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Letter to the Editor

Condylar Size in Malocclusion Skeletal Patterns: Measurements of Three Dimensional Models

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Dear Editor-in-Chief

The condyle acts as the center for rotational mandible movement in the skull. It is an important structure that greatly influences the temporomandibular joint (TMJ), and its shape and size are related to the development and treatment of temporomandibular joint disorders (TMD) (1). The bony structure of the TMJ can be imaged using computed tomography (CT), with maxillofacial cone-beam computed tomography (CBCT) being widely used to assess the maxillofacial region (2). CBCT is especially helpful for identifying small regions of the mouth and maxillofacial region, and can be used as a preoperative simulation tool by reconstructing three-dimensional (3D) images.

Moreover, CBCT can provide higher resolution imaging combined with a shorter scan time (typically 10–70 seconds). In addition, the radiation exposure is much smaller than that of conventional CT, and two-dimensional (2D) CBCT images can be used as the basis for reconstructing 3D images (3). The images and 3D information provided by CBCT are useful in studies of condyle morphology. However, many of the studies that have utilized CT images only made simple linear measurements due to uncertain information and angular limitations associated with planar measurements, which limited their accuracy.

In this study, we reconstructed the CBCT data of patients with malocclusion of classes I, II, and III as 3D models and compared the differences in the measured shapes and sizes of the condyles among these malocclusion groups. The CBCT data of 60 patients with malocclusion who met the inclusion criteria were obtained in the DICOM (Digital Imaging and Communications in Medicine) format from a CBCT scanner (Alphard 3030, Asahi, Kyoto, Japan). After importing the corresponding DICOM file from MIMICS software (version 17), a skull 3D model was created based on the uploaded CBCT image, and the presence of malocclusion was confirmed visually. The condyle size was measured by observing the model condyle from various angles (Figs. 1, 2).

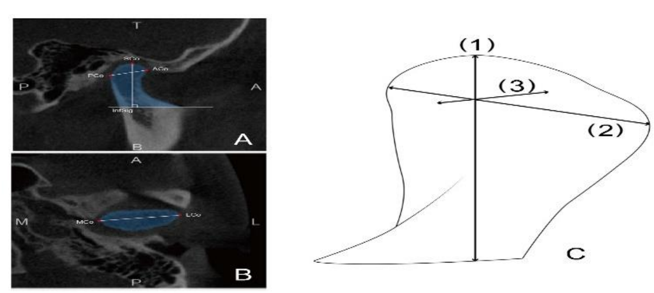

Fig. 1: Measurement of condylar Heigth, Width and Length

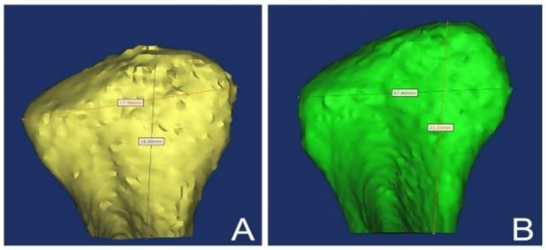

Fig. 2: Condylar shape (A. Class Ⅱ, B. Class Ⅲ)

The independent-samples *t*-test was performed to detected sex-related differences in the measured values, while one-way ANOVA was used to compare the measured values among the three experimental groups.

Table 1: Mean values of condylar measurments of subjects in three subgroup

Measurements			***N***	***Mean***	***SD***	***F***	**P**
Male	Height	Class Ⅰ	20	22.28a	2.23	10.107	<.001*
		Class Ⅱ	20	18.81b	2.68		
		Class Ⅲ	20	21.72b	2.9		
	Width	Class Ⅰ	20	21.75	1.77	0.514	0.601
		Class Ⅱ	20	21.27	2.56		
		Class Ⅲ	20	21.95	2.18		
	Length	Class Ⅰ	20	11.09	1.58	1.273	0.288
		Class Ⅱ	20	11.45	1.54		
		Class Ⅲ	20	10.76	0.88		
	Volum	Class Ⅰ	20	2590.35a	631.07	10.365	<.001*
		Class Ⅱ	20	1845.32b	560.02		
		Class Ⅲ	20	2481.37b	474.78		
	Surface	Class Ⅰ	20	1243.96a	188.44	10.19	<.001*
		Class Ⅱ	20	1007.99b	191.61		
		Class Ⅲ	20	1212.87b	156.73		
Female	Height	Class Ⅰ	20	19.49a	2.03	8.308	.001**
		Class Ⅱ	20	17.89ab	2.99		
		Class Ⅲ	20	20.81b	1.53		
	Width	Class Ⅰ	20	19.04a	2.27	5.909	.005**
		Class Ⅱ	20	18.00ab	3.09		
		Class Ⅲ	20	20.97b	2.88		
	Length	Class Ⅰ	20	10.15	1.15	0.445	0.643
		Class Ⅱ	20	10.26	1.13		
		Class Ⅲ	20	9.9	1.42		
	Volume	Class Ⅰ	20	1870.03a	433.5	7.837	.001**
		Class Ⅱ	20	1502.38ab	498.79		
		Class Ⅲ	20	2099.16b	507.09		
	Surface	Class Ⅰ	20	970.57a	163.31	8.687	.001**
		Class Ⅱ	20	841.17ab	189.27		
		Class Ⅲ	20	1070.10b	168.85		

* p-value were obtained by one-way ANOVA($p<0.001$)/** p-value were obtained by one-way ANOVA($p<0.05$)$^{a-b}$. The same characters were not significant by Scheffe Comparisons in three group.

The values measured for the left and right condyles in classes I, II, and III were analyzed, which revealed no significant sex-related differences in height, width, length, volume, or surface area. The analysis of the condyle measurements of class I patients showed significant sex-related differences in all of the values ($P < 0.05$).

The measured values of width, length, volume, and surface area differed significantly between the sexes in class II, while there were significant differences in the length, volume, and surface area in class III. The differences among the three experimental groups were evaluated by analyzing the condyle dimensions of men, which revealed significant differences in the measured values of height, volume, and surface area. Significant differences among the experimental groups were detected using post-hoc Scheffe's analysis, with a significant difference in the height values between classes I and II. Among the three experimental groups, the condyle measurements in women showed significant differences in height, width, volume, and surface area (Table 1).

TMJ diseases are often categorized according to various causes (e.g., disc escape, incorrect spatial relationship between the condyle and fossa, orofacial pain, and reduction of joint noise or mandibular movements), but it is difficult to determine the criteria (standard) for diagnosing the disease even when CBCT is available (4).

The protocol adopted in this study made a more accurate classification of malocclusion possible, and it was possible to measure both the surface area and volume, which are typically very difficult to measure. These measurements represent basic data that are useful in various research fields related to the TMJ. The condyle is an important part of occlusion, and so identifying correlations between condyle dimensions and each type of malocclusion is expected to be useful for clinical practice.

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Conflict of interests

The authors declare that there is no conflict of interests.

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