Original Article

Relevance of anterior mandibular body ostectomy in mandibular prognathism

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ABSTRACT

Purpose: We tried to find out the relevance of anterior mandibular body ostectomy in deformities of the mandible specially prognathism, which is primarily limited to anterior part only. **Patients and Methods:** Ten patients with skeletal deformity along with malocclusion, which was limited to anterior body of mandible were selected. Selected patients had proper molar interdigitation (even if class 3) and in general had anterior crossbite (except one). All patients had crossed their growth spurts and had no hormonal influence on facial deformity. Specific protocol, including cephelometric analysis cephalometry for orthognathic surgery, prediction tracing and model surgeries were devised. Pre and post-surgical orthodontics and body ostectomy were performed in all patients along with 18-month post-op follow-up. **Results:** There was significant reduction in prognathism and horizontal dysplasia in all ten patients. Anterior crossbite as well as axis of incisiors over mandibular plane was corrected in all patients due to decrease in length of mandibular body. All patients showed decreased facial height and better lip competence with intact posterior occlusion and no (negligible or transient) sensory loss. **Conclusions:** Our study could confirm that people whose deformity is limited to the anterior part of mandible with reasonable occlusion posteriorly can get satisfactory cosmetic and functional results through body ostectomy alone rather than going for surgical procedure in the ramal area, which is liable to cause sensory and occlusal disturbances.

Key words: Body ostectomy, cephalometry for orthognathic surgery, mandibular prognathism

Introduction

Mandibular deformities present with infinite variation with different aesthetic and functional problems. It is in itself a herculean task to classify them and then to decide ortho-surgical management. Peculiarities of deformities and different norms of aesthetics in various races, societies and ethnic region make it hard to label any procedure as complete or to discard any as obsolete.

Mandibular body ostectomy[1] is a procedure, which can be accomplished intra-orally without the facial scar, does not require prolonged inter maxillary fixation and there is no change in posterior occlusion. It is not only stable but also versatile and can be undertaken for multiple deformities affecting the body of mandible. The anterior body of mandible is coupled with various deformities, which can be corrected ortho-surgically by limiting the surgical procedure in the anterior part of mandible. The anterior body[2] ostectomy has an obvious advantage of not involving the inferior alveolar neuro vascular bundle as well as the additional surgical procedures can be simultaneously undertaken to widen or narrow dental arch widths by mid symphysis ostectomy.

The purpose of this study was to find out whether anterior mandibular body ostectomy is a relevant procedure to achieve satisfactory functional and aesthetic results in patients whose skeletal deformity is largely limited to anterior part of the mandible.

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Materials and Methods

Before beginning, study design had been approved by the review committee of Government Dental College (GDC) Rohtak (India). Ten patients (7 females, 3 males) age ranging between 17 and 25, having skeletal deformity along with malocclusion were selected from the outdoor patient department of Oral and Maxillofacial Surgery and Orthodontics, GDC Rohtak, Haryana (India). Selection criteria: The inclusion criteria were as follows:

1. Patients with skeletal deformity along with malocclusion which was too severe to be corrected orthodontically alone were selected
2. Deformity due to the mandible, which was limited to anterior part only with posterior molars interdigitating properly (even if class III) were selected
3. Patients had an increased curve of Spee in general and also anterior cross bite except one patient who had an open bite
4. Patients had crossed all growth spurts. All patients had medical examination done to rule out hormonal influence on facial deformity.

Pre- and post-operative radiographs (Cephalogram, Orthopantomogram [OPG]) and photographs both extra-oral (frontal and lateral both sides) and intra-oral (occlusion, frontal and lateral) were taken [Figures 1-7] and investigations of soft and hard-tissues as well as occlusions were carried out to select cases where the dento osseous deformity could be satisfactorily corrected by body ostectomy alone. Study models were made and model surgery was performed to predict the possible outcome of surgery. Definite protocol for all phases was devised. Patients were kept on regular follow-up for 18 months post-operatively.

Sequence of treatment

1. Pre-surgical orthodontics: Pre-surgical orthodontics were performed in order to bring deformity in its original form from compensating covering mechanism of stomatognathic system in order to achieve maximum correction
2. Surgical stage: All patients were operated under general anesthesia. Once under anaesthesia-sufficient adrenaline (1:200000) was infiltrated in mandibular vestibular area. After waiting for 5-7 min, an incision

Figure 1a: Pre-operative extraoral frontal view

Figure 1b: Post-operative extraoral frontal view

Figure 2a: Pre-operative occlusion

Figure 2b: Post-operative occlusion

Figure 3a: Pre-op extraoral lateral (patient-1)

Figure 3b: Post-op extraoral lateral (patient-1)

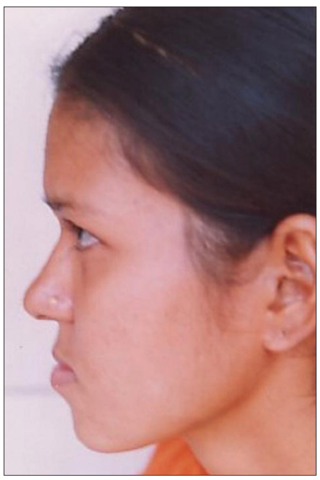

Figure 4a: Pre-op extraoral lateral (patient-2)

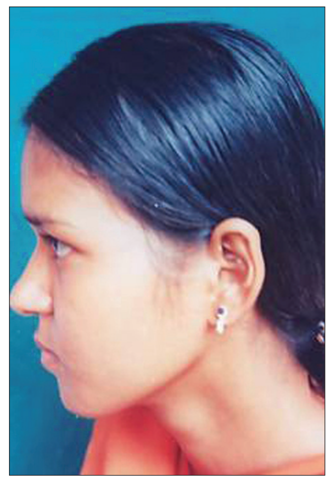

Figure 4b: Post-op extraoral lateral (patient-2)

Figure 5: Pre-op ceph of patient

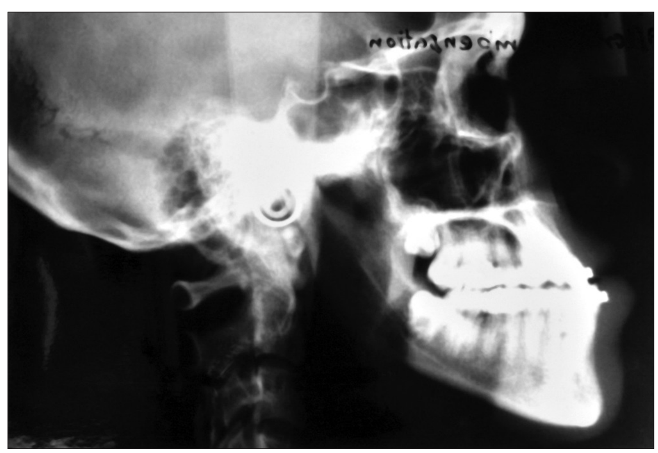

Figure 6: After orthodontic decompensation

was made with help of 15 no blade on gingival tissue around the neck of two or three teeth distal to be selected ostectomy site and carried posteriorly beyond the first premolar site. The[1] incision was then carried obliquely tapering into the vestibule. Keeping location of mental foramina in mind, the incision was carried directly down to the bone. mucoperiosteal flap was reflected anterio-posteriorly and inferiorly by subperiosteal elevation till the mental neurovascualr bundle was visible [Figure 8]. The lower border of the mandible was exposed. Exposure of the ostectomy site was complete now. First premolars were extracted bilaterally. A small periosteal elevator was then inserted after creating a sub-periosteal tunnel on the lingual side of first premolar socket to protect soft tissue in the floor of mouth as well as lingual mucoperisoteum. Two vertical osteotomy cuts were carried out through both cortices in the first premolar sockets with the help of reciprocating saw [Figures 9-11]. Step osteotomy was done where it was required to protect neurovascular bundle [Figures 12 and 13]. In general, geometry of the osteotomy cuts is rectangular but can be triangular or trapezoidal in cases of open bite. Care was taken that width of crestal bone removed was just adequate to avoid any future periodontal defect. Furthermore, the

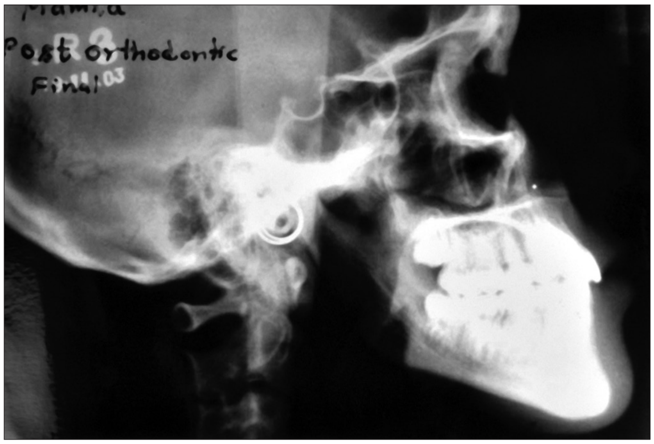

Figure 7: Post-surgical cephalogram (8 months follow-up)

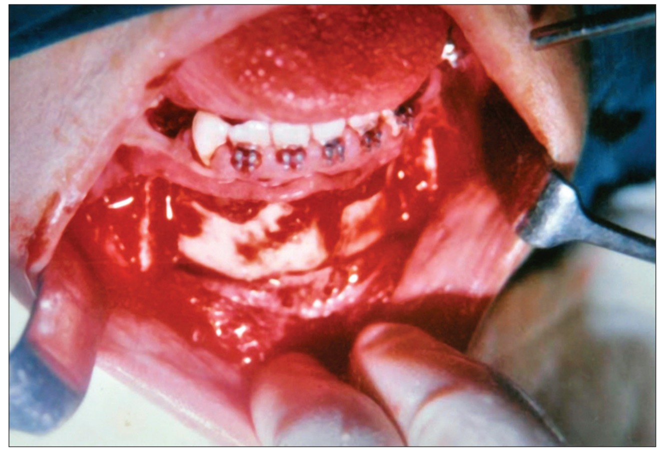

Figure 8: Surgical exposure

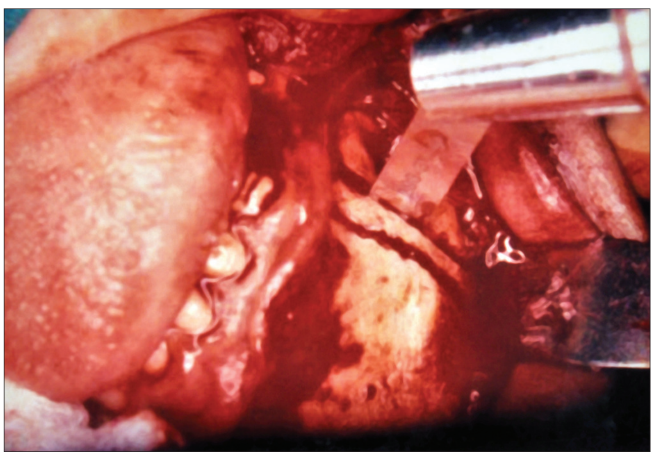

Figure 9: Ostectomy cuts

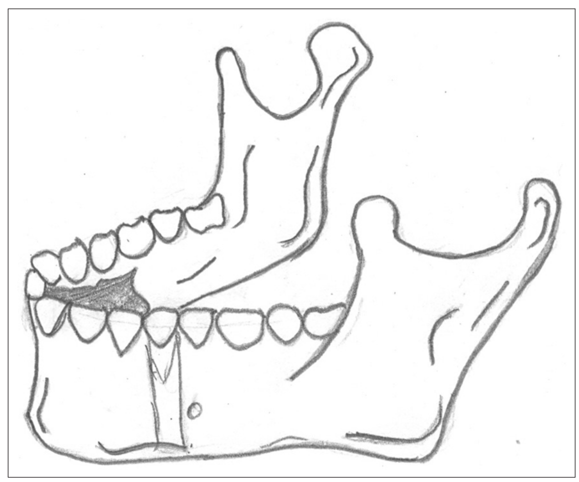

Figure 10: Diagramatic representation of osteotomy cut

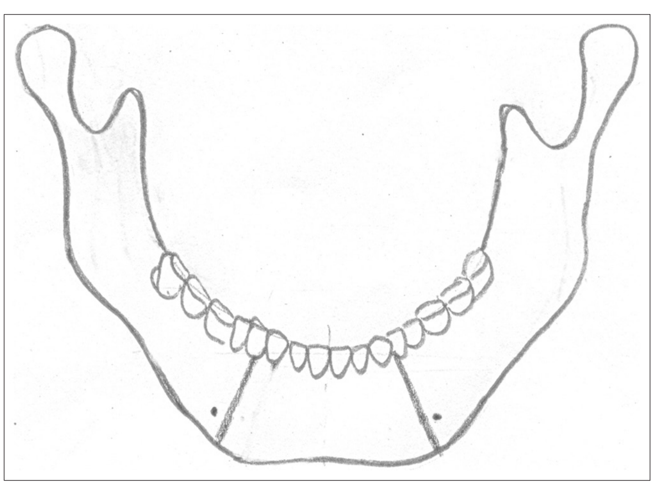

Figure 11: Occlusal view diagram of body osteotomy

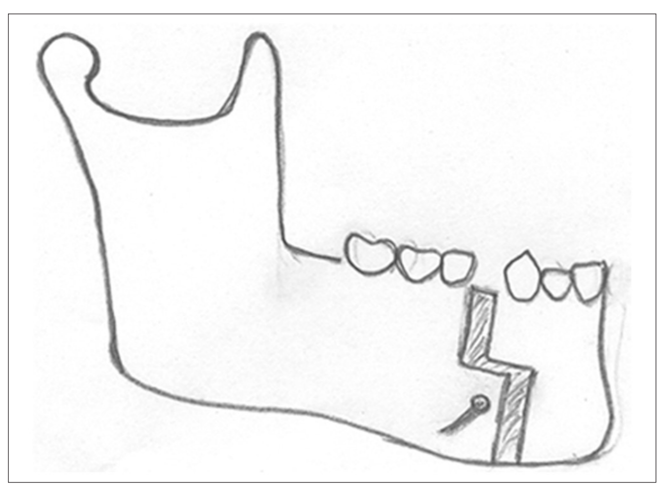

Figure 12: Diagramatic presentation of step osteoptomy modification

width of ostectomy was kept convergent bucco-lingually and tapering superio-inferiorly [Figure 14]. This step in ostectomy is of extreme importance because to get maximum bony approximation, ostectomy cut must follow the natural contour of mandible in ostectomy. Anterior part was pushed back as planned, bridle wire was placed around the necks of canine and second premolars adjacent to osteotomy site and lightly secured. This is of significance to provide sufficient stability to segments and prevention of inadvertent tearing of lingual soft-tissue. Mini-plates were used to fix osteotomized segments [Figure 15] whenever need was felt. Multilayer suturing was done with special attention while suturing mentalis muscle

3. Post-surgical orthodontic stage and retention phase.

The present study comprised of 10 cases, which required anterior mandibular push back. All these cases were operated by mandibular body ostectomy alone.

The cephalometric analysis for hard and soft-tissues was carried out by using COG'S (Hard and Soft-tissues), Steiner's analysis and Wit's appraisal, but the cephalometric points pertaining only to anterior mandibular region which would be affected by procedures were utilized.

Hard and soft-tissue measurements were carried out at the time of diagnosis, after orthodontic decompensation, immediately after surgery and follow-up. Subsequently their mean and medians were calculated as shown in Tables 1-6. These measurements were worked out as P_1 (Pre-surgical), P_2 (After decompensation), P_3 (Prediction tracing), P_4 (After surgery), and P_5 (Follow-up).

Results

Hard tissue cephalometry

Linear Measurement

a. Degree of horizontal dysplasia
   i. N-B (IIHP): When mean and median values of this measurement were analyzed for body ostectomy, there was reduction of approximately 4 mm post-operatively, which means anterior mandibular prognathism has been reduced.
   ii. N-Pog Parallel to horizontal plane (IIHP): Mean and median value of N-Pog decreased by 4.3 mm

Table 1: Linear cephalometric hard tissue analysis (mean) (in mm)

Linear measurement points in COGS	P_1	P_2	P_3	P_4	P_5
NB (∥HP)	7.2	6.5	2.6	2.8	3
NPg (∥HP)	9.1	8.9	4.6	4.7	4.7
Co-Gn	123.6	123.9	117.6	119	119.2
ANS-Gn (⊥HP)	64	65	64	65.2	65.1
Ar-Go	50	50	50	50.5	50.8
Go-Pg	81.3	81.4	77	77.4	77.6
B-Pg	6.7	6.9	8.2	7.9	8
Wits analysis	−4.3	−4.6	−0.9	−0.3	−0.25
1 ± MP (⊥MP)	43.7	43.5	41	42	41.5

P_1: Pre-operative, P_2: After orthodontic decompensation, P_3: Prediction tracing, P_4: Post-operative values P_5: Follow-up, COGS: Cephalometry for orthognathic surgery, HP: Horizontal plane, NB: Nasion-pointB, ANS: Anterior nasal spine

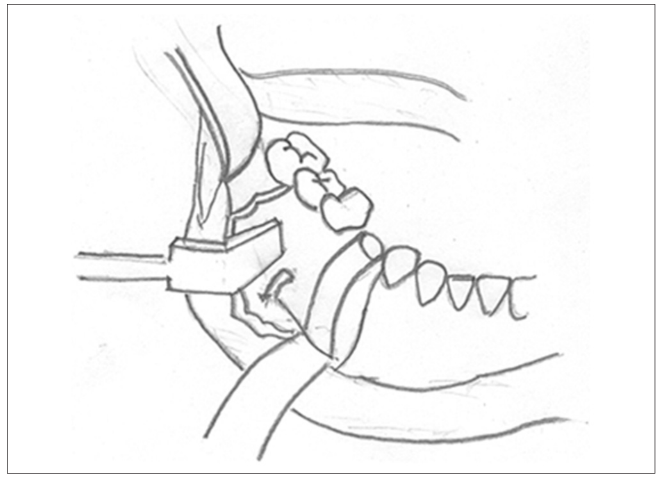

Figure 13: Diagramatic presentation of surgical procedure diagram showing regular osteotomy cuts

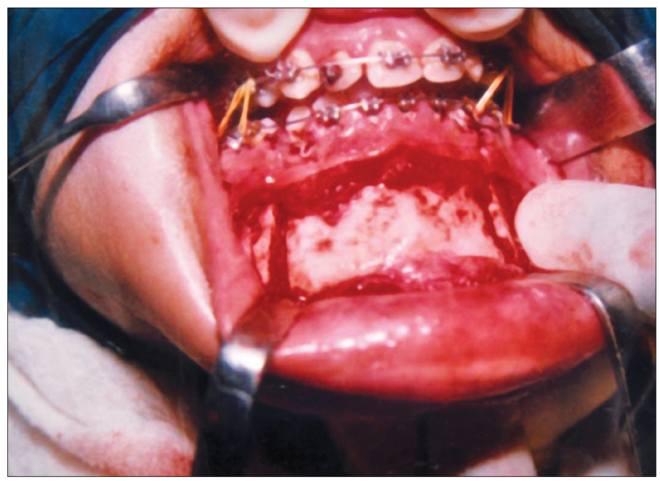

Figure 14: Convergent cuts photograph

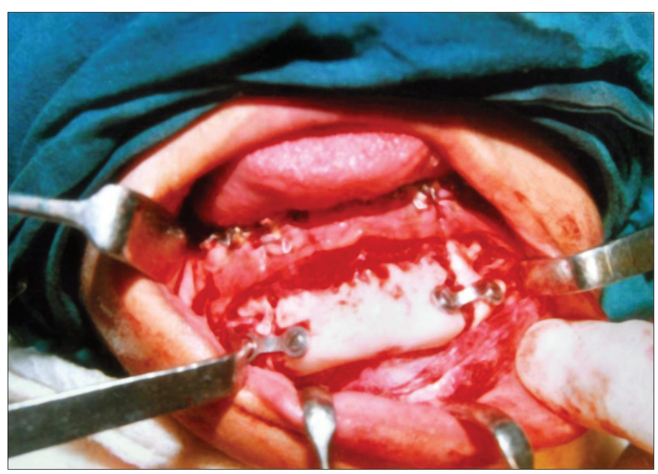

Figure 15: Fixation of osteotomized segments

Table 2: Linear cephalometric hard tissue analysis (median) (in mm)

Linear measurements in COGS analysis	P_1	P_2	P_3	P_4	P_5
NB (∥HP)	8	6	5	5	5
NPg (∥HP)	10	12	7	8	6.5
Co-Gn	122	124	117.5	118	119
ANS-Gn (⊥HP)	63	63	64	65	65.5
Ar-Go	50	50.5	50	50.5	51
Go-Pg	80	84	75	76	76
B-Pg	5.5	5.5	6	6.5	7.8
Wits analysis	−3.5	−4.4	−1.5	−1	−1
$_1$±MP (⊥MP)	44	44.5	41	41	41

P_1: Pre-operative, P_2: After orthodontic decompensation, P_3: Prediction tracing, P_4: Post-operative values, P_5: Follow-up, COGS: Cephalometry for orthognathic surgery, HP: Horizontal plane, NB: Nasion-pointB, ANS: Anterior nasal spine

Table 3: Angular cephalometric hard tissue analysis (mean) (in degree°)

Angular measurements in COGS analysis	P_1	P_2	P_3	P_4	P_5
NA-Pg	−1.2	−0.6	5	5.6	5.6
Ar-Go-Gn	130	130	130	129.5	129.5
OP-HP	2.9	2.7	4.2	4.6	4.5
$_1$±MP	87.6	90.2	85.2	86	84.7
SNA	87	89	87	88.8	88.6
SNB	88.6	90.3	84.5	85.5	85.1
ANB	−1.6	−1.3	2.5	3.3	3.5

P_1: Pre-operative, P_2: After orthodontic decompensation, P_3: Prediction tracing, P_4: Post-operative values, P_5: Follow-up, SNA: Angle between sella-nasion plane and A point, SNB: Angle between sella-nasion plane and B, ANB: Angle between point A-nasion-point B

Table 4: Angular cephalometric hard tissue analysis (median) (in degree°)

Angular measurements in COGS analysis	P_1	P_2	P_3	P_4	P_5
NA-Pg	−2	−1.5	4	5	4.5
Ar-Go-Gn	129	129	129	129	129
OP-HP	1.5	1.5	3.8	4	4
$_1$±MP	87.5	90.7	86	85	84
SNA	87	89	88	89	89
SNB	90.5	91	85	86.5	87
ANB	−3.5	−2	3	2.5	2

P_1: Pre-operative, P_2: After orthodontic decompensation, P_3: Prediction tracing, P_4: Post-operative values, P_5: Follow-up, SNA: Angle between sella-nasion plane and A point, SNB: Angle between sella-nasion plane and B, ANB: Angle between point A-nasion-point B

Table 5: Soft tissue cephalometric analysis (mean)

Soft tissue linear and angular measurements in COGS analysis	Pre-operative mean (P_1)	Prediction tracing (P_2)	Post-operative mean (P_3)
Linear (in mm)			
G-Pg′ (HP)	8.5	5.8	5.5
Li to (Sn-Pg′)	6.9	4.1	3.9
Si to (Li-Pg′)	4.8	4.8	4.9
Angular (in degree°)			
G-Sn-Pg	4.8	8.8	9.4
Sn-Gn′-C	90.8	95.6	94.9

COGS: Cephalometry for orthognathic surgery

Table 6: Soft tissue cephalometric analysis (median)

Soft tissue linear and angular measurements in COGS analysis	Pre-operative mean (P_1)	Prediction tracing (P_2)	Post-operative mean (P_3)
Linear (in mm)			
G-Pg′ (HP)	8	6	6
Li to (Sn-Pg′)	7	5	4
Si to (Li-Pg′)	5	5	5
Angular (in degree°)			
G-Sn-Pg	3	10	11
Sn-Gn′-C	90	95	93

COGS: Cephalometry for orthognathic surgery

and 3.5 mm respectively. This shows that the chin was moved back.

iii. Co-Gn: Value was decreased by 4.6 mm and 4 mm on comparing mean and median values respectively. So the length of mandibular body decreases, which justifies our surgical procedure i.e. mandibular body ostectomy.

iv. Anterior nasal spine ANS-Gn (^HP): Values shows insignificant difference from pre-operative which means that the lower facial height does not change appreciably with anterior body ostectomy.

b. Maxilla-mandible linear measurements

i. Ar-Go: As predicted there was no change (change is in fractions) in mean/median values.

ii. Go-Pg: This is a linear measurement, which establishes length of mandibular body and is of utmost importance in context of mandibular body ostectomy. As was desired, the length of mandibular body decreased by 4.1 mm and 4 mm in mean and median values respectively.

iii. B-Pog: Chin prominence increased by 1.3 mm and 2.3 mm (mean and median) respectively, with respect to mandibular denture base.

iv. $_1$+-MP (^MP): This value defines that how far the incisors have erupted in relation to mandibular plane. Value of this is also effected by orthodontic decompensation. There was a decrease of 2.2 mm and 3 mm in mean and median respectively, showing axis of incisors comparatively straightened over mandibular plane, which was desirable also.

Wits Appraisal: In our study wit's appraisal measurement increased by 4 mm and 4.5 mm in means and median values, which depicts lessening of class III skeletal discrepancy.

Angular measurements

Facial convexity

Facial angle taken from the Cog's analysis, which depicts the overall facial convexity.

N-A-Pg: There was definite increase from –ve to + ve value showing decrease in facial concavity.

Ar-Go-Gn: There was minimal or insignificant change in value of Ar-Go-Gn.

Inclination of occlusal plane

Occlusal plane- horizontal plane OP-HP: After ostectomy OP-HP angle increase by 1.6°/2.5° in mean/

median showing better lip competence with normal bite.

$_1$+-(MP) Angle: This angulation describes procumbency or recumbency of mandibular incisors, which is vital in assessing the long-term stability of dentition. In our study, mean value of this angle decreased by approximately 3° which was actually better for stability of dentition (according to opinion of orthodontist) after push back.

Steiner's analysis

As no surgical procedure was performed on maxilla, there was almost no change in Angle between sella-nasion plane and A point (SNA) angle value. SNB angle was reduced by 3.5° in both mean and median values, which suggests reduction in mandibular prognathism.

Relative maxilla-mandible position

Angle between point A-nasion-point B

Angle tells maxillo-mandibular relationship. Value of this angle changed from negative to positive. This cephalometric finding was matched by clinical correction of cross-bite to normal overbite.

Overall, there was significant reduction in degree of horizontal dysplasia, reduction in chin prominence, decreased mandibular body length, and better lip competence. Angular changes includes change in maxillomandibular relationship from negative to positive, reduction in mandibular prognathism, recumbency of mandibular incisors, and straightening of incisors axis over mandibular plane [P_1-P_5].

Discussion

Present study consists of push back of an anterior mandible via body ostectomy with subsequent observation of hard and soft-tissue changes along with various complications that had or could have occurred. Our study has been able to confirm the fact that in people whose deformity is limited to anterior part of the mandible with properly interdigitating occlusion posteriorly, can get better cosmetic and functional results through body ostectomy rather than any procedure on ramal part which is liable to cause disturbed occlusion post-operatively.

There were a number of patients who were potential candidates of body ostectomy but only ten patients opted for surgical correction and rest were more keen on less-invasive methods even with compromised results. Primary aim of this group (7 females and 3 males) was improved cosmetics.

Diagnostics

Authors like Nathanson,[3,4] Legan and Burston[5] have repeatedly stressed upon the importance of cephalometry in diagnosis and treatment planning of orthognathic procedures. In our study, we used lateral cephalograms with cephalometry for orthognathic surgery (COGS), Steiner's analysis to find out hard and soft-tissue changes. Moynihan[3] discussed the importance of model surgery. Study in discussion followed modified method of model surgery by Barrow and Dingman,[6] which helped in near accurate mock surgery.

Pre-surgical orthodontic considerations

Pre-surgical orthodontics is required to bring deformity in its original form from compensating covering mechanism of stomatognathic system in order to achieve maximum correction. Nakajima[7] suggested the need for approximately 16 months of pre-surgical orthodontics for leveling of arches, correction of incisal inclination or bringing about rotation. In our study, we found 9 months (mean) time to be sufficient to bring about intra-arch corrections. This could be because of difference in technique used for orthodontics or may be due to greater deformities in Nakajima's[7] cases. Fonseca[8] talked about straightening of premolar's root so that roots are not damaged during ostectomy cuts. We found it to be useful finding, which helped us to minimize damage to adjacent roots.

Actually, assessment of complete deformity can be made only after adjustments of incisors on basal bone. Ideal positions in this regard was suggested by Worms and Isaacson.[9] In present study, we performed surgery only after orthodontic decompensation.

Surgical procedure

Since the time (1907) when Blair[10] performed first body ostectomy, the procedure has undergone various changes. In this study, we followed procedure given by Epker.[1]

Converse and Shapiro[11] described intra-oral approach in which access was gained via horse-shoe shaped incision involving gingival margins of teeth on either side. We found that if gingival tissue is incised around the neck of two or three teeth distal to selected ostectomy site, it gives better exposure and easy post-surgical suturing.

Sandor *et al*.[12] and Kajikawa[7] advocated extraction of first premolars before ostectomy cuts but in the present study we first marked ostectomy cuts taking guidance from the long axis of premolars and then extracted them. In our view, this helps in better assessment regarding direction and width of cut.

Most of the referred authors advocated ostectomy cut should be convergent bucco-lingually to follow natural contour of mandible. We completely agree with this statement as this allowed smooth push back and maximum bony contact.

Two patients in study required step osteotomy. Wedgewood[13] and Stoelinga *et al*.[12] in the prescribed horizontal cut to be kept superior to mental foreman and at least 5 mm longer that planned advancement. In studied patients, same technique was used and it was felt that 3-5 mm above the foreman cut give adequate space to protect neurovascular bundle. Another modification is oblique mandibular chin-body osteotomy for the correction of broad chin by reshaping of lateral cortex with bur to reduce the width of chin and mandibular body. It can be used as supplemental operation to osteotomy of prominent mandibular angles and horizontal advancement genioplasty.[14]

In present study, a mean of 4 mm of backward movement on each side was observed with a maximum of 9 mm. Nordenram and Waller[4] reported 5-10 mm push back by body ostectomy. Kajikawa[7] and others also reported a case with 5 mm push back. Nakajima[7] *et al*. found a mean time of 2 h and 45 min taken during procedure and a loss of approximately 400 ml of blood. In our study average time of operation was 2 h with mean blood loss of around 200 ml. Perhaps liberal infiltration of saline solution with adrenalin (1:200000) and occasional hypotensive anesthesia, helped in less blood loss. Nakajima[7] in his case, recommended tranosseous wiring for stabilization and fixation. In this study, we found that after intimate contact of bone only bridle wire tightening and fixing arch wire into pre-adjusted brackets provided more than enough stabilization and immobilization, as the arch wire is cinched back. This method has added advantage of allowing minor movements through elastics (immediately after surgery) to achieve stable occlusion. In seven out of ten cases, this method was adopted and rest required plating at the lower border.

Cephalometric findings

Although orthodontists had been predicting facial profile as a result of growth and treatment for long time, but as late as in 1972 there was little information regarding post-orthognatic cephalometric changes. From Steiner's[15] to Bench[16] all tried to predict and analyze facial forms, but it was in (1978-80) when Legan[5,17] and Burston provided one of the most acceptable orthognathic analysis named COGS for treatment planning and predicting outcome. We found it to be reliable in planning of treatment and expected post-surgical results.

Unfortunately, most of the work on anterior mandibular body ostectomy was done before 1980's, hence there is no comprehensive cephalometric data available for us to compare with past studies. It is important to note that even before introduction of COGS,[5,17] authors have always stressed upon importance of cephalogram in body ostectomy for assessment of skeletal and dental deformities. In this study, hard and soft-tissue findings have already been described under results section.

Complications

a. Sensory disturbance: Fordyce's and Wedgewood[13] reported a study in which authors described bilateral mental nerve anesthesia as an early feature of all cases. They reported 13% cases with long-term parasthesia. We found that there was certainly a degree of parasthesia present bilaterally immediately after surgery, which improved in subsequent weeks (usually 2-4 weeks). In this study, there was no patient who reported of permanent parasthesia.
b. Crestal bone loss: Kent and Hinds[18] in their study of anterior alveolar surgery mentioned loss of 1-5 mm of crestal bone 1 year after surgery. Our findings of mean crestal bone loss of 1.5 mm matched that of Kent and Hinds.[17] We felt that this might be due to inadvertent loss of fraction of alveolar bone during ostectomy and partially due to unsatisfactory periodontal hygiene kept by patients in follow-up periods.
c. Anterior teeth vitality: Present study took into account seven patients for teeth vitality. There was no response to pulp testing in anterior teeth immediately after surgery. It was observed that most of the teeth returned to vitality within 4-8 months, except in 4 out of 42. This is almost in line with the findings of Thiesen and Gurensey,[19] who reported 90% teeth return to vitality in 6-12 months.
d. Adjacent teeth damage during ostectomy: Only two teeth out of forty involved at ostectomy site were damaged, which is mere 5% as compared to 10% mentioned by Fordyce and Wedgewood,[16] in their study. This is attributed to better orthodontics with straightened roots of canine and second premolar and also due to the reason that we preferred extraction of first premolar only after marking ostectomy cut through its midaxis.
e. Relapse: No relapse was seen in any of patients in our series. Perhaps post-surgical orthodontics along with retention appliance eliminated any chances of relapse. Same sentiment is shared by almost all authors. Fordyce[13] was the only one who had reported relapse after body ostectomy.
f. Infection: There was no post-operative infection, this was possible due to
    i. Stringent asepsis measures taken
    ii. Protocol followed for antibiotic administration
    iii. Proper alignment and fixation of ostectomized anterior part of mandible.
    iv. Use of hydrocortison limited post-operative edema and swelling.
g. Post-operative occlusion: Posterior occlusion

remained intact in all patients but anteriorly, canine relation was changed to class I in eight out of ten patients. In two patients, gap of approximately 2.5 mm between canine and second premolar was left even after post-op orthodontic. This might be due to less than predicted push back.

h. Post-operative speech effect: Speech was not particularly affected, but atleast one patient reported of difficulty in pronouncing labiodental sounds even after 6 months of operation.
   i. Aesthetics: Eight patients were completely satisfied with straightening of previously concave profile. One patient complained of deviation of chin, although on radiologic and clinical examination, no deviation was evident. Another patient felt, her face gives too much roundish appearance. This was due to the fact that her chin prominence was reduced considerably.

Conclusion

It is not always[20] advantageous to perform push-back procedures on ramal part, as it could disturb well digitating posterior occlusion. There is definite indication of anterior mandibular body ostectomy in many cases, with anterior cross-bite and satisfactory posterior occlusion (though, it may be class III). Not only this procedure has advantage of not involving neurovascular bundle, but is also quick and economical. We believe that a wonderful procedure like this one still retain its relevance to give reasonably satisfactory results in function and aesthetics, if cases are properly selected.

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