Comparison of Management of Mandibular Angle Fractures by Three Approaches

Goparaju V. S. Sudhakar¹ · Gaddipati Rajasekhar¹ · Srikanth Dhanala¹ · Nandagopal Vura¹ · Sudhir Ramisetty¹

Received: 17 June 2014 / Accepted: 5 March 2015 / Published online: 3 April 2015
© The Association of Oral and Maxillofacial Surgeons of India 2015

Abstract

Background and Objectives Various methods have been reported in the literature for treating mandibular angle fractures comparing extra oral, intra oral and transbuccal approaches for achieving the goals of restoration of anatomic form, maintenance of segment position and bony union.

Materials and Methods This study was conducted to assess the simple and effective surgical approach in treating mandibular angle fractures and the outcome by means of three approaches i.e. intra oral, transbuccal and extra oral approaches.

Results/Conclusion A total of 45 patients with mandibular angle fracture were divided into three groups. Group I— intra oral approach—15 patients, Group II—transbuccal with intraoral approach—15 patients, Group III—extra oral approach—15 patients. The results of our study found intraoral approach to be much better because it is simple, precise, duration is short, and post operative complications are less with minimal morbidity and pain.

Keywords Angle fracture · Extraoral · Intraoral · Osteosynthesis · Transbuccal

Introduction

Mandibular angle fractures constitute 20 % of mandibular fractures on the whole [1]. Various approaches for the reduction of fracture at the angle region have been described

in the literature. They include intraoral and extra oral approaches like transbuccal and submandibular approach etc.

Each technique has its own advantages. Selection of technique is dependent on the type of case such as displaced or undisplaced fracture of mandibular angle, or whether it is associated with other fractures of the maxillofacial region.

The aim of this study was to compare the three approaches, and to determine the effective approach to treat mandibular angle fractures. Various factors such as case selection, ease of surgical approach, post operative complications have been assessed.

Materials and Methods

A prospective randomized clinical study was conducted on patients with angle fracture at the department of Oral and Maxillofacial Surgery, Mamata Dental College, Khammam, Telangana state. Informed consent was taken from all the patients prior to surgery and ethical committee permission was obtained. Selection criteria included patients above 15 years of age with no significant medical history. Unilateral or bilateral mandibular angle fractures alone, or fractures associated with other facial fractures were taken for the study during the years December 2011 to December 2013.

However, patients with systemic diseases, edentulous mandible, comminuted mandibular angle fractures were excluded from the study. The selection criteria for surgical correction included clinical and radiological assessment. Pain, oedema, deviation of mandible, occlusal derangement, crepitus, step deformity, tenderness at the fracture site, buccal ecchymosis have been correlated with radiographic evidence.

✉ Goparaju V. S. Sudhakar
drgopalbds@gmail.com; sudhakargvs@yahoo.com

¹ Department of Oral and Maxillofacial Surgery, Mamata Dental College, Giriprasadnagar, Khammam, Andhra Pradesh, India

A total of 45 patients with mandibular angle fracture were divided into three groups.

- Group I intra oral approach—15 patients
- Group II transbuccal with intraoral approach—15 patients
- Group III extra oral approach—15 patients

A single 2.5 mm, four hole stainless steel miniplate with gap and 2.5 mm × 8 mm screws, was used in all cases irrespective of the surgical approach and technique performed.

Surgical Procedure

Patients were selected for the surgical technique based on 1:1:1 ratio for the surgical procedure respectively. All the patients were treated on an inpatient basis under general anesthesia after necessary investigations and preanesthetic evaluation. The three surgical approaches used were intra oral, transbuccal and extraoral (submandibular) approach. The only difference between the three groups was the surgical approach alone.

Intraoral Approach

An intra oral incision was placed after injecting local anesthetic with vasoconstrictor. A vestibular incision through the mucosa approximately 5 mm away from the attached gingiva extending up to external oblique ridge was placed. Mucoperiosteal flap was raised and the fracture site was exposed [2] (Figs. 1, 2).

Transbuccal Approach

In this technique an incision similar to intraoral approach was placed along the angle and ascending ramus and the fracture

Fig. 1 Intra oral approach incision

Fig. 2 Fixation with miniplate by intra oral approach

site was exposed. Extraorally, a stab incision was given orienting the scalpel blade parallel to the relaxed resting skin tension lines (RSTL) for insertion of trans buccal trocar instrument based on the study conducted by Gulses et al. [4]. The site for osteosynthesis was guided by placing index finger and marking it on the cheek. A thumb finger was placed intra orally cross matching the index finger.

The cannula with trocar was inserted through the facial tissue down to the bone and the trocar removed to open the cannula for drilling and screw insertion. The transbuccal instrument system comprising of transbuccal guide, mountable retractor, drill sleeves, drill guide and 2 mm diameter drill bit were used. Access was gained to the fracture site and stability was established by reduction of fractured segment by intraoperative intermaxillary fixation [3] (Figs. 3, 4).

Extraoral Submandibular Approach

The submandibular or extra oral approach was described by Risdon. The incision was marked 2 cm from the inferior border of the mandible in the submandibular skin crease. The area of the incision was infiltrated using 2 % Lignocaine Hydrochloride with adrenaline as vasoconstrictor(1:80,000). After the incision through the skin using no 15 BP blade, subcutaneous tissue and underlying platysma muscle were exposed. They were undermined by blunt dissection, and divided sharply at the level of skin incision and retracted superiorly for better access. Facial artery and facial vein were identified and ligated. The pterygomassetric sling was incised at the inferior border and the fracture site was exposed [5–10] (Figs. 5, 6).

After reduction, fixation of the fracture segments was done along the external oblique ridge according to the Champy's concept, using single 2.5 mm stainless steel four hole miniplate with gap and 8 mm screws in all the cases and in all the three surgical approaches.

Postoperatively all patients were given intravenous antibiotics and analgesics for 4 days and oral medications for

Fig. 3 Anatomical landmark for transbuccal approach

Fig. 4 Transbuccal trocar insertion

5 days at the time of discharge. All the patients were discharged after 5 days of surgery from the hospital. Irrespective of the surgical approach performed, patients of all the three groups were kept on elastic intermaxillary fixation for 2 weeks postoperatively and no occlusal defects were observed in any patient. Patients were followed up at immediate post operative period, 1st, 2nd, 4th and 6th week respectively. The follow up of the patients immediately after the postoperative period was of prime concern to notice the possible changes in the evaluation criteria aforementioned. The patients were recalled for further

Fig. 5 Incision marking for extraoral approach

Fig. 6 Osteosynthesis by extra approach

follow up at 3rd and 6th month intervals. The late post operative period ascertained the further continuation of the follow up to evaluate the residual changes. All the analytical procedures were performed during the aforementioned time intervals of follow up. Pre and post operative radiographs were taken for all the patients.

A senior faculty member (professor) who was blinded to the treatment group was responsible in assessing the duration of surgery, pain assessment, post operative infection, surgical scar and facial nerve function. The analysis of the surgical scar was made using Vancouver scar scale in the extraoral submandibular approach cases. Vascularity, pigmentation (color), contour, patient acceptance, pain, stiffness, thickness are the factors which were observed in detail pertaining to each patient individually. Post operative pain was measured using visual analogue scale. The marginal mandibular branch of facial nerve was assessed for paresthesia and nerve injury during immediate and late post operative period. This was done with regard to the blunt trauma caused due to soft tissue retraction and tissue dissection. House and Brackmann classification was followed for demarcating the type of nerve injury in patients with extraoral surgical approach. This was carried out accounting the time period from date of surgery (nerve

injury), and age factor as related to the progress of recovery and regeneration after nerve injury [3, 8–11].

Results

A total of 45 patients with mandibular angle fracture were recruited into the study. The age ranged from 16 to 51 years with mean age of 29.6 years. Out of 45 patients 31 were males and 14 were females. Twenty-four patients were associated with injuries other than mandibular angle and 21 had isolated angle fracture.

In group I (intraoral approach) the average duration of time taken for the surgical technique was 65 min from incision to closure, 93.5 min in group II (transbuccal approach) and 85.5 min in group III (extraoral submandibular approach) (Table 1). The time duration mentioned above with regards to respective technique is pertaining only to the surgical procedure excluding the time taken for the placement of arch bars and maxillomandibular fixation. However, the time duration did not include treatment of the other fractures but only the mandibular angle fracture alone. The average mouth opening (inter incisal opening) in the first week of postoperative period of the three groups was compared. In group I it was 33 mm, group II 28 mm, and group III 30 mm, which shows good and speedy recovery towards normal mouth opening. However, adequate mouth opening was noticed in all the individuals during their periodic review. There were no soft tissue infections in group I, where as group II and III had 20 % of infection rate (three patients each) which was mild, that resolved with local irrigation and administration of antibiotics. No occlusal defects were observed in any of the patients with regards to all the three groups.

Pain assessment was done postoperatively by visual analogue scale (VAS). The pain assessment showed minimal for group I, as compared to the other two groups. The statistical values related to pain in group I were 4.7, group II were 5.13 and in group III were 5.26. Scar assessment was done using Vancouver Scar rating scale. There was no visible scar in group I. In group II—the scar rating scale showed a value of 3.6 and group III patients showed a score of 6.73. Post operative transient facial nerve weakness with regard to marginal mandibular nerve was observed in eight patients with extraoral submandibular approach and in two patients by transbuccal approach (buccal branch). This was of the grade II variety as per House–Brackmann classification where mild dysfunction, slight weakness and mild synkinesis were observed. The transient marginal mandibular nerve weakness was attributed to the traction of soft tissues during the surgical procedure and it subsequently recovered over a period of 6 weeks.

Table 1 Results of the assessed parameters

	Group-I	Group-II	Group-III
Males	10	10	11
Females	6	4	4
Mean age	29.6 years		
<i>Fractures associated with mandibular angle#</i>			
Males	6	5	5
Females	3	2	3
<i>Isolated angle#</i>			
Males	5	5	5
Females	2	2	2
Post operative infection	–	3	3
Time duration of surgery	65 min ± 3.27	93.5 min ± 4.36	85.5 min ± 4.90
Mouth opening during 1st post operative week	33 mm ± 2.33	28 mm ± 3.76	30 mm ± 1.89
Pain assessment (VAS)	4.7 ± 3.16	5.133 ± 5.84	5.267 ± 6.51
Scar assessment (VRS)	–	3.60 ± 1.55	6.73 ± 0.88
Facial nerve weakness (marginal mandibular nerve)	–	2 ± 0.43	8 ± 1.78

Discussion

Multiple studies were described about the mandibular angle fractures in the literature. Only few studies were presented regarding surgical approaches to the angle fractures. Amongst those studies, most of them are retrospective studies since a prospective study on trauma patients is a challenging task. In fact no single approach has been shown to be ideal and treatment of mandibular angle fracture remains conceptually controversial with regard to the favourable and unfavourable fractures at the angle region [1–6, 8, 13, 14, 16].

The extra oral submandibular incision is specifically indicated in cases of displaced unstable fracture segments, unfavourable angle fractures and when the fracture is located more distal to the third molar region. This approach provides better surgical access, such that the fracture segments are reduced first after exploring the fracture site, followed by intermaxillary fixation for securing occlusion and finally fixation is done with bone plates. This sequence helps to control the torque of the fracture segments,

mainly the proximal segment because of the pull by the muscles of mastication. The classic Risdon's incision is more posterior and vertical near the angle of the mandible as compared with the traditional submandibular incision [2, 7].

The transbuccal approach is indicated in cases where there is trismus with restricted mouth opening, and when the fixation is preferred by means of lag screws. It is also a procedure of choice over the submandibular approach in bilateral unfavorable angle fractures, which helps in preventing damage to marginal mandibular nerve. This approach is usually employed because it results in less inconspicuous scar formation and allows direct visualization of the fracture site, confirmation of the occlusion status during placement of bone plates and relatively low risk of facial nerve injury [4, 13, 14].

The intra oral surgical approach is a good option in treating favorable angle fractures with adequate mouth opening and in treating female patients and young individuals whose concern is the postsurgical scar if done by extraoral approaches (submandibular and transbuccal). An extensive study made by Edward Ellis [2, 5] states that the intraoral surgical approach showed very minimal complications.

Ellis [2, 5, 6, 16] made a 10 year review of various forms of treatment for mandibular angle fractures. The results showed that the use of extraoral open reduction and internal fixation with the AO/ASIF reconstruction plate, or intraoral open reduction and internal fixation using a single miniplate is associated with the fewest complications, ranging from 0 to 7.5 %. Kotrashetti et al. have done a comparative study between transbuccal and extraoral approach for treating mandibular fractures and convey that extraoral approach is more versatile in treating displaced and unfavorable angle fractures with regard to ease of surgical access and time for surgical procedure completion. Our comparative study emphasized on choosing the better surgical approach amongst the three, in treating mandibular angle fractures.

The interrelationship of the evaluation criteria with regard to each group are as follows. In our study the following evaluation criteria were included for all the three groups containing 15 patients each. They are—duration of surgery, post operative pain assessment, scar formation and facial nerve injury.

Group I: The duration of surgery from incision to wound closure was measured and it was 67 min. The maximal inter incisal opening post operatively during the first week was recorded and it was 33 mm. The intensity of pain was very mild. On a visual analogue scale it was recorded as 4.7. There was no incidence of post operative infection at the surgical site as the wound healed uneventfully. Scar assessment was done using Vancouver scar rating scale and there was no visible scar. Facial nerve weakness was not observed in any of the patients.

Group II: The transbuccal trocar technique is technique sensitive. The average duration of surgery in this technique was 93.5 min. This was attributed to the dissection and placement of trocar cannula transbuccally and transorally in the safety zone to avoid damage to the facial nerve. The maximal interincisal opening recorded was 28 mm. The intensity of pain measured by Visual analogue scale showed a value of 5.1 which is of moderate variety. Post operative infection at the surgical site was noticed in three patients. Facial nerve weakness was observed in two patients which was of Grade II type (House–Brackmann Scale). The post surgical scar was less conspicuous and it showed a value of 3.6 by scar rating scale.

Group III: The average duration of surgery by extraoral submandibular approach was recorded as 85.5 min. The interincisal opening was 30 mm. Visual analogue scale rating of pain intensity obtained was 5.26. Post operative infection was noticed in three patients at the operated area. Post operative transient facial nerve weakness with regard to marginal mandibular nerve was observed in eight patients. Again, this was of the grade II variety as per House–Brackmann classification. In the evaluation of post surgical scar at the submandibular region, the Vancouver scar rating scale showed a score of 6.73.

The evaluation criteria that were framed for this study for three different surgical approaches showed a prominent variation and the values are presented. Overall, the result attributes to the type of surgical approach, anatomy at the surgical site, soft tissue dissection and depth of the surgical wound created.

Irrespective of the surgical technique and the evaluation criteria the reduction and fixation of the fracture showed no variation or complication towards fracture union at the mandibular angle region.

The average duration of surgery for each group was measured from the incision to the closure and the average duration of surgery was less in the intra oral group (67 min) and then extra oral group (85.5 min) followed by transbuccal group (93.5). But in the study of Sugar et al. [3] mean length of surgery in transbuccal group was 64.9 min and 59.6 min in the intraoral group. The inter incisal opening or mouth opening was measured on the first post operative day to sixth week. Mouth opening during the first postoperative week was evaluated, which showed 33 mm by intraoral approach; 28 mm by transbuccal approach and

30 mm by extraoral approach. The mean mouth opening measured was more in intraoral approach group than in group II and group III which means early improvement in mouth opening and function. All the three groups attained their maximum mouth opening by sixth post operative week.

The intraoral surgical approach takes less operating time and gives good, quick access to the mandibular angle with less manipulation of the surrounding soft tissues.

Toma et al. [8] stated that higher complication and post operative infection rate include a longer operative time in a contaminated field and extended manipulation of tissues. This was assessed in our study where group I had no infection; group II and group III (three individuals in each group) had post operative infection which could be due to increased operative time and improper patient maintenance and wound dehiscence. Wound dehiscence was least in intra oral approach in our study which is 10 % that healed by secondary intention.

The infections in the two groups (II and III) were mild, which subsided with antibiotics and local wound irrigation and did not require further surgical intervention or rehospitalization. Pain assessment by visual analogue scale (VAS) was carried out for the three approaches in the first postoperative day. The mean VAS scores were; group I—4.7, group II 5.13 and group III 5.26. The VAS showed mild intensity of pain for the intraoral approach and moderate intensity of pain for transbuccal and submandibular approaches. The increased pain scores in group II and group III may be due to the injury to the masseter muscle fibres.

Scar assessment was done in all the three surgical approaches using Vancouver scar rating scale. The greatest advantage of the intraoral approach is absence of external visible scar which does not compromise aesthetics. In our study, the Vancouver scar scale showed a mean of 3.60 in group II and 6.73 in group III and no scarring in group I. The submandibular incision line is well hidden along the skin creases of neck, whereas the transbuccal approach has a prominent scar on the angle region. This could be the reason for reduced scar rate in the extra oral approach. Other complications like hypertrophic scar or keloid formation were not reported in this study. Marchena et al. [12] in their study revealed preoperative parasthesia could due to displacement of fracture segment as in unfavourable fracture. The submandibular approach has a risk of injuring the branch of facial nerve i.e. marginal mandibular nerve. Though in our study marginal mandibular nerve injury with transbuccal approach was not encountered but the risk of injuring the nerve is not overruled. Siddiqui et al. [15] reported one case of marginal mandibular nerve injury with transbuccal instrument. This risk was absent in intraoral approach. In our study we noticed marginal mandibular

nerve weakness in two patients by transbuccal approach (group II) and in eight patients by extraoral approach. There was no permanent damage of facial nerve reported with all the three approaches.

Conclusion

We studied the three surgical approaches prospectively and measured outcomes and compared the results with each other to determine the versatile approach for treating mandibular angle fractures. The results of our study found intraoral approach to be much better because it is simple, precise, duration is short, post-operative complications are less with minimal morbidity. Patients also have early masticatory function and short hospital stay. There is no risk of damage to the branches of facial nerve, no visible external scar which makes it more versatile without any secondary procedures. This approach also has much less intensity of pain as compared to the transbuccal and extraoral approaches.

References

1. Champy M, Lodde JP, Schimdt R et al (1978) Mandibular osteosynthesis by miniature screwed plates via buccal approach. *J Oral Maxillofac Surg* 6:14–21
2. Ellis E III (1999) Treatment methods for fractures of mandibular angle. *Int J Oral Maxillofac Surg* 28:243–252
3. Sugar AW, Gibbons AJ et al (2009) A randomised controlled trial comparing fixation of mandibular angle fractures with a single miniplate placed either transbuccally and intraorally, or intraorally alone. *Int J Oral Maxillofac Surg* 38:241–245
4. Gulses A, Kilic C, Sencimen M (2012) Determination of a safety zone for transbuccal trocar placement: an anatomical study. *Int J Maxillofac Surg* 41:930–933
5. Ellis E III (2009) Management of fractures through angle of the mandible. *Oral Maxillofac Surg Clin N Am* 21:163–174
6. Ellis E III (1993) Treatment of mandibular angle fractures using the AO reconstruction plate. *J Oral Maxillofac Surg* 250–254
7. Fonseca RJ (2010) Oral and maxillofacial surgery-trauma, vol 1. Elsevier Saunders, Amsterdam, pp 481–484
8. Toma VS, Mathog RH, Toma RS, Meleca RJ et al (2003) Transoral versus extraoral reduction of mandibular angle fractures: a comparison of complication rates and other factors. *Otolaryngol Head Neck Surg* 128(2):215–219
9. Wong DL, Hackenberry Eaton M, Wilson D, Winkelstein ML, Schwartz P (2001) Wong–Baker FACES rating scale: Wong's essentials of pediatric nursing. Mosby, St.Louis, p 1301
10. Portenoy RK, Tanner RM (2012) Visual analogue scale and verbal pain intensity scale: pain management, theory and practice. Oxford University Press, Oxford, pp 3–18
11. Sun MZ, Michael BS, Oh C, Kaur G (2012) Neuroanatomical correlation of the House–Brackmann grading system in the microsurgical treatment of vestibular schwannoma. *Neurosurg Focus* 33(3):E7
12. Marchena JM, Padwa BL, Kaban LB (1998) Sensory abnormalities associated with mandibular fractures. *Int J Oral Maxillofac Surg* 56:822–825

13. Kale TP, Baliga SD, Ahuja N, Kotrashetti SM (2010) A comparative study between transbuccal and extraoral approaches in treatment of mandibular angle fractures. *J Maxillofac Oral Surg* 9:9
14. Saikrishna D, Sujith Kumar (2008) A clinical study on transbuccal fixation of mandibular angle fractures. *J Oral Maxillofac Surg Ind* 66:73–76
15. Siddiqui A et al (2007) One miniplate versus two in the management of mandibular angle fractures; a prospective randomized study. *Br J Oral Maxillofac Surg* 45:233–235
16. Ellis E III, Walker L (1996) Treatment of mandibular angle fractures using one non compression miniplate. *J Oral Maxillofac Surg* 54:864–871