

INDIVIDUALIZED IDEAL OCCLUSAL PLANE FOR ORTHOGNATHIC SURGERY AND ORTHODONTIC TREATMENT (PRELIMINARY STUDY)

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Abstract

Introduction: To correct abnormal occlusal plane by orthognathic surgery, we need to have clear criteria for therapeutic occlusal plane. Authors introduced the concept of individualized ideal occlusal plane(Y-plane), which is determined by the size and form of the mandible, and the ideal incisor tip considering upper and lower lip. Authors studied the following to verify if the actual occlusal plane of the patients with optimal jaw relationship corresponds with the individualized ideal occlusal plane.

Patients: We reviewed 44 patients who have normal occlusion visited in the Dept. of orthodontics, Pundang CHA hospital.

Methods: We evaluated if there are agreement between individualized ideal occlusal plane(Y plane) and occlusal plane of actual patients. And we confirmed if tested group has a normal face by measuring FABA, FMA, AB-LOP.

Results: There were no significant differences of FABA, FMA, AB-LOP, Mo-Y plane between male and female. FABA, FMA and AB-LOP were included in the normal value. Average distance of Mo-Y plane was 0.75 ± 0.78 mm.

Conclusion: Individualized ideal occlusal plane may be applied to orthognathic surgery

Key words : Individualized ideal occlusal plane, Orthognathic surgery, Occlusal plane

I. Introduction

Great numbers of conditions manifesting as masticatory disturbances, facial disproportion, poor pronunciation, limited articulation and accompanying these symptoms, serious psychological disturbances cannot be radically treated by orthodontic procedures alone. When the condition basically originates from skeleton pattern, the treatment plan must include both surgical and orthodontic procedures. Skeletal discrepancy is mainly corrected by the movement of the maxilla, mandible or both in either horizontal or vertical plane¹⁾.

Recently with the advanced development of orthognathic surgery techniques, surgeries which expect denture rotation effect by means of the changing the occlusal plane are performed. According to traditional

concept of two jaw surgery the surgeon should increase or at least maintain the occlusal plane angle without respect to initial preoperative inclination of occlusal plane for favorable and safe surgical procedure outcome. However, this approach causes unfavorable functional side-effects. Previously considered as unsafe, occlusal plane angle decreasing procedure is found to be as safe as occlusal plane angle increasing one recently^{2,3)}.

For the maxillofacial surgeons, the decision of the operative tactics concerning the occlusal plane angle is always hard to make. For instance, it appears extremely difficult to determine the amount of concrete vertical movement in maxillary posterior region even within normal range of occlusal plane angle (normal range of occlusal plane to FH plane angle: 8-12 degrees).

In prosthetic dentistry various approaches are

applicable regarding to different clinical situations balanced occlusal restoration to the edentulous jaw or natural teeth restoration^{4,6)}. Using the results of various studies it appears possible to find an ideal or individualized occlusal plane for every particular case taking into account individual skeletal pattern properties by means of estimation of relation between occlusal plane curvature and mandibular incisor tip.

On the one hand, individualized ideal mandibular occlusal plane was suggested by Sang-Duck Yang⁷⁾. He postulated that normal mandibular occlusal plane in patients with normal occlusion is located in an imaginary arch formed between incisor point(1.5mm in front of Nap to L1, soft tissues stomion incised in cross-manner) and the center of the imaginary head of mandible(transverse horizontal axis from orbitale crosses the FH plane under the angle 6.5 degrees crossing mandible in segment 1/3 in frontal direction), the radius of curvature is linear distance between anterior point(incisor tip) and posterior point(center of mandibular movement) (Fig.1). And he reported that mandibular occlusal plane corresponded to Y-plane in average 15 children of both sexes in the age of 11. It demonstrated the existence of individualized ideal occlusal plane in the patients

with normal occlusal plane. It is essential for surgeons to take into account above mentioned normal relations between anatomical points(individualized occlusal plane) for forming individual approach to every other case and operative tactics for maximal operation outcome. Authors examined whether the mandibular occlusal planes of the patients with normal occlusion in adults are in accord with individualized ideal occlusal plane considering that most of the orthognathic patients are adults.

II . Material and methods

1. Patients

Forty-four patients (male : 19, female : 25) among the patients who visited to Dept. of Orthodontics, Bundang CHA Hospital, who satisfied with inclusion criteria were studied, from December 2002 to June 2003.

Inclusion criteria was followings

- (1) Patients who did not require surgical procedures
- (2) Patients who had skeletal age of 18 and more at the admission.

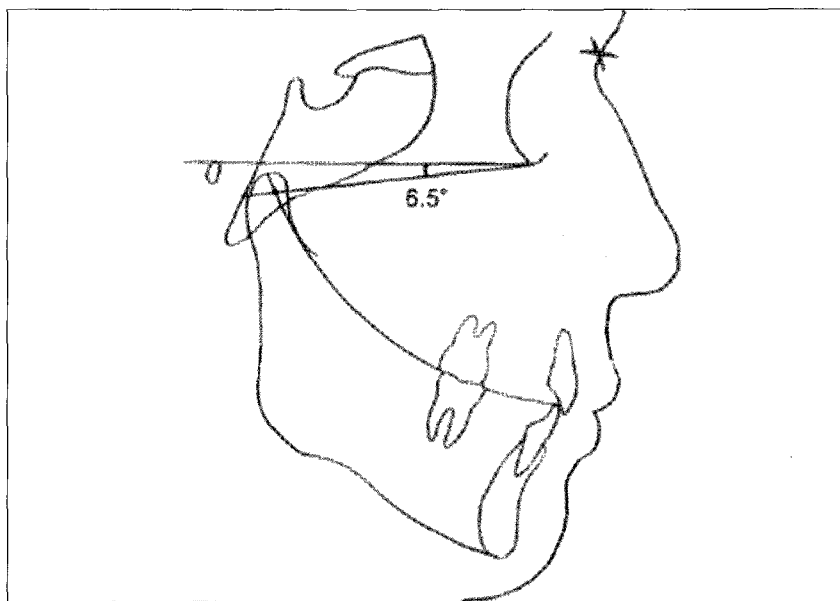


Fig. 1. Individualized ideal occlusal plane (Y plane): it corresponds with individual skeletal pattern.

- (3) Patients who did not experience of orthodontic treatment without crowding and spacing.
- (4) Sn'-Stm : Stm-Me' equal to 1:2~1:2.1
- (5) F'A'B'A' (FH to A'B' plane angle, Y-angle) should be in the range of 79°-83° on Lat. cephalogram
- (6) Overbite and overjet should be in the range of 1.5~3.0 mm

2. Methods

Cephalography(lateral) were taken in all the experiment participants. All the images were prepared on 0.003' acetate film, measured for FABA, FMA, AB-LOP, Mo-Y plane and the outcomes were compared with average, standard deviations, and Student's t-test was performed for the significance according to the sex.

According to the study results, individualized ideal occlusal planes have following two standard points along occlusal surface of mandible on occlusal inclination and in vertical plane (Fig.2).

* Mandible incisors location

1.5mm in front of Na^p to L1 in anterior direction (on orthognathic procedure FABA - 81 degrees), vertically soft tissues stomion cross point .

* Transverse horizontal axis (THA)

6.5 degrees from orbitale to FH plane inferiorly. This line crosses the condyle of the mandible in 3 division in the anterior 1/3.

* Place of Y-plane formation

circular arch with radius of the distance between these two standard points.

III . Results

The study objects were 44 patients (male : 19, female : 25) of average. Age: male - 27.0±7.9, female 24.56±4.6, average age was estimated as 25.6±6.3. FABA, FMA, AB-LOP measurements applied to estimate jaw deformity and occlusion showed the average results 82.2±3.0, 24.1±4.6, 90.2±4.5 respectively. It means that the experimental group had normal jaw relation and occlusion. The average distance between Y-plane to Mo(midsectional point of vertical overlapping between upper and lower 1st molar was 0.75±0.78mm. All these data had no significant differences between the sex (Table 1).

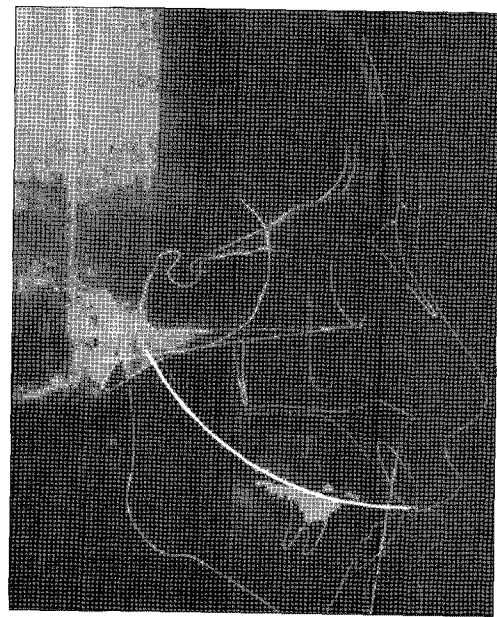


Fig. 2. Individualized ideal occlusal plane to the lateral cephalogram of patient with normal jaw and occlusal relation.

Table 1. Measurement in Korean adults with normal occlusion.

	Males (n=19)		Females (n=25)		Total (n=44)		P-value
	Mean	SD	Mean	SD	Mean	SD	
Age	27.00	7.92	24.56	4.57	25.61	6.27	0.24
FABA	81.43	3.01	82.86	2.84	82.24	2.97	0.17
FMA	23.14	4.52	24.80	4.70	24.08	4.64	0.25
AB-LOP	89.06	5.22	91.06	3.75	90.20	4.50	0.15
Mo-Y plane	0.69	1.02	0.79	0.55	0.75	0.78	0.68

Statistical significances were tested by student's t-test

IV. Discussion

Occlusal plane is functional complex formed by each tooth's cutting plane and occlusal surface. It can manifest diversely in variety of complex abnormalities and cause different physiological effects. The teeth, mandible, maxilla, chewing muscles, as well as chewing habits take part in occlusal plane formation. In adults normal occlusal plane inclination is considered as follows : Downs average - 9.3 degree, Goldman average - 8.6 degree, Wolford average - 4~12 degree, Steiner SN plane - 14 degree^{2,3,8-10}.

Not only movement of mandible, maxilla but also the change of occlusal plane angle are recognized as important factor in orthognathic surgery. Reyneke and Evans reported the intentional change of occlusal plane angle in simultaneous 2 jaw surgery in mandibular prognathic patients and retrognathic patients¹¹. The technique included maxillary posterior part upward movement and clockwise rotation, avoiding counterclockwise rotation was considered as favorable for operation outcome.

Wolford et al. reported the cases where the operation results showed esthetic benefit with certain defects to functions^{2,3}.

Epker et al. reported that probability of recurrence and operation outcome depend on inclination and operation technique, concluding that clockwise rotation was more preferable and led to lesser number of recurrences¹².

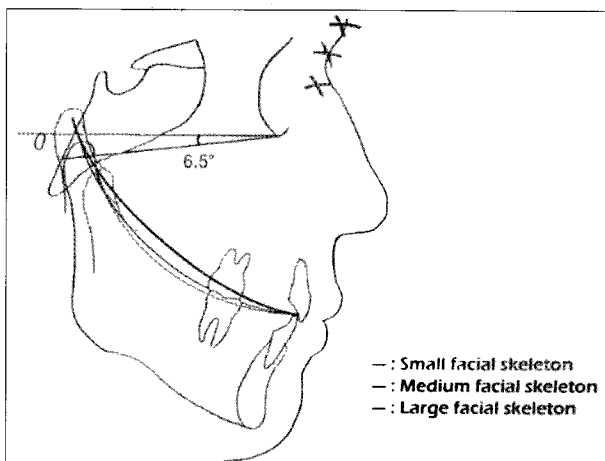


Fig. 3. Different type of ideal occlusal plane(Y-plane) according to the facial skeleton.

Based on Downs, Goldman, Wolford and Steiner's research, the average occlusal plane inclination angle and its importance was estimated^{2,3,8,10}. The main purpose of these studies was to estimate how the skeletal pattern differences of different individuals affect individual occlusal plane angle. During this orthodontic research Bonwill presented orthodontic approach named "Bonwill triangle" - imaginary triangle the sides of which connect both mandibular heads and the middle between mandibular incisors⁴. Each side of "Bonwill triangle" is 4 inches long. According to the orthodontic theory mandible moves in antero-posterior direction in the plane of this imaginary triangle.

The imaginary line called curve of Spee is a concave, depressed imaginary line connecting mandibular incisors, canine and molar buccal occlusal cusp with the center on lacrimal process of orbit⁶. Mandible moves in antero-posterior and lateral directions along the curve of Spee. Monson developed an integrated approach including "Bonwill triangle", curve of Spee, teeth occlusal surfaces connecting both heads of mandible, called "4 inch sphere", which is imaginary curve of a sphere with 4 inch radius⁵. This approach is beneficial to curve of Spee, which can be the same among the individuals with very different anatomical features and doesn't reflect whole anatomical pattern because it reaches only to the ramus of mandible.

Above mentioned occlusion theories suggest that

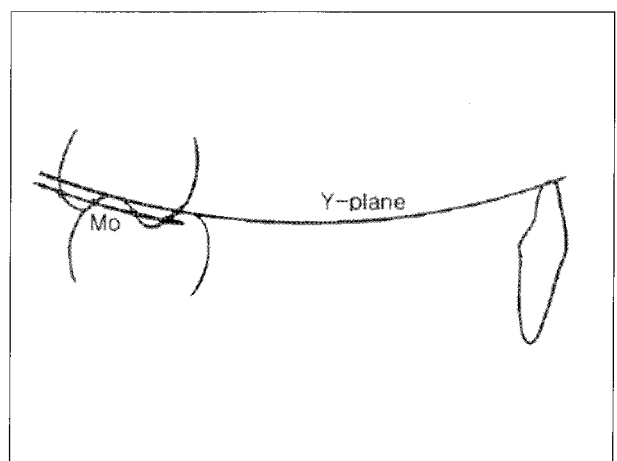


Fig. 4. The distance between middle section point of maxillomandibular first molar cusp and Y plane.

curvature of occlusal plane and mandibular 3 point (2 condyle head and incisor tip) are closely related. Yang postulated that normal mandibular occlusal plane in patients with normal occlusion is located in an imaginary arch formed between incisor point and the center of the imaginary head of mandible, the radius of curvature is linear distance between incisor tip and center of mandibular movement⁷⁾. So, concavity of the curvature is changed according to the distance between two points (Fig.3).

In addition, Delaire and Schendel settled individual approach which accounts entire cranial anatomy¹³⁾. In other words, he settled the imaginary line that starts at ANS, passes the tip of odontoid process, continues to the inferior part of OM crossing the point where CF4 line divides the menton distance by half. This parallel is considered to be ideal individual occlusal plane.

In the current study authors investigated whether individualized ideal occlusal plane(Y plane) exists in 44 adult patients with normal jaw relation. In the experimental group we used FABA, FMA, AB-LOP measurements to estimate if the participants have normal or abnormal anatomical jaw relation. The results were as follows 82.2 degrees, 24.1 degrees, 90.2 degrees respectively. According to this data, the conclusion that the participants did not have anatomical anomalies was made. There were no significant differences in measurements in data outcome between males and females. Additionally, the average distance between middle point of 1st molar cusp tip to Y-plane was 0.75mm (Fig.4). True distance between the cusp tip and Mo was 0.5mm. The cusp tip of mandibular first molar is located on the Y plane considering errors during taking the cephalography and measurement.

This study confirmed statistically that individual occlusal plane is located in Y plane in adults with normal occlusal plane while previous study evaluated individual occlusal plane of average age 11 years, even small numbers. We considered that measurement of individual occlusal plane inclination will be valuable for planning the treatment in adult patients. We also suppose that the measurement is essential for the preoperative estimation of appropriate occlusal angle and operative tactic choice. We

know that some individual anatomical anomalies cannot be surgically corrected, however we can compromise in ideal and reality.

The effects of recovering individual occlusal plane angle will be useful for increasing in postoperative stability, formation of physiological occlusal pathway and functional occlusion. Oral function test such as maximum masticatory effect, mastication efficiency electromyogram evaluation will be needed in order to verify the effects of recovering the individual occlusal plane physiologically and esthetically¹⁴⁾. In summary, it is suggested that individualized occlusal plane of adults with normal jaw and occlusal relation would be located in Y-plane.

V. Conclusion

It is suggested that individualized occlusal plane of adults with normal jaw and occlusal relation would be located in Y-plane. So, we suggest that Y-plane will be the index of establishment of individualized occlusal plane on orthognathic surgery.

References

1. Neal JJ, West CR, Lovius BB : The stability of the lower labial segment following surgical correction of Class III skeletal discrepancy. *Br J Oral Maxillofac Surg* 26 : 190, 1988
2. Wolford LM, Chemello PD, Hiliard F : Occlusal plane alteration in orthognathic surgery. Part I: Effects on function and esthetics. *Am J orthod Dentofac Orthop* 106 : 304, 1994
3. Wolford LM, Chemello PD, Buschang PH : Occlusal plane alteration in orthognathic surgery, Part II: Long-term stability of results. *Am J Orthod Dentofac Orthop* 106 : 434, 1994
4. Bonwill WGA : The science of the articulation of artificial dentures. *Dent cosmos* 20 : 321, 1878
5. Monson GS : Applied mechanics to the theory of mandibular movement. *Dental Cosmos* 1039, 1932
6. Spee FG : The gliding path of the mandible along the skull (English Translation : *JADA* 100 : 670, 1980)
7. Sang-duck Yang : Evaluation and establishment of occlusal plane in clinical orthodontics. *Korean Foundation for Gnatho Orthodontic Research* 5 : 5, 2001
8. Downs WB : Variations in facial relationships: Their significance in treatment and prognosis. *Am J Orthod* 34 : 812, 1948
9. Steiner CC : Cephalometrics for you and me. *Am J Orthod* 39 : 729, 1953
10. Goldman S : The variations in skeletal and denture patterns in excellent adult facial types. *Angle Orthod* 29, 1959

11. Reyneke JP, Evans WG : Surgical manipulation of the occlusal plane. *Int J Adult Orthodon Orthognath Surg* 5 : 99, 1990
12. Epker BN, Wesberg GA : Mechanisms of early skeletal relapse following surgical advancement of the mandible. *British J Oral Surg* 20 : 175, 1982
13. Delaire J, Schendel SA : An arthitectoral and structural craniofacial analysis: A new lateral cephalometric analysis. *Oral Surg Oral Med Oral Pathol* 52 : 226, 1981
14. Willen van den Braber, Hilbert van der Glas, Andries van der Bilt Frederik Bosman : Masticatory function in retrognathic patients, before and after mandibular advancement surgery. *J oral Maxillofac Surg* 62 : 549, 2004

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