

Relationship Between the Gonial Angle Changes after Mandibular Surgery and Presurgical Occlusal Plan Steepness

A. Tehranchi

Professor Dentofacial Deformities Research Center, Research Institute of Dental Sciences and School of Dentistry, Shahid Beheshti University of Medical Sciences

N. Ameli

Postgraduate Student of Orthodontics, Orthodontic Department, Shahid Beheshti University of Medical Sciences, Dental School, Tehran, Iran, Email: nazilaa.aameli@gmail.com Tel: +989122888022

E. Hasanrezaee

Orthodontist

Background and aim: The objective of this study was to investigate the relationship between the gonial angle changes and occlusal plan steepness in patients underwent Bilateral Sagittal Split Osteotomy (BSSO) surgery.

Materials and method: In this analytical retrospective clinical trial, 18 males and 12 females were studied who had been underwent BSSO surgery for mandibular advancement in. Cephalometric landmarks were calculated on the patients' lateral radiographs taken before and 1-6 months postsurgery using Dolphin software. The patients assigned into 3 groups according to different occlusal plan steepness. Landmarks' changes before and after surgery were analyzed by Paired t-test. The changes occurred regarding the normal and flat facial types assessed by Student t-test while the relationship between the presurgical occlusal plan and the landmark changes was evaluated using the Pearson Coefficient.

Results: After BSSO, the gonial angle had increased in all patients with the mean value of 6.83° ($P < 0.0001$) but occlusal plan steepness increased to an insignificant value (mean 2.82°). Increased values of the gonial angle were similarly reported in the patients with normal occlusal plan steepness and flat occlusal plan while no significant relationship was found between occlusal plan steepness before the surgery and the gonial angle changes after surgery. However, fair more increase occurred in patients with normal steepness than lower ones.

Conclusions: The results showed that there is no significant relationship between the gonial angle changes after surgery and the occlusal plan steepness prior the surgery of BSSO for mandibular advancement.

Keywords: Gonial angle, Occlusal plan, Bilateral Sagittal Split Osteotomy

Introduction:

Gonial angle is an indicator of mandibular plan steepness and could be used for predicting facial growth pattern. (1) This angle forms between the line tangent to the inferior border of mandible and a line tangent to ramus and condyle and indicates the mandibular shape according to the relationship between body and ramus. (2)

Large gonial angle demonstrates a tendency to backward rotation of mandible and posterior growth of condyles, which is manifested by steep mandibular plan. (3) On the other hand, decreased gonial angle is an indicator of forward direction of mandibular growth and vertical growth of condyle. (4) The mean angle has been reported 128 ± 7 degree in different individuals with the 3-5 degree difference between two genders. (3,4) But in some studies no difference have been shown between male and female. (5)

Gonial angle and occlusal plan could be altered during growth, functional therapy and orthognatic surgery. (6) Simultaneously, gonial angle has an important role in facial profile harmony and esthetics. (6) Occlusal plan steepness also is important in relapse especially in open bite cases and its tilt could be a predictive factor in relapse following orthognatic surgery. Moreover, an ideal occlusal plan steepness would lead to more stable and esthetic results following surgery. (7)

Orthognatic surgeries perform to improve function and esthetics and Bilateral Sagittal Split Osteotomy (BSSO) is one of the conventional approaches specifically in mandibular prognathism. (8) Obtuse gonial angle is one of the features of mandibular prognathism and treatment should improve this angle. Also, since gonial angle is an important morphologic point in mandible, its changes would play an impressive role on facial esthetics.

Although several studies have reported the gonial angle changes following various surgeries (9), gonial angle changes in relation to occlusal plan steepness? (Please define this variable) (occlusal plane to Frankfort Horizontal plane) following BSSO has not been evaluated. So, the purpose of the present study is to evaluate the relationship between gonial angle changes with occlusal plan steepness following mandibular surgery via BSSO.

Methods and Materials:

In this analytical retrospective study, 30 patients (18 male and 12 female) who were diagnosed as having mandibular retrognathism and underwent BSSO for mandibular advancement in Taleghani hospital were included. All samples had pre and post surgery lateral cephalograms. Patients with other surgeries rather than BSSO, cleft lip/palate, syndroms and two jaw deformities were excluded.

Obweseger modification technique was performed by expert oral and maxillofacial surgeons and lateral bone cuts ended in gonial region. Cephalometric variables including gonial angle changes, occlusal plan to SN and occlusal plan to mandibular plan angle were measured on lateral cephalograms of patients taken before and 1-6 months after surgery using Dolphin imaging software.

Patients were divided into 3 groups according to occlusal plan to Frankfort Horizontal plan angle:

- 1- Normal occlusal plan angle (1.5-14 degree)
- 2- Flat occlusal plan angle (< 1.5 degree)
- 3- Steep occlusal plan angle (> 14 degree)

Then, gonial angle changes evaluated before and after surgery.

Data were analyzed using SPSS version 17. Paired t-test used for determining variable changes before and after surgery and differences in changes among groups were analyzed using student t- test. (20 patients normal angle, 7 patients flat angle and 3 patients steep occlusal plan angle is better to compare with ANOVA) Relationship between different amounts of occlusal plan steepness before surgery and various variable changes were evaluated by Pearson Correlation test.

Results:

In this study, lateral cephalograms of 30 patients were evaluated before and after BSSO surgery. 19 patients (63/3%) had normal occlusal plan angle and 11 patients (36/7%) had flat occlusal plan angle before surgery. After surgery, 20 patients (66/7%) had normal angle, 7 patients (23/3%) showed flat angle and 3 patients (10%) had steep occlusal plan

angle.

Table 1 shows the landmarks measured before and after surgery. Although occlusal plan steepness, occlusal plan to SN, gonial angle and occlusal plan to mandibular plan angle all increased after surgery (2.82, 0.72, 6.83 and 4.73 respectively), only gonial angle and occlusal plan to mandibular plan angle changes were statistically significant. ($P < 0.0001$)

Changes in occlusal plan steepness, occlusal plan to SN, gonial angle and occlusal plan to mandibular plan angles are shown in fig 1-4.

The mean increase in gonial angle showed no statistically significant difference between patients with flat occlusal plan and patients with normal occlusal plan ($P > 0.83$), ($r = 0.25$). Occlusal plan to SN angle showed a mean increase of 1.34 degree in patients with normal occlusal plan while it decreased by -0.36 degree in patients with flat occlusal plan, but the difference was not significant.

Patients with normal occlusal plan demonstrated more increase in occlusal plan to mandibular plan angle which was statistically significant. ($P < 0.0001$), ($r = 0.824$)

Pearson Correlated test showed a significant and positive relationship between occlusal plan changes to SN and occlusal plan steepness. ($P < 0.007$) ($r = ?$), ($r = 0.483$) and also between occlusal plan to mandibular plan angle with occlusal plan steepness. ($P < 0.0001$) In other words, increase in occlusal plan steepness results in an increase of occlusal plan to SN and occlusal plan to mandibular plan angles.

Fig 1- Changes of occlusal plan steepness before and after surgery

Fig 2- Changes of occlusal plan to SN angle before and after surgery

Fig 3- Gonial angle changes before and after surgery

Fig 4- Changes of occlusal plan to mandibular plan angle before and after surgery

Discussion:

Gonial angle has an important role in developing a balance and esthetic profile. In this study, relationship between gonial angle changes and occlusal plan steepness following mandibular advancement via BSSO, was evaluated. Results showed a significant increase in gonial angle after surgery.

Obweseger introduced BSSO technique and reported that gonial angle would decrease following mandibular setback. (10) Bays, Singer (11) and Wisteh, Gomes (12) showed that mandibular advancement results in an increase of gonial angle. Gu et.al (13) reported that sagittal split ramus osteotomy in 62 patients would result in 2.6 degree decrease in gonial angle.

Jonsson et.al (14) reported a mean of 5 degree increase in gonial angle following Sagittal Split surgery but a mean decrease of 3.3 degree after Oblique Sliding Osteotomy. Claudio et.al (9) demonstrated an increase in gonial angle following vertical reduction of maxilla and mandible advancement which is consistent with our results, although there are some differences in the amount of increase in gonial angle.

Yazdani et.al (6) showed a decrease in gonial angle of 2 and 7 degree in mandibular setback via BSSO and Vertical Ramus Osteotomy, respectively.

Several reasons have been reported for this increase in gonial angle. One of them is the forward of proximal segment. Another factor is the resorption which occurs in gonial region and has been mentioned by Jonsson et.al. (15)

Differences in reported results could be due to different fixation duration, use of intermaxillary elastics after IMF release, different modifications of BSSO technique, follow up intervals and presence of TMJ disorder which leads to postsurgical relapse. (16) Also, gonial angle resorption due to overstripping of muscles medial to proximal segment, might be a factor.

In the present study, occlusal plan to SN angle and changes in occlusal plan steepness showed a nonsignificant and

limited increase (0.72 and 2.82 degree, respectively), which is consistent with Yazdani et.al results. (6)
 Various facial patterns show different reactions to BSSO surgery which should be considered when planning a treatment. Moreover, the type of orthodontic and surgical treatment should be modified according to different facial patterns to prevent unwanted changes and establish the treatment stability in mandibular position and occlusion. (17)

Conclusion:

According to present study, we concluded that:

- 1- Gonial angle increases significantly following mandibular advancement via BSSO while occlusal plan steepness increase is limited and nonsignificant.
- 2- Increase in gonial angle is similar in patients with normal and flat occlusal plans and there is no relationship between presurgical occlusal plan steepness and postsurgical gonial angle changes.
- 3- No significant difference observed between male and female patients.

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Table 1- Measurements before and after BSSO surgery

Mean (pre)	Mean post))	SD (pre)	SD (post)	Min (pre)	Min (post)	Max (pre)		
	Max (post)		Landmark					
3.4	6.22	4.49	6.44	-3	-1	11	24	Occlusal plan steepness
13.03	13.75	2.22	2.8	8.5	9.5	18	17.5	Occlusal plan to SN angle
128.23	135.07	4.17	2.79	120	130	136	142	Gonial angle
19.2	13.93	1.95	4.13	15.5	17	23	33	Occlusal plan to mandibular plan angle