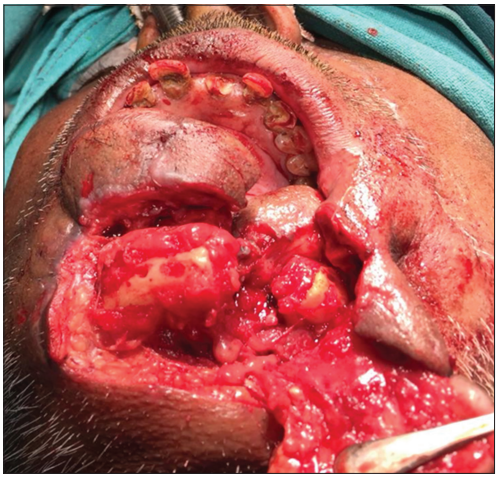

Figure 4: Advancement of nasolabial flap and its repositioning

Figure 6: Post-operative clinical picture showing healing after 1 month

Figure 5: Clinical picture showing closure of the wound with 5–0 prolene

Figure 7: Post-operative clinical picture showing healing after 2 months, which was satisfactory and there were no complications

DISCUSSION

The main goals of mandibular reconstruction are to achieve functional and esthetic recovery by restoring mandibular arch continuity, maintain soft-tissue coverage, and to improve the patient's post-operative quality of life. The success rate of mandibular reconstruction has increased as a result of advances in plate design and materials. However, plate-related complications still develop frequently and can sometimes cause serious problems for patients.[3]

Plate exposure continues to be the most common plate-related complication in the mandibular reconstructive surgery. The factors responsible for this may be related to properties of the plates themselves, the perimandibular native soft tissue, the limitations of various soft-tissue transfers, and the surgical reconstructive technique.[6]

Plate exposures can be classified as intraoral or extraoral. Nicholson *et al.* noted a pattern, where extraoral plate exposure occurred at a mean of 10 months post-operatively, whereas intraoral plate exposure occurred at a mean of 6 weeks–3 months.[6]

FACTORS CONTRIBUTING TO PLATE EXPOSURE

Numerous factors might contribute to the exposure of reconstruction plates used for primary mandibular reconstruction after mandibulectomy.

Persistence of Dead Space below the Plate

Dead space persisting beneath a plate might contribute to plate exposure. The neighboring skin is drawn into the dead space, and the skin covering the surface of the plate is under tension during healing and scar formation at the wound site. Small amount of dead space might have been the cause for plate exposure in this case report.

Thin Soft Tissue over the Plate Surface

If the skin over the plate is thin, physical irritation and compression of the skin against the plate may contribute to plate exposure. Physical irritation is noted near the chin in the present case.

Imbalance between the Soft Tissue on the Plate Surface and the Form of the Plate

When the form of the soft tissue on the plate surface is not balanced with the form of the plate, a prominent part of the plate presses against the overlying soft tissue and contributes to plate exposure.

Extent of Mandibular Resection

Mariani *et al.* have found a high rate of plate exposure when resection includes the central segment of the mandible.[7] It is thought that physical irritation and compression of the skin against the plate occurs when the central segment is resected; in contrast, plate exposure occurs less often when resection is limited to the lateral segment. Thus, more soft tissue is placed around a plate when resection involves the lateral segment than when resection involves the central segment. In our case, mandibular resection was extended to the central region as well, which might be one of the contributing factors for plate exposure. Yao *et al.* found that a greater surgical defect size may also trigger plate-related complications. Patients with segmental mandibulectomy defects were more likely to develop plate exposure.[8]

In a study by Christopher *et al.*, they showed decreased plate exposure with mandibulotomies compared to those with mandibulectomy defects. This is likely due to the length of the plate in addition to the associated soft-tissue defects.[9] In the present case, mandibulectomy was performed.

Dead Space due to Displacement between the Reconstructive Plate and the Surrounding Tissue

There is a period of post-operative instability until the surrounding tissue adheres to a plate. Dead space that forms around the plate due to displacement can lead to hematoma formation, plate contamination, and contribute to plate exposure. There was repeated drooling of saliva into the dead space; this could be a cause for infection and plate exposure in the present case.

Effects of Radiation Therapy

Okura *et al.* have reported that the rate of plate exposure is higher in cases of pre-operative radiation therapy.[10] Greene *et al.* have described segmental reconstruction of the radiated mandible with alloplastic prostheses.[11] Radiation therapy can interfere with adhesion between the plate and the surrounding tissue and can thus lead to dead space forming around the plate. Radiation therapy may increase the amount of poorly vascularized scar tissue, thus increasing the possibility of plate exposure.[8]

Fortunately, the patient in the present case report did not undergo radiotherapy, as post-surgical biopsy reports revealed no positive margins and no nodal involvement.

Necrosis of Soft Tissue Surrounding a Plate

Necrosis of soft tissue, including transferred flaps, surrounding a plate is directly related to plate contamination and exposure. In particular, tissues that are ischemic after resection should be trimmed. The necrotic tissue, that is, present is trimmed after the plate removal, and the wound is closed in this case.

Allergy to Metal

Reconstructive plates are unsuitable for patients with allergies to metal. No metal allergy is reported in our case.

Infections

Infections of the head and neck following ablative surgery may lead to bacterial colonization of plates, resulting in biofilm formation, wound contamination, and subsequent plate exposure requiring hardware removal to eliminate the nidus of infection.[9]

Persistent infection was not controlled by all types of higher antibiotics in this case.

METHODS FOR PREVENTING PLATE EXPOSURE

Filling Dead Space beneath the Plate

Dead space persisting beneath the reconstruction plate can contribute to post-operative plate exposure.

Thus, dead space beneath the plate should be filled with a sufficient volume of surrounding tissue or transferred soft tissue.

Placing Soft Tissue of Sufficient Thickness over the Surface of a Plate

Placing transferred soft tissue, such as a de-epithelized flap or a muscle, between the plate and the facial skin so that soft tissue of sufficient thickness is present over the surface of the plate in patients who are slender or have little subcutaneous fat or when the striated muscle and subcutaneous fat of the face have been resected with a tumor is more beneficial.

Adequate reconstruction after ablative surgery with sufficient soft-tissue restoration is critical in avoiding plate exposures. Whichever reconstruction method is chosen, if insufficient bone and soft tissue were used to reconstruct the defect, wound contracture and steady pressure of the plate against the skin may lead to eventual plate exposure.[9]

In one study, over-reconstructing medial soft-tissue aspects and obliterating dead space resulted in a reduction of plate exposures from 38% to 8% even in patients reconstructed with lateral defects with a plate and soft tissue.[12]

Anchoring the Plate to the Surrounding Tissue

Anchoring the plate to the surrounding tissue can prevent hematoma and dead space formation due to post-operative movement.

Shaping and Adjusting the Plate Pre-operatively with three-dimensional (3D) Models

3D bone models can be used to shape and adjust the reconstruction plate pre-operatively. The technique of plate pre-bending before mandibular resection is generally accepted. Expansion of the mandibular contour by tumor may, however, make this technique difficult as overprojection of the symphyseal region typically occurs in this situation.[6] In the present case, 3D models were not used for reconstruction plate adaptation, instead, plate adaptation was done intra-operatively and fixation is done.

Setting Back the Reconstruction Plate

When no soft tissue surrounds the plate, when the transferred flap is too thin to fill the dead space beneath the plate, or when placing soft tissue across the surface of the plate surface is difficult, the plate can be bent inward of the normal mandibular line to reduce the volume of dead space and to reduce compression of the superficial soft tissue.

Selecting an Appropriate Flap to be used with a Plate

Flaps used with reconstruction plates include the rectus abdominis myocutaneous flap, the anterolateral thigh flap combined with the vastus lateralis muscle, and omentum flaps. Kiyokawa *et al.* have reported the usefulness of the pectoralis major myocutaneous flap in reconstruction with a mandibular plate.[13] Yokoo et al. have reported on the indications for and efficiency of transfer of the anterior rectus sheath in oromandibular reconstruction.[14]

Metal plates require sufficient soft-tissue coverage to prevent extrusion. This complication usually results in removal of the plate. The pectoralis major myocutaneous flap is widely used to help prevent this occurrence.[15] The pectoralis major musculocutaneous flap is commonly recruited to provide tissue from outside the field in recent times. Kellman and Gullane described the effect of gravity on the soft tissue suspended from the plate as a mechanism, leading to flap failure of pedicle flaps and plate exposure. They contend that these problems may be negated by the use of free-flap reconstruction.[16]

However, the most important point of selecting a flap is to understand both the cause of flap exposure and concepts for preventing it. There are no inherently good or bad flaps; however, the most appropriate flap must be selected for each patient. The most important point of reconstruction with a mandibular plate is to fill the dead space beneath the plate with tissue from the transferred flap.[5]

CONCLUSION

Mandibular reconstruction remains a challenging task for the head-and-neck reconstructive surgeon. Numerous factors, including the defect size, location of the defect, and presence of wound healing compromising conditions, must be judiciously reviewed and considered to prevent plate-related complications. Based on the literature, factors contributing to exposure of mandibular reconstruction plates and points that may prevent plate exposure are mentioned. Use of a plate is a useful reconstructive method, especially for patients who cannot tolerate the transfer of a vascularized bone graft.

In the present case report, small amount of dead space in the submental region, average amount of soft-tissue coverage on the chin, muscle pull, and patient's early and eagerness for masticatory function causing hyperactivity of the muscles could have contributed to the plate exposure.

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