Role of lingual splint in prevention of mandibular flaring in management of mandibular fracture

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Introduction
For the past decades, there has been a significant increase in head–maxillofacial traumas, and mandible fracture occupies the second most frequent incidence of facial bone fractures, with incidence of approximately 38%. They are mainly caused by road traffic accidents (RTA).

Aim
The aim was to study the effect of repairing the parasymphyseal mandibular fractures with rigid fixation alone vs usage of lingual splint with rigid fixation regarding occurring of mandibular flaring.

Patients and methods
A prospective randomized clinical study was carried out in Benha University Hospital, and it included 30 patients who had isolated parasymphyseal mandibular fractures. Patients were allocated into two groups: group A (15 patients underwent rigid fixation of parasymphyseal mandibular fracture) and group B (15 patients underwent rigid fixation of parasymphyseal mandibular fracture with usage of lingual splint).

Results
This study showed that in group B the mean bigonial width and bicondylar breadth were lower than that in group A; these differences were statistically significant at 3 months after operation, but there were no significant difference between both groups in the preoperative time and just after operation. Regarding complications, there were no significant differences between the two groups regarding intraoperative and postoperative complications.

Conclusion
Adding lingual splint as adjuvant to rigid fixation will offer more stability and accuracy for reduction, and it will prevent occurrence of lingual splay of fracture fragments and mandibular angle flaring, with subsequent minimizing effect on temporomandibular joint.

Keywords:
fracture mandible, lingual splint, mandibular flaring, rigid fixation, temporomandibular disorders

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Introduction

In the past decades, head–maxillofacial traumas and mandible fractures have shown a significant increase, being the second most frequent incidence of facial bone fractures, with incidence of approximately 38%. They are mainly caused by car accidents because it is a resistant bone that needs strong blow to be fractured, which can also be a consequence of sport activities, firearm or sharp accident, physical assault, work-related accident, metabolic diseases, or tumors [1].

Innovations in the management of cranio-maxillofacial trauma have continued to evolve; the introduction of rigid internal fixation provides advancement in the treatment of facial fractures by optimizing primary bone healing, in comparison with secondary bone healing seen with closed techniques [2].

Fractures of mandible have many categories. According to the location, they are categorized as follows: symphysis, parasymphysis, body, angle, ramus, condylar, coronoid, and dentoalveolar.

Moreover, the fracture patterns may be open, closed, greenstick, comminuted, pathologic, or complex (complicated).

According to biomechanics, mandibular fracture displacement may be stable or unstable. Fractures of mandible can be diagnosed by physical examination, where signs and symptoms of mandibular fractures included pain, swelling, paresthesia, trismus, malocclusion, ecchymosis, gingival laceration, mobility of bone segments, palpable bony steps, and deviation of mandible.

The treatment techniques could be closed, using arch bars, intermaxillary fixation screws, interdental wire fixation, skeletal suspension wires, and various bonded and nonmetallic tooth-borne systems, or open, which include semirigid fixation using miniplates and monocortical screws or rigid fixation using nonlocking plates/screws and locking plates/screws, which are either threaded locking screws or tapered locking screws. The lag screw technique was introduced to oral and maxillofacial surgery by Brons and Boering in 1970. Lag screw fixation has been commonly used to compress fracture fragments without the use of bone plates [3].

Miniplate (semirigid) fixation was introduced at 1978. The use of miniplates placed along line of osteosynthesis has been demonstrated to be an effective treatment modality. Over the decades, there were many modifications in the technique using transoral and transbuccal approaches. Case selection is of utmost importance for this technique to be effective. It is not recommended in cases that lack adequate buttressing of bone or doubtful patient compliance [4].

Strategy for treatment of maxillofacial fracture involves restoring normal function, maintaining normal occlusion, and preventing facial deformities. To achieve these objectives, maxillofacial surgeons must reduce, fixate, and retain in position anatomically aligned bone fragments, and they should be long enough to allow for bony union. The lingual splint is frequently used in the treatment of symphysis fractures to prevent inward tilting of the alveolar ridge and to counteract the tendency of the inferior border to become distracted [5].

Fortunately, most patients do not have long-term negative sequelae because of closed reduction techniques. The temporomandibular joint is a site of alteration that may lead to permanent changes of structure and function. These changes included but are not limited to stiffness of the joint and limited opening, atrophy/denervation of muscles, loss of bite strength and range of motion, and change in cartilage structure internally in the joint [6].

Aim

The aim was to study the effect of repairing the parasymphyseal mandibular fractures with rigid fixation alone vs usage of lingual splint with rigid fixation regarding occurring of mandibular flaring.

Patients and methods

All operative and nonoperative procedures were explained in full details to the patients, who signed informed consents and accepted to be involved in the study. In addition, approval from the Ethical Committee of ENT Department, Benha University, was obtained.

This study was conducted at Otorhinolaryngology Department in Benha University Hospital. It included 30 patients with age above 20 years, who were divided into two groups:

(1) Group A: 15 patients underwent rigid fixation of parasymphyseal mandibular fracture.
(2) Group B: 15 patients underwent rigid fixation of parasymphyseal mandibular fracture with usage of lingual splint.

All cases had isolated parasymphyseal mandibular fracture with history of different patterns of traumatic causes indicated for rigid fixation of maximum 1-month duration, with no multiple mandibular fractures or history of mandibular fixation operation. None of them had neurological, cervical spine, or other system injury.

The mode of trauma was road traffic accident (RTA) in 50% of cases, other causes such as fall (accidental) in 23.3% of cases, and other causes, for example, industrial, assault, and sports, in 26.7%.

(1) Diagnosis was based on the following:
    (a) History taking:
        (i) Personal history.
        (ii) History of present illness: onset, course, duration, the mechanism of injury, including the direction of the force, whether there is any complaint of malocclusion, and whether there is any associated pain, especially in the cervical spine, and associated symptoms of other systems.
        (iii) Past history.
    (b) Clinical examination:
        (i) Primary survey (ABCDE).
        (ii) Secondary survey.
        (iii) Local examination:

The physical examination included an assessment from the skull to the clavicles for soft tissue injuries, ecchymosis, preauricular swelling, hematoma, and asymmetries, as well as midline structures including the larynx and trachea. Neck zones I–III were examined for penetrating trauma, crepitus, and hematoma.

The mandible and lower facial third were examined and palpated for mobility, mucosal lacerations, fractured or avulsed teeth, malocclusion, bony steps or discontinuity, and any hematomas/ecchymosis of the floor of the mouth.

Bimanual manipulation of the mandible was done to assess for fracture mobility, assessment of symmetry and deviation upon mouth opening, maximal interincisal opening, and evaluation of the dentition for avulsion of teeth and/or dentoalveolar fractures.

Examination of the condyles was done for mobility or tenderness in preauricular area to exclude condylar or subcondylar fracture.

Evaluation of neurosensory disturbance was done in the distribution of the inferior alveolar nerve/mental nerve.

(c) Investigations:
(i) Computed tomography (CT) facial bone (coronal, axial): with reconstructed 3D view of the mandible and slice thickness of 1–3 mm (Fig. 1).
(ii) Preoperative panoramic radiographic orthopantograph done (Fig. 2).

For every patient, CT imaging was evaluated considering the following axes:
(1) Intergonial width (taking as a reference): the most prominent part of the lower edge of the mandibular ramus on both sides.
(2) Intercondylar breadth: (taking as a reference): the lateral poles of both mandibular condyles.

These axes were measured by using Mimics 17 program.

Treatment:

Preoperative:

Although RTA accounted for as a cause of injury for 50% of this group, none of them had major vital signs instability, central nervous system, cervical spine injury, abdominal, or any other important system injury. Ten patients had chin-cut wounds that were sutured in the emergency room. Seven patients had cheek-cut wounds.

Laboratory tests were ordered based on information obtained from the history and physical examination.

All patients signed an informed consent form acknowledging that they are aware of risks and complications, that they know they will be receiving anesthesia, and that we had explained the operation to them.

All patients were instructed to discontinue prescription and over-the-counter medications that 'thin' the blood, such as aspirin, before surgery. Patients who took prescription medications on a regular basis discussed this with us.

Figure 1

Computed tomography scan shows parasymphyseal fracture with minimal displacement.

Treatment of mandibular fractures

Group A

The basic aim is to reduce and fix the bone ends in all of cases; functional reduction has been restored through MMF (Erich arch bars) (Fig. 3).

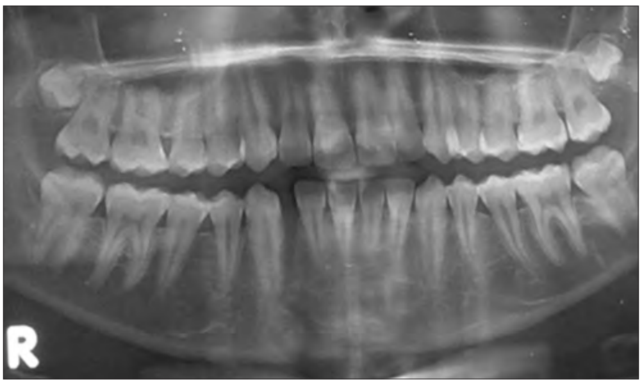
Surgical technique: mandibular intraoral approach

Skin preparation was done at surgical site, as dirt and skin oils are removed with scrubbing action and antiseptic agents were used (Betadine), and draping on surgical site was done, and this was accomplished by the circulating nurse who wore sterile gloves and mask.

Injection of local anesthesia and vasoconstrictor agents at the site of incision was done, and this was for a hemostatic state (Fig. 4).

Exposure to parasymphysis and symphysis was done via genioplasty incision. A high mucosal incision was done in the area of premolar, 4 mm below the attached gingiva, to get a good cuff of mucosa for closure of

Figure 2



Panoramic graph showing parasymphyseal fracture.

Figure 3

Arch bar used for MMF and improper occlusion.

Figure 5

Arc shape incision.

the incision to prevent occurring of dehiscence and continue in arc shape in the midway between the vermilion border of the lip and the level of free gingiva in the anterior lower incisor (Fig. 5).

Dissection of mucosa from mentalis muscle for about 1 cm then second incision obliquely directed to the lower border of the mandible (Fig. 6) was done. This allows much more attachment to the mentalis muscle to prevent dropping of the lower lip. Subperiosteal dissection to connect the two ends in the area of premolar dissection is done from up to down motion to identify and dissect the mental nerve. Sometimes, we needed skeletonization of the mental nerve to avoid traction on it.

Anatomical reduction was done through approximating of the two bone ends and then fixation by Two-plate technique (superior monocortical tension band 2 mm miniplate and inferior border bicortical compression plate 2.3 mm, Fig. 7) after anatomical and functional reduction. Holes are drilled in each sides of fracture using 1.5-mm diameter drill, and application of 13-mm screws inside 1-mm miniplates with minimum of two holes in each end was done.

The two-plate technique uses a superior tension band, low-profile/miniplate to prevent fracture distraction at the alveolar process level, whereas a

Figure 4

Local anesthesia and vasoconstrictor infiltration.

Figure 6

Mentalis muscle dissection.

more rigid intermediate-profile plate (reconstructive plate 2.3 mm) is placed in the compression zone at the inferior border. The superior border plate is a monocortical plate respecting the local dental anatomy. The inferior border plate is fixated with bicortical screws to maintain rigidity, immobility, and fracture reduction (Fig. 8).

Closure is done in layers

(1) Mentalis muscles: by one suture in midline then suturing each muscle (Fig. 9).
(2) Mucosa: continuous sutures were used using 3/0 vicryl suturing material (Fig. 10).

In all these cases, visualization, access to the fracture sites, and handling of fracture segments were done without special difficulties.

No specific complications for the approach (mental nerve injury, injury to roots of the teeth, injury to facial vessels, and facial muscles malfunction) had occurred.

Figure 7

Fixation of 2.3 reconstructive plates.

Figure 9

Closure of mentalis muscle.

Group B

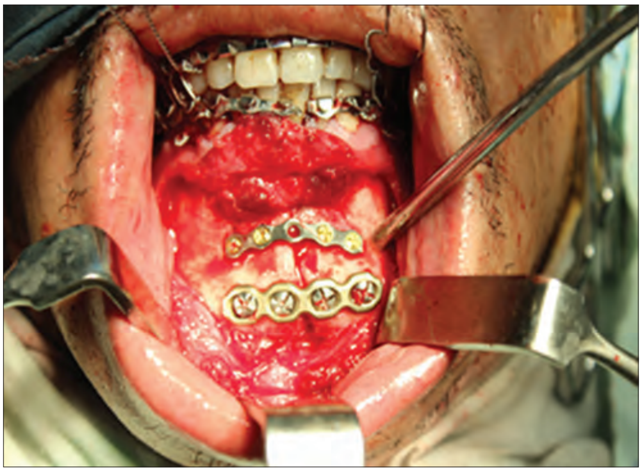
The same technique as group A was applied on group B (Fig. 11).

(1) MMF via Erich arch bars.
(2) Exposure to parasymphysis and symphysis was done via genioplasty incision.
(3) Dissection of mucosa from mentalis muscle.
(4) Then lingual splint fixation was done as the difference between two groups.
(5) Fixation by two-plate technique.
(6) 3/0 vicryl suturing.

Lingual splint construction

(1) The initial requirement in the fabrication of a lingual splint is obtained by an accurate impression of the patient's mandibular and maxillary arches. Alginate is used to take dental impressions. Binding of alginate with water forms a viscous gum, which is able to mold the surfaces of the teeth which occurring at the laboratory dentiform.
(2) The patient should be seated in a chair in a relaxed forward position and instructed to breath slowly through his or her mouth after the tray is inserted. The setting time for the impression material is ~3 min, or when it becomes firm and rubbery. The tray may be easily removed after the impression material has set by pushing down posteriorly on one side with a finger to break the suction seal. Once removed, the tray is wrapped in a moist towel (and possibly placed in a plastic bag) until it is ready to be used. The impression of the other jaw is done next and placed with the first impression.
(3) Dental stone or plaster is poured into the impressions to create models of the dental arches. Pouring dental stone (Hydrocal) or plaster of Paris into the alginate trays creates the plaster models (Fig. 12).

Figure 8



Two-plate technique.

Figure 10

Wound after complete closure with suturing.

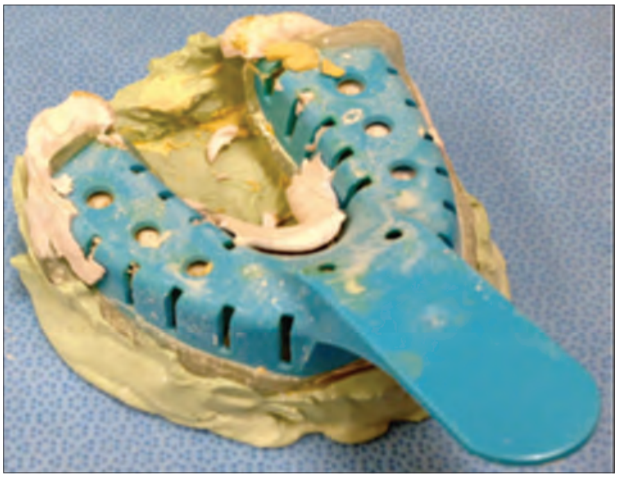
The models were sent to the laboratory to reconstruct a heat-cured acrylic splint after creation of anormal occlusion on articulators (Fig. 13).

(4) Stabilization of the splint is achieved by circumdental fixation. It is important that the splint is ligated below the height of the contour of the teeth. If not, circumdental wires may become unstable and the splint displaces occlusally (Fig. 14).

Figure 11

Exposure of fracture line after MMF via (Erich arch bars).

Figure 12

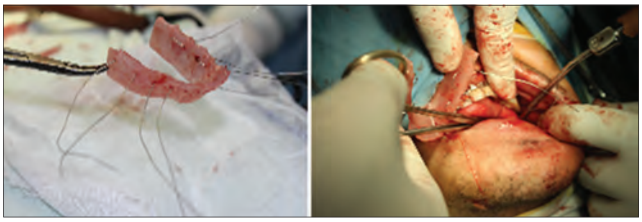


Creation of upper and lower models.

Figure 13

Lingual splint on the cast.

Figure 14



Lingual splint before and during fixation.

(5) Ensure postoperative radiography, antibiotic, mouth wash, and soft diet.
   (a) Follow-up radiographic examination:

Follow-up CT was done for all patients at 0 and 3 months, and the mandibular width was evaluated considering the following axes:

(1) Intergonial width: taking as a reference the most prominent part of the lower edge of the mandibular ramus on both sides.
(2) Intercondylar breadth: taking as a reference the lateral poles of both mandibular condyles. And these axes were measured by using Mimics 17 program.

Immediate postoperative results showed properly reduced fracture segment with no interfragmentary gap in both groups.

Clinical examination to test mobility, deformity, infection, or malocclusion was done in each visit.

Examples: case 1 shown in Fig. 15 and case 2 shown in Fig. 16.

Results

Demographic characteristics in both study groups

Table 1 shows the relation between both groups regarding age and sex. The mean age in group A was 21 years and 24 years in group B. Percent of male was 66.6 and 73.3 in groups A and B, respectively, and percentage of females was 33.3 and 26.7 in groups A and B, respectively.

There were no significant differences between both groups regarding age and sex. *P* values were 0.539 and 1.0, respectively (Table 1).

Pattern of trauma in both study group

Table 2 shows the frequency distribution of pattern of trauma in both study group. The percentage of RTA as a cause was 46.7 and 53.3%; the percentage of fall was 26.7 and 20%; and the percentage of other causes was 26.7 and 26.7% in groups A and B, respectively.

There was no significant difference between both groups regarding pattern of trauma (*P* = 1) (Table 2 and Fig. 17).

Preoperative, postoperative, and after 3 months bigonial width in both study groups

Preoperative

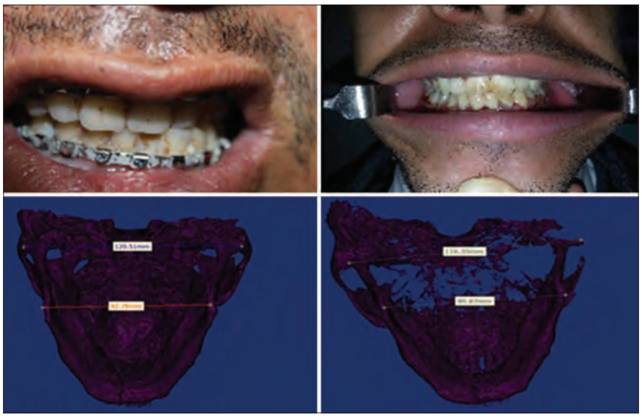
Mean bigonial width was 94.59 in group A and 96.05 in group B.

There was no significant difference in bigonial width between both groups (*P* = 0.126).

Postoperative

Mean bigonial width was 91.87 in group A and 92.31 in group B.

Figure 15



Case 1.

There was no significant difference in bigonial width between both groups (*P* = 0.126).

At 3 months

Mean bigonial width was higher in group A (92.65) than that in group B (89.94).

This difference was statistically significant (*P* < 0.001) (Table 3).

Table 1 Demographic characteristics in both study groups

Age (years)	Group A (*n*=15) [*n* (%)]	Group B (*n*=15) [*n* (%)]	*P*
Mean±SD	21±1	24±5	0.539
Sex			
Males	10 (66.7)	11 (73.3)	1.0
Females	5 (33.3)	4 (26.7)	1.0

Table 2 Frequency distribution of pattern of trauma in both study groups

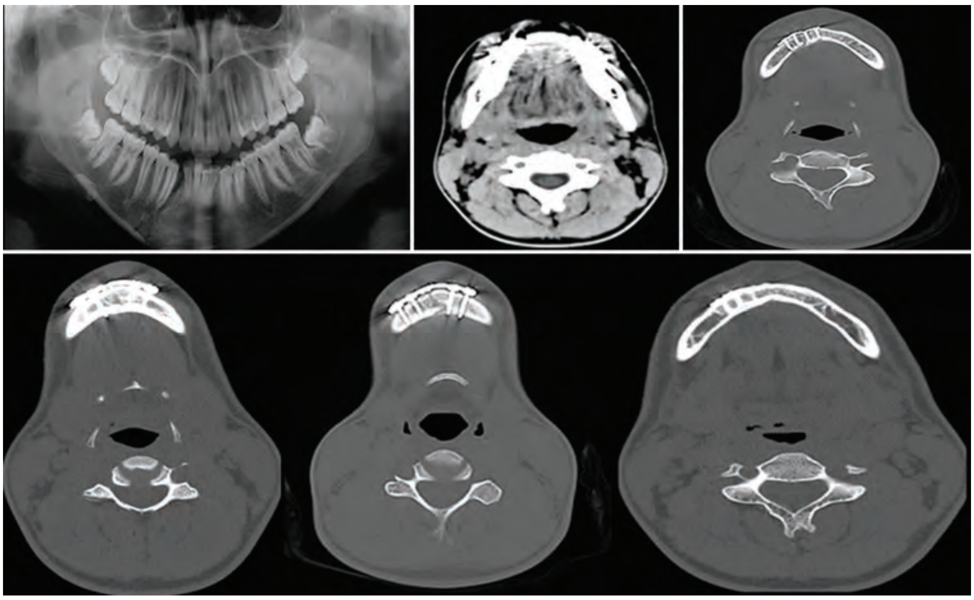
Pattern of trauma	Group A (*n*=15) [*n* (%)]	Group B (*n*=15) [*n* (%)]	*P*
Fall	4 (26.7)	3 (20.0)	1.0
Others	4 (26.7)	4 (26.7)	
RTA	7 (46.7)	8 (53.3)	

RTA, road traffic accident.

Table 3 Bigonial width preoperatively, postoperatively, and at 3 months

Bigonial width	Mean±SD		*P*
	Group A (*n*=15)	Group B (*n*=15)	
Preoperative	94.59±2.84	96.05±1.45	0.126
Postoperative	91.87±2.38	92.31±0.48	0.126
At 3 months	92.65±2.08	89.94±0.69	<0.001

Figure 16



Case 2.

Preoperative, postoperative, and after 3 months bicondylar breadth in both study groups

This table shows mean and SD of bicondylar breadth preoperative, postoperative, and at 3 months after operation in both groups and comparison between them.

Preoperative

Mean bicondylar breadth in group A was 116.26 and 117.05 in group B.

There was no significant difference in bicondylar breadth between both groups ($P = 0.081$).

Postoperative

Mean bicondylar breadth in group A was 112 and 112.7 in group B.

There was no significant difference in bicondylar breadth between both groups ($P = 0.126$).

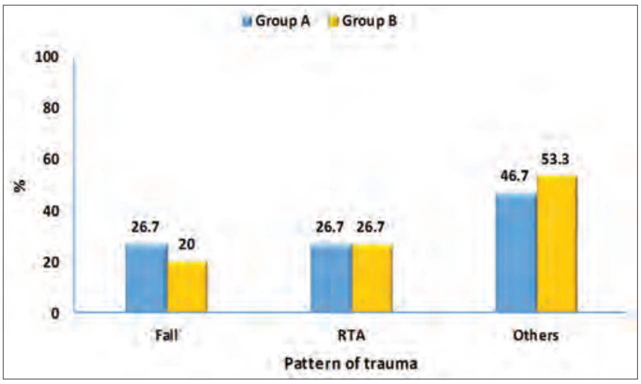
Table 4 Bicondylar breadth preoperatively, postoperatively, and at 3 months

Bicondylar breadth	Mean±SD		*P*
	Group A (*n*=15)	Group B (*n*=15)	
Preoperative	116.26±0.85	117.05±1.3	0.081
Postoperative	112±1.21	112.71±3.07	0.126
At 3 months	114.82±0.81	112.62±4.15	0.029

Table 5 Comparison between the two groups regarding complications

Complication	Group A (*n*=15) [*n* (%)]	Group B (*n*=15) [*n* (%)]	*P*
Decreased range of motion (1 week)	4 (26.7)	3 (20.0)	1.0
Paresthesia or numbness (1 week)	2 (13.3)	2 (13.3)	1.0
Malnutrition	2 (13.3)	2 (13.3)	1.0
Edema	4 (26.7)	3 (20.0)	1.0
Loss of loose teeth	2 (13.30)	2 (13.3)	1.0

Figure 17



Frequency distribution of pattern of trauma in both groups.

At 3 months

Mean bicondylar breadth was higher in group A (114.82) than that in group B (112.62). This difference was statistically significant ($P = 0.029$) (Table 4 and Fig. 18).

Complications

Table 5 shows the comparison between both groups regarding complication. The percentage of decreased range of motion for 1-week duration after operation and edema was 26.7 in group A and 20 in group B. Paresthesia or numbness (1 week), malnutrition, and loss of loose teeth were seen in 13.3% in both groups.

Regarding complications, there were no significant differences between two groups regarding intraoperative and postoperative complications, such as decreased range of motion (for 1 week duration), paresthesia or numbness (for 1-week duration), malnutrition, loss of loose teeth, and edema. Moreover, decreased range of motion during first weak after operation and edema noticed to be the most common complication in both groups (Table 5 and Fig. 19).

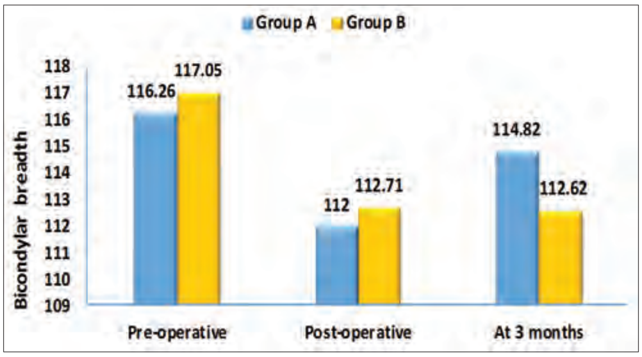
Statistical methods

Data management and statistical analysis were done using SPSS vs. 25. Numerical data were summarized using mean and SD. Categorical data were summarized using numbers and percentages. Comparisons between both groups were done using Mann–Whitney *U* test for numerical variables. Categorical variables were compared using χ^2 test or Fisher exact test if appropriate. All *P* values were two sided. *P* values less than 0.05 were considered significant.

Discussion

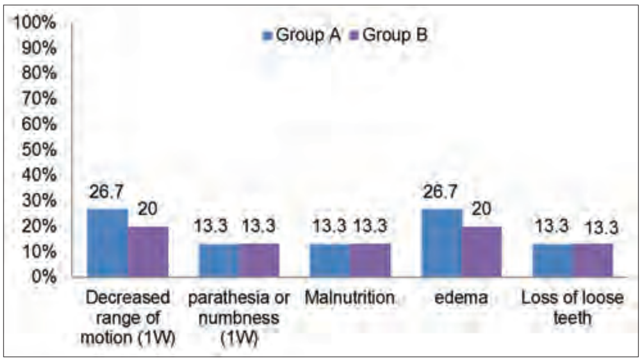
Lingual gap occurs owing to improper reduction of fragments in symphyseal and parasymphyseal fractures,

Figure 18



Preoperative, postoperative, and at 3 months bicondylar breadth in both groups.

Figure 19



Comparison between the two groups regarding complications.

causing transverse and longitudinal dimensional changes and a subsequent increase in facial width [7].

The use of lingual splints provides simple reduction and fixation of sagittal mandibular fractures, especially those that are displaced lingually [8].

There were no significant differences between both study groups regarding age in this study. Mean age was 22.3 years in both groups. This was consistent with Natu *et al.* [9], who found that the incidence of parasymphyseal mandibular fracture which was the commonest site in his study increased with increasing age from 0 to 30 years and then progressively decreased from 31 years of age. Moreover, it was consistent with John *et al.* [10], who reported that mandibular fractures are relatively less frequent in children in comparison with adults; this is owing to the protective anatomic features of children and infrequent exposure of children to alcohol-related traffic accidents. In addition, Barde *et al.* [11] found that the highest incidence of mandibular fractures is found in the age group of 21–30 years. This is owing to very high use of two-wheelers, early bikers, lack of safety measures in the form of helmets, and improper road conditions, as most of the fractures in this group belong to RTAs.

Although there were no significant differences between both study groups regarding sex, the percent of males was higher than the percent of females in both groups, as male:female ratio was 2.3:1. Barde *et al.* [11] show that there was a male dominance, as the sex distribution revealed a male:female ratio of ~3.7:1. This is in contrast to a study by Subhashraj *et al.* [12], which showed an increasing trend of female involvement in maxillofacial trauma. The reasons may be related to increased mobility and social engagements of females. The male-dominant culture is being shifted to work culture where men as well as women are getting equal opportunities.

In addition, our study showed that there was no significant difference between both groups regarding the pattern of trauma, either falls, RTA, or other causes, but RTA was the most common cause of fracture in both groups, as it represented 15 cases out of 30. Adults between the age group of 21 and 50 years were mainly victims of RTA, whereas those over the age of 50 years suffered fractures from falls. There is a major difference in the etiology of maxillofacial trauma in developing and developed nations. The common cause of maxillofacial trauma in developing countries is RTAs, whereas assault is the most common cause in developed countries.

The findings of Barde *et al.* [11] also support the same, as in 68% of their patients, RTA was the cause of injury, and the parasymphyseal fractures were found to be most common in RTAs. Our findings also support the same results. However, Dongas and Hall [13] and Olasoji *et al.* [14] reported assault as the main cause.

Our study showed that in group B the mean bigonial width was lower than that in group A; this difference was statistically significant at 3 months after operation, but there was no significant difference between both groups in the preoperative time and just after operation.

Moreover, the same results were found regarding bicondylar breadth. The mean bicondylar breadth was lower in group B than that in group A. This difference was statistically significant at 3 months after operation, but there was no statistically significant difference between both groups in the preoperative time and just after operation.

Patients who underwent rigid fixation of parasymphyseal mandibular fracture with the use of lingual splint have lower bigonial and bicondylar width than patients who underwent rigid fixation only. This difference was noticed after 3 months of operation, which means that adding lingual splint as adjuvant to rigid fixation will offer more stability and accuracy for reduction, and it prevents the occurrence of lingual splay of fracture fragments and mandibular angle flaring with subsequent effect on temporomandibular joint.

Miniplates are the commonly used implants to achieve osteosynthesis in mandibular fractures. However, the major limitations of using miniplates in sagittal fractures are first, inability to check the anatomic reduction on the lingual aspect intraoperatively, and second, inability to prevent lingual splay and torsional forces during fixation.

In such situations, lingual splints may be an important method of achieving the interfragmentary reduction, especially in the buccolingual direction. The wires of the lingual splint when tightened achieve fracture reduction in comparison with the use of lag screw technique, as demonstrated by the clinical cases of Schouman *et al.* [15] and that was consistent with our results.

Our study findings are consistent with the results obtained by Balasubramanian *et al.* [16] who mentioned that the role of lingual splints in sagittal fractures of the mandible is noteworthy. They serve as a simple but effective adjunct to fracture reduction, before semirigid (miniplates) or rigid (lag screws) fixation, especially to prevent lingual splay of fracture fragments. However, its use was affected by the time and cost of preparation.

Romeo *et al.* [17] had reported that the use of lingual splints has some limitations, such as additional time and expensive preoperative laboratory work for splint fabrication, but this was inconsistent with our experience during preoperative preparation, as fabrication of lingual splint did not represent more financial burden for the patient.

In fact, lingual splints offer many advantages: they improve the precision in achieving anatomic reduction of the fracture, in addition to permitting verification of the accuracy of dental occlusion intraoperatively, and also reduce the intraoperative time for fracture reduction. However, our study did not record the time objectively, and a randomized controlled trial comparing the time taken for reduction of fractures with or without splints might provide accurate data regarding the same.

The greatest advantage of the lingual splint is that the model surgery performed before splint fabrication permits the surgeon to visualize how the fractured components of the mandible need to be rotated, to establish the reduction of the fractures. The splint also stabilizes the fractured segments, preventing rotation during the application of rigid plate in screw fixation [18].

On the contrary, the lingual gap created by parasymphyseal fractures is directly proportional to the transverse mandibular dimension.

The Mimics 17 program that we used for measuring dimensions in our study does not allow one to represent the interaction between the jaw and the muscles at work, the behavior of soft tissue, and the behavior of the joint capsule, all of which restrict lateral expansion on the part of the mandibular rami and condyles. In spite of this limitation, the fact that a discrepancy between lingual cortical plates creates a relevant increase in the intergonial and intercondylar distances, consequently increasing the posterior facial width, can nevertheless be extrapolated to clinical practice.

Thus, with parasymphyseal fractures in which there are no concomitant compromises to the mandibular condyles, a clear widening of the mandibular angles is produced, but the mandibular condyles move less, as they are surrounded by the joint capsule, which limits lateral movement. However, a discrepancy is still produced, in which the condylar surface loses its relationship with the temporal fossa, causing a functional alteration of the temporomandibular joint that will affect the entire stomatognathic system, creating a discocondylar alteration and, eventually, degenerative disease of the joint surfaces.

The key point to prevent a lingual gap after parasymphyseal fractures is to restore the transverse bigonial dimension through proper reconstruction of the mandibular arch [19].

Moreover, findings of Ellis and Tharanon [20] in 1992 were consistent with the results of our study. They mentioned that rigid internal fixation devices alone can easily generate mandibular widening. This means that a small mistake in the reduction produces a major change in the position of the mandibular ramus and even the intermaxillary fixation with wires in the buccal surface of the teeth or fixation by means of arches, which tilts the mandibular segments lingually.

They mentioned different alternatives to avoid creating a lingual gap with parasymphyseal fractures and thus also dimensional alterations in the jaw, proposed using wire or intermaxillary arch fixation, which is thought to apply digital pressure in the area of the gonial angles to eliminate the lingual gap while at the same time attaining proper interdigitation of the teeth.

Regarding the technique used to visualize the fracture site, we prefer to use an intraoral approach, such as an extended lower vestibulotomy, as well as a genioplasty procedure in which the entire basilar edge is peeled back until access to the lingual plate has been gained, thus allowing direct visualization of the proper setting of the fracture tips in the lingual plate.

The most important factor to ensure proper reduction of parasymphyseal fractures is to visualize an adequate setting of the lingual cortical plates. Although the indirect view makes it hard to visualize the proper setting of the lingual plates, obliging the use of an endoscope or mirror, as some authors recommended, we used the lingual splints to adjust the fracture lines at the lingual cortical aspects which allowed us to dispense with the usage of the mirror and endoscope.

Therefore, an alternative is an extraoral submental approach or mandibular degloving that expands the surgical field and allows a direct view of the lingual plate, unless there is an injury in the submental region that allows access.

Some authors propose that, when faced with parasymphyseal fractures and when there is no adequate access allowing a view of the lingual cortical plates, one must evaluate the possibility of opening a submental approach, assessing its advantages and disadvantages and considering that the complications caused by inadequate reduction in these types of fractures lead to increased morbidity, making it difficult to intervene again when facial proportions are altered.

Regarding complications, there were no significant differences between two groups regard intraoperative and postoperative complications, such as decreased range of motion (for 1 week duration), paresthesia or numbness (for 1-week duration), malnutrition, loss of loose teeth and edema. Moreover, decreased range of motion during first weak after operation and edema were noticed to be the most common complication in both groups.

Moreno *et al*. [21] reported that the occurrence of postoperative complications like postoperative infection, and malocclusion, in the treatment of mandibular fractures is mainly related to the severity of the fracture rather than to the type of treatment used.

Chaurasia *et al*. [22] mentioned that complications such as deviation and crepitation were more common in fracture patients treated with miniplates compared with normal individuals with no history of fractures of the mandible and symptoms of TMD.

The presence of joint sounds as crepitation or grating sounds is usually a sign of degenerative joint disease. Imaging of the TMJ is necessary to confirm the degenerative changes of joint like resorption of bony surface as well as presence of osteophytes [23].

Studies reported joint sounds and deviation on opening mouth in asymptomatic individuals. This could be the reason that some individuals in the control group had joint sounds and deviation on opening mouth, although they did not have any history of mandibular fracture or trauma to TMJ, but the incidence was higher in mandible fracture group. This shows that trauma to the jaws resulting in fracture of mandible can lead to internal derangement and osteoarthritis of TMJ [24].

Although four of our patients complained of TMJ crepitation and pain, this was not the scope of our study. However, further studies and evaluation using MRI and CT scans as well as longterm follow-up are required to exactly determine the relation between fracture mandible and its repair with different fixation techniques and occurring of changes on TMJ functions, and if it related to the severity of fracture or the type of treatment.

Conclusion

Patients who underwent rigid fixation of parasymphyseal mandibular fracture with use of lingual splint have lower bigonial width and bicondylar breadth than patients who underwent rigid fixation only. This difference was noticed after 3 months of operation, which means that adding lingual splint as adjuvant to rigid fixation will offer more stability and accuracy for reduction and prevent occurring of lingual splay of fracture fragments and mandibular angle flaring with subsequent minimization effect on temporomandibular joint.

Recommendations

In treatment of parasymphyseal fracture, we recommend the use of lingual splint as adjuvant to rigid fixation will offer more stability and accuracy for reduction and prevent occurring of lingual splay of fracture fragments and mandibular angle flaring.

Further studies and evaluation using MRI and CT scans as well as longterm follow up are required to exactly determine the relation between fracture mandible and its repair with different fixation techniques and occurring of changes on TMJ functions.

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Conflicts of interest

There are no conflicts of interest.

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