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Relationship between Preoperative Maxillomandibular Transverse Discrepancy and Post-Surgical Stability in Class II Malocclusion

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Abstract: The aim of this study was to examine the relationship between the presurgical maxillomandibular transverse index and post-surgical stability one year after mandibular advancement. For the material and methods, twenty-two subjects who were treated with mandibular advancement were enrolled in this study. Postsurgical stability was defined as the horizontal mandibular position change of <2 mm in lateral cephalogram 1 year after surgery. Subjects were divided into two groups according to the maintenance of postsurgical stability: a stable group (group S) and a less stable group (group LS). Presurgical maxillomandibular transverse index was determined as Yonsei transverse index (YTI) one month before surgery. A logistic analysis was performed on the postsurgical stability according to the YTI value. The presurgical, post-expansion target YTI value was obtained using receiver operating characteristic (ROC) curve. There were no notable differences in the baseline characteristics of the two groups except for vertical positions of point A, B, and gender distribution. Before surgery, however, there was a significant difference in YTI at both the fossa and CR level between the groups. The amount of mandibular advancement did not show a significant difference. The odds ratio for YTI was 0.35 (p = 0.024). The prediction of stability of presurgical YTI yielded an area under the ROC curve of 0.88. The cut-off value for YTI was 1.45 mm. It can thus be concluded that presurgical transverse index showed a correlation with postsurgical stability, and correcting it in the presurgical phase to a certain level appears to aid in securing postsurgical stability.

Keywords: dentistry; orthodontics; mandibular advancement; post-surgical stability; two-jaw surgery; transverse discrepancy; maxillary expansion

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1. Introduction

Surgico-orthodontic therapy has become the standard procedure for correcting skeletal discrepancies between the maxilla and mandible [1]. Recently, several studies also reported successful results for patients with severe skeletal Class II malocclusion through the surgico-orthodontic procedure [2–4]. To achieve optimal outcomes, post-surgical stability is crucial, which depends on both the patient's factors and the operative technique [5]. Additionally, establishing a sufficient occlusion before surgery was found to play an important role in maintaining stability after surgery [6–8].

In most malocclusions accompanied with a severe skeletal deformity, the dentition may often be compensated to secure interdigitation [9]. Orthodontists employ various techniques to achieve presurgical decompensation in all three planes.

The treatment of adults with Skeletal Class II relationships is frequently complicated by the underlying transverse discrepancies. Sayin and Turkkahraman [10] reported that untreated Class II malocclusions are narrower in terms of overall maxillary dental arch width than Class I subjects. Uysal suggested treating Class II division 1 patients with rapid palatal expansion due to their narrow upper alveolar intermolar width [11].

There have been many attempts to correct the transverse issues. Expanding the constricted upper dental arch often involves transpalatal arch (TPA), rapid palatal expansion (RPE) or miniscrew-assisted RPE (MARPE), surgically assisted RPE (SARPE) and so forth [12,13].

With advancements in orthodontic methods, nonsurgical maxillary skeletal expansion procedures have emerged as effective means to address transverse deficiencies prior to surgery [12,14]. These advancements have alleviated the burden on patients who had to undergo another step of surgery, and also for orthodontists who had to deal with post-surgical relapses of expansion. Despite the increasing popularity of these techniques and the recognized importance of achieving sufficient occlusion before surgery, there is a lack of research exploring the relationship between transverse deficiency and post-surgical stability in skeletal Class II malocclusions.

Cone-beam-computed tomography (CBCT) technology allows for the acquisition of three-dimensional images with less distortion [15]. The utilization of this technique has facilitated the accurate localization of the center of resistance (CR), a critical landmark for defining tooth position and its displacement [16,17].

The purpose of this study is to examine the relationship between the presurgical maxillomandibular transverse index using CBCT and post-surgical stability one year after mandibular advancement. We hypothesized that post-surgical stability would differ depending on the transverse differences before surgery.

2. Materials and Methods

2.1. Study Design/Sample

This study followed the guidelines of the Declaration of Helsinki, and our institutional review board approved this retrospective study and waived the requirement for patient-informed consent. The study sample was composed of subjects who presented skeletal Class II malocclusion and underwent mandibular advancement surgery with genioplasty from March 2005 through February 2022 in this institution.

The inclusion criteria were as follows: age at surgery $\geq$ 18 years; skeletal Class II malocclusion with ANB > 4°; requirement for conventional orthognathic bimaxillary surgery. The exclusion criteria were as follows: patients with syndromes; no record of maxillary arch expansion; Menton deviation > 4 mm from the facial midline; a known history of temporomandibular joint disease; an incomplete series of lateral cephalometric radiographs or CBCT images.

Among patients who were treated with the aforementioned surgery, 29 patients were treated with "transpalatal arch (TPA)", "rapid palatal expander (RPE)" or "miniscrew-assisted RPE (MARPE)". In total, 3 patients were excluded due to lack of CBCT records; 1 patient received surgery before comprehensive orthodontic treatment; 3 patients had a known history of fibromatosis, hemifacial macrosomia or idiopathic condylar resorption. Eventually, 22 patients (8 male, 14 female) who fulfilled the inclusion criteria were enrolled in this study (Figure 1).

Horizontal change at Infradentale (Id) in the lateral cephalograms 1 year after surgery was the primary predictor variable in this study. The study sample was divided into two groups according to the amount of Id change (T3-T2): group S including patients with changes within 2.0 mm, and group LS including patients with changes equal to or more than 2.0 mm [5].

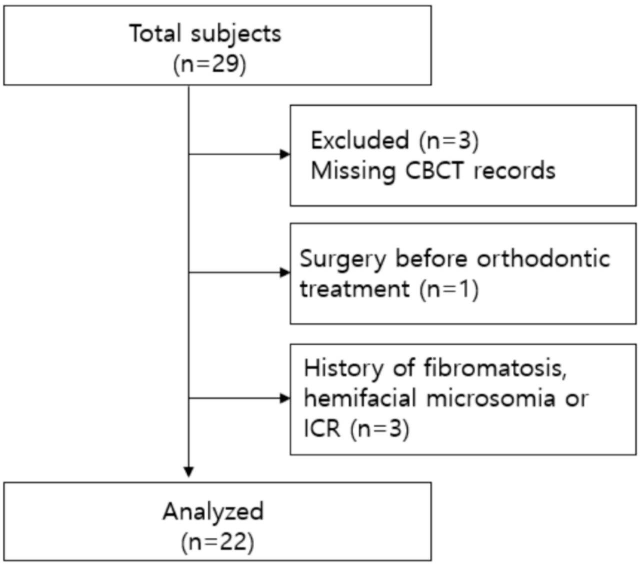

Figure 1. Flow chart of recruitment of subjects.

2.2. Skeletal and Dental Evaluation

Cephalography of the following four phases of treatment was collected: initial (T0), 1 month before (T1), 1 month after (T2), and 12 months after surgery (T3). CBCT was performed on T1, T2 and T3.

Lateral cephalograms were digitized using V-ceph 5.5 (Osstem, Seoul, Republic of Korea). A line through Nasion, rotated 7° from the Sella–Nasion line, was used as the horizontal reference line (x-axis). The y-axis was perpendicular to the x-axis and passed through Sella (Figure 2). Id was applied to determine mandibular position, as this point would be less affected by surgery [18].

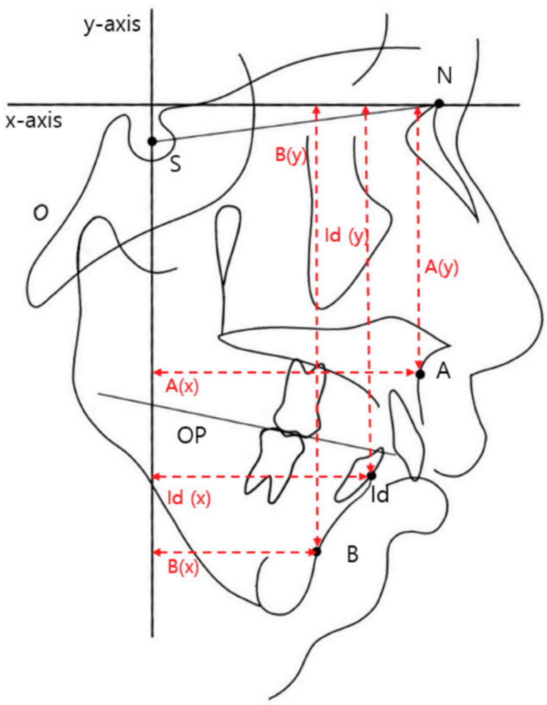

Figure 2. Skeletal landmarks used in cephalometric analysis.

CBCT examinations (Alphard, version 3030; ASAHI Roentgen IND, Kyoto, Japan) were conducted by scanning of the maxillofacial regions (10 mA, 80 kV; 0.39 mm voxel size;

scan time, 17 s; and a field view of no more than 200 mm in height × 179 mm in depth). Images were then reoriented as parallel to the palatal plane (sagittal), passing through the furcation of the maxillary first molars (axial), and parallel to the hard palate (coronal). Measurements took place in axial slices, and width was defined as the distance between one furcation point and the vertical projection of the other furcation when observed from the coronal slice at the first molar plane.

This study identified 4 angular and 6 linear cephalometric measurements along with 4 linear measurements from CBCT images. Based on the previous findings, the estimated center of resistance (CR) was located at the middle of the root furcation of the first permanent molars [14,16]. Measurements from CBCT images included the inter-central fossa and inter-CR widths at the first molars. Yonsei transverse analysis was applied for transverse measurements [16]. YTI at T1 was chosen to represent the transverse discrepancy at the preoperative phase, to investigate the relationship with post-surgical stability (Figures 2 and 3). All cephalograms and CBCT images were traced by the same examiner.

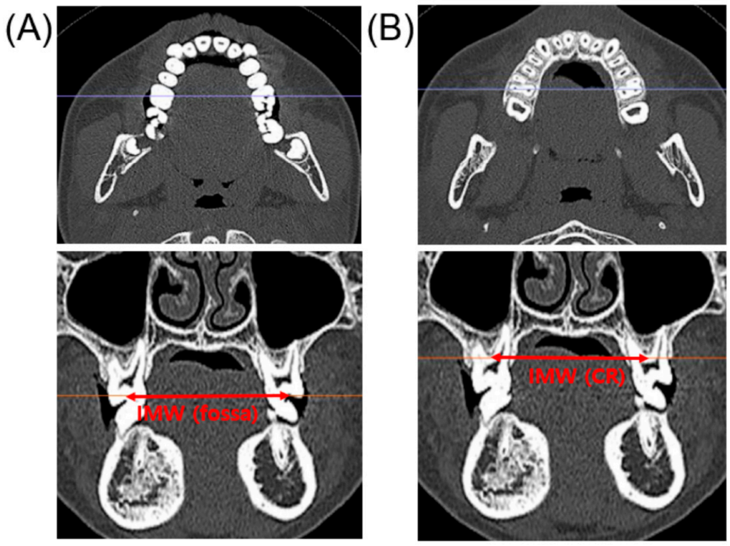

Figure 3. Measurements used in CBCT images: (**A**) IMW at central fossa. (**B**) IMW at CR.

2.3. Statistical Analysis

Statistical analyses were carried out using SPSS software for Windows (version 26.0; SPSS Inc., Seoul, Republic of Korea).

Based on the YTI values from our preliminary study and utilizing G*Power 3.1 (Dusseldorf, Germany), the required sample size was calculated to be more than 13, with a type II error rate (β) of 0.2, and a significance level (α) of 0.05. Descriptive statistics, including the mean and the standard deviation (SD), were used to describe the distribution of each variable.

For analysis of the method's errors, all the linear and angular measurements of 30% of the subjects, randomly selected, were repeated by the same investigator on 2 separate occasions 2 weeks apart to evaluate the intra-examiner reliability.

The Shapiro–Wilk test was used to verify the normality. Independent T-tests and Mann–Whitney *U* tests were used to compare the numerical values between group S and LS. Fisher's exact tests were used to compare categorical variables.

Univariate logistic regression was performed for the values that had significant differences between the groups. Subsequently, if $p < 0.05$ after the regression, the variable was chosen as the candidate for multiple logistic regression. Regarding the target transverse index, the optimal cut-off value was determined using receiver operating characteristic (ROC) curve analysis to predict stability. Area under ROC (AUROC) was used to assess the predictive performance.

2.4. Surgical and Orthognathic Treatment

Decompensation of the dentition was conducted before orthognathic surgery [19]. The upper arches of the subjects were expanded via TPA, RPE or MARPE. The expansion method was selected according to the amount of expansion required, molar inclination, periodontal biotype, age, gender, and the clinical preference of the orthodontist. Presurgical orthodontic treatments were performed for at least 6 months.

Transpalatal arches (TPAs) constructed from 0.036-inch round stainless-steel wire or 0.032 × 0.032-inch TMA (Burstone system) were activated until the desired intermolar width was achieved. The tooth-borne RPE device comprised four rigid stainless-steel wire connectors, soldered onto bands placed on the maxillary first premolars and molars. RPEs were constructed using a Hyrax expander (Dentaurum, Ispringen, Germany). The MARPE device featured four robust plates with miniscrew holes, extending from the jackscrew body, soldered onto the bands of the maxillary first premolars and molars (Biomaterials Korea, Seoul, Republic of Korea).

All patients went through conventional bimaxillary surgery, including Le-fort I osteotomy on the maxilla with posterior nasal spine impaction and bilateral sagittal split ramus osteotomy (SSRO) for mandibular advancement. Rigid internal fixation with self-reinforced biodegradable poly-70 L/30 DL-lactide (BioSorb FX; CONMED LINVATEC Biomaterials, Utica, NY, USA) or titanium miniplates were used to stabilize the maxilla. After drilling and tapping, 4 L-shaped plates with mono-cortical screws were placed in the canine fossa and zygomatic buttress bilaterally. Bilateral SSRO was carried out for mandibular advancement with concomitant genioplasty. Semi-rigid fixation with a titanium miniplate was used for the fixation of the proximal and distal segments.

3. Results

Cephalometric variables describing the presurgical cranial and dentofacial morphology of the subjects are summarized in Table 1. Group S included 13 patients with mean ΔId(x) of −1.6 mm, and group LS included 9 patients with mean ΔId(x) of −0.6 mm. There were no significant differences between groups in age and horizontal measurements. However, a significant difference was found in gender distribution.

Table 1. Patients' baseline values.

	Group S (*n* = 13)	**Group LS (*n* = 9)**	***p*-Value**
Demographic variables			
Age (y)	25 ± 3.7 (19, 35)	25.7 ± 5.1 (22, 33)	0.13
Sex, *n* (%)			0.022 *
Men	2 (15.4)	6 (66.7)	
Women	11 (84.6)	3 (33.3)	
Lower premolar extraction (%)	12 (92.3)	7 (77.8)	0.54
Cephalometric variables			
Angular measurements (°)			
ANB	8.3 ± 3.1	8.4 ± 3.7	0.956
SN-OP	27.1 ± 6.6	25.8 ± 4.2	0.57
SN-MP	49.4 ± 7.6	49.7 ± 6.5	0.934
Linear measurements (mm)			
A(x)	61.5 ± 3.9	61.5 ± 3.4	0.977
B (x)	37.0 ± 7.3	37.0 ± 7.3	0.994

Table 1. *Cont.*

	Group S (n = 13)	Group LS (n = 9)	p-Value
A(y)	66.1 ± 3.3	70.6 ± 5.8	0.021 *
B(y)	113.3 ± 7.2	122.8 ± 11.7	0.028 *
Id(x)	51.3 ± 4.8	51.3 ± 5.2	0.99
Id(y)	99.4 ± 6.9	105.7 ± 9.1	0.077

Abbreviations:ANB, angle of the lines connecting point A, nasion, and point B; SN-OP, angle of the Sella–Nasion plane to the occlusal plane; SN-MP, angle of the Sella–Nasion plane to the mandibular plane; A(x), horizontal position of point A; B(x), horizontal position of point B; A(y), vertical position of point A; B(y), vertical position of point B; Id(x), horizontal position of infradentale; Id(y), vertical position of infradentale; * $p < 0.05$.

3.1. Pre-Surgical Observations

At T1, most of the measurements of point A and Id were similar between the two groups (Tables 2 and 3). However, the LS group showed significantly lower vertical height at B(y) ($p = 0.012$).

Table 2. Descriptive statistics of the angular measurements according to the predictor variable (group) at different time periods.

Outcome Variable (°)		T1	T2	T3
ANB	Group S	8.3 ± 3.4	4.7 ± 3.5	4.7 ± 3.2
	Group LS	8.1 ± 3.1	5.7 ± 3.4	5.5 ± 2.8
	p-value	0.865	0.53	0.541
SN-OP	Group S	28.0 ± 5.9	27.1 ± 6.6	26.5 ± 6.7
	Group LS	27.7 ± 3.9	25.9 ± 4.6	26.9 ± 4.7
	p-value	0.873	0.645	0.882
SN-MP	Group S	48.5 ± 8.0	44.9 ± 5.9	45.4 ± 5.8
	Group LS	49.5 ± 5.7	47.0 ± 6.3	47.7 ± 5.7
	p-value	0.754	0.422	0.352

Abbreviations: T1, 1 month before surgery; T2, 1 month after surgery; T3, 1 year after surgery.

Table 3. Descriptive statistics of the linear measurements according to the predictor variable (group) at different time periods.

Outcome Variable (°)		T1	T2	T3
A(x)	Group S	61.8 ± 4.1	60.8 ± 4.6	60.7 ± 4.3
	Group LS	61.7 ± 3.4	61.1 ± 4.1	60.9 ± 3.9
	p value	0.985	0.888	0.924
B(x)	Group S	38.2 ± 9.1	43.6 ± 8.9	43.3 ± 8.8
	Group LS	37.3 ± 6.8	41.3 ± 8.1	41.5 ± 8.0
	p value	0.806	0.537	0.633
A(y)	Group S	66.5 ± 2.9	63.7 ± 4.5	63.6 ± 4.2
	Group LS	70.5 ± 5.7	68.1 ± 5.1	67.5 ± 5.5
	p-value	0.072	0.047 *	0.071
B(y)	Group S	113.9 ± 7.2	113.3 ± 6.7	113.8 ± 7.1
	Group LS	124.4 ± 10.7	122.2 ± 8.7	118.9 ± 10.2
	p-value	0.012 *	0.013 *	0.177

Table 3. *Cont.*

Outcome Variable (°)		T1	T2	T3
Id(x)	Group S	49.3 ± 5.0	53.4 ± 7.0	52.8 ± 6.7
	Group LS	50.7 ± 4.7	53.8 ± 5.5	52.2 ± 5.2
	p-value	0.529	0.887	0.83
Id(y)	Group S	99.6 ± 6.0	99.2 ± 5.2	98.8 ± 5.1
	Group LS	106.0 ± 9.2	103.2 ± 7.5	102.5 ± 7.2
	p-value	0.059	0.158	0.172

* $p < 0.05$.

Intermolar widths (central fossa, CR) in the upper arch and lower IMW in the central fossa did not show a significant difference between the two groups. On the other hand, the lower IMW at the CR ($p = 0.017$) and YTIs (central fossa, CR) showed a significant difference ($p = 0.012$ and 0.001), indicating a difference in transverse decompensation (Table 4).

Table 4. Descriptive statistics of the transverse measurements according to the predictor variable (group) at different time periods.

		T1	T2	T3
IMW_Mx_crown	Group S	46.5 ± 2.8	46.7 ± 2.9	45.5 ± 2.6
	Group LS	45.0 ± 3.9	45.3 ± 3.2	45.3 ± 3.2
	p-value	0.295	0.298	0.874
IMW_Mx_CR	Group S	45.7 ± 2.6	45.5 ± 2.9	45.1 ± 2.9
	Group LS	45.0 ± 3.3	44.1 ± 3.7	44.6 ± 3.3
	p-value	0.578	0.307	0.686
IMW_Mn_crown	Group S	40.2 ± 2.4	40.5 ± 2.2	39.8 ± 2.3
	Group LS	41.3 ± 3.3	41.7 ± 3.4	41.0 ± 3.1
	p-value	0.382	0.32	0.307
IMW_Mn_CR	Group S	42.1 ± 2.3	43.2 [40.8;44.4]	42.7 ± 2.4
	Group LS	45.0 ± 2.8	43.9 [42.6;45.6]	44.0 ± 3.1
	p-value	0.017 *	0.181	0.307
YTI_crown	Group S	6.3 ± 2.9	6.2 ± 2.9	5.7 ± 2.2
	Group LS	3.7 ± 1.4	3.6 ± 1.6	4.3 ± 1.7
	p-value	0.012 *	0.026 *	0.122
YTI_CR	Group S	3.6 ± 2.2	2.5 ± 3.2	2.4 ± 3.0
	Group LS	0.0 ± 1.9	−0.8 ± 2.2	0.6 ± 2.0
	p-value	0.001 *	0.014 *	0.136

Abbreviations: IMW_Mx_crown, intermolar width (IMW) of the maxillary arch at the central fossa; IMW_Mx_CR, IMW of the maxillary arch at the furcation; IMW_Mn_crown, IMW of the mandibular arch at the central fossa; IMW_Mn_CR, IMW of the mandibular arch at the furcation; YTI_crown, YTI at the central fossa; YTI_CR, YTI at the furcation; * $p < 0.05$.

3.2. Surgical Change

One month after surgery, there was no significant difference in the horizontal position of the maxillae between the groups. In the vertical plane, point A in group S was better positioned than group LS (Table 3).

The amounts of mandibular advancement in both groups did not show significant differences. The advancement in group S was 4.1 mm for point Id, whereas advancement in group LS was 3.1 mm for point Id. The amounts of vertical correction also did not differ.

Anterior movement of the mandible was accompanied by significant increases in SNB of 2.8° (group S) and 2.4° (group LS) (Table 2).

IMWs (central fossa, CR) in the upper and lower arch did not show significant differences. Hence, YTIs (central fossa, CR) showed a significant difference (p = 0.026 and 0.014) (Table 4).

3.3. 12 Months after Surgery

At T3, there was no significant difference in the maxillary position between the groups. Though post-surgical horizontal changes measured from point Id (p = 0.009) and vertical changes measured in point B (p = 0.03) were different according to groups, there were no significant differences between the horizontal and vertical mandibular positions of the two groups at T3 (Table 3).

ANB remained stable over the year for both groups, when there was a significant difference in the occlusal plane angle change. SN-OP decreased by 0.6° in group S when it increased by 1.0° in group LS. SN-OP at T3, however, did not show a difference (Table 2).

Both YTIs (central fossa, CR) and IMWs did not show a difference at T3. However, there was a significant difference in the change of IMWs (T3-T2) between the groups. IMW_Mx_crown and IMW_Mx_CR decreased by 1.1 and 0.4 mm in group S, whereas IMW_Mx_crown and IMW_Mx_CR increased by 0.1 mm and 0.5 mm in group LS (Table 4).

3.4. Prediction of Stability

The prediction of stability based on YTI_CR yielded an AUROC of 0.88. A selected cut-off with the highest Youden index value on the ROC curve was YTI_CR at 1.45 mm, with sensitivity of 0.888 and specificity of 0.846, suggesting good predictive accuracy at this threshold, as illustrated in Figure 4.

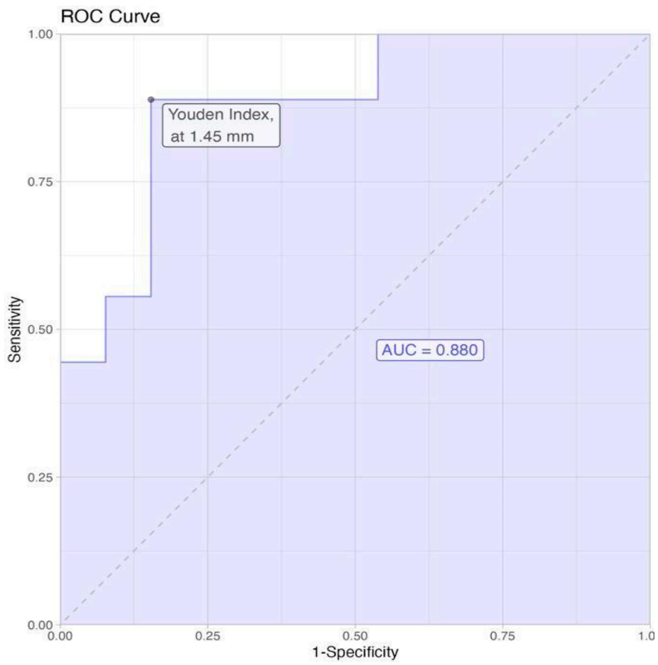

Figure 4. Receiver operating characteristic (ROC) curve.

Multiple logistic regression analysis was run with group as the criteria and preoperative YTI and gender as predictors. The odds ratio (OR) for YTI was 0.35 (p = 0.024, CI: 0.14, 0.87), indicating a decrease in odds with increasing YTI_CR. However, gender did not emerge as a statistically significant factor, highlighting that YTI_CR is a more pivotal determinant in the model used for predicting post-surgical stability.

4. Discussion

The primary finding of this research is that pre-operative transverse index, following orthodontic treatment, is associated with >2 mm horizontal shifts at point Id, one-year post-surgery for Class II patients. This finding may implicate the effect of transverse discrepancy on post-surgical stability. Additionally, the prediction of stability based on YTI_CR yielded AUROC of 0.88, which is considerably high.

Addressing transverse discrepancies is a fundamental goal of orthodontic treatment and may be relevant to achieving post-treatment occlusal stability [16,20]. However, occlusal stability does not necessarily translate to post-surgical stability. This study's results indicate that YTI is correlated with post-surgical stability, suggesting that adequate occlusal alignment may influence surgical outcomes. While sagittal discrepancies have been known to affect post-surgical stability, to the best of our knowledge, this study is the first to uncover the impact of transverse discrepancies [2].

The average post-surgical change of the subjects was less than 2 mm, possibly disguising the troublesome cases. As Bailey et al. addressed, there are a certain portion of problematic cases and statistics based on normal distribution which may be misleading when used to describe post-surgical responses [5]. Proffit et al. reported that skeletal position changes greater than 2 mm after surgery are clinically significant [2,5]. Therefore, our sample was divided into two groups with and without clinically significant changes. Among 22 patients, 9 experienced horizontal mandibular changes greater than 2 mm. Posterior mandibular displacement (in other words, relapse) was observed in seven (31.8%) patients. This result is in accordance with previous findings on the incidence of relapse after mandibular advancement for Class II/high angle patients [21,22].

The risk of post-surgical instability is known to be associated with diverse factors, such as operative procedure, the extent and direction of relocation, fixation, age and growth potential, orthodontic recurrence and unsecured occlusion [3]. Of all potential factors, preoperative mandibular plane angle and fixation methods were commonly reported to be associated with relapse [21–23]. In our cohort, such factors were homogenous between the groups except gender and preoperative YTI, subsequently leading to further investigation of prediction based on this index. Considering that surgical results of men were thought to be more stable than those of women postoperatively [24], YTI may show more association with stability considering the confounding effects.

Zhang et al. reported that YTI provided superiority over other transverse values regarding reliability [25], which aligns with the high reliability of measurements in this study. It should be noted that YTI was initially introduced in the measurement of the transverse discrepancy of non-extracted dentures; however, in this study, all but three were extracted. This dominance of lower premolar extraction might have contributed to the larger YTI value than seen in other studies (-0.39 ± 1.87 mm) [14,16]. Since there was no significant difference in YTI between the groups, taking into consideration the extraction cases and also the proportion of extracted dentures, we inferred that the investigation was valid. This application of YTI to extracted dentures may expand the usage of this index in the future.

Transverse issues can be associated with anteroposterior problems [26]. Inadequate transverse occlusion can possibly affect the incisal relationship [14]. Surgery cases would not be an exception. In this study, a subject with a greater YTI value tended to have better post-surgical stability. A possible explanation for this is that an adequate transverse occlusion could yield a more stable mandibular position shortly after surgery.

Using the maxillomandibular transverse index (YTI), the prediction of post-surgical stability was evaluated through the area under the ROC curve, which demonstrated excellent performance [27]. For the practical clinical application of YTI, a cutoff value of 1.45 mm was established, corresponding to the maximum Youden index. This cutoff value proved to be effective when predicting stability. A 1.45 mm measurement may serve as a benchmark for preoperative transverse correction. Additionally, the approach of using the AUROC curve in this study could provide a framework for identifying other cutoff values, thereby offering a clinical guideline that could be extrapolated to further discoveries in the dental field.

In considering the biomechanical principles in the early post-surgical phase of mandibular advancement, it is essential to note that the distal segment can be susceptible to angular forces [28]. Despite achieving absolute fixation at the osteotomy site, taking into account factors such as plate insertion and para-mandibular musculature direction, a three-dimensional study on BSSO revealed significant relapse of the distal segment in a posterior, inferior, and clockwise pitch direction [29]. This indicates that any impact on the intersegment site could potentially result in post-surgical instability [21]. The transverse occlusal plane may serve as a direct reservoir for the contraction forces of the para-mandibular muscles.

5. Limitations

This retrospective cohort study has several limitations, the general issue being follow-up period and sample size. Changes in the first post-surgical year refer to the post-surgical stability, which directly relates to the surgical healing, post-surgical orthodontics, and short-term physiologic adaptation. Proffit et al. reported that the procedures typically used to treat Class II/long face issues are quite stable during the first post-surgical year, whereas after one to five years, a considerable number of patients experience clinically problematic skeletal changes [2,21,30]. Therefore, it is insufficient to conclude that the post-surgical stability of our study is concrete in the long term. Additionally, since our sample consisted of 22 adults, this places emphasis on further prospective studies involving a larger group of patients, and a longer evaluation of the post-surgical stability after non-surgical maxillary expansion. Additionally, it is known that there are limitations of this technique, such as the possible fracture and failure of the miniscrews; however, possibly due to our small sample size, we did not encounter these particular problems [31]. For the measurement of surgical stability in a two-dimensional lateral cephalogram, the study utilized point Id, which is considered to not be affected by genioplasty. In a three-dimensional approach, the use of the iterative close point (ICT) algorithm could be plausible [32].

6. Conclusions

This study focused on the transverse aspects among the various factors related to post-surgical stability. The findings suggest that pre-surgical and post-orthodontic transverse discrepancy are related to the post-surgical stability of bimaxillary surgery with mandibular advancement. To prevent post-surgical instability, the transverse aspects of the occlusion should be considered prior to surgery, and YTI analysis could be one of the solutions.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of Yonsei University Dental Hospital (2-2021-0021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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