Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Case Report

Virtual surgical planning for treatment of mandibular fracture: a case report.

[1]A.B. Rai, [2]Zibran Khan, [3]Soham Nevkar, [4]Mansi Akabari, [5]Vasu Bhut

[1]Professor, [2]Reader, [3,4,5]Post Graduate, Department of Oral and Maxillofacial Surgery, Pacific Dental College and Hospital, Udaipur, Rajasthan, India

ABSTRACT:
Mandibular fractures are common injuries that can cause significant functional and aesthetic impairments for patients. Treatment of these fractures traditionally involves manual manipulation and fixation of the fractured bony segments, which can be complex and challenging. However, advances in technology have led to the development of virtual surgical planning (VSP), a revolutionary approach that uses 3D imaging to plan and execute surgical interventions. VSP has been shown to improve surgical outcomes, reduce operative time, and minimize the risk of complications in various surgical procedures. In this article, we will explore the use of VSP for the reduction of fracture fragments and the fabrication of a 3-dimensional model for the treatment of mandibular para-symphysis fracture.
Keywords: Virtual surgical planning, 3D model, mandibular fracture.

Received: 15 March, 2023 Accepted: 18 April, 2023

Corresponding author: Soham Nevkarm, Post Graduate, Department of Oral and Maxillofacial Surgery, Pacific Dental College and Hospital, Udaipur, Rajasthan, India

This article may be cited as: Rai A.B, Khan Z, Nevkar S, Akabari M, Bhut V. Virtual surgical planning for treatment of mandibular fracture: a case report. J Adv Med Dent Scie Res 2023;11(5):43-48.

INTRODUCTION

Mandibular fractures are a common type of facial injury, which can be complex to treat due to the intricate nature of the jawbone. These fractures affect almost 65-76% of all maxillofacial fractures, mainly after motor vehicle collisions and aggressions[1]. The basic principle of treatment is the reduction, containment, and immobilization of fractured segments; the orientation of dental occlusion, within normal standards, will lead to a perfect consolidation of fractured segments with good functional and aesthetic recovery of the patient[2].

Virtual surgical planning (VSP) uses three-dimensional computed tomographic (CT) scans that can be translated into stereolithographic models to fabricate surgical templates, facilitating intraoperative procedures which can shorten the overall surgical time, as the surgeon can visualize and plan the entire procedure, reducing the need for intraoperative adjustments[3]. This can also lead to a quicker recovery period for the patient. Despite its many benefits, the use of 3D models and VSP is not without limitations. For example, it requires specialized equipment and expertise, which may not be available at all medical centers. Additionally, the cost of this technique may be higher than traditional approaches. In this article, we will be emphasizing the use of VSP and the 3-dimensional model used for the preadaptation of the mini plates forthe treatment of mandibular Para symphysis fracture.

CASE REPORT

A 22-year-old male patient reported to Pacific dental college and Hospital, Udaipurwith a history of fall from height sustaining an injury to his lower jaw, on extra oral examination mild swelling was evident in the chin region, intra-oral examination revealed segmental mobility between left lateral mandibular incisor and left mandibular canine, mild occlusal discrepancy was seen bilaterally(fig 1). A CT face scan revealed a thin radiolucent line between the left lateral mandibular incisor and left mandibular canine extending to the inferior border ofthe mandible suggesting of left para-symphysis fracture of the mandible(fig2). Maxillomandibular fixation(MMF) followed by open reduction and internal fixation under local anaesthesia (LA) was planned for the management of fracture. Ivy eyelets were placed in

the upper and lower arch in the molar and premolar areas respectively and MMF was done under LA.

3 dimensional (3D) scans were obtained from the computed tomography (CT) of the patients,3D models were created and fracture segments were virtually reduced using a free software (slicer software v 5.2.1 and open-sourceblender software)(fig3).For the reduction of the fracture segments the occlusal plane and the continuity of the mandibular inferior border was taken into consideration, a stereolithographic model was printed of the reduced fracture segments and this model was used to prebent the stainless steel miniplates (one 2.5mm- 4 hole with gap plate and other 1.5mm- 4 hole with gap plate)for the open reduction and internal fixation(fig 4 and fig 5). The complete waiting time for this procedure was only 1 day

In the operating theatre, under all aseptic conditions a vestibular incision was placed in the lower labial vestibule , a full thickness mucoperiosteal flap was reflected and fracture site was exposed(fig 6), minor manipulation of the fracture fragments were done to reduce them into anatomical position, the prebent plates which were autoclaved were checked for adaption in relation to the reduced fracture fragments and no intraoperative re-adaptation was needed these plated were fixed using monocortical screws of 8mm length (Fig 7). MMF was released to check for the stability of the occlusion. Closure was done in layers using 3-0 vicryl sutures.Post operative orthopantomogram (OPG) showed reduction of the fracture fragments as expected (fig 8). Post operative healing was uneventful, eyelets were removed 7th post-op day. The whole procedure took little over 30 minutes. The patient was satisfied with the outcome of the treatment.

Figure 1: Intra oral picture (preoperative).

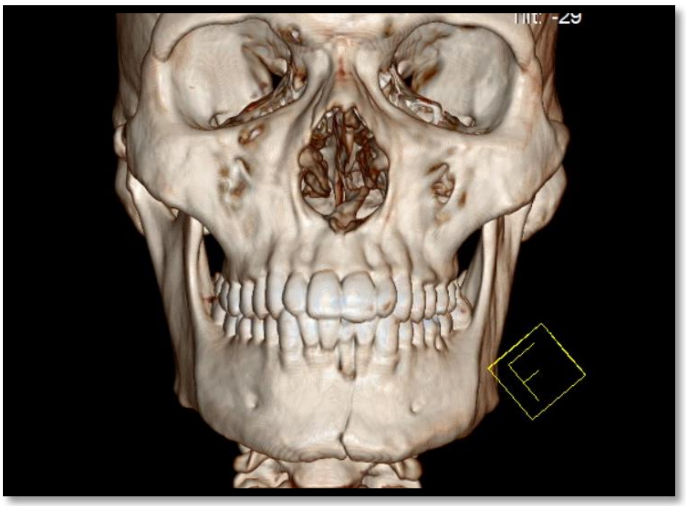

Figure 2: Preoperative CT Face(3D reconstruction).

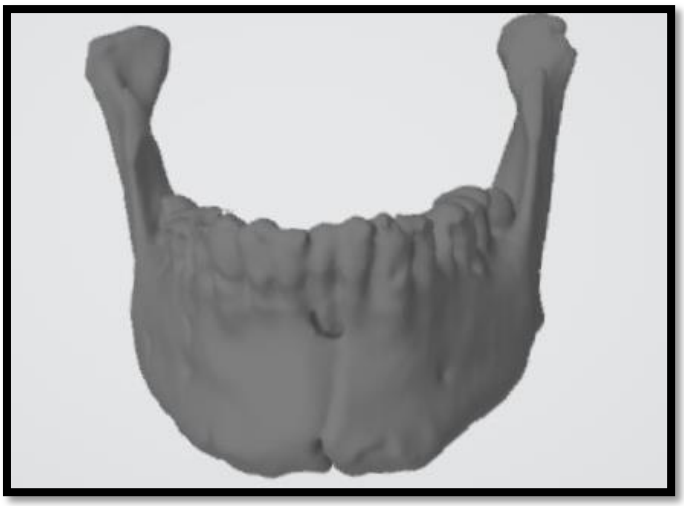

Figure 3: Reduction of fracture fragments using VSP.

Figure 4: Fabrication of a 3D model.

Figure 5: Adaptation of the miniplates on 3D model

Figure 6: Exposure of the fracture site

Figure 7: Fixation of fracture fragments using prebent miniplates.

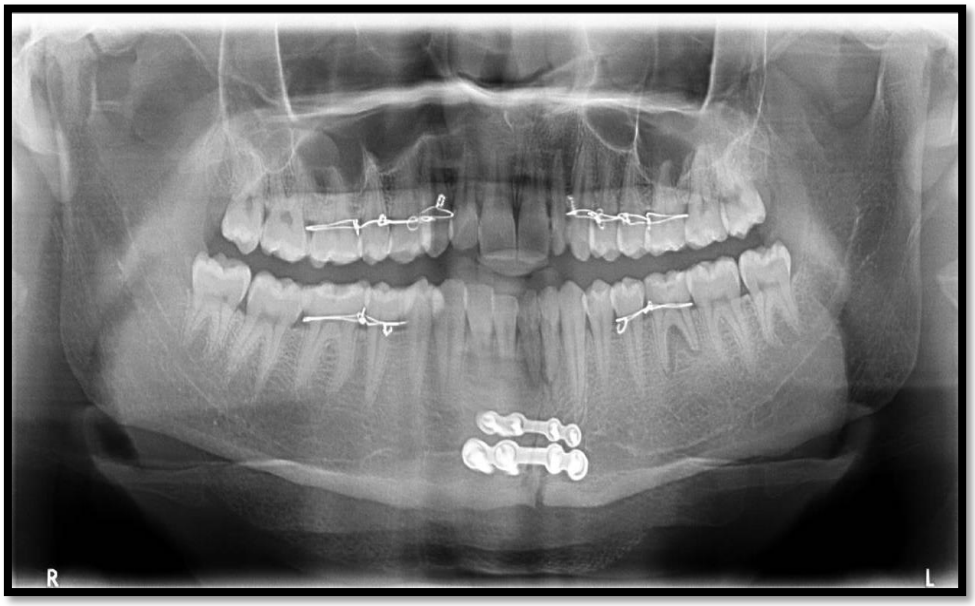

Figure 8: Post operative OPG

DISCUSSION

The primary objective of this article was to emphasize the use of VSP in treatment of fracture cases of mandible. VSP fulfilled the proposed goals of reducing surgical time and guiding the realignment of displaced mandibular bone segments with precision and predictability. Useof VSP and fabrication of stereolithographic model and contouring the plates on an exact or nearly exact model of the patient was more accurate and also greatly decreased operating time.

Three-dimensional printing is increasingly utilized for surgical planning, surgical simulation and predictable, accurate and efficient reconstruction in facial trauma[4, 5]. Open-sourcesoftwareas used by Elegbede et al[6, 7], with a minimal learning curve was utilized so that even surgeons with novice computer skills can be quickly trained to create reliable, accurate and high-quality models.3-dimensional model not only help surgeons in treatment planning but also aids in patient education and consultation[8]. Martin et al[8] found that saving time in the operating room is one of the major advantages of the use of prebent plates, not only for financial reasons but also by decreasing the exposure of the patient to general anaesthesia time; the possible complications and the recovery period are also decreased.

Toro et al[9]reported reduction of the operating time of 1 to 1.5 hours when using CT-guided stereolithography and virtual reality surgical planning. Reconstructed models can also be used as a didactic instrument in academic settings[8]. Additional intangible benefits include a) plate contouring ex vivo, without cumbersome in vivo soft tissue obstruction from mental nerve and buccal vestibular mucosa; (b) providing trainees an educational opportunity to work with 3d modelling software and printers, fracture reduction and plate selection-contouring without the time constraints and stress of the or environment.

Mandibular fractures are often associated with trauma and are more frequently seen in young men. They represent 20 to 60% of all facial fractures[10]. Accidents usually account for a higher percentage of the causative factor[11]. The most affected region are the angle and para symphysis[1, 2]. The objective of the treatment of mandibular fractures is to re-establish function, anatomy and aesthetics, through the reduction and often fixation of fragments. Among the forms of treatment are internal fixations, functionally stable or rigid. They promote better coaptation of the fracture traces and allow a good evolution with very low complication rates[2]. They are performed through load-sharing and load-bearing devices. Load-sharing shares the load with bone on each side of the fracture, which are mini-plates from 1.5mm to 2.5mm thickness, indicated for fractures with solid bone fragments that can withstand part of the functional load (simple linear fractures). Load-bearing, on the other hand, is resistant and rigid enough to support all the load generated to the jaw, they are reconstruction plates from 2.4mm to 2.7mm thick, with indication of fractures with comminutions and small bone surface due to atrophy or damage, resulting in a loss of the mandibular portion[2, 12]. In this article the use of VSP was done to reduce the fracture segments andfabrication of a 3D model was done so that the mini plates used for open reduction and internal fixation can be adapted preoperatively so that the intraoperative time could be saved.

CONCLUSION

Management of mandibular fractures can be challenging at times but, newer technology, such as VSP, can improve the outcomes and decrease the time in the Operating theatre. In our experience, they have proven to be beneficial for the surgeon and patient alike. The reduction in overall surgical time is significant and represents a great advance in surgery. In conclusion, the use of VSP and prebending of miniplates on 3D models for the treatment of mandibular fractures is an exciting development in the field of maxillofacial surgery. While it has its limitations, this technique has the potential to improve treatment outcomes and reduce surgical time for patients not only fractures but also in other aspects of oral and maxillofacial surgery.

REFERENCES

1. Miloro M. Princípios de cirurgia bucomaxilofacial de Peterson. Princípios de cirurgia bucomaxilofacial de Peterson. 2008, p. 766-.
2. Ramos JER, Oliveira L, Souza A, Souza L, Tino M and Lellis A. Surgical management of complex mandibular fracture: case report. BJSCR. 2020; 30: 49-52.
3. Neumann P, Siebert D, Schulz A, Faulkner G, Krauss M and Tolxdorff T. Using virtual reality techniques in maxillofacial surgery planning. Virtual Reality. 1999; 4: 213-22.
4. King BJ, Park EP, Christensen BJ and Danrad R. On-site 3-dimensional printing and preoperative adaptation decrease operative time for mandibular fracture repair. Journal of Oral and Maxillofacial Surgery. 2018; 76: 1950. e1-. e8.
5. Wagner JD, Baack B, Brown GA and Kelly J. Rapid 3-dimensional prototyping for surgical repair of maxillofacial fractures: a technical note. Journal of oral and maxillofacial surgery. 2004; 62: 898-901.
6. Elegbede A, Diaconu SC, McNichols CH, et al. Office-based three-dimensional printing workflow for craniomaxillofacial fracture repair. Journal of Craniofacial Surgery. 2018; 29: e440-e4.
7. Marschall JS, Dutra V, Flint RL, et al. In-house digital workflow for the management of acute mandible fractures. Journal of Oral and Maxillofacial Surgery. 2019; 77: 2084. e1-. e9.
8. Salgueiro MI and Stevens MR. Experience with the use of prebent plates for the reconstruction of mandibular defects. Craniomaxillofacial trauma & reconstruction. 2010; 3: 201-8.
9. Toro C, Robiony M, Costa F, Zerman N and Politi M. Feasibility of preoperative planning using anatomical facsimile models for mandibular reconstruction. Head & face medicine. 2007; 3: 1-11.

10. Castro-Núñez J, Shelton JM, Snyder S and Sickels J. Virtual surgical planning for the management of severe atrophic mandible fractures. Craniomaxillofacial trauma & reconstruction. 2018; 11: 150-6.
11. Pombo M, Luaces-Rey R, Pertega S, et al. Review of 793 facial fractures treated from 2001 to 2008 in a coruña university hospital: types and etiology. Craniomaxillofacial Trauma & Reconstruction. 2010; 3: 49-54.
12. Scolozzi P and Richter M. Treatment of severe mandibular fractures using AO reconstruction plates. Journal of oral and maxillofacial surgery. 2003; 61: 458-61.