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Difference of Vertical Mandibular Symmetry Based on Mandibular Growth Pattern in Orthodontic Patients

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***Abstract*–Mandibular asymmetry presents a problem when disruption in the balance of the size, shape and arrangement of facial tissue occurs. The highest growth potential of the mandible is in the condyle region and may affect the growth pattern of the mandible. The aim of this study is to analyze the vertical mandibular symmetry based on mandibular growth pattern. This is an analytic study with cross-sectional design on 79 pre-treatment panoramic radiographs and lateral cephalometry of orthodontic patients at RSGMP FKG USU at age 18 and above with complete dentition till second molar. The vertical mandibular symmetry based on Habets' method modified by Kjellberg on condylar asymmetry index. Mandibular growth pattern was determined by measuring mandibular plane to cranial base with Steiner analysis. The difference of vertical mandibular asymmetry and mandibular growth pattern was analyzed by *Pearson's Chi-square* analysis. There was 57.0% (n = 45) samples had symmetry condyles while 43.0% (n = 34) samples had asymmetry condyles. In a normal vertical mandibular growth 34.2% (n = 27) of the samples had a symmetry condyle and 21.5% (n = 17) of the samples had an asymmetric condyle. Whereas in abnormal vertical mandibular growth 22.8% (n = 18) samples had symmetric condyles and 21.5% (n = 17) samples had asymmetric condyles. There was no significant difference of vertical mandibular symmetry based on mandibular growth pattern (p = 0.379). Further research should consider the type of malocclusion which affected the condyle rotation in mandibular growth pattern.**

Keywords–vertical mandibular symmetry, mandibular growth pattern, condyle asymmetry

I. INTRODUCTION

Mandibular asymmetry leads to dimensional differences in size or shape between the right and left sides of the mandible. The highest growth potential of the mandible is in the condyle region and may affect the growth pattern of the mandible. There are various factors which influence the morphology of the condyle such as: age, sex, anatomy of TMJ, occlusal force, and malocclusion [1]. Previous study reported that there were no statistically significant differences of mandibular asymmetry between male and female subjects in different occlusion pattern [2]. This variance led to index asymmetry findings of vertical mandibular asymmetry based on panoramic radiograph, postero-anterior and lateral cephalogram, Computed Tomogram (CT), Cone Beam Computed Tomography (CBCT) analysis [3-10].

Mandibular asymmetry presents a problem when disruption in the balance of the size, shape and arrangement of facial tissue occurs. There were increasing skeletal asymmetry along with increasing age in Jakarta subpopulation of 8-30 year old subjects based on postero-anterior radiograph. Those were pre pubertal 9.1%, pubertal 12.6%, and post pubertal 17.9% [11]. Class II division 1 malocclusion has a significant effect on the condylar asymmetry index when compared to class I division 2, class III malocclusion, and normal malocclusion in 11-15 year old subjects [2]. There were association between asymmetrical jaw function and joint remodeling in 3-D morphology of condyle in mandibular asymmetry [9].

Mandibular asymmetry is a three dimensional quantification of bilateral condyles. The optimum size or volume of the condyle are indicative and predictible of a precise mandibular asymmetry clinical. deformity in patients with mandibular asymmetry as a result of undergrowth and overgrowth of mandibular growth center, such as: condyle [9,12]

The validity of panoramic radiograph for diagnosing vertical asymmetry of the posterior mandible has been widely used [5,8,13-16]. The Habets' method used 6% cutoff to measure the condylar height asymmetry (1988) whilst Kjellberg (1993) reported the modification in point determination of condylar point because the variance of mandibular condyle morphology. While Fuentes compare the Kjellberg's

and Habets' methods in the vertical mandibular asymmetry assessment, he found that Kjellbergs's method was easier to perform in terms of identifying and measuring points [15].

Altering facial proportions and treating to a cephalometric range is logical for orthodontists as a method to determine the vertical dimension which related to stomatognathic problems, such as: temporomandibular disorder, stability, muscle pain, bite force, phonetic, and facial esthetics [17]. Mandibular growth pattern was determined by measuring mandibular plane to cranial base with Steiner analysis. The posterior rotation of the mandible has a marked effect on mandibular condyle morphology and position. This condition led to three basic types of skeletal vertical growth pattern exists: high angle, normal angle, and low angle [18,19].

Since uunderstanding the importance of condylar asymmetry in development of rational treatment protocols for adults with end-stage asymmetry and to minimize secondary deformity in growing orthodontic patients, this study's aim was to analyze the vertical mandibular symmetry based on mandibular growth pattern.

II. MATERIALS AND METHODS

This is an analytic study with cross sectional design. The samples were secondary data of patient's medical record, i.e. pre-orthodontic treatment panoramic radiographs and lateral cephalometry of 70 out-going orthodontic patients in dental hospital of Faculty of Dentistry Universitas Sumatera Utara from June 2016 to March 2017. This research has been approved by health Research Ethical Committee of Medical Faculty Universitas Sumatera Utara No, 163/TGL/KEPK/FK USU-RSUP HAM/2017. All the panoramic and cephalometry lateral was conducted from same radiograph machine. The sample was selected with purposive sampling method base on inclusion and exclusion criteria. The inclusion criteria include fine quality of panoramic radiograph and lateral cephalometry, patients aged 18 years old and above, and with complete dentition up to second molar. The asymmetry of condyles was manually determined with Kjellberg's method on tracing paper above tracing box. The difference of condyle height on both sides was measured with the formula of (R-L)/(R+L) X 100%. The difference of greater than 6% represents asymmetrical mandible. The measurement of mandibular growth pattern is determined by the angle of MP:SN, based on Steiner's method using Go-Me line as a mandibular plane.

Measurement of condyle asymmetry index and mandibular growth pattern on 20 samples is performed by inter-observer ($p>0.05$) and intra-observer ($p>0.05$) with T-test to ensure validity and reliability of measurement. Further analysis to determine difference of vertical mandibular asymmetry and mandibular growth pattern were conducted intra-observer. The difference of condylar asymmetry and vertical mandibular growth was analyzed by Pearson's Chi-square analysis.

III. RESULTS

The meant of age of subjects were 21.09±1.77 year-old with male subjects were 22.8% (n=18) and female subjects were 77.2% (n=61). The average of asymmetry index among vertical mandibular symmetry were 5.31±4.87% whilst mandibular growth pattern were 32.76°±2.93° in normal subjects and 29.09°±9.64°. The difference of condylar asymmetry and vertical mandibular growth were shown in Table I.

TABLE I. DIFFERENCE OF VERTICAL MANDIBULAR SYMMETRY BASED ON MANDIBULAR GROWTH PATTERN

Vertical Mandibular Symmetry	**Mandibular Growth Pattern**						***p***
	Normal		***Abnormal***		***Total***		
	n	***%***	***n***	***%***	***N***	***%***	
Symmetry	27	34.2	18	22.8	44	55.7	0.379
Asymmetry	17	21.5	17	21.5	35	44.3	

[a.] *Chi-Square test*: $p<0.05$: Significant difference

IV. DISCUSSION

The coordination among the various muscles, ligaments and the associated movements of the mandibular condyle related to Temporomandibular joint (TMJ) capability in producing the opening, closing, lateral and translatory movements. By early identification of vertical mandibular symmetry based on panoramic radiograph, the diagnosis of temporomandibular might be obtained. The method of asymmetry index in percentage that was mentioned in this research, has been widely used for orthodontic diagnose in panoramic radiograph [2,5,13,14,20-22], postero-anterior radiograph [10] and CBCT [19].

This research used digital panoramic radiograph that was reported are sufficient accurate for clinical use. Even though the vertical measurements were less reproducible than horizontal measurements, the 6% difference between the condylar vertical sizes based on panoramic radiograph was acceptable with respect to a 1mm change in the head position [13]. Panoramic radiograph is common as routine radiograph in any dental practice. The proper diagnosis of vertical mandibular asymmetry is essential for addressing treatment limitations and therapeutic options because the complexity of orthodontic treatment is limited to reduce the symptoms, not the etiology factors. A high prevalence of both dimensional angular mandibular asymmetries was shown in the studied population. The structure that has been reported to have greatest distortion is the mandibular ramus with its condyloid and coronoid process. Then this research used Habets' method modified by Kjellberg on condylar asymmetry index to assess vertical mandibular asymmetry.

The mean age of patients in this study is 21.09±1.77 year-old (18-25 year old patients). The variances of expression growth factor mandibular condyle growth and morphology should be considered. The imbalance of sex in this research based on Sezgin and Celik studies that reported there were no significant differences between male and female subjects. This

study reported that there was no significant difference of vertical mandibular symmetry based on mandibular growth pattern. Our results agreed with Celik's et al that reported about no significant differences in condylar height asymmetry with different vertical growth pattern [19] This condition might be caused of the limitation of 2D cephalometry in growth assessment whereas Steiner's cephalometric analyses is not accurate enough to plan orthodontic treatment [23]. However, vertical mandibular symmetry assessment was required to detect functional problem of stomatognathic that related to static and dynamic occlusion. Although a static relationship in principle, the vertical dimension of occlusion is initially determined by the interaction of the genetic growth potential of the craniofacial tissues, environmental factors, and the dynamics of neuromuscular function during dentocraniofacial growth [24].

As a conclusion in this research, the abnormality of vertical mandibular growth factor is variance based on vertical mandibular asymmetry. Further research should consider the type of malocclusion which affected the condyle rotation in mandibular growth pattern.

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