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Case Report

Treatment of extended comminuted mandibular fractures with infected cutaneous fistule Post-ORIF using a reconstruction plate: A case report

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ABSTRACT

Introduction: We report a case of an extended comminuted mandibular fracture using a reconstruction plate, miniplates and arch bar. Cases of extended comminuted mandibular fractures report high rates of complications. In this case, the patient subsequently suffered from an infected cutaneous fistule and non-union of the comminuted segments.

Case report: An 18-year old male arrived at the emergency room after a motorcycle accident with extensive comminuted mandibular fractures extending bilaterally with splitting at the mandibular angle and shattered bony fragments of the alveolus and mandible body. ORIF was performed using a locking reconstruction plate, miniplates and screw followed by maxillomandibular fixation using the arch-bar. Two weeks after the operation, a cutaneous fistule formed in the submental region. After multiple local debridements with little improvement, surgical debridement was done and a small comminuted bone fragment that underwent nonunion was removed. Final evaluation of the patient showed optimal results with satisfactory masticatory function and an acceptable anatomical shape of the lower jaw.

Discussion: Extensively comminuted mandibular fractures are known to be difficult to manage. Although the controversy between open versus closed reduction of comminuted mandibular fractures remain, advancements in surgical techniques and equipment has shifted towards open reduction and internal fixation, allowing for better and faster anatomical and functional restoration.

Conclusion: ORIF should be the treatment of choice in extended comminuted mandibular fractures. A mandibular reconstruction plate can be used to achieve a good results with a relatively faster return of function. Although the incidence of infection in mandibular fractures is high, adequate debridement and plate removal can bring good results as seen in this case. Shifting from closed to open reduction allows the patient to have faster results with less complications in the future.

1. Intro

The topic concerning the management of comminuted mandibular fractures remains highly controversial. It has been reported that facial fracture reduction in the United States contributed to an inpatient hospital cost of $1.06 billion annually [1]. Extensively comminuted mandibular fractures are known to be difficult to manage and have high rates of complications. Potential complications of comminuted mandibular fractures include infection, wound dehiscence and exposed or infected hardware. The debate remains as to whether closed reduction or open reduction and internal fixation (ORIF) is a better option for these cases.

We report a case of extended comminuted mandibular fracture that extends bilaterally and splits at the angle treated by open reduction, internal fixation and reconstruction using miniplates, reconstructive plates and arch bar. This article will discuss the complications of this case as well as discuss the treatment options for extensive comminuted mandibular fractures. This case report has been reported in line with the SCARE Criteria [2].

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2. Case report

An 18-year old male arrived at the emergency room at Dr. Sardjito General Hospital after a motorcycle accident. His injuries included extensive comminuted mandibular fractures extending bilaterally with splitting at the mandibular angle and shattered bony fragments of the alveolus and mandible body (Fig. 1). The patient had no previous history of craniofacial trauma and was not on any routine medication at the

(A)

(B)

Fig. 1. (A) Patient with edema of the lower face, external wounds and malocclusion. (B) CT scan 3d shows comminuted segment of left parasymphysis and mandible body, complete split fracture segment of left ramus, and complete fracture of right angle.

time. The patient did not have a history of smoking, alcohol consumption or drug use.

Under general anesthesia, open reduction and internal fixation of the extended comminuted mandibular fracture was performed was performed by a plastic surgeon with four years of experience in craniofacial surgery using a locking reconstruction plate, miniplates and screw followed by maxillomandibular fixation (MMF) using the arch-bar. Two weeks after the operation it was observed that a cutaneous fistule had begun to form in the submental region (Fig. 2). Local debridement and primary closure was done but the patient still complained of discharge. The MMF was used for 1 month after. CT scan was done to evaluate bone healing (Fig. 3). A surgical debridement was done and a small comminuted bone fragment was found to have undergone nonunion. It was decided to remove this bone fragment and the miniplates that were used to fixate the fragment. During the follow up examination, discharge was still seen to be present in the stitches after debridement (Fig. 4), Wound care was then routinely done on the patient. The patient was given 30 mg ketorolac three times a day and 1 gr of ceftriaxone twice a day.

Re-debridement and removal of the mandibular reconstruction plate was to be done within 6 months. Because of the formation of the fistula and evidence of infection in the patient, it was decided to remove the mandibular reconstruction plate and miniplates of the left mandible. During the operation it was discovered that a large segment of the comminuted fracture in the left mandible that was fixated using a mandibular reconstruction plate had undergone nonunion. This segment of the bone was subsequently removed during the procedure. During the follow up examination, there was no evidence of wound dehiscence nor discharge (Fig. 5). CT scan evaluations showed defects in the left corpus of the mandible (Fig. 6). Final evaluation of the patient showed optimal results with a maximal mouth opening (MMO) of 42 mm. The patient also had satisfactory masticatory function, an acceptable anatomical shape of the lower jaw and has an underbite in the mandibular incisors which will be consulted and treated by an orthodontist (Fig. 7). The patient's masticatory functions were also good and he reported of no trouble chewing solid food, opening or closing his mouth.

3. Discussion

Comminuted fractures of the mandibles are caused by high impact trauma causing the mandibular bone to be broken, splintered or crushed into several pieces within the same area of the mandible [3,4]. The mandible plays an important role in both structural support and masticatory function, therefore proper planning of treatment is crucial in such cases due to its difficulty and severity. The aim of treatment of fractures is to restore the anatomy, function of the mandible and also return the patient's aesthetic appearance [5].

Patients with comminuted fractures of the mandible can be successfully treated by closed reduction with MMF, external pin fixation or open reduction using stable internal fixation. Before reliable implants and instrumentation, closed reduction or conservative treatment was considered to be the optimal treatment to preserve blood supply to the bone fragments, avoid periosteal stripping and to prevent secondary infections [6]. Advancements in surgical techniques and equipment has shifted towards open reduction and internal fixation, allowing for better and faster anatomical and functional restoration [7]. Closed reduction for the treatment for comminuted mandibular fractures were once the preferred option in order to avoid periosteal stripping and devascularization of comminuted bony segments. Earlier papers published on comminuted fractures of the mandible showed that attempts at bone plate stabilization had much worse outcomes as compared with wire fixation [8]. This paradigm started to shift after Kazanjian published a paper discussing severely comminuted mandibular fractures [9]. He proposed that most non united fractures are not caused by initial loss of bone, but are caused by inadequate immobilization of comminuted fragments of bone which may lead to infection.

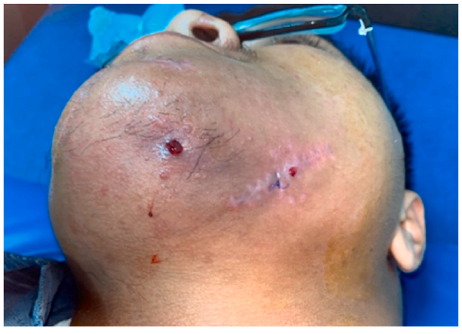

Fig. 2. Two weeks post surgery with visible discharge from the wound in the lower left jaw.

Mandibular fracture fixation using plates and screws has been reported as early as 1886. Advancements in medicine and technology have allowed surgeons to improve surgical techniques and have a better understanding of the biomechanics for bone healing [10]. Today ORIF for treatment of comminuted mandibular fractures has been observed to provide faster return of function compared with conservative treatments. Anatomical restoration is also much easier to restore using ORIF because it allows the surgeons to have better visualization and control of the comminuted segments [7]. The degree of comminution and the extent of displacement are important factors in deciding of when to use open or closed techniques. Smith and Teenier suggested that ORIF in comminuted mandibular fractures are indicated in 1) severe injuries with significant displacement to allow for the restoration of the pre-traumatic anatomic relationships, 2) edentulous and partially edentulous patients who do not have stable occlusion and may benefit from the ORIF of comminuted fractures and 3) cases with multiple fractures of the midface and where the mandible could be used as a guide to reposition the midfacial bones [11].

It was decided that open reduction with a mandibular reconstruction plate combined with miniplates was the best option for this patient due to its severity and the presence of a split fracture in the coronoid process until the ramus of the mandible. This patient also had multiple displaced comminuted segments in the left corpus of the mandible that would have benefited greatly from open reduction. A mandibular reconstruction plate was used because repair of the mandible requires adequate stability in order to allow bone healing and to also bear the entire load of mastication [12]. Miniplates were used to fixate the smaller comminuted segments. In our patient, MMF was also used to immobilize the fractured segments of the mandible by externally locking the occlusion into place. In facial fractures, dental occlusions are an important guide to reduce fractures and can also be used as a therapeutic tool [13].

The efficacy of mandibular reconstruction has improved greatly in recent years due to the use of titanium reconstruction plates that provide better biocompatibility and locking screws for biomechanical enhancement. These improvements effectively provide rigid fixation needed for proper bone healing [14]. A 10-year review by Ellis et al. found that in cases of comminuted mandibular fractures, ORIF with a bone reconstruction plate had low complication rates [6]. These complications such as infections, plate exposure, fracture or loosening of the fixation do occasionally occur in patients after mandibular reconstruction. In our patient, a cutaneous fistula started to develop because of an infected comminuted bone fragment that underwent nonunion. A post-operative fistula in mandibular reconstruction is a major complication which will usually require additional surgeries, reosteosynthesis and reconstruction [15]. A meta-analysis published by Tassone et al. demonstrated a pooled incidence of orocutaneous fistules of 7.7% over the last five decades in patients that underwent resection and reconstruction in oral cavity cancer patients. Many studies show that radiotherapy is a risk factor for the development of fistulas because of the decrease in local tissue vascularity leading to infection and plate exposure [16].

Post-operative inflammatory complications (POICs) are known to

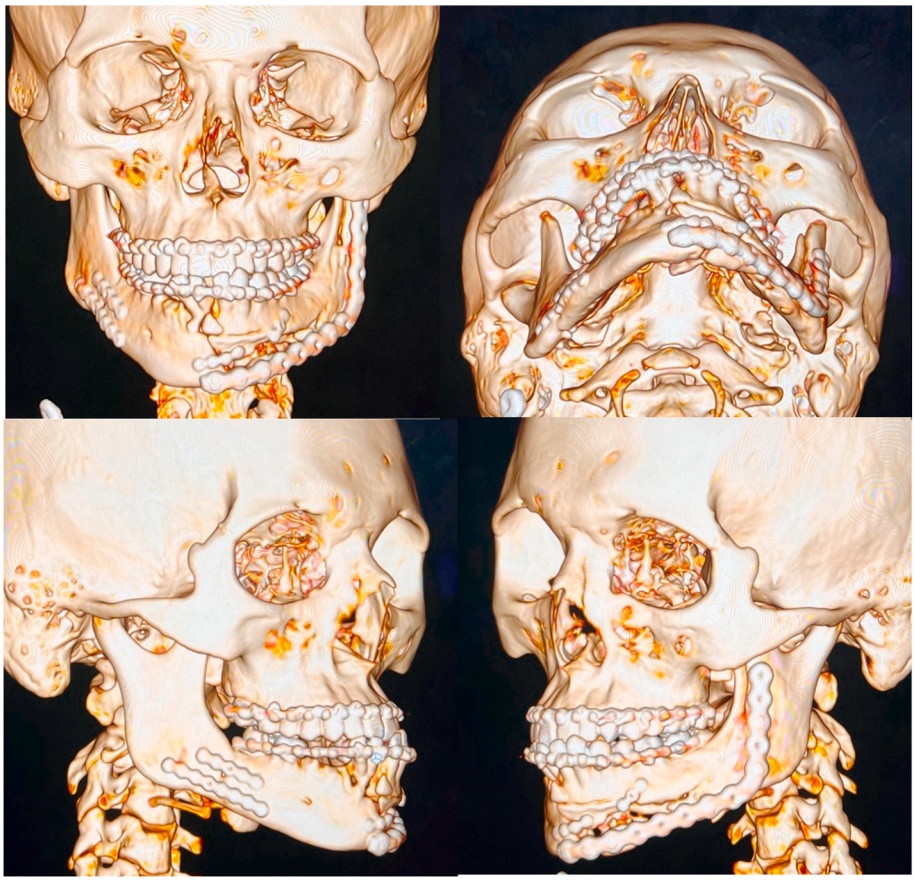

Fig. 3. 3D CT scan evaluation after 2 months showed good alignment of the mandible, and non union of the comminuted segments in the left region.

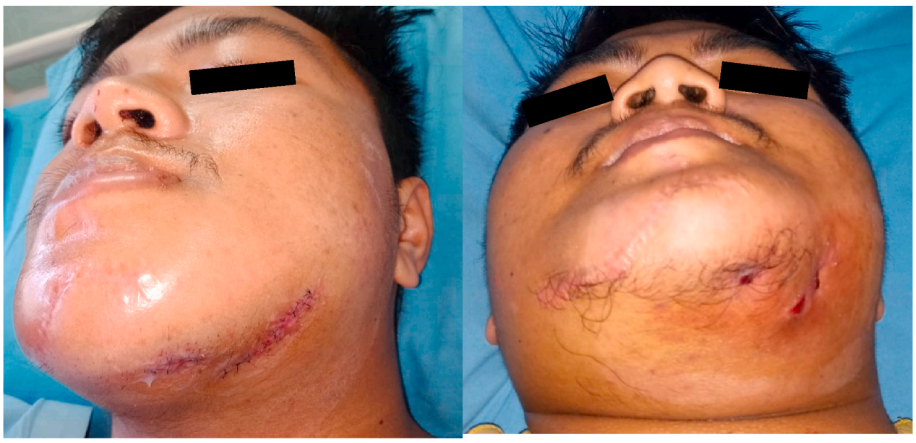

Fig. 4. (A). One week post surgical debridement and mini plate removal. (B) One month after, the fistule and discharge are still present.

occur in frequencies up to 30% after mandible fractures. A POIC is defined as 1) recurrent swelling, fever, increased pain or trismus; 2) wound dehiscence with purulent drainage; 3) exposed or infected hardware; 4) abscess formation; 5) radiographic evidence of osteomyelitis; and/or 6) presence of a fistula. Infection of jaw fractures represents the most commonly encountered postoperative complication and mandibular fractures are reported to be associated with the highest rate of infections among other maxillofacial fractures [17]. Infected mandibular fractures are when purulent drainage from the fracture site, either intraoral or through extraoral fistula in chronic cases or as associated facial cellulitis in acute presentation occur. It is difficult to determine whether or not these infections happen from the injury itself or from the treatment [18,19]. A case-control study documented that fracture severity assessed using the Mandibular Injury Severity Score (MISS) was associated with an increased risk for development of POIC [20]. The MISS developed by Shetty et al. converts anatomical and clinical characteristics of mandibular fractures into a single numeric value and can be used to predict the outcomes of the patient [21]. These variables include 1) fracture type, 2) location of fracture, 3) occlusion, 4) soft tissue involvement, 5) infection and 6) displacement.

Although internal fixation using reconstruction plates and miniplates have allowed accurate reduction and promote osteosynthesis, its

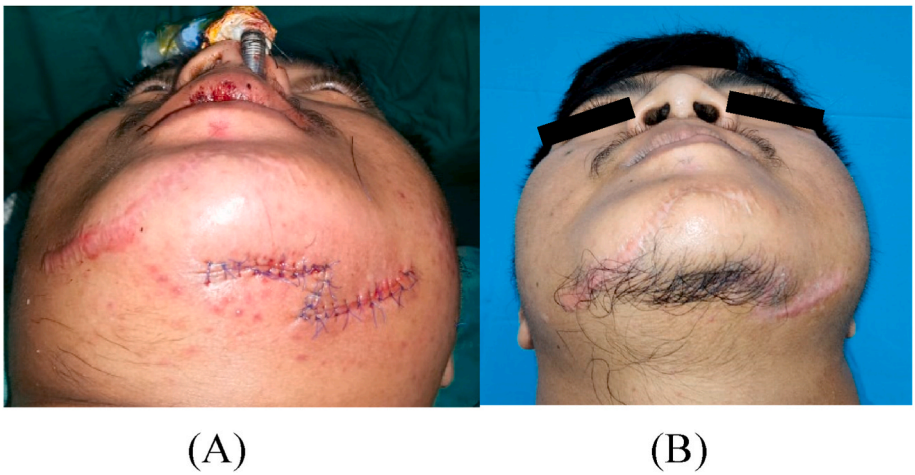

Fig. 5. (A). Immediate post surgical re-debridement and reconstruction plate removal. (B) Two months after, wound healed, no discharge nor fistule.

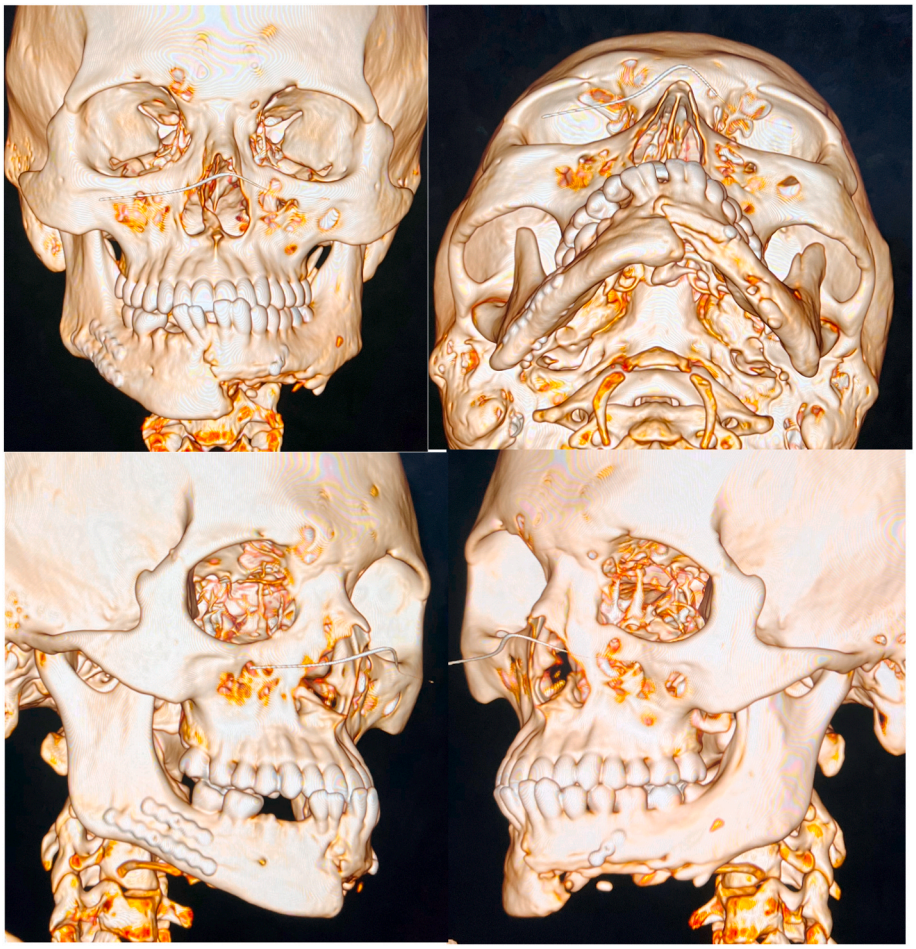

Fig. 6. CT Scan 3D post reconstruction plate removal showed defect of the left mandible with stable and good alignment of the mandibular arch.

disadvantages are that it is still a foreign body which may lead to infection [22]. In this patient, the subsequent infections post operation eventually led to the removal of the reconstruction plates and also the miniplates. The removal of the reconstruction plate was done 6 months after internal fixation in this patient. In the twentieth century, elective surgery to remove all previously inserted plates was the norm and even recommended by the surgeon [23]. Nowadays, routine plate removal is most common when indicated when there are complications such as wound dehiscence, infections, thermal or touch-sensitive skin, pain, hypesthesia, palpability of metal and titanium intolerance. Removal within a year or less after osteosynthesis is frequently reported [24]. Plate removal should ultimately be done with consideration of the bone healing process and the rigidity of the comminuted fragments of the mandible.

Miniplate removal in this patient was done 3 months after insertion. Nearly 10% of all miniplates inserted will be removed because of various

Fig. 7. One year post surgery follow-up photograph, showing acceptable lower jaw shape, maximal mouth opening of 42 mm, and underbite anterior occlusion.

reasons, with infection and dehiscence being the leading causes. In a cohort study following up patients who had miniplates inserted in the oral and maxillofacial region, 72% of the patients had removal of miniplates within the first year of insertion [25]. Brown et al. found that plate removal was not observed in patients with plates that had been in situ for more than 30 months [26].

4. Conclusion

ORIF should be the treatment of choice in extended comminuted mandibular fractures. A mandibular reconstruction plate can be used to achieve a good results with a relatively faster return of function. Although the incidence of infection in mandibular fractures is high, adequate debridement and plate removal can bring good results as seen in this case. Shifting from closed to open reduction allows the patient to have faster results with less complications in the future.

Ethical approval

Ethical approval was obtained for publication of this case report. A copy is available for review by the Editor-in-Chief of this journal on request.

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This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors and there are no conflicts of interests declared.

Author contribution

NV contributed to the conceptualization, design of the study and the data collection. ANP drafted the initial manuscript. SIW and RNR drafted the manuscript. MRS and ID revised the manuscript for important intellectual content.

Please state any conflicts of interest

None.

Registration of research studies

None.

Guarantor

NV and ANP are the guarantor for this study.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

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None.

Consent

Written informed consent was obtained from the patient for publication of the case report and the accompanying images. A copy of the written consent is available for review on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104319.

References

[1] R.P. Nalliah, V. Allareddy, M.K. Kim, S.R. Venugopalan, P. Gajendrareddy, V. Allareddy, Economics of facial fracture reductions in the United States over 12 months, Dent. Traumatol. 29 (2013) 115–120.

[2] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, A. Thoma, Z. Mei, The SCARE 2020 guideline: updating consensus surgical CAse REport (SCARE) guidelines, Int. J. Surg. 84 (2020) 226–230.

[3] K. Lee, K. Yoon, K.S. Park, J. Cheong, J. Shin, J. Bae, I. Ko, H. Park, Treatment of extensive comminuted mandibular fracture between both mandibular angles with bilateral condylar fractures using a reconstruction plate: a case report, J Korean Assoc Oral Maxillofac Surg 40 (3) (2014 Jun) 135–139, https://doi.org/10.5125/jkaoms.2014.40.3.135. Epub 2014 Jun 27. PMID: 25045641; PMCID: PMC4095810.

[4] R.A. Finn, Treatment of comminuted mandibular fractures by closed reduction, J. Oral Maxillofac. Surg. 54 (1996) 320–327.

[5] M.E. Abreu, V.N. Viegas, D. Ibrahim, R. Valiati, C. Heitz, R.M. Pagnoncelli, D. N. Silva, Treatment of comminuted mandibular fractures: a critical review, Med. Oral Patol. Oral Cir. Bucal 14 (5) (2009 May 1) E247–E251. PMID: 19218899.

[6] Edward Ellis, Oscar Muniz, Kapil Anand, Treatment considerations for comminuted mandibular fractures, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 61 (2003) 861–870, https://doi.org/10.1016/S0278-2391(03)00249-0.

[7] Bruno Chrcanovic, Open versus closed reduction: comminuted mandibular fractures, Oral Maxillofac. Surg. 17 (2013) 95–104, https://doi.org/10.1007/s10006-012-0349-2.

[8] J.F. Kelly, Management of War Injuries to the Jaws and Related Structures, US Government Printing Office, Washington, 1977.

[9] V.H. Kazanjian, An outline of the treatment of extensive comminuted fractures of the mandible: based chiefly on experience gained during the last war, Am. J. Orthod. Oral Surg. 28 (5) (1942) B265–B274.

[10] A. Bhagol, V. Singh, R. Singhal, Management of mandibular fractures, in: A Textbook of Advanced Oral and Maxillofacial Surgery, IntechOpen, 2013, https://doi.org/10.5772/53854.

[11] B.R. Smith, T.J. Teenier, Treatment of comminuted mandibular fractures by open reduction and rigid internal fixation, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 54 (3) (1996) 328–331, https://doi.org/10.1016/s0278-2391(96)90754-5.

[12] E. Ellis 3rd, O. Muniz, K. Anand, Treatment considerations for comminuted mandibular fractures, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 61 (8) (2003) 861–870, https://doi.org/10.1016/s0278-2391(03)00249-0.

[13] J.C. Koshy, E.M. Feldman, C.J. Chike-Obi, J.M. Bullocks, Pearls of mandibular trauma management, Semin. Plast. Surg. 24 (4) (2010) 357–374, https://doi.org/10.1055/s-0030-1269765.

[14] D. Radwan, F. Mobarak, Plate-related complications after mandibular reconstruction: observational study osteotomy, Egyptian J. Oral. Maxillofacial Surg. 9 (1) (2018) 22–27, https://doi.org/10.21608/OMX.2018.5623.

[15] T. Wilkman, J. Törnwall, J. Vuola, P. Lassus, The free scapular flap with latissimus muscle reduces fistulas in mandibular reconstruction, J. Plast. Reconstr. Aesthetic Surg. : JPRAS 69 (6) (2016) 802–808, https://doi.org/10.1016/j.bjps.2016.03.007.

[16] P. Tassone, T. Galloway, L. Dooley, R. Zitsch 3rd, Orocutaneous fistula after oral cavity resection and reconstruction: systematic review and meta-analysis, Ann. Otol. Rhinol. Laryngol. (2021), https://doi.org/10.1177/00034894211047463, 34894211047463. Advance online publication.

[17] Ehab Abdelfadil, Ahmed Salem, Samah Mourad, Fouad Al-Belasy, Infected mandibular fractures: risk factors and management, J. Oral Hygiene. Health. 1 (2013), 1000102, https://doi.org/10.4172/2332-0702.1000101.

[18] B. Alpert, G.M. Kushner, P.S. Tiwana, Contemporary management of infected mandibular fractures, Craniomaxillofacial Trauma Reconstr. 1 (1) (2008) 25–29, https://doi.org/10.1055/s-0028-1098959.

[19] P.E. Gordon, M.E. Lawler, L.B. Kaban, T.B. Dodson, Mandibular fracture severity and patient health status are associated with postoperative inflammatory complications, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 69 (8) (2011) 2191–2197, https://doi.org/10.1016/j.joms.2011.03.071.

[20] V. Shetty, K. Atchison, C. Der-Matirosian, J. Wang, T.R. Belin, The mandible injury severity score: development and validity, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 65 (4) (2007) 663–670, https://doi.org/10.1016/j.joms.2006.03.051.

[21] A.S. Murthy, J.A. Lehman Jr., Symptomatic plate removal in maxillofacial trauma: a review of 76 cases, Ann. Plast. Surg. 55 (6) (2005) 603–607, https://doi.org/10.1097/01.sap.0000183802.38116.37.

[22] Y. Kubota, T. Kuroki, S. Akita, T. Koizumi, M. Hasegawa, N. Rikihisa, N. Mitsukawa, K. Satoh, Association between plate location and plate removal following facial fracture repair, J. Plast. Reconstr. Aesthetic Surg. 65 (2012) 372–378.

[23] Oliver Bissinger, Luisa Biermann, Andreas Kolk, Klaus-Dietrich Wolff, Carolin Götz, Osteosynthesis plate removal: patient benefits and burdens, Appl. Sci. 10 (2020) 1810, https://doi.org/10.3390/app10051810.

[24] V. Bhatt, P. Chhabra, M.S. Dover, Removal of miniplates in maxillofacial surgery: a follow-up study, J. Oral Maxillofac. Surg. : Off.J. Am. Assoc. Oral. Maxillofacial. Surg. 63 (6) (2005) 756–760, https://doi.org/10.1016/j.joms.2005.02.005.

[25] J.C. Koshy, E.M. Feldman, C.J. Chike-Obi, J.M. Bullocks, Pearls of mandibular trauma management, Semin. Plast. Surg. 24 (4) (2010) 357–374, https://doi.org/10.1055/s-0030-1269765.

[26] J.S. Brown, M. Trotter, J. Cliffe, et al., The fate of miniplates in facial trauma and orthognathic surgery: a retrospective study, Br. J. Oral Maxillofac. Surg. 27 (1989) 306.