A STUDY ON THE TEMPOROMANDIBULAR DISORDERS IN DENTOFACIAL DEFORMITY PATIENTS

—Individual ideal occlusal and mandibular plane to cranial base—

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—Abstract—

Dentofacial deformities are important contributing factors in developments and prognosis of temporomandibular disorders.

Nowadays,several authors have reported that alteration of occlusal plane is the important factor in functional and esthetic improement of orthognathic surgery of dentofacial defomty patients.

The objects of this article are to investigate the incidence and the changes of the symptoms of the temporomandibular disorders through the orthognathic surgery of 41 dentofacial deformity patients and to suggest the interrelation between changes of temporomandibular disorder and occlusal plane and mandibular plane.

The result s are as follows :

1. The incidence of the temporomandibular disorder was 46% and it was decreased to 20% after orthognathic surgery.
2. There were no significant relationships between types of DFDs, types of anterior bite and changes of temporomandibular disorder symptoms.
3. There was a significant relationship between postoperative occlusal and mandibular planes and changes of temporomandibular disorder symptoms.
4. To obtain a optimal function of gnathologic system in correction of dentofacial deformities,it is proposed to achieve the parallelism of postoperative occlusal plane and mandibular plane to its individual ideal occlusal plane and mandibular plane.

Key words : temporomandibular disorder,dentofacial deformity, occlusal plane

I. Introduction

Temporomandibular joint is the very complicated and important site in function, and diagnosis and treatment of temporomandibular disorder are difficult because of complexity of its many kinds of causes. The study of TM disorder have extensively discussed by Laskin

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[1], Wisth[2], O'Ryan[3], Kerstens[4].

The origin of TM disorder is divided by central and local factors and emotional & physical stress have been considered to the most important of central factor of TM disorder[5]. Malocclusion, bad oral habits and dentofacial deformity are significant causes of local factors.

The symptoms of TM disorder are considered to be : pain and tenderness on TMJ & masticatory muscles, limitation of mouth opening, TMJ noises(click, crepitus) Masticatory system has the individual originality in function and morphology in dentofacial deformity patients as well as normal person and furthermore, units of craniofacial region are functionally equilibrated each other even in the dentofacial deformity patients although dentofacial units are deformed.

So, it is obvious that craniofacial deformity is closely related with functional disorder of masticatory system.

We tried to study whether the incidence of TM disorder in dentofacial deformity patients is different from the incidence in normal person and whether the symptoms of TM disorder change when dentofacial area have been changed in morphology and function through the orthognathic surgery.

Nowadays, cephalometric analysis was used for looking for the contributing factors of TM disorder, and one of them, occlusal plane and mandibular plane have been discussed as the one of the significant factors.

Recently, occlusal plane is considered as important factor in establishing the diagnosis and treatment planning of dentofacial deformity[6,7,8,9]. It was reported that alteration of occlusal plane in orthognathic surgery could reduce postoperative relapse and obtained functional improvement[6]. And Delaire[10] have suggested that individual occlusal plane/mandibular plane which are decided by their craniofacial relationship is significant factors in diagnosis of dentofacial deformity.

The objects of this article are to investigate the incidence and the changes of the symptoms of the TM disorder after surgery of dentofacial deformity patients, and to suggest the interrelation between changes of TM disorder and occlusal/mandibular plane.

II. Materials and methods

1. Materials

41 dentofacial deformity patients who were diagnosed as dentofacial deformity and were operated in Dental college of Yonsei University, were observed.

The deformity groups were classified as shown by Table 1.

Follow-up periods after surgery were over 10 months to 38 months(mean period 21 months). Lateral craniofacial cephalometric X-rays were taken and analyzed preoperatively and postoperatively.

Table 1. Classification of Deformity Group

	Noraml bite	Open bite	Deep bite	Total
Mn. Prognathism	14	6	3	23(56%)
Facial asymmetry /Mn. Prognathism	5	5	0	10(24%)
Mn. Retrognathism	5	0	3	8(20%)
Total	24(58%)	11(27%)	6(15%)	41(100%)

2. Methods

1) TMD analysis

The sumptoms of TMD were considered to be joint noises (clicking, crepitus), joint pain & tenderness, muscle pain and limitation of mouth opening. The incidence of TMD was checked preoperatively and the postoperative changes also were observed.

And we classified 4 groups as the existence of TMD preoperatively and postoperatively. The first group was classified by the patients in which TMD disappeared postoperatively. The second group in which TMD existed preoperatively and postoperatively, he third group who were free from TMD preoperatively and postoperatively, the fourth group in which TMD developed newly postoperatively, were also classified.

2) Cephalometric analysis

Preoperative and postoperative cephalometric analysis were done.

We obtained postoperative occlusal and mandibular plane and superimposed it to individual ideal occlusal and mandibular plane. Individual occlusal and mandibular plane were obtained by analyzing individual craniofacial units based on the Delaire's architectural and structural craniofacial analysis[10].

Individual indeal occlusal plane was defined as the division line between craniopalatal line (it pass ANS and parallel cranial base line) and craniomandibular line (it pass ideal menton and skull base). (Fig.1, Table 2)

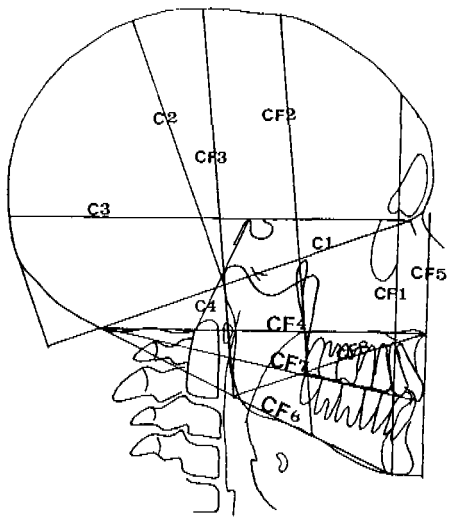

Fig 1. Schema of the Delaire's Architectural and structural Analysis

Table 2. Description of reference lines

C1 : cranial base line	CF1 : anterior line of craniofacial balance
C2 : cranial height	CF2 : middle line of craniofacial balance
C3 : superior line of the cranial base	CF3 : posterior line of craniofcial balance
C4 : basilar slope	CF4 : craniopalatal line : it pass ANS and parallel C3 line
CF5 : theoretical facial height	
CF6 : craniomandibular line (individual ideal mandibular plnae) : it pass ideal menton and skull base	
CF7 : craniooclusal line (indibidual ideal occlusal plnae) : bisecting line between cranipalatal line(CF4) and craniomandibular line(CF6)	
CF8 : line of anteroposterior, vertical facial balance	

III. Results

1. TMD analysis

Symptoms of TMD were observed diversely such as clicking, limitation of mouth opening, pain & tenderness on TMJ and muscle pain.

19 patients(46%) of 41 patients presented one or more of the above mentioned symptoms preoperatively.

As the classified groups of deformity, 10 patients(43%) of 23 mandibular prognathism cases, 5 patients(50%) of 10 facial asymmetry with prognathism cases and 4 patients(50%) of 8 retrognathia cases presented TMD symptoms preoperatively.(Table 7)

Table 3. Incidence of TMD in Deformities

	Preop. TMD Cases
Mn. Prognathism	10(43%)
Facial asymm/ Mn. Prognathism 10	5(50%)
Mn. Retrognathia 8	4(50%)
Total 41(100%)	19(46%)

And 13 patients(68%) of 19 patients who have had TMD symptoms were free from symptoms after surgery. Otherwise, 4 cases(18%) of 22 patients with no TMD symptoms preoperatively, presented newly developed symptoms with an incidence of 18% postoperatively(Table 4).

2. Occlusal and mandibular plane analysis

Each deformity group such as mandibular prognathism, facial asymmetry with prognathism and mandibular retrognathia was checked preop. & postoperatively for the presence of subjective or objective symptoms of TMD.

Changes of symptoms after surgery were checked and compared with the relationship of parallelism between individual ideal occlusal plane and postoperative occlusal plane(Table 5,6,7).

And we classified 4 groups as the existence of TMD preoperatively and postoperatively. The relationship of parallelism between individual ideal occlusal & mandibular plane and postoperative occlusal & mandibular plane was examined in each group.(Table 8).

In the first group, postoperative occlusal and mandibular plane was parallel to the individual ideal occlusal and mandibular plane except 2 case.

In the second group, all case was not parallel. In the third group, postoperative occlusal and mandibular plane was parallel to the individual ideal occlusal and mandibular plane except 1 case. In the fourth group, all the case was not parallel(Table 6).

Table 4. Incidence of TMD in Pre and Post-operative

SUREGRY		Mn Prog	Asy Mn Prog	Mn Def		
Pre	Post	N O D	N O D	N O D		
+	−	3 1 2	2 1 0	4 0 0	13(68%)	46%
+	+	3 0 1	0 2 1	0 0 0	6(32%)	
−	−	8 5 0	3 1 0	0 0 1	18(82%)	54%
−	+	0 0 0	0 1 0	1 0 2	4(18%)	
					41	100%

− : Asymptomatic + : Symptomatic

N : Noraml O : Open D : Deep

Table 5. Mandibular prognathism

Preop.	Postop.	Cases(23)	Postop. Occpl & Mn pl to individual ideal Occ pl & Mn pl
+	−	6(26%)	All is // except 1 case
+	+	4(17%)	All is not //
−	−	13(57%)	All is //
−	+	0	

Table 6. Facial asymmetry with Mandibular prognathism

Preop.	Postop.	Cases(10)	Postop. Occpl & Mn pl to individual ideal Occ pl & Mn pl
+	−	3(30%)	All is // except 1 case
+	+	2(20%)	All is not //
−	−	4(40%)	All is // except 1 case
−	+	1(10%)	All is not //

Table 7. Mandibular retrognathia

Preop.	Postop.	Cases(8)	Postop. Occpl & Mn pl to individual ideal Occ pl & Mn pl
+	−	4(50%)	All is //
+	+	0	
−	−	1(12%)	All is //
−	+	3(38%)	All is not //

Table 8. Case Analysis in each Group

	Preop.	Postop.	Cases	Postop. Occpl & Mn pl to individual ideal Occ pl & Mn pl
1st group	+	−	13	All is // except 2 case
2nd group	+	+	6	All is not //
3rd group	−	−	18	All is // except 1 case
3th group	−	+	4	All is not //

// ; Parallel

Ⅳ. Discussion

According to the functional matrix theory which is one of the many theories on growth and development of the craniofacial region, regardless of normal or not, the craniofacial structure of an individual is influenced by a balance between the surrounding skeletal structures including the cranial base, cranial vault, cervical vertebrae and the soft tissues[11, 12].

To accomplish functional recovery as well as morphologic correction of facial contour of dentofacial deformity patients, functional equilibration between the surrounding tissues has to be predicated and considered to treatment planning. TMD which happen to the functional unit of craniforacial region also has to be considered in treatment planning in the szame reason.

As the previous studies[13, 14, 15], various causes interact on TMD and influence each other,

and so many studies suggested cause / effect analysis and treatment regimens diversely. The most important factors in the development of the TMD are trauma, emotional stress and pathological occlusion. In the local factors of TMD, dentofacial deformity is considered to be an important factor because dentofacial deformity itself develops or influences the occlusal disharmony, functional disorder of major masticatory muscles, and forms pathological functional equilibration of craniofacial region.

It has been already pointed out by many authors[4,16,17,18] that dentofacial deformity is an important causative factor of TMD. Wigdorowicz et al[19]. Suggested that functional disorder of gnathologic system of dentofacial deformity was two times more prevalent than that of normal person, and Williamson[14] reported that 72% of children who complain TMD have had occlusal disharmony such as overbite or openbite. It was suggested by Magnusson[20] that dentofacial deformity patients couldn't remove occlusal interferences through the ordinary treatment such as stabilizing splint or occlusal adjustment and resolve the TMD through the orthognathic surgery. And Karabouta[21] also reported that orthognathic surgery might be sufficiently curative for patients presenting TMD symptoms preoperatively.

In our study, the incidence of TMD of dentofacial deformity patients was 46% preoperatively, and it was less than Upton[16](57%), and similar result with Rotskoff[22](43%) and Karabouta[21](40.8%)'s results.

As their reports were obtained under the similar conditions that material is dentofacial deformity patients with TMD symptoms, it was thought that group under this condition may show nearly same incidence like our study.

Preoperative symptoms of 19 patients(68%) of dentofacial deformity patients disappeared after surgery and 4 patients(18%) of no preoperative TM disorder patients complained newly developed symptoms after surgery, so totally the incidence of TMD decreased to 20% and it was in accordance with Upton(12%), Rotskoff(29%) and Karabouta (11,1%)'s results. In respect of this result of the decreased incidence of it after surgery, Magnusson[20] suggested that orthognathic surgery may be used for additional goal of treatment for TMD as well as functional and esthetic improvement. Upton reported that dentofacial deformity might be an important etiologic factor in the development of TMD because surgical correction of the disharmony in a significant percent of patients with maxillimandibular disharmonies and concomitant TM disfunction might alleviate or improve the TMD symptoms and there was also possibility that orthognathic surgery could produce TMD symptoms.

But it is not well documented how we explain the dentofacial deformity patient with no TMD symptoms and how we predict the prognosis of TMD after surgery if dentofacial deformity might be an important etiologic factor of TMD as they have reported until now.

Numerous studies[17,20,23,24] have discussed on prediction and protection of TMD which might alleviate or develop after surgery. And one of the important viewpoint of the study is that postoperative TMD is considered under the viewpoint of postoperative complication such as postoperative relapse which we have to minimize. In this viewpoints, misleading position of proximal segment, translocation of condyle, countclockwise rotation of mandibular movement, improper maxillomandibular fixation, movement distance of mandible and trauma on masticatory muscles were suggested to contributing factors of postoperative complica-

tions.And Parker[25] suggested the continuous interplay between the destructive factors and the adaptive factors as a model depicting the etiology of TMD. Hypomobility after maxillary and mandibular osteotomies by Strum & Bell [26], and changes in condylar position by Greebe [27] was proposed as etiologic factors in the development of Tm disorder after surgery.

However, Will[28] reported that maintenance of the condylar position during surgery might not prevent TMD. Kerstens[4] also suggested that it was not clear whether a responsible factor for newly developed symptoms is the dentofacial deformity with a potential TMJ-problem or the surgical procedures TMJ-symptoms.

Until now, no reliable methods have been found for predicting and preventing postoperative TMD and cause / effect factors which predict or control prognosis of TMD is not clear, either yet.

At another viewpoint which analyzed change of TMD of dentofacial deformity patients, trying to identify the correlating factors through cephalometric analysis have been proceeded in several departments of dentistry. Type of malocclusion, direction of facial rotational growth, incisor guidance angle and posterior slope angle of articular eminence already have been studied by several authors[29, 30, 31].

Recently, the effects of alteration of occlusal plane have attracted considerable attention, not only in treatment planning but also in consideration of postoperative stability. Reyneke[7] reported several effects which could be obtained by the alteration of occlusal plane during surgery. Wolford[6] also suggested that selective surgical alteration of the occlusal plane angle could acquire optimal functional and esthetic relationships.

In the previous studies of occlusal plane, the normal value was reported as 8° + 4° to FH plane(Rickette[32]), 18.28° + 4.48° to SN plane(Sin[33]) and 17.16° + 3.41° (Kim[34]).

Otherwise, Delaire[10] suggested individual ideal occlusal plane that is defined to the division line between craniopalatal line(it pass ANS and parallel cranial base) and craniomandibular line(it pass ideal menton and skull base) instead of using normal value. Kim[35] proposed the ideal occlusal plane of Korean normal adult by using an architectural and structural craniofacial analysis and our study also obtained individual ideal occlusal and mandibular plane by the same method.

In the cephalometric analysis for identifying the correlating factors to TMD, our study focused on the occlusal and mandibular plane and tried to compared postoperative occlusal and mandibular plane with individual ideal occlusal and mandibular plane.

Each group showed very interesting results. Figure 2 showed mandibular retrognathia

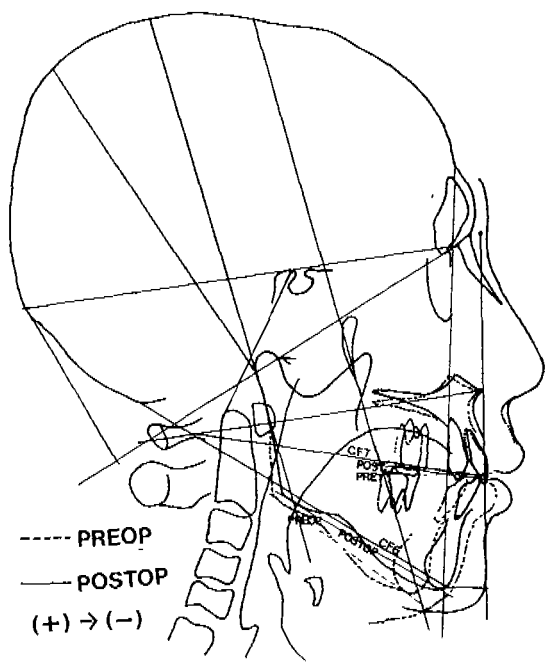

Fig 2. Schema of 1st Group

patient who complaine pain and clicking on Rt. TMJ. Through the orthognatic surgery, occlusal and mandibular plane have been changed parallel to ideal occlusal and mandibular plane and all symptoms disappeared after surgery. The first group in which TMD disappeared after surgery, showed the result as fig.2 except 2 cases.

1 case of non-parallel cases to ideal occlusal and mandibular plane was facial asymmetry with mandibular prognathism with Rt.TMJ clicking and pain. Bimaxillary surgery by maxillary Le-Fort I osteotomy and mandibular sagittal split osteotomy was doen and symptoms of TMD disapeared. Preoperative angle difference between occlusal plane and ideal occlusal plane was 10 degree and it decreased to 7 degree postoperatively and it is not sure whether slight alteration of occlusal plane was effective or repositioning of Lt.side deviated mandible acquired the improved symptoms.

The other case of non-paralledl cases was mandibular prognathism with both TMJ clicking. Superior repositioning by maxillary Le-Fort I osteotomy and mandibular setback by sagittal split osteotomy was done. Occlusal plane was not parallel to ideal occlusal plane before and after surgery, but both clicking sound disappeared after surgery. Decisive factor which induct the resolution of symptom was not found in this case and it was thought that more study would be needed.

All of the second group in which TMD symptoms remained after surgery was not parallel to ideal occlusasl and mandibular plane postoperatively as shown by Figure3.

Figure 3 shows mandibular prognathism with both TMJ clicking. Mandibular setback by sagittal split osteotomy was done and there there was no altheration of occlusal plane and there was no change of TMD symptom after surgery.

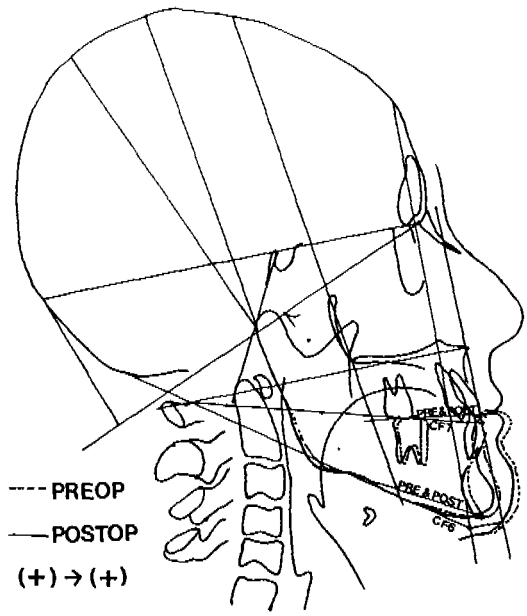

Fig 3. Schema of 2nd Group

Figure 4 showed the cae which was diagnosed as mandibular prognathism and bimaxillary surgery was taken. Postoperative occlusal and mandibular plane retained parallel to indibidual ideal occlusal and mandibular plane. The third group who have no preop.and postop.symptoms, have shown the same result as shown Fig.4 and Table 8, except 1 case.

1case was facial asymmetry with mandibular prognathism partient and preoperative occlusal and mandibular plane was not parallel to ideal occlusal and mandibular plane. Condylectomy on right side was done and there was no TMD before and after surgery and there was no trial for alteration of occlusal plane because treatment planning was condylectomy only. Probably the result of no symptoms before and after surgery was thught that Lt. TMJ as well as Rt.TMJ adapted to postoperative new environment very well.

Figure 5 shows mandibular prognathism patient with openbite whose occlusal & man-

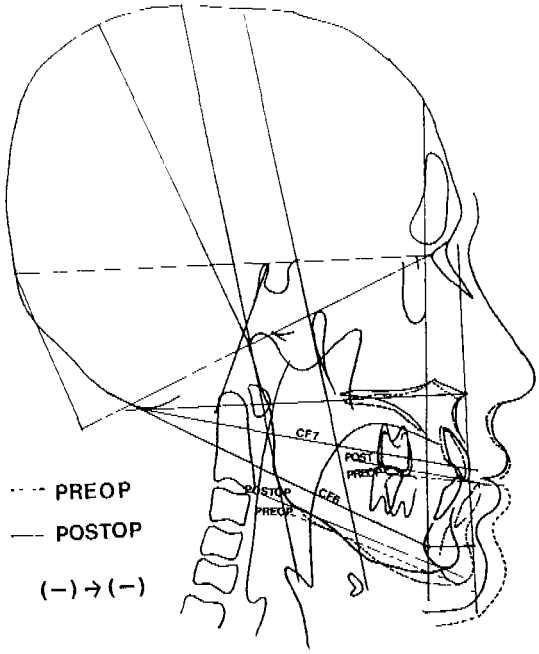

Fig 4. Schema of 3rd Group

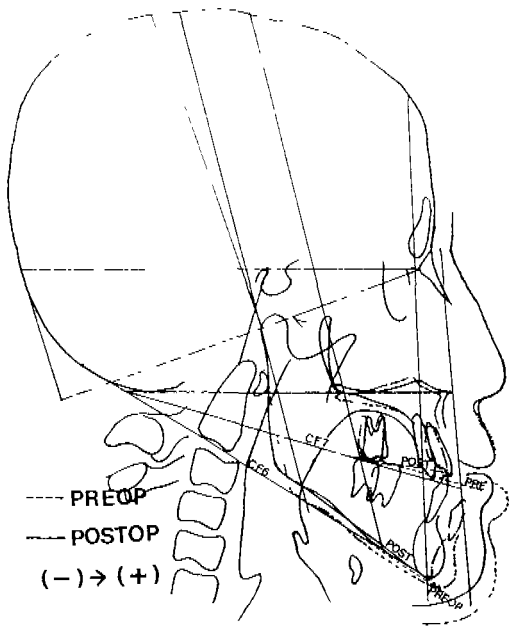

Fig 5. Schema of 4th Group

dibular plane paralleled ideal occlusal & mandibular plane preoperatively, and postoperative occlusal & mandibular plane was not parallel to ideal occlusal & mandibular plane. In all case of the fourth group who have newly developed symptoms, postoperative occlusal & mandibular plane was not parallel to ideal occlusal & mandibular plane. Taking into account of above results, it was thought that postoperative development of TMD may relate to the hange of occlusal plane.

We classified patient group as the postoperative change of TMD symptoms and compared postoperative occlusal & mandibular plane with individual ideal occlusal & mandibular plane.

The results were that preoperative symptoms of TMD disappeared or postoperative newly developed symptoms were not seen when postoperative occlusal & mandibular plane were parallel to individual ideal occlusal & mandibular plane.

Otherwise, When postoperative occlusal & mandibular plane were not parallel to ideal occlusal & mandibular plane, most preoperative symptoms didn't improve and furthermore, in all cases in which newly developed postoperative symptoms developed, postoperative occlusal & mandibular plane were not parallel to individual ideal occlusal & mandibular plane.

So the result showed that there was high possibility of correlation between TMD and occlusal & mandibular plane.

We also classified dentofacial deformity group as mandibular prognathism, facial asymmery with mandibular prognathism and mandibular retrognathia, and as anterior bite forms(openbite, deepbite and normal bite) and we tried to observe the interrelation between deformity pattern and incidence of TMD, but

we couldn't notice significant difference between each groups.(Table 4)

V. Conclusion

Dentofacial deformities are one of the important contributing factors in developments and prognosis of temporomandibular disorders.

To analyze the changes of TMD sympyoms in dentofacial deformity patient before and after orthognathic surgery, we focused on the occlusal and mandibular plane through craniofacial cephalometric analysis.

We investigated the incidence and the changes of the symptoms of the temporomandibular disorders through the orthognathic surgery of 41 dentofacial deformity patients and observed the interrelation between changes of temporomandibular disorder and occlusal & mandibular plane.

The results are as follows ;

1. The incidence of the temporomandibular disorder was 46% and it was decreased to 20% after orthognathic surgery.
2. There were no significant relationships between types of DFDs, types of anterior bite and changes of temporomandibular disorder symptoms.
3. There was a significant relationship between postoperative occlusal and mandibular planes and changes of temporomandibular disorder symptoms.
4. To obtain a optimal function of gnathologic system in correction of dentofacial deformities, it is proposed to achieve the parallelism of postoperative occlusal plane and mandibular plane to its individual ideal occlusal plane and mandibular plane.

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악안면기형환자의 측두하악장애에 관한 연구
-두개저에 대한 각 개인의 이상적인 교합평면 및 하악평면-

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악안면기형은 측두하악장애의 발생과 예후에 있어 중요한 기여인자 중의 하나이다. 최근에는 여러 학자들에 의해 교합평면의 변화가 악안면기형환자의 악기형수술을 통한 기능적, 심미적 개선에서 중요한 한 요인임이 보고되었다.

저자는 41명의 악안면기형환자를 대상으로 하여 측두하악장애의 발생율을 조사하고 교합평면 및 하악평면을 중심으로한 두개안면방사선사진 계측을 통해 악교정수술 전후의 측두하악장애의 변화양상을 관찰하고 그 상관관계를 조사하여 다음과 같은 결론을 얻었다.

1. 악안면기형환자의 측두하악장애의 발생율은 46% 로 나타났고 악교정수술후 전체환자의 20% 로 감소하였다.
2. 측두하악장애의 술전후의 변화양상과 악안면기형의 유형 및 전치부의 피개상태 사이에는 상관관계가 없었다.
3. 측두하악장애의 술전후의 변화양상과 교합평면 및 하악평면의 변화사이에는 상관관계가 높았다.
4. 악안면기형의 교정시에 적절한 저작계의 기능을 얻기 위해서 술후의 교합평면 및 하악평면을 각 개인의 이상적인 교합평면 및 하악평면과 평행하도록 설정하는 것이 바람직할 것으로 사료된다.