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Evaluation of stability after two jaw surgery

조선대학교 대학원

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이 승 용

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국문초록

양악 수술 후 교합평면의 안정성 평가

이 승 용

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본 연구의 목적은 두개안면구조에 존재하는 각각의 기준평면들과 하악의 계측점 및 교합평면과의 관계를 계측함으로써 양악 수술 후의 안정성을 평가하는데 있다.

Le Fort I 골절단술 및 하악 양측성 시상분할 골절단술을 시행한 골격성 3급 부정교합 환자 20명에 대한 수술 직전, 수술 직후, 1년 이상 경과 관찰 시의 측모두부방사선규격 사진을 분석하여 다음과 같은 결과를 얻었다.

1. 교합평면의 술후 회귀량은 SN plane과 FH plane에 대해서 각각 -0.26±2.8°, -0.44±3.29°로 양악 수술 후 교합평면의 안정성은 유지되었다. N·ANS plane과 occlusal plane이 이루는 각에 있어 T2와 T3 시기의 다소와 간의 유의한 차이를 보였으나 그 외의 교합평면의 경사도에서는 유의성 있는 차이를 보이지 않았다.
2. B point와 Pogonion point의 회귀량은 최소 1년 이상 경과 후에 있어 각각 0.85±0.46㎜, 0.76±0.48㎜ 전방 이동하였으며, 1.16±0.36㎜, 1.13±0.71㎜ 상방 이동하였다. 수직적 회귀량이 수평적 회귀량보다 다소 크게 나타났다.

I. Introduction

Dentofacial deformity patients have functional and esthetical impairment due to skeletal disharmony, and the patients could not solve the dentofacial skeleton problem itself by growth control or orthodontic therapy alone. In such cases, to solve the problems, together with orthodontic treatments, realign the jaw by accompanying orthognathic surgery, or relocate the segments of alveolar bone, and thus appropriate function and esthetics could be obtained. [1-3)]

Initially, orthognathic surgery was performed only on the mandible, however, the skeletal Class III malocclusion does not necessarily imply mandibular prognathism. Particularly, for cases with the substantial antero-posterior, vertical, and horizontal skeletal disharmony, orthognathic surgery is required for the maxillo-mandibular bone. Such Le-Fort I osteotomy on the maxilla allows the three-dimensional move of the maxilla and permits to obtain more satisfactory results for dentofacial deformity patients. Therefore, 2 jaw surgery has been improved afterward, and it became one of methods used widely for the treatment of dentofacial deformity patients.[4)]

In such orthognathic, Le Fort I osteotomy and diverse mandibular ramus surgeries became traditional surgeries to be used for the skeletal disharmony and the recovery of malocclusion in dentofacial deformity patients, nonetheless, consequent relapse, TMJ Dysfunction, dysesthesia, infection, bleeding, scar, etc. have been also reported abundantly.[5,6)] Among them, stability and the relapse tendancy after orthognathic surgery are important factors determining the success or failure of surgery itself. Bothur et al.[7)] have reported that the movement within 5mm range is stable regardless of the fixation method or with or without bone graft.

Proffit et al.[8] have reported that in 2 jaw surgery, the relapse trait is comparable to one-jaw surgery, however, in the grade 3 malocclusion cases, 2 jaw surgery was more stable than one-jaw surgery, and in the grade 3 malocclusion patients, 2 jaw surgery was more stable than in the grade 2 malocclusion patients. Donasky et al.[9] have reported that after 1 year, 2 jaw surgery accompanied Le Fort I osteotomy and mandibular advancement surgery was more stable than 2 jaw surgery accompanied mandibular recession surgery. However, in Franco et al.[10] cases, 2 jaw surgery showed 53.4% relapse rate, and thus it showed a higher relapse rate than 43.7% relapse rate shown in surgery performed only on the mandible.

In 2 jaw surgery, the change of the occlusion plane occurs unavoidably, and the rotation of such change of the occlusion plane has been considered to be an important factor for the stability of bone fragment after surgery. Wolford et al.[11] and Reuneke et al.[12] reported the effects obtained by changing the occlusion plane during surgery, and Sinobad examined the association of the occlusion plane with the palatal surface.

Therefore, in this study, the stability after 2 jaw surgery was evaluated by measuring the standard plane present in the craniofacial plane, the B point in the mandible (Pogonion point), and the relation to the occlusion plane of which location is inevitably changed during 2 jaw surgery.

Ⅱ. Patients and methods

a. Patients

This study was conducted on patients with the skeletal III malocclusion, visited the dental clinic, Chosun University, from 2000 to 2007, and among patients underwent 2 jaw surgery in the department of oral maxillofacial surgery at our hospital (Le-Fort I osteotomy in the maxilla and bilateral saggital split osteotomy in the mandible), the difference of the mandibular recession rate was less than 3㎜ and thus severe facial asymmetry was not shown, and 20 patients able to followed up for minimum 1 year. All patients underwent orthodontic therapy prior to surgery, the firm fixation using small metal plates was performed on the maxilla and the mandible, and after surgery, intermaxillary fixation was performed by placing splints approximately for 2 weeks. As the gender of the subject patients, the male was 14 patients and the female was 6 patients, their age distribution was form 18.10 years to 32.79 years, and the mean age was 21.89 years.

B. Methods

In this study, the time immediately prior to surgery was defined as T1, immediately after surgery was T2 (average 21.7 days), and more than one year after surgery was T3 (average 13.4 months).

The lateral cephalometric radiographs of all patients were taken by the Planmeca Proline XC (PLANMECA, Finland, Helsinki), in the department of diagnostic radiology, dental clinic, Chosun University, at the time points T1, T2, and T3 under identical conditions.

On each lateral cephalometric radiographs, projection images were

prepared, the standard point (Fig. 1) and the standard surface (Fig. 2), and the measurement categories were determined, and the distance as well as the angle were measured up to 0.1㎜ and 0.5°, respectively.

(1) Landmarks

① ANS (Anterior nasal spine): anterior nasal spine. The most anterior point of nasal floor, or the tip of premaxilla on the median plane.
② Me (Menton): the lowest point of mandibular median area.
③ S (Sella) : The center of sella turcica
④ N (Nasion): The most anterior point of fronto-nasal suture on the median plane.
⑤ PNS (Posterior nasal spine): The most posterior area of nasal floor
⑥ A (Subspinale) : The deepest point between the ANS and the Prosthion on the median plane.
⑦ B (Supramentae) : The deepest point between the Infradentale and the Pogonion on the median plane.
⑧ Pg (Pogonion) : The most anterior point of chin contour on the median plane.
⑨ Or (Orbitale) :The lowest point of bony orbit contour.
⑩ P (Porion): The highest point of external auditory canal.

(2) Standard lines

<Horizontal planes>

① SN plane :The line connecting the nasion in the center of sella turcica
② HP (Horizontal plane): The horizontal standard line on the SN plane with 7° ascending slope.

③ FH plane (Frankfort horizontal plane): The line connecting the orbitale on the anatomical porion.

④ palatal plane: The line connecting the ANS to the PNS.

⑤ mandibular plane : The line connecting the lowest point of mandibular ramus and the menton.

<Vertical planes>

① VP (Vertical plane): The vertical standard line vertical to the HP on the N point.

② N-ANS plane: The line connecting the nasion and the ANS.

③ N-Pg plane: The line connecting the nasion and the pogonion.

④ AB plane: The line connecting the point A and the point B.

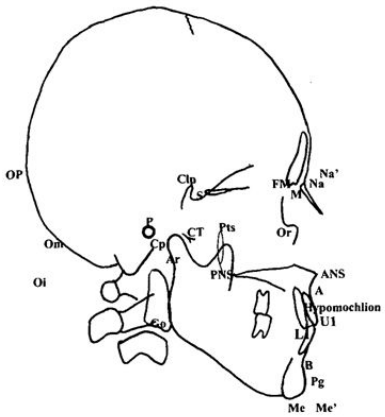

Fig 1. Reference points.

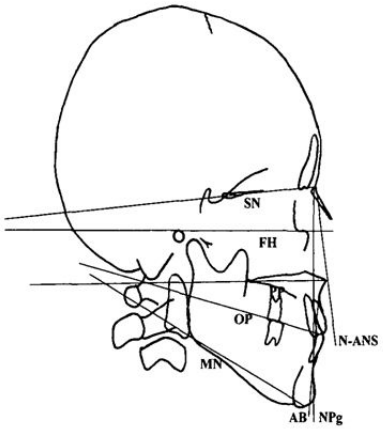

Fig 2. Reference planes for measurement of occlusal plane angle.

(3) Measurement categories

<The slope of occlusal plane>

① SN plane - Occlusal plane

② FH plane - Occlusal plane

③ Palatal plane - Occlusal plane

④ Mandibular plane - Occlusal plane

⑤ N.ANS plane - Occlusal plane

⑥ N.Pg plane - Occlusal plane

⑦ AB plane - Occlusal plane

<The horizontal as well as vertical distance of the B point and the Pogonion point>

① Horizontal distance of B point: VP - B

② Horizontal distance of Pogonion point: VP - Pg

③ Vertical distance of B point: HP - B

④ Vertical distance of Pogonion point: HP - Pg

Ⅲ. Results

The mean of the occlusal plane angle to the horizontal as well as vertical measurement plane measured immediately prior to surgery (T1), immediately after surgery (T2), and one year after surgery (T3) is shown in Table 1. The angle of the SN plane and the occlusal plane immediately prior to surgery was found to be 17.39±6.70°, immediately after surgery was 20.81±6.38°, and one year after surgery was 20.54±5.37°, and the angle of the FH plane and the occlusal plane immediately prior to surgery was shown to be 13.45±7.26°, immediately after surgery was 14.55±5.26°, and one year after surgery was 14.11±4.44°.

The mean change amount according to the occlusal plane to the horizontal and vertical measurement plane calculated by the immediate surgical change (T2-T1), the long-term follow-up change (T3-T2), and the total change (T3-T1) was shown in Table 2. The change of the angle of the SN plane and occlusal plane of the immediate surgical change was 3.42±3.64°, and the follow-up change was shown to be -0.26±2.8°, and regarding the change of the angle of the FH plane and the occlusal plane, the immediate surgical change was 5.1±5.65°, and the follow-up change was shown to be -0.44±3.29°.

The mean of the location the B point and the Pogonion point measured immediately prior to surgery (T1), immediately after surgery (T2), and one year after surgery (T3) is shown in Table 3, and similarly, the mean value of the movement amount caused by surgery and during the follow up period is shown in Table 4. The horizontal and vertical relapse movement of the B point was 0.85±0.46㎜ and

1.16±0.36㎜, and the horizontal and vertical relapse movement of the Pogonion point were shown to be 0.76±0.48㎜ and 1.13±0.71㎜.

Table 1. Average occlusal plane angles at preoperative (T1), immediate postoperative (T2), and long-term postoperative (T3)

	Preoperative (T1)	Immediate postoperative (T2)	Long-term postoperative (T3)
SN plane - Occlusal plane	17.39±6.70	20.81±6.38	20.54±5.37
FH plane - Occlusal plane	13.45±7.26	14.55±5.26	14.11±4.44
Palatal Plane - Occlusal plane	9.73±5.07	10.74±5.18	10.07±4.49
Mandibular plane - Occlusal plane	18.58±4.37	18.47±4.94	19.36±4.83
N·ANS plane- Occlusal plane	102.72±6.91	107.57±5.32	106.05±4.84
N·Pg plane- Occlusal plane	100.69±5.45	100.26±3.89	99.26±3.80
AB plane- Occlusal plane	100.53±10.76	93.83±2.94	93.2±4.19

Table 2. Average immediate surgical (T2-T1), follow-up (T3-T2), and total changes (T3-T1) of occlusal plane angles

	Immediate surgical change	Follow-up change (T3-T2)	Total change
SN plane - Occlusal plane	3.42±3.64	-0.26±2.8	3.15±4.25
FH plane - Occlusal plane	5.1±5.65	-0.44±3.29	4.65±5.14
Palatal Plane - Occlusal plane	1±3.64	-0.17±2.37	0.97±3.76
Mandibular plane - Occlusal plane	-6.11±3.72	0.39±3.21	-6.28±3.42
N·ANS plane - Occlusal plane	4.86±5.26	-1.52±2.29	3.34±5.27
N·Pg plane - Occlusal plane	-1.43±3.74	-0.3±2.2	-1.53±3.6
AB plane - Occlusal plane	-6.7±9.44	-0.63±2.64	-7.33±8.46

Table 3. Distance of between B/Pogonion point and HP/VP

	Preoperative (T1)	Immediate postoperative (T2)	Long-term postoperative (T3)
Horizontal distance of B point	70.88±7.07	65.98±6.83	66.85±7.54
Horizontal distance of Pogonion point	72.76±7.49	68.15±7.42	69.01±8.36
Vertical distance of B point	99.06±6.83	96.01±5.98	98.23±7.54
Vertical distance of Pogonion point	111.03±10.68	108.39±9.65	109.19±9.45

Table 4. Horizontal and vertical movement of B/Pogonion point

	Immediate surgical change	Follow-up change (T3-T2)
Horizontal distance of B point	-6.23±5.65	0.85±0.46
Horizontal distance of Pogonion point	-6.54±5.46	0.76±0.48
Vertical distance of B point	-4.34±1.49	1.16±0.36
Vertical distance of Pogonion point	-3.98±1.76	1.13±0.71

IV. Discussion

For dentofacial deformity patients, by performing orthodontic therapy and orthognathic surgery simultaneously, not only the malocclusion within the oral cavity, but also the severe disharmony of the temporomandibular bone could be improved. Recently, simultaneous 2 jaw surgery that performs surgery not only on the mandible but also on the maxilla has been performed widely. In such manners, as orthognathic surgery is performed frequently, the accurate prediction of the change of soft tissues caused by the amount of movement of hard tissues is required, and much attentions have been paid on the changes occurred after long term postsurgical follow ups.

The definition of the relapse trait varies depending on the point of view of investigators. Pepersack et al.[13] defined relapse as cases that anatomical structures are moved to the anterior by more than 1.5mm based on the maxillar tooth in cases treated for mandibular prognathism. MacIntosh[14] defined clinical relapse as cases that the chin contour was changed by more than 1.0mm in regard to skeletal changes. Marianne et al.[15] considered the relapse less than 2㎜ after surgery as stable. Martis et al.[16] considered relapse as one of postsurgical complications, and the postsurgical change less than 1mm was not included in relapse, and it was not clinical problems.

The occlusal plane is the functional plane in the masticatory area formed by the complex effects of the growth and development of the tooth and the alveolar bone.[17] All intrinsic and extrinsic factors and environmental factors acting on this area exert effects on the formation of the occlusal plane by the mutual reactions of the maxilla, the

mandible and other bone tissues, various facial muscles including masticatory muscles, and teeth.[18] In dentofacial deformity patients, the diagnosis of the occlusal plane associated with the craniofacial structure, the establishment of treatment protocols, and the evaluation of the stability after surgery could be considered to be greatly meaningful.

The occlusal plane is formed by the occlusal plane of each tooth and the incisal edge, and depending on individuals and depending on the pattern of malocclusion, it presents as diverse patterns.

The occlusal plane could be changed artificially by 2 jaw surgery, and thus it is desirable to diagnose dentofacial deformity based on the understanding of the occlusal plane and to treat. The establishment of the new occlusal plane could be classified to the clockwise rotation of the maxillo-mandibular complex that is the direction expanding the occlusion plane during 2 jaw surgery and the counterclock wise rotation treatment of the maxillo-mandibular complex that reduces the occlusal plane. Generally, in the orthognathic surgery for open bite, the procedure of the clockwise rotation of the maxillo-mandibular complex that increases the occlusal plane angle to the skull base reference plane has been recognize as a stable surgery.

Reyneke et al.[12] have reported that the clockwise rotation of the occlusal plane by raising the posterior area of the maxilla to the upper part that increases the occlusal plane angle against the cranial standard plane is advantageous for stability, and additionally, the mandible is moved to the posterior upper area and thus esthetic effects could be elevated. However, recently, Wolford (? Stein….)[4] have reported that if it is used appropriately to each case, both the clockwise and

counterclock wise rotation do not create problems in maintaining stability after surgery. Epker[19] pointed out problems to change the occlusal plane artificially without understanding the mutual functional relationship of cranial facial area. Irvani[20] have reported if less than 1.0° change of the occlusal plane angle after surgery is defined as stable surgery, even after the reduction of the occlusal plane angle caused y the counterclock wise rotation, stability after surgery could be secured.

In this study, the change of the occlusal plane angle by 2 jaw surgery on the SN plane as well as the FH plane was 3.42±3.64° and 5.1±5.65°, respectively, and it was smaller than 5.6±2.8° of the change of the occlusal plane angle in clockwise rotation reported by Wolford et al.[11] At the follow ups performed 1 year after surgery, the change was -0.26±2.8° and -0.44±3.29°, respectively. The change of the occlusal plane angle was values comparable to -0.6±1.5° (clock-wise rotation) and 0.2±1.3° (counterclock-wise rotation) that are the changed amount of the surgery on the occlusal plane angle during long term follow ups reported by Wolford et al.[11], and it was found that the occlusal plane was maintained stably even after surgery.

Moss[21] has reported in a study performed on 31 patients that during the long term observation, the maxillary front teeth became protruded, the mandibular front teeth became upright, and the SNB was decreased, however, the SNA was hardly changed, and the relapse trait in the Pog area was shown to be greatest.

In the analysis of the relapse trait, numerous studies pertinent to the movement direction after surgery have been conducted. Weiss et al.[22] have reported that in maxillary advancement surgery, average

postsurgical changes occurred in the antero-posterior direction, and the horizontal location during the initial 6 weeks after surgery, changes to both direction occurred, however, in average, it hardly changed and it was not statistically significant.

In this study, the horizontal as well as vertical relapse volume of the B point and the Pogonion point were examined. After longer than 1 year, the horizontal and vertical relapse of the B point was 0.85±0.46 ㎜ and 1.16±0.36㎜, respectively, the horizontal and vertical relapse volume of the Pogonion point was 0.76±0.48㎜ and 1.13±0.71㎜, respectively. The relapse occurred in the antero-posterior direction, and considering the previous studies reported by Pepersack[13], MacIntosh et al.[14], it is evaluated that in both directions, postsurgical stability was maintained.

V. Conclusion

On the skeletal grade 3 malocclusion patients performed 2 jaw surgery using Le-Fort I osteotomy and bilateral mandibular saggital split osteotomy, the lateral cephalometric radiographs of the time points immediately prior to surgery, immediately after surgery, and follow ups performed after more than 1 year were analyzed and the following conclusion was obtained.

1. The postsurgical relapse volume of the occlusal plane to the SN plane and the FH plane was -0.26±2.8° and -0.44±3.29°, respectively, and after 2 jaw surgery, the stability of occlusal plane was maintained. Regarding the angle formed by the N·ANS plane and the occlusal plane, a significant difference between the time point T2 and T3 was shown, and other than that, in the slope of occlusal plane, a significant difference was not shown.

2. In regard to the relapse of the B point and the Pogonion point at the time after minimal 1 year, it advanced to the anterior area by 0.85±0.46㎜ and 0.76±0.48㎜, respectively, and moved to the upper area by 1.16±0.36㎜ and 1.13±0.71㎜, respectively, and the vertical relapse amount was shown to be slightly larger than the horizontal relapse amount.

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본인이 저작한 위의 저작물에 대하여 다음과 같은 조건아래 조선대학교가 저작물을 이용할 수 있도록 허락하고 동의합니다.

- 다 음 -

1. 저작물의 DB구축 및 인터넷을 포함한 정보통신망에의 공개를 위한 저작물의 복제, 기억장치에의 저장, 전송 등을 허락함
2. 위의 목적을 위하여 필요한 범위 내에서의 편집·형식상의 변경을 허락함. 다만, 저작물의 내용변경은 금지함.
3. 배포·전송된 저작물의 영리적 목적을 위한 복제, 저장, 전송 등은 금지함.
4. 저작물에 대한 이용기간은 5년으로 하고, 기간종료 3개월 이내에 별도의 의사 표시가 없을 경우에는 저작물의 이용기간을 계속 연장함.
5. 해당 저작물의 저작권을 타인에게 양도하거나 또는 출판을 허락을 하였을 경우에는 1개월 이내에 대학에 이를 통보함.
6. 조선대학교는 저작물의 이용허락 이후 해당 저작물로 인하여 발생하는 타인에 의한 권리 침해에 대하여 일체의 법적 책임을 지지 않음
7. 소속대학의 협정기관에 저작물의 제공 및 인터넷 등 정보통신망을 이용한 저작물의 전송·출력을 허락함.

동의여부 : 동의(○) 반대( )

2011 년 2 월 일

저작자: 이 승 용 (서명 또는 인)

조선대학교 총장 귀하