Effects of orthognathic surgery

on psychological status of patients with jaw deformities

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1. Introduction

The purpose of orthognathic surgery is to correct functional and esthetic problems due to underlying jaw deformities. The motives of patients who request orthognathic surgery are many and varied[1], but the desire for esthetic improvement and the resulting psychologic benefit are frequently major motives rather than a desire for functional improvement[1-6]. Moreover, self perception of poor esthetics is not always correlated to morphometric measures such as physical characteristic and cephalometric values[7-9], especially in patients with psychological problems, and it has been reported that patients with elevated psychological distress prior to orthognathic surgery tend to experience more difficulties and more discomfort after surgery[10]. Therefore, the psychological function and personality structure of patients who undergo orthognathic surgery are of interest to orthodontists and oral and maxillofacial surgeons.

There are many types of psychological tests, and they have many different purposes. The Minnesota Multiphasic Personality Inventory (MMPI) [11] is the most widely used psychological test that assesses personality traits and psychopathology. In this study, we investigated the psychological status of patients with jaw deformities analyzed by MMPI and the changes following orthognathic surgery.

2. Materials and methods

2.1. Subjects

The subjects were 119 patients (38 males and 81 females) in whom jaw deformities were surgically corrected in the clinic of Oral and Maxillofacial Surgery, Niigata University Medical and Dental Hospital between April 2006 and August 2011 (Table 1). The mean age ± SD at surgery was 25.5 ± 9.4 years (range:

16 - 59 years).

Skeletal morphology was examined with the use of lateral and frontal cephalograms, which were taken simultaneously with the teeth in centric occlusion. Lateral and frontal cephalograms were traced and digitized by translating the points on landmarks. On the lateral cephalogram, eight measurements, including measurements of facial angle, mandibular plane angle, Y-axis, occlusal plane angle, SNA, SNB, ANB, and the gonial angle, were performed to assess the anteroposterior and vertical relationships between facial skeletal structures (Fig. 1). On the frontal cephalogram, the X-axis was the line connecting bilateral latero-orbitales, the Y-axis was perpendicular to the X-axis passing through the neck of the crista galli, and asymmetry was assessed with the absolute X-value of the menton (Fig. 2).

The patients were divided into groups according to the type of anteroposterior skeletal pattern. Eighty-four patients had skeletal class III malocclusions (class III group), 20 patients had skeletal class II malocclusions (class II group), and 15 patients had skeletal class I malocclusions with facial asymmetry and/or open bite (class I group). The mean ages ± SD at surgery were 25.4 ± 10.2 years (range: 16 - 59 years) in the class III group, 25.2 ± 6.0 years (range: 17 - 35 years) in the class II group, and 26.8 ± 8.6 years (range: 17 - 44 years) in the class I group. The patients were also divided into groups according to the presence or absence of facial asymmetry, which was diagnosed if the absolute X-value of the menton on a frontal cephalogram was over 4 mm. Fifty-one patients had facial asymmetry (asymmetry group) and 68 patients had no facial asymmetry (symmetry group). The mean ages ± SD at surgery were 26.4 ± 10.2 years (range: 16 - 59 years) in the asymmetry group and 24.9 ± 8.8 years (range: 16 - 55 years) in the symmetry group.

A combination of Le Fort I osteotomy and bilateral sagittal split osteotomies and/or other surgeries was

used in 81 patients, and bilateral sagittal split osteotomies were performed in 38 patients. Secondary genioplasty was used in 19 patients. No cases of cleft palate or craniofacial syndrome were included. All of the subjects received pre- and postoperative orthodontic treatment, and osteosynthesis was achieved using titanium miniplate and/or resorbable fixation devices. Maxillomandibular fixation was performed one day after surgery and maintained for 14 days. Psychological status of each of the patients was assessed by Minnesota Multiple Personality Inventory (MMPI) before surgery and more than six months after surgery. The study protocol was approved by the Ethics Committee of Niigata University, and informed consent was obtained from the subjects.

2.2. Minnesota Multiphasic Personality Inventory (MMPI)

We used the New Japanese Version of MMPI (The Society for MMPI New Japanese Version, 1993) [11], which is a self-report personality inventory consisting of 550 items that describe feelings or actions which the person is asked to agree with or disagree with. MMPI is made up 10 clinical subscales, which are a result of answering certain questions on the test in a specific manner:

1. Hypochondriasis (Hs) scale measures a person's perception and preoccupation with their health and health issues.
2. Depression (D) scale measures a person's depressive symptoms level.
3. Hysteria (Hy) scale measures the emotionality of a person.
4. Psychopathic Deviate (Pd) scale measures general social maladjustment and the absence of strongly pleasant experiences.
5. Masculinity/Femininity (Mf) scale measures a stereotype of a person and how they compare.

6. Paranoia (Pa) scale primarily measures interpersonal sensitivity, moral self-righteousness and suspiciousness.

7. Psychasthenia (Pt) scale measures a person’s inability to resist specific actions or thoughts, regardless of their maladaptive nature.

8. Schizophrenia (Sc) scale measures a person's unusual/odd cognitive, perceptual, and emotional experiences.

9. Hypomania (Ma) scale measures a person's energy.

10. Social Introversion (Si) scale measures the social introversion and extroversion of a person.

Additionally, MMPI contains four validity scales designed to measure a person’s test-taking attitude and approach to the test:

Cannot say (CNS) scale is numbers of items answered "I cannot say either way" and is high in general neurotic patients.

Lie (L) scale is intended to identify individuals who are attempting to put themselves in a good light.

Frequency (F) scale is intended to detect unusual or atypical ways of answering the test items, like if a person were to randomly fill out the test.

Correction (K) scale is intended to identify psychopathology in people who otherwise would have profiles within the normal range.

These scales are standardized to ensure that the averages may be 50 points, and more than 70 points are considered as a high score.

2.3. Statistical analysis

All data of MMPI were compared with standard values calculated from measurements in 114 Japanese men and 86 Japanese women in their twenties[12]. To assess the significance of differences between the groups, we used Student's *t*-test, one-way repeated measures analysis of variance (ANOVA), and the Tukey multiple comparison test, as appropriate. Probabilities of less than 0.05 were accepted as significant. Data were analyzed using IBM SPSS Statistics 20 for Windows (IBM Japan, Ltd., Japan).

3. Results

3.1. Comparison of preoperative and postoperative MMPI scores with standard values

The preoperative scores on D, Hy, Pt, and Si scales were significantly higher than standard values for their generation, and the score on Ma scale was significantly lower than standard values. The scores on CNS, D, and Hy scales significantly decreased after surgery. However, the postoperative scores on D, Pt, and Si sales were significantly higher than standard values, and the postoperative score on Ma scale was significantly lower than the standard value (Table 2).

Thirty-five of the 119 patients had high scores (> 70) on some clinical subscales. In 16 of the 35 patients with high scores before surgery, all scores were within normal ranges after surgery, but the other 19 patients still had high scores on some clinical subscales after surgery.

Five of the patients were diagnosed as having mental diseases before surgery. One patient with atypical autism had high scores on F, Hs, D, Hy, Pd, Pa, Pt, Sc and Si scales before and after surgery. A patient with schizophrenia had high scores on F, Pd, Pa, Pt and Sc scales before surgery and on F, D, Hy, Pd, Pa, Pt and Sc scales after surgery. A patient with depression had a high score on the Pt scale before surgery and high scores on the Pt and Sc scales after surgery, and another patient with depression had a high score on the Sc

scale before surgery and high scores on the Sc and Si scales after surgery. A patient with orthostatic disturbance had a high score on the Pa scale before surgery.

3.2. Comparison of MMPI scores among types of jaw deformities

The D scale in the skeletal class III group was higher than those in the other skeletal groups, and D and Hy scales in the skeletal class III group significantly decreased after surgery (Table 3). There was no significant difference in clinical subscales between the asymmetry and symmetry groups, though there was a significant difference in the CNS scale between the two groups and Hy scale in the asymmetry group significantly decreased after surgery (Table 4).

4. Discussion

The desire for esthetic improvement and the resulting psychologic benefit are frequently major motives of patients who request orthognathic surgery rather than a desire for functional improvement[1-6]. The motivations, perceptions, and expectations of the individual play a significant role in determining not only the surgical success but also the psychosocial success. Although satisfaction with orthognathic surgery is generally high, an important minority of patients are dissatisfied with the outcome[13]. In our previous study[14] using questionnaires, 8% of the patients in whom jaw deformities had been surgically corrected more than one year ago answered that they were dissatisfied with the results in regard to their chief problems. Dissatisfaction after orthognathic surgery is not caused by the skill of the operator, but is due to the patient's psychological problems. With regard to the psychological impact of dentofacial disharmony, previous studies have shown that patients with jaw deformities do not appear to be more psychologically distressed or

depressed than normal[13,15-17]. On the other hand, it has been reported that patients who were psychologically distressed before orthognathic surgery tend to experience more difficulties and more discomfort with symptoms, social/self-concerns, general health, and overall recovery after surgery[18,19]. In particular, patients with body dysmorphic disorder are often not satisfied with the results of surgery[20]. Therefore, patients' reasons for seeking surgery, their expectations and their ability to adapt after the operation should be evaluated on an individual basis by understanding their psychological status regarding the jaw deformities.

Psychological aspects in patients with jaw deformities have been researched in a variety of ways such as questionnaires,[14,21-24], psychological tests[15,25-28] and an interview technique[29]. Among them, psychological tests are useful for understanding more objectively the psychological characteristics of the patient. MMPI is one of the most frequently used psychological tests in mental health, and the test is used by trained professionals to assist in identifying personality structure and psychopathology. The present study was designed to obtain useful information for proper treatment planning by investigating the psychosocial status of patients with jaw deformities. The results were compared with standard values from measurements in 200 Japanese men and women in their twenties.

In previous studies, MMPI scores in patients with jaw deformities were not significantly different from standard values for their generation[17,30]. Some studies, however, indicated that 18% to 33% of patients have clinically elevated levels of psychologic distress before orthognathic surgery[31-33]. In the present study, the MMPI scores on depression, hysteria, psychasthenia and social introversion scales were significantly higher than standard values and the score on the hypomania scale was significantly lower than the standard value.

There are some indications that differences might exist in the psychological status of patients with different types of jaw deformity. A comparative study of skeletal class II and skeletal class III patients

showed that skeletal class III patients had stronger feelings of insecurity regarding their facial appearance[34]. In the present study, the depression scale of skeletal class III group patients was higher than the scales in the other skeletal groups. One reason might be that patients with skeletal class III malocclusion exhibit higher levels of psychological stress than those with the other jaw deformities in social situations. Indeed, it has been suggested that patients with skeletal class II malocclusion are less likely to experience psychological problems than those with skeletal class III malocclusion because it is possible for skeletal class II patients to disguise their skeletal discrepancy by protruding their mandible[35].

In the present study, 31% of the patients had high scores (> 70) on some clinical subscales and five of the patients were diagnosed as having mental diseases before surgery. However, we had no major trouble before and after surgery by careful observation and response. Therefore, MMPI is viewed as an effective method to screen patients with psychological problem for orthognathic surgery. Patients with some psychological problems should be followied by appropriate counseling to help them respond to the additional stress of surgery, and patients' consent to the surgical procedure may be helpful and may reduce postoperative trouble and dissatisfaction.

Benefits of orthognathic surgery for quality of life were reviewed by Hunt et al.[36] and Soh et al.[37] for 29 articles published from 1966 to December 2000 and 21 articles published from 2001 to June of 2012, respectively. According to those reviews, patients with jaw deformities experience an improvement in quality of life after surgery, and the positive effect of orthognathic surgery on psychosocial status has been generally accepted. In the present study, scores on D and Hy scales significantly decreased after surgery, suggesting that improvement in jaw deformities has a positive influence on psychosocial status.

5. Conclusion

Orthognathic surgery has a positive influence on psychosocial status in patients with jaw deformities, especially patients with skeletal class III malocclusion, but patients with some psychological problems should be followed by appropriate counseling and careful response. MMPI is viewed as an effective method to screen patients with psychological problems for orthognathic surgery.

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Table 1. Numbers of patients in groups classified according to type of anteroposterior skeletal pattern and presence or absence of facial aymmetry.

Groups	Male	Female
Skeletal Class III	31	53
Skeletal Class II	2	18
Skeletal Class I	5	10
Asymmetry	17	34
Symmetry	21	47

Table 2. MMPI scores before and after surgery compared with standard values.

Scales	Standard values	Patients	
		Before surgery	After surgery
Cannot say	47.97±8.3	49.54±6.4	48.10±5.8
		*	
Lie	46.31±8.7	48.30±9.1	49.13±10.0
		**	
Frequency	49.79±10.8	52.04±10.8	52.30±14.7
Correction	49.35±10.2	50.78±10.1	51.84±10.0
		*	
Hypochondoriasis	49.84±10.0	51.80±9.7	51.85±9.5
Depression	48.58±10.9	53.76±11.9	52.35±11.4
	**	*	
		**	
Hysteria	50.58±9.9	53.08±9.1	51.51±9.3
	*	*	
Psychopathic deviatio	51.47±10.0	52.75±11.3	52.79±10.4
Masculinity-femininity	49.67±10.7	51.34±10.2	51.82±10.9
Paranoia	52.83±11.0	54.73±11.0	54.14±10.8
Psychasthenia	50.35±10.7	54.75±11.7	54.29±12.5
	**		
		**	
Schizophrenia	50.92±10.7	53.59±15.1	53.92±14.9
Hypomania	52.81±10.6	48.37±9.8	47.14±9.5
	**		
		**	
Social introversion	48.04±10.8	53.41±11.8	53.02±10.9
	**		
		**	
		*:p<0.05, **:p<0.01	Mean±SD

Table 3. Comparison of MMPI scores among types of anteroposterior skeletal pattern.

Scales	Type of jaw deformity	Patient	
		Before surgery	After surgery
Cannot say	Skeletal Class III	49.88±6.3	47.98±5.5 *
	Skeletal Class II	47.15±5.7	47.25±6.2
	Skeletal Class I	50.8±7.2	49.93±6.7
Lie	Skeletal Class III	48.98±9.1	49.38±9.7
	Skeletal Class II	45.6±8.1	46.6±10.6
	Skeletal Class I	48.07±9.6	51.07±11.0
Frequency	Skeletal Class III	52.15±12.3	52.35±15.3
	Skeletal Class II	52.05±10.2	52.50±12.6
	Skeletal Class I	51.40±16.3	51.80±15.5
Correction	Skeletal Class III	50.50±9.9	51.31±10.2
	Skeletal Class II	51.15±11.5	52.40±10.8
	Skeletal Class I	51.60±10.5	54.07±8.2
Hypochondoriasis	Skeletal Class III	51.62±10.0	51.40±9.8
	Skeletal Class II	52.90±9.4	52.60±8.4
	Skeletal Class I	51.33±8.4	53.20±9.1
Depression	Skeletal Class III	54.83±12.8	52.74±11.8 *
	Skeletal Class II	51.80±8.8	50.65±10.1
	Skeletal Class I	50.33±9.3	52.47±11.1
Hysteria	Skeletal Class III	52.85±9.6	50.90±9.5 *
	Skeletal Class II	52.40±8.8	53.90±7.9
	Skeletal Class I	55.27±6.4	51.73±9.9
Psychopathic deviation	Skeletal Class III	52.42±11.4	51.32±9.1
	Skeletal Class II	50.90±7.8	53.70±7.8
	Skeletal Class I	57.07±14.5	59.8±16.7
Masculinity-femininity	Skeletal Class III	51.10±10.1	51.61±10.7
	Skeletal Class II	50.45±8.0	50.60±9.0
	Skeletal Class I	53.93±12.8	54.67±13.8
Paranoia	Skeletal Class III	54.33±11.1	53.23±11.0
	Skeletal Class II	56.20±9.7	56.55±9.4
	Skeletal Class I	55.00±12.5	56.07±11.0
Psychasthenia	Skeletal Class III	54.62±12.8	52.92±12.1
	Skeletal Class II	54.40±8.4	57.95±11.8
	Skeletal Class I	55.93±9.6	57.13±14.7
Schizophrenia	Skeletal Class III	53.82±16.1	53.86±14.9
	Skeletal Class II	52.25±8.7	53.20±13.2
	Skeletal Class I	54.07±17.2	55.20±17.8
Hypomania	Skeletal Class III	47.90±9.7	46.76±9.6
	Skeletal Class II	49.95±9.4	46.85±8.4
	Skeletal Class I	48.87±10.9	49.67±11.1
Social introversion	Skeletal Class III	54.02±11.6	53.52±11.0
	Skeletal Class II	52.95±11.9	51.80±9.8
	Skeletal Class I	50.60±13.2	51.80±12.4
		*:p<0.05	Mean±SD

Table 4. Comparison of MMPI scores between asymmetry and symmetry groups.

Scales	Presence or absence of facial asymmetry	Patient	
		Before surgery	After surgery
Cannot say	Asymmetry	49.05±6.2	48.64±6.0
	Symmetry *	50.88±6.8	46.63±4.7
		**	
Lie	Asymmetry	48.23±9.1	48.70±9.7
	Symmetry	48.47±9.0	50.28±10.7
Frequency	Asymmetry	50.62±10.1	50.91±13.2
	Symmetry	55.91±17.0	56.09±17.9
Correction	Asymmetry	51.48±9.7	52.00±10.2
	Symmetry	48.88±11.2	51.41±9.5
Hypochondriasis	Asymmetry	52.02±9.6	52.26±9.5
	Symmetry	51.19±10.0	50.72±9.4
Depression	Asymmetry	53.56±11.4	51.92±10.9
	Symmetry	54.28±13.3	53.53±12.8
Hysteria	Asymmetry	53.44±8.7	51.31±8.9
		**	
	Symmetry	52.09±10.3	52.06±10.4
Psychopathic deviation	Asymmetry	53.28±10.9	52.92±10.7
	Symmetry	51.31±12.7	52.44±9.8
Masculinity-femininity	Asymmetry	51.53±10.2	52.61±11.1
	Symmetry	50.84±10.1	49.69±10.2
Paranoia	Asymmetry	54.90±10.9	54.31±10.8
	Symmetry	54.28±11.3	53.69±10.9
Psychastenia	Asymmetry	54.80±10.8	54.13±11.2
	Symmetry	54.59±14.2	54.75±15.7
Schizophrenia	Asymmetry	53.28±14.5	53.64±14.6
	Symmetry	54.44±17.1	54.66±15.8
Hypomania	Asymmetry	47.78±9.3	47.09±9.9
	Symmetry	49.97±11.0	47.28±8.7
Social introversion	Asymmetry	53.53±11.5	53.38±11.1
	Symmetry	53.09±12.6	52.03±10.5
		*:p<0.05, **:p<0.01	Mean±SD

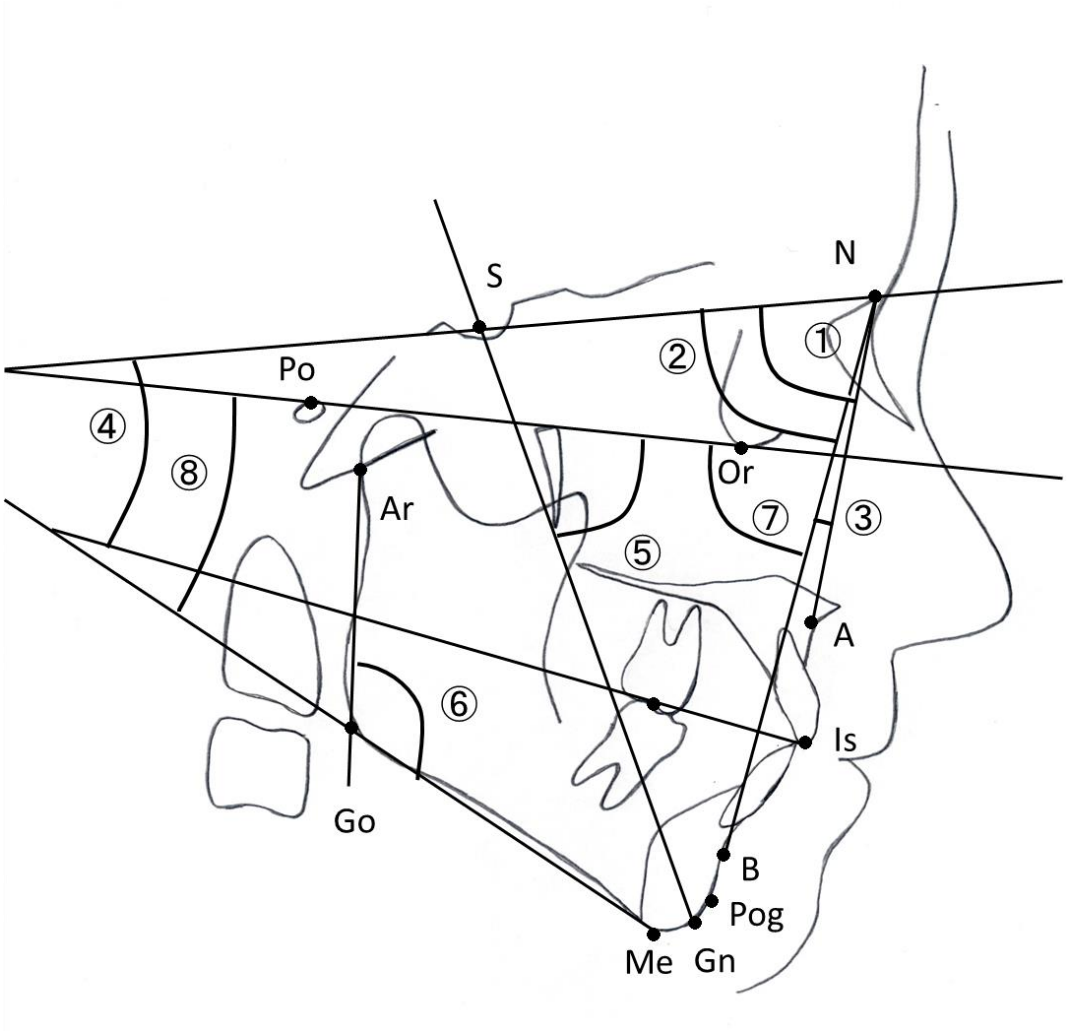

Fig 1. Measurement on a lateral cephalogram

① SNA: Angle between line S-N and line N-A.

② SNB: Angle between line S-N and line N-B.

③ ANB:Difference between SNA and SNB.

④ Occlusal plane angle: Angle between line S-N and occlusal plane.

⑤ Y-axis: Angle between FH plane and line S-Gn.

⑥ Gonial angle: Angle between ramus plane and mandibular plane.

⑦ Facial angle: Angle between FH plane and facial plane.

⑧ MP: Angle between FH plane and mandibular plane.

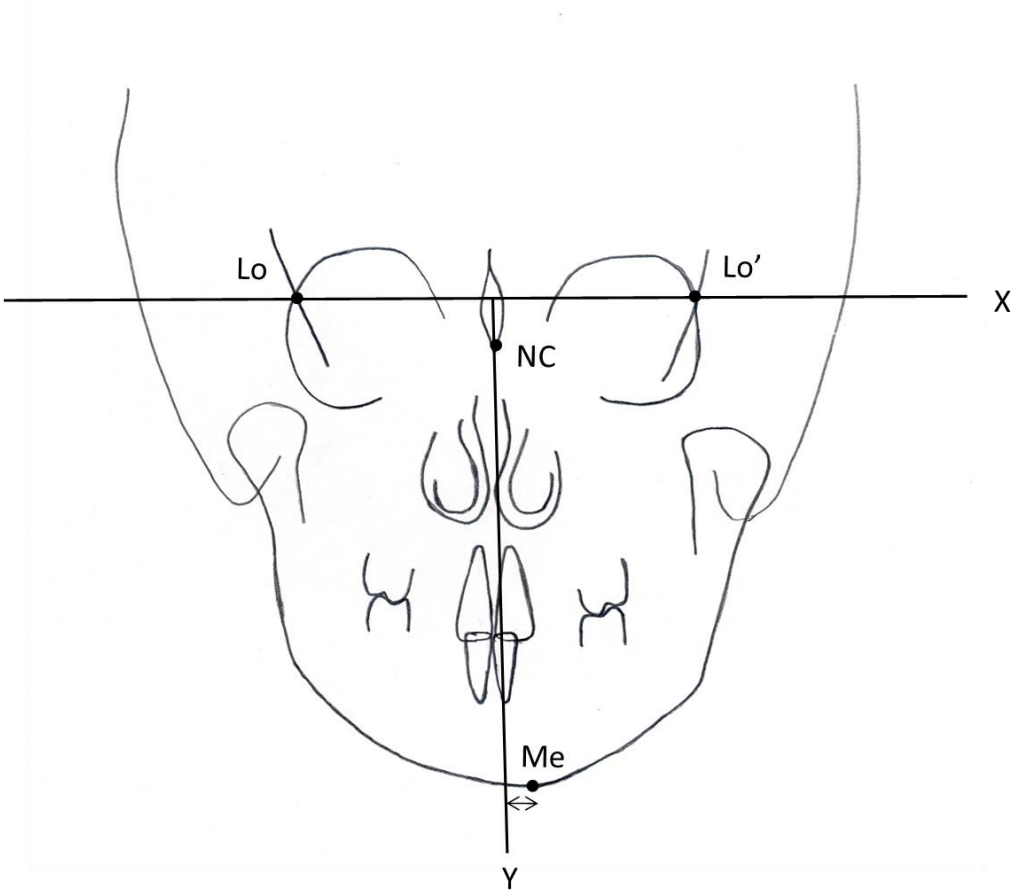

Fig 2. Analysis of asymmetry on a lateral cephalogram

The X-axis is the line connecting bilateral latero-orbitales. The Y-axis is perpendicular to the X-axis passing through the neck of the crista galli. Asymmetry of the facial skeletal structure is assessed with the absolute X-value of the menton.