



BODY OSTECTOMY FOR CORRECTION OF SEVERE MANDIBULAR EXCESS USING PIEZOSURGERY

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ABSTRACT

Prognathic mandible affects the patient's appearance and profile. Many techniques have been advocated for the surgical correction of mandibular excess and improving aesthetic and functional results. This study was conducted to investigate the efficacy of body ostectomy for severe mandibular excess by using piezosurgery. The study consisted of nine patients. They had cosmetic and psychosocial hindrance related to mandibular excess. In the cephalometric analysis, severe mandibular excess (≥ 8 mm reverse overjet) were selected. All patients underwent mandibular body ostectomy using piezosurgery. Clinical evaluation was made postoperatively. The average time of operation was 3.5 h with mean blood loss of around 300 ml. The postoperative course was uneventful. Generalized patient satisfactions were recorded. An acceptable occlusion was developed. The patients' facial esthetics were improved. Mandibular body ostectomy provides satisfactory outcomes (esthetic and functional) in cases of severe mandibular excess especially with intact posterior occlusion. Ultrasonic bone surgery could spare adjacent soft tissue and neurovascular bundle and hence reduce trauma, bleeding and enhance visibility. The surgical procedure duration is longer with the application of piezosurgery.

Keywords: mandibular ostectomy, ultrasonic bone surgery, nerve protection.

INTRODUCTION

The mandible serves two main purposes; aesthetic and functional roles. esthetically, it contours and makes up the structural support of the lower third of the face. The chin, lateral facial lines, position of the lips, and the appearance of a frown or a smile are all directly related to the shape and

position of the mandible. The shape and dynamic appearance of the mouth are both directly related to the position, size, and shape of the alveolus and teeth⁽¹⁾. Functionally, which is perhaps more important, the mandible shape, position, and movement are important in normal articulation and the production of fluent speech. It is also important in normal chewing and necessary in swallowing (oral phase).

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Facial disharmony and functional problems are more common in skeletal class III malocclusion. Extraorally, prognathic mandible affects the patient's appearance and profile. Concave profile in association with speech and mastication problems are noticed obviously in such cases ⁽²⁾. Intraorally, the lower first molar is in advanced position relative to upper first molar. Using cephalometric analysis, mandibular excess with skeletal class III malocclusion can be diagnosed. More forward position of skeletal pogonion, excess of the lower facial height are common signs ⁽³⁾. The treatment of cases with sever mandibular excess constitutes a greater challenge for orthodontists. Combination of orthodontic and surgery might be indicated for managing such cases ⁽⁴⁾.

Many techniques have been advocated for the surgical correction of mandibular excess and improving aesthetic and functional results. The site of mandibular osteotomy is highly controversial. The versatile osteotomy pattern includes condylar neck, ramus, angle, and body of the mandible. Each pattern has its own specifications and advantages ^(5,6).

Blair in 1900s conducted the first report to improve the mandibular body ostectomy for treatment of mandibular excess ⁽⁷⁾. In 2012, Sencimen et al, ⁽²⁾ treated cases of mandibular excess with edentulous gaps in dental arch by rectangular ostectomy of Body. They stated that body ostectomy might be used in cases of mandibular excess especially that having normal maxilla. They recommended dissecting and protecting the neurovascular bundle to avoid nerve damage.

Ultrasonic bone cutting was used in maxillofacial surgery especially in dental implant procedures ⁽⁸⁾. This technique of bone surgery provides bone cutting and saving the adjacent soft tissue and hence, a clear surgical field with minimal heating are provided ⁽⁸⁾.

AIM OF THE STUDY

This study was conducted to investigate the efficacy of body ostectomy for sever mandibular excess by using piezosurgery.

PATIENTS AND METHODS

The study consisted of nine patients with ages ranged from 23 to 38 years with mean age 26.7 years. All cases were patients of the hospital of Delta University for Science and Technology. They had cosmetic and psychosocial hindrance related to mandibular excess. A satisfactory Oral hygiene, moderate size of the tongue and absence of TMJ disorders and periodontal problems were confirmed. An informed consent was taken for the procedure. Preoperative assessment included the clinical history, physical and radiographic examination. Lateral cephalometric and panoramic x-ray view were done. Cone beam CT was used for nerve mapping. In the cephalometric analysis, severe mandibular excess (≥ 8 mm reverse overjet) were selected.

Diagnostic models were used for space analysis and mock surgery. Moreover, the size of the ostectomy segment was measured on model and lateral cephalogram. The lateral cephalometric radiograph was obtained, preoperatively and 6 months postoperatively, with lips in repose and all teeth in centric occlusion. The measured data were collected and statistically analyzed. Presurgical orthodontic treatment was directed to dental decompensation and arch coordination. Postsurgical orthodontic treatment was done for occlusion refinement.

Intervention

All patients underwent mandibular body ostectomy (Fig. 1). Full presurgical investigations were done for all patients. One gram of ampicillin sodium (Egyptian Int. Pharmaceutical Industries. Co. A.R.E) was administered intravenously. All patients were operated under general anaesthesia.

The buccal mucosa was infiltrated with lidocaine and epinephrine for hemostasis. An intraoral buccal vestibular incision (extended to gingival sulcus in the osteotomy site) was performed. The mandibular lateral surface was exposed subperiosteally to give good access. The intended osteotomy segment was then marked with ink according to radiographic analysis and model simulation. The mental foramina were explored and the mental nerve was protected. The lower first molars were extracted and Osteotomy was performed using piezosurgery (Woodpecker, Zhengzhou Chong yang Trading Co., Ltd, China). The buccal and lingual bone plates were removed and the osteotomy was extended to the inferior border of the mandible. Dissection and preservation of neurovascular bundle was performed. The block of bone in the area of the lower first molars were removed. Complete osteotomy and detachment of the bone segment must not be performed until completing the osteotomy of the opposing side to prevent the tension the neurovascular bundle. The distal segment of the mandible was set back and fixed with plates and screws. The flap was sutured using 3-0 vecryl. Intermaxillary fixation was applied for one week followed by intermaxillary elastics for 6 weeks.

All patients received antibiotic and analgesic for 5 days. Cold fomentation was instructed for

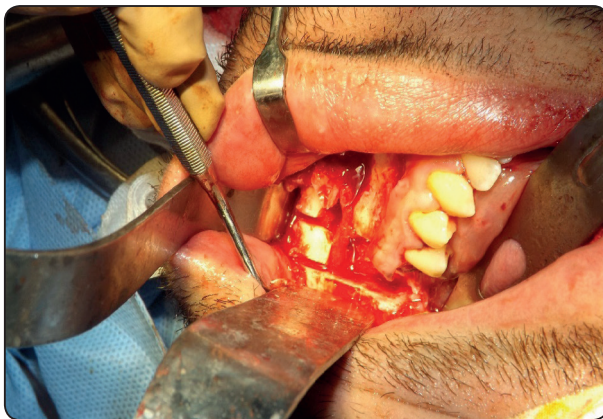


Fig. (1) Intraoperative photographic picture showing mandibular osteotomy by using of piezosurgery.

8 hrs following the operation. Hot mouth wash was prescribed three times daily on the second postoperative day to enhance oral hygiene. The lips were lubricated with petroleum jelly. Soft diet was recommended in early postoperative seven days. Clinical evaluation was made postoperatively for assessment of pain, infection, edema, nerve affection, tissue reaction, wound dehiscence, plate exposure, facial scarring, psychosocial tolerance, maximum mouth opening, and TMJ problems. Pain was subjectively evaluated by patients themselves; as experiencing none, mild, moderate or severe pain. Postoperative orthodontics was performed for finishing and refining the occlusion. Posttreatment functional retainer was applied for all cases to decrease relapse.

RESULTS

Between 2014 and 2017, a total of 9 patients received mandibular body osteotomy (4 women and 5 men). The age ranged from 23 to 38 years (mean age 26.7 years). All patients presented with a skeletal diagnosis of mandibular hyperplasia. None of the 9 patients were excluded from the study. The data recorded from all patients were thus available for evaluation (Table 1). The average time of operation was 3.5 h with mean blood loss of around 300 ml. The postoperative course was uneventful. All cases were discharged from the hospital on the second postoperative day. All cases tolerated the operation with minimal morbidity. The osteotomy was done through intraoral incision and hence, there was no facial scarring or cosmetic hindrance. They were able to return to work a few days after surgery with good psychosocial tolerance. No patient had a difficulty in receiving adequate oral nutrition during the postoperative healing period. The patient was kept on blenderized food for 3 weeks. Generalized patient satisfactions were recorded. an acceptable occlusion was developed. The patients' facial esthetics were improved.

Wounds dehiscence and Plate exposure was noticed in 2 cases and were controlled by thorough oral hygiene. The postsurgical pain was mild in two cases and moderate in one cases. It was controlled by analgesics. However, Immediate postoperative transient hypoesthesia of the mental nerve was noticed in 2 cases (3 sides). The hypoesthesia disappeared within 2 weeks. No permanent sensory disturbance of the incisors and lower lip was reported. No sensory disturbances of the lingual nerve were noted. No injury of the facial nerve or its branches was occurred.

Oral hygiene was reasonable, with the mean plaque score below one. On the 6th postoperative month, three patients showed increased probing depth (4 to 5 mm) in teeth (33.3%) adjacent to the osteotomy sites. localized gum recession (within 1 to 3 mm) was noted in 2 teeth. No tooth discoloration was noted. All teeth showed positive response to vitality tests (electric pulp tests and cold tests).

A thorough strict adherence to oral hygiene was kept throughout the overall procedures. Only one patient developed a local infection five-week

after surgery, which required systemic antibiotic and oral hygiene instruction. Two cases had lower lip injures due to pressure of the retractor. The lesion healed without scarring. There was mild to moderate postoperative edema that was controlled with administration of the conventional anti-inflammatory drugs.

During the 1st postoperative week, two patients experienced strain on the TMJ, but none of the patients had limited mouth opening. No permanent deleterious effect on the TMJ was noticed. No obvious radiographic changes were noted on the condylar surfaces. Two cases developed a mild openbite that was closed within a week using elastic band traction. Nevertheless, all patients claimed that these symptoms caused no disturbance in their social life.

Radiographically, there was no root injury or resorption of the teeth adjacent to the osteotomy area. no signs of periodontal pathological were noted. The mean cephalometric data (pretreatment and posttreatment) are summarized in table 2. Significant decrease in SNB angle and decrease in

TABLE (1) Clinical data of the patients

Case No.	Age	Sex	Osteotomy size in mm	Complications							
				Pain	Infection	edema	Mental nerve affection	Wound dehiscence	Scarring	TMJ tension	Mouth opening limitation
1	23	F	9	-	-	Mild	-	-	-	-	-
2	25	M	8	-	-	Mild	-	-	-	-	-
3	38	F	14	Mild	-	moderate	Left	Left	-	+	-
4	26	M	15	moderate	+	Mild	-	-	-	-	-
5	27	F	8	-	-	Mild	-	-	-	-	-
6	31	M	8	-	-	Mild	-	-	-	+	-
7	24	M	14	-	-	moderate	-	-	-	-	-
8	23	F	8	-	-	Mild	-	Left	-	-	-
9	25	M	13	Mild	-	moderate	Left + Right	-	-	-	-

arches discrepancies (ANB angle) were resulted (Fig. 2). The mean SNB angle was 89.3° in preoperative analysis and was decreased to 82° postoperatively. The mean ANB angle was -7° in preoperative analyses. Wits appraisal was changed from 10mm to zero. These results indicating reduction of the length of the mandibular skeletal base and decrease in the skeletal discrepancy between the jaws improving the frontal and lateral facial proportion (Figs. 3-5).

The horizontal lower lip position relative to the E-line was improved from 4 to -2 mm (Table 2). The concave profile of all cases was improved to a more balanced profile. The mean posttreatment anterior facial height (Na-Me) was 120 mm, posterior facial

height (S-Go) was 76 mm. The nasolabial angle was improved from 81° to 89° (Table 2).

Facial photographs showed that overall facial balance was improved (Figs. 3-5). The associated soft tissue excess was markedly improved in all patients with marked functional and psychosocial improvement. All cases achieved a nearly balanced facial proportion (Figs. 3-5). Better lip competence and decreased facial height, with intact posterior occlusion, were recorded. An improvement of the speech and pronunciation were resulted by correction of skeletal discrepancy. Moreover, there were greater patient satisfactions and pleasure with better self-esteem.

TABLE (2) Cephalometric data

Landmark (Symbol)	Normal	Preoperative mean	6 months Postoperative Mean	Change
SNA	81°±3	81.4°	80.9°	-0.5
SNB	78°±3	89.3°	82°	-7.3
ANB	3°±2	-7°	2°	9
Wits Appraisal* (A-B/OP**)		oB ahead of oA by 10mm	0	10mm
Harvold***	Co-ANS	95mm	94mm	-1mm
	Co-Gn	132mm	120mm	-12mm
	Difference	37mm	26mm	
Cranium max. plane (SN/ANS-PNS)	8°	7.7°	8°	-0.3°
Max. mand. plane (ANS-PNS/Go-Gn)	27°±5	26°	25.7°	-0.3°
Total anterior facial height (N-Me)	119mm	122mm	120mm	-2mm
Upper anterior facial height (N-ANS)	54mm	56mm	55mm	-1mm
Lower anterior facial height (ANS-Me)	65mm	67mm	65.6mm	-1.4mm
Total posterior facial height (S-Go)	79mm	77mm	76mm	-1mm
Upper posterior facial height (S-PNS)	46mm	45mm	44.3mm	-0.7mm
Lower posterior facial height (PNS-Go)	33mm	32mm	31.7mm	-0.3mm
1/max. plane (1/ANS-PNS)	109±6°	120°	108°	-12°
1̄- mand. plane (1̄/Go-Me)	93±6°	91°	92°	-1°
Interincisal angle (1/1̄)	135±10°	131°	136°	4°
Over jet (mm)	2-4	-8 mm	2mm	10mm
Overbite(mm)	33%	reduced	Average	
Esthetic plane Li (mm)	-2mm	4 mm	-2 mm	-6mm
Nasolabial angle	90°-110°	81°	89°	8°
* ♀= 0, ♂=oB ahead of oA by 1mm				
**OP Functional occlusal plane				
***Co-ANS (♀=94mm, ♂=100mm) Co-Gn (♀=120mm, ♂=130mm) difference (♀=26mm, ♂=30mm)				

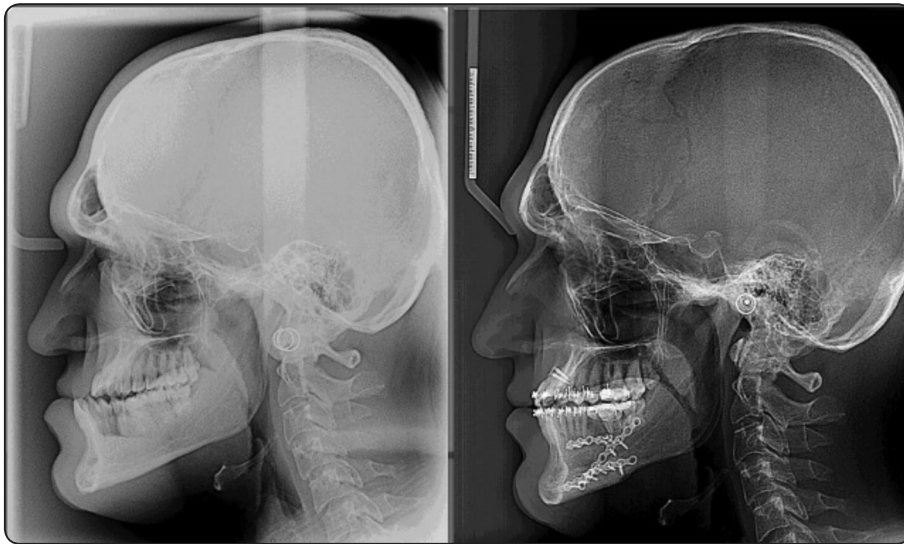


Fig. (2) preoperative (left) and postoperative (right) lateral cephalogram of the case No. 9 showing an improved and balanced facial profile and occlusion following mandibular bod ostectomy.



Fig. (3) Photographs for a patient records (case No. 1), preoperative (left), postoperative (right), showing marked improvement of the facial proportions following mandibular body ostectomy.



Fig. 4. Photographs for a patient records (case No. 9), preoperative (upper), postoperative (lower), showing marked improvement of the facial proportions following mandibular body ostectomy.



Fig. (5) Intraoral postoperative photographic pictures (case No. 9) showing an improved occlusion (canine class I occlusion).

DISCUSSION

Among dentofacial abnormalities, mandibular prognathism constitutes a major complication that requires a variety of surgical interventions⁽⁹⁾. Mandibular body ostectomy is performed in such cases⁽¹⁰⁾. It was firstly reported by Blair in 1906⁽⁷⁾. Edentulous mandibular, edentulous gaps in posterior of dental arch, or normal posterior occlusion are candidate for such procedure⁽⁵⁾. Many reports had been conducted for neurovascular bundle protection⁽¹¹⁾. Recently, bilateral sagittal split osteotomy is more used instead of mandibular body ostectomy⁽¹²⁾. Body ostectomy might involve many risks such as dental, periodontal and neurovascular bundle damage. However, body ostectomy be effective severe mandibular body elongation especially that accompanied with open bite^(13,14). Normal posterior occlusion, non-restorable posterior teeth, posterior edentulous area might be considered as an indication of body ostectomy especial when the size of setback are within the tooth or teeth width⁽¹³⁾.

In the region of head and neck, bones, blood vessels and nerves are closely related. Consequently, a higher risk of neurovascular bundle damage resulted with mandibular orthognathic surgery^(15,16). The damage may be caused by direct trauma, consequent oedema or compressions through the fixation^(15,16). There is inability to

distinguish between soft and hard tissue by using of manual and motor-driven instruments. Such instruments are difficult to control, provide limited visibility and generate a significant amount of heat in the cutting zone⁽¹⁷⁾, thus, they may damage the IAN⁽¹⁸⁾, resulting in sensory disturbances and pain⁽¹⁹⁾. Using ultrasonic vibrations instrument, act only on mineralized tissue (bone) and spare soft tissues⁽²⁰⁾. The piezosurgery insert is very small as Compared to oscillating saws, hence it provides more precise safety⁽²⁰⁾. It can thus prevent damage of the IAN⁽¹⁸⁾ and provides a bloodless surgical field⁽²¹⁾.

The ultrasound bone surgery is applied in maxillofacial surgery in cases of Le Fort I osteotomies, sagittal split osteotomies, rapid maxillary expansion and minor microsurgical interventions^(21, 22). Landes et al.⁽²¹⁾ compared between conventional surgical methods and piezosurgery. They concluded that there was decrease in the blood loss when using piezosurgery but no effect on surgery time. However, Ueki et al.⁽²³⁾ used piezosurgery for pterygomaxillary disjunction in cases of Le Fort I osteotomies. They reported no damage of the surrounding tissues. Chiarini L et al.,⁽²⁴⁾ did high condylectomy on cases of condyle hyperplasia. They also confirmed the safe use of piezosurgery. Rullo et al⁽²⁵⁾ reported a little pain and swelling with the use of ultrasonic bone surgery in case of genioplasty.

In this study, mandibular body ostectomy with an average of 11 mm of mandibular setback on each side was done with a maximum of 15 mm. The changes of cephalometric measurements portray reduction of class III skeletal discrepancy and improvement of the facial proportions. In cases of nearly moderate mandibular excess, BSSO is a good choice. On contrary, it might be contraindicated with severe mandibular excess (>8-10mm) especially that with excessive anterior open bite⁽²⁶⁾. Nordenram and Waller⁽²⁷⁾ reported 5-10 mm set back by body ostectomy. Nakajima T et al⁽²⁸⁾ also reported a patient with 5 mm set back. They found a mean time of 2 h and 45 min taken during procedure and a loss of approximately 400 ml of blood. In the current study average time of operation was 3.5 h with mean blood loss of around 300 ml. The reduction of blood loss might be related to the sparing action of piezosurgery on soft tissues⁽⁸⁾. However, the cavitation phenomenon of ultrasonic surgery helps to disperses the saline as an aerosol washing away the blood improving the surgical field visibility. Furthermore, the cavitation effect will bring about haemostatic effect, resulting in a bloodless surgery⁽⁸⁾. The blood loss is reduced by 25–30% compared with surgical burs or oscillating saws^(21,29).

Postoperative infection was not recorded. This might be attributed to asepsis procedures, prophylactic antibiotic administration, and rigid fixation. However, Walmsley et al.⁽³⁰⁾ has proposed that the cavitation effect of piezoelectric devices breaks the bacterial cell wall providing anti-microbial efficacy. Fordyce's and Wedgwood Fordyce's in 1976⁽³¹⁾ reported bilateral mental nerve anesthesia as an early feature of all cases. They reported 13% cases with long-term parasthesia. In the current study, three sites of metal parasthesia were reported immediately after surgery. It was resolved in two weeks. These results came in accordance with many studies⁽³²⁻³⁴⁾ who reported no permanent parasthesia. They reported rapid recovery of neurosensory

function with no permanent affection by the using of ultrasound bone surgery^(32, 34). In the present study all teeth in the distal segment were vital and responded to pulp testing. Contrary, Nakajima et al. and Theisen F^(35, 36) reported 90% of the anterior teeth responded to electric pulp tester. Moreover, Bansal P et al.⁽³²⁾ reported a negative response to electric pulp testing on immediate postoperative period. Only 38 teeth out of 42 returned to normal vitality. In the current study there was no damage in the teeth near the osteotomy sites. Contrary to this finding Bansal P et al.⁽³²⁾; Fordyce and Wedgwood⁽³¹⁾ reported 5% and 10% damage.

CONCLUSION

Mandibular body ostectomy provides satisfactory outcomes (esthetic and functional) in cases of severe mandibular excess especially with intact posterior occlusion. Ultrasonic bone surgery could spare adjacent soft tissue and neurovascular bundle and hence reduce trauma, bleeding and enhance visibility. The surgical procedure duration is longer with the application of piezosurgery.

Conflicts of interest

There are no conflicts of interest.

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