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Original research

Evaluation of the relationship between tooth decay and trabecular bone structure in pediatric patients using fractal analysis: a retrospective study

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Purpose
The movement of chewing affects the growth and development of the stomatognathic system. Tooth decay, which is known to have effects on chewing, can affect the jaw bone due to its indirect effect on the mechanical forces transmitted to the jaw bone. This study aimed to evaluate the relationship between dental caries and jawbone trabeculation during the growth and development processes in children using fractal dimension (FD) analysis.

Materials and Methods
A total of 120 patients were divided into three groups. The groups were determined as follows: group 1: 40 patients without deep dentin caries/apical rarefying osteitis, group 2: 40 patients with deep dentin caries/apical rarefying osteitis on the right or left sides, and group 3: 40 patients with deep dentin caries/apical rarefying osteitis on both the right and left side. Digital panoramic images of the selected patients were evaluated using FD analysis.

Results
There was no statistically significant difference in the FD analysis among the groups ($p>0.05$). Age and sex factors were not found statistically significant in the in-group evaluation ($p>0.05$). In group 3, FD values of the right condyle ($r= -0.42$, $p<0.05$), right ramus ($r= -0.37$, $p<0.05$) and left ramus ($r= -0.45$, $p<0.05$) were negatively correlated with age.

Conclusion
There is no relationship between tooth decay and trabeculation of the jawbone in children aged 8-13 years.

Keywords: *Bone, dental caries, fractals, mandible, radiology*

Introduction

Tooth decay is one of the most common public health problems in childhood. It may cause discomfort, pain, decreased quality of life, and changes in chewing patterns in children (1,2). Chewing is a developmental function that matures through experience. Childhood is very important for performing mastication skills. Proper chewing function stimulates the development of the maxilla and mandible (3).

It is known that individuals may have a preference for the chewing side to improve comfort and chewing efficiency (4). Changes in chewings pattern may be due to tooth decay, which causes pain and decreases the occlusal contact area. With the mechanical stimulus caused by chewing, pain in a decayed tooth decreases chewing performance and the maximum chewing force (2). Decerle *et al.* (5) reported that untreated dental caries decreased chewing performance in adults by reducing the inter-arch occlusal contact area. Barbosa *et al.* (6) reported that there was a

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positive correlation between the number of decayed teeth and median particle size, as represented by the degree of fragmentation of a test food after chewing. The degree of fragmentation of the food was determined by sieving. An increase in the number of decayed teeth decreased chewing performance.

Changes in occlusal forces cause microscopic and macroscopic changes in jawbones. Trabecular bone architecture has a suitable structure for load-bearing functions (7). Trabecular bone is more determinant in evaluating changes in bone structure because it has a higher metabolic activity compared with cortical bone (8). Fractal dimension (FD) analysis measured on digital panoramic radiographs (DPRs) is a way to measure to determine early periodontal problems in the alveolar bone and mandibular trabecular architecture (9). The popularity of FD has increased in recent years, it offers features such as easy to access, providing objective data about trabecular structures, not being affected by variables such as radiologic density, and projection geometry (10,11). FD analysis can be performed using the existing DPR of patients without the need for extra imaging and materials (12).

Underlying peripheral sensorimotor pathways mature as oral motor skills mature in childhood (13). It is important to understand the effects of dental caries on the jawbone to ensure the correct growth and development of the stomatognathic system because the growth and development process adapts to functional models. The purpose of this study was to assess the relationship between dental caries and jawbone trabeculation using FD analysis in children in the growth and development periods. The null hypothesis was that there would be no difference among the non-carious group, the unilateral carious group, and the bilateral carious group in the mandibular trabecular FD values.

Materials and Methods

Ethical statement

This study has been reviewed and approved by the Recep Tayyip Erdoğan University Clinical Studies Ethics Committee (2020/127).

Patient selection

DPRs of systemically healthy patients aged 8-13 years who presented to Recep Tayyip Erdoğan University, Faculty of Dentistry Pediatric Dentistry Department between 01.2018 and 04.2020 were scanned retrospectively. To exclude changes that might occur in the bone and chewing pattern during tooth eruption, patients with first molars whose root development was completed and unerupted second molars were included in the study. Patients with disorders of temporomandibular joint, those exposed to trauma in the area to be measured, any systemic disease, who received orthodontic treatment in the last 2 years/had ongoing orthodontic treatment, parafunctional habits in their anamnesis, unilateral/bilateral cross-bite were not included in the study. Also, radiographs with errors that might affect the diagnostic capacity such as patient movement and positioning error were not included in the study.

Patients who met the inclusion criteria were divided into three groups according to the following conditions in their permanent first molar teeth:

-Patients without apical rarefying osteitis / deep dentin caries (the non-carious group) (Group 1),

-Patients with apical rarefying osteitis / deep dentin caries on the left or right sides (the unilateral carious group) (Group 2),

-Patients with apical rarefying osteitis / deep dentin caries on both the left and right side (the bilateral carious group) (Group 3),

Four hundred DPRs were investigated; 120 of the radiographs that met our inclusion criteria were included in the study. Forty eligible patients were randomly selected for each group, with equal numbers of boys and girls. DPRs of the patients were obtained at 66 kVp, 8 mA, 16.6 seconds using a Planmeca Promax 2D S2 device (Planmeca Oy; Helsinki, Finland).

Evaluation of Images using Fractal Dimension Analysis

Images were evaluated by a dentomaxillofacial radiologist (D.N.G.). DPRs were recorded in TIF (high-resolution option) format to ensure standardization of the images and adjusted to 2836 x 1500 pixels. The ImageJ (V.1.53) software (National Institutes of Health, Bethesda) bundled with 64-bit Java for Windows was used for the FD analysis of the images. FD analysis was performed on DPRs, which was transferred to the ImageJ program (National Institutes of Health, Bethesda), and three regions of interest (ROI) of 15 x 15 pixels were determined for each patient with the antegonial notch in the left and right hemi-mandible, the condyle, and in the center of the ramus (Figure 1).

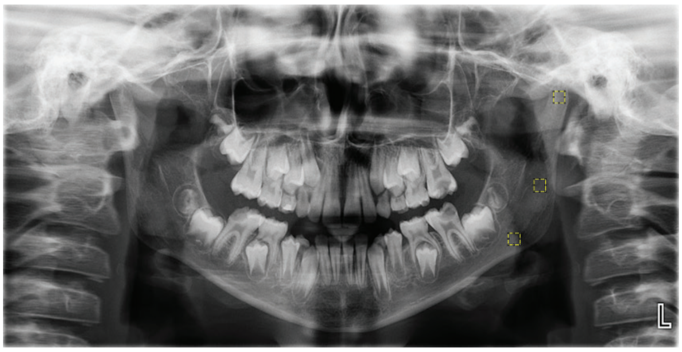

Figure 1. *Selection of the ROIs on DPRs.*

The ROIs were evaluated by one dentomaxillofacial radiologist with 6 years of experience (D.N.G.). The copied ROI was blurred using the 'Gaussian Blur' filter. With this option, bright areas caused by changes in soft tissue and bone thickness became blurred and were removed from the original image. Then, using the "Make Binary" option, the image was converted to black and white and the borders of the trabecular structure and cortical bone were clarified. Image noise was reduced by using the 'Erode' option. With the "Dilate" option, the generations were extended and clarified. The "Invert" button makes the white areas were converted to black and the black areas to white. Thus, the borders of the trabecular bone became clear. Finally, by selecting the 'Skeletonize' option, the trabecular structure was converted into a skeleton structure format. Images were prepared for FD analysis. Using the "Fractal Box Counter," the measurements were divided into squares of 2, 3, 4, 6, 8, 12, 16, 32, and 64 pixels. the total number of frames and the number of frames containing the trabecular structure were calculated for different dimensions. The number of frames containing the total number of frames and the trabecular structure were calculated for different dimensions. The values were transferred to a logarithmic scale automatically and the slope of the curve fitting the points on the graph gave the result of the FD measurement (Figure 2).

The kappa coefficient was used to calculate the intra-observer correlation coefficient. For this purpose, 20 patients were randomly re-measured 2 weeks later.

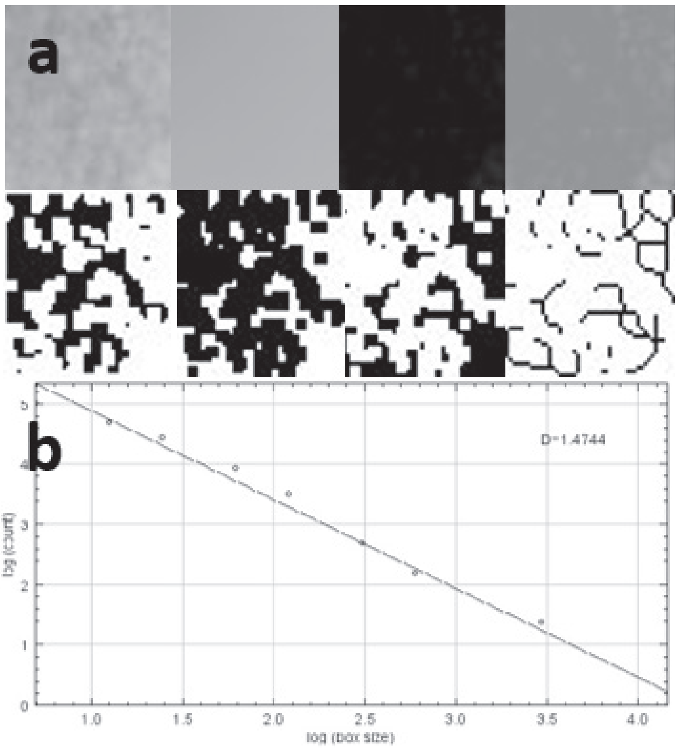

Figure 2. *Steps of FD analysis: Top row left to right respectively; cropped and duplicated ROI, gaussian blur, subtracted blurred image from the original image, addition of a gray value of 128 to each pixel location. Bottom row from left to right respectively; erosion, dilatation, inversion, skeletonization. b. FD analysis with the box-counting method.*

Statistical analysis

Post-hoc power analysis was performed with the G*Power 3.1.0 software package (Universitat Dusseldorf, Germany) to determine the number of patients to include in the study. For statistical analysis, the SPSS Statistics 23.0 (SPSS, Chicago, IL, USA) program was used. The age, sex, and distribution of the patients were analyzed using descriptive statistical methods. The suitability of the variables to normal distribution was evaluated using the Kolmogorov-Smirnov/Shapiro-Wilk tests. Mean and standard deviation were used for variables with normal distribution, and median and range values were given for variables that did not show normal distribution. The paired-samples t-test was used for measuring data independent groups with parametric distribution, and the independent samples t-test was used in independent groups. Data of non-parametric distributed dependent groups were assessed using the Wilcoxon test, and independent groups were evaluated using ANOVA and the Kruskal-Wallis test. The relationship between FD analysis and age was calculated using Spearman's correlation analysis. The statistical significance level was accepted as $p<0.05$.

Results

The null hypothesis was accepted. The post hoc power was calculated as 0.16 (noncentrality parameter: 1.42, critical F: 3.07, 1-b error probability: 0.83, effect size: 0.109). It was determined that 8 of the 120 patients were aged 9 years, 26 were aged 10 years, 32 were aged 11 years, 39 were aged 12 years, and 15 patients were aged 13 years. The mean ages of 60 female and 60 male patients were 11.20 ± 1.11 and 11.25 ± 1.14 years, respectively.

The relationship between sex and FD is shown in Table 1. The Total FD values were found to be the highest in the condylar region and the lowest in the gonial region. However, there was no significant difference between right, left, and total FD values and sex (Table 1). In Table 2, the relationships between group 1, group 2, and group 3 FD values are evaluated. No statistically significant difference was observed among the average FD values and the groups.

The correlations between the FD values and the age of patients in groups 1 and 3 are presented in Table 3. No re-

Table 1: *The relationship between gender and FD values of regions.*

ROI	Female			Male			Total			p
	Mean±SD	Med	(Min-Max)	Mean±SD	Med	(Min-Max)	Mean±SD	Med	(Min-Max)	
Right condyle	1.44±0.08	1.46	(1.14-1.56)	1.43±0.10	1.45	(1.20-1.79)	1.44±0.09	1.46	(1.14-1.79)	0.517[a]
Right gonial	1.37±0.09	1.36	(1.14-1.54)	1.36±0.12	1.38	(1.03-1.69)	1.37±0.11	1.37	(1.03-1.69)	0.705[b]
Right ramus	1.35±0.16	1.41	(1.03-1.56)	1.36±0.14	1.37	(1.04-1.59)	1.36±0.15	1.37	(1.03-1.59)	0.906[a]
Left condyle	1.43±0.10	1.46	(1.12-1.59)	1.42±0.09	1.42	(1.11-1.56)	1.43±0.10	1.43	(1.11-1.59)	0.715[a]
Left gonial	1.35±0.12	1.37	(1.09-1.59)	1.32± 0.12	1.33	(1.00-1.54)	1.34±0.12	1.34	(1.00-1.59)	0.125[b]
Left ramus	1.37±0.11	1.38	(1.05-1.56)	1.35± 0.13	1.38	(1.02-1.55)	1.36±0.12	1.38	(1.02-1.56)	0.446[b]
Total condyle	1.44±0.09	1.46	(1.12-1.59)	1.43± 0.09	1.44	(1.11-1.79)	1.43±0.09	1.45	(1.11-1.79)	0.399[a]
Total gonial	1.36±0.11	1.36	(1.09-1.59)	1.34± 0.13	1.34	(1.00-1.69)	1.35±0.12	1.36	(1.00-1.69)	0.164[b]
Total ramus	1.36±0.14	1.38	(1.03-1.56)	1.35± 0.13	1.37	(1.02-1.59)	1.36±0.14	1.38	(1.02-1.59)	0.692[a]

Med: Median; FD: Fractal dimension; SD: Standard deviation; Min: Minimum, Max: Maximum; a Mann-Whitney U; b Independent samples t-test lationship was found between the FD values of group 1 and age. However, a negative correlation was found between FD values and age in group 3 for the right condyle (r= -0.42, p<0.05), right ramus (r= -0.37, p<0.05), and left ramus (r= -0.45, p<0.05).

The variability in the FD values of the study groups determined according to the presence of dentin caries is evaluated in Table 4. It was observed that the FD values of each group in the condyle area were higher than the other regions; however, no statistically significant relationship was found. In addition, no significant difference statistically was present among the right, left, and total FD values and sex. Intra-observer correlation coefficients were found to be excellent (k>0.75).

Discussion

Biologic changes occurring in hard tissue are affected by mechanical forces. One of the most important features of the internal structure of living bones is the ability to adapt to the mechanical forces to which they are exposed. Trabecular bone architecture is optimally structured for load-bearing function and bone grows in response to applied mechanical force (7). As with the entire skeletal system, trabecular and alveolar cortical bone also has a continuous remodeling cycle. Given that the occlusal forces generated during chewing are transmitted to the jawbones through the tooth, it is expected that trabecular bone tissue properties change in response to mechanical force. In our study, the effect of the presence of dental caries on the jawbones in children aged 8-13 years was evaluated retrospectively using FD analysis, which is an objective evaluation method.

Motor control of chewing is provided by inter-arch occlusal contact, the temporomandibular joint, dental pulp, and periodontal receptors (14,15). Accordingly, any situation that affects the tooth structure and position may affect the chewing system (5). Tooth decay is the most common oral health problem (2). If tooth decay is not treated, it can lead to pulpal and periapical infection and tooth loss. Kaya *et al*. (2) examined the relationship between chewing and tooth decay and reported that the presence of tooth decay led to a decrease in occlusal contacts due to cavitation formation and decreased chewing performance. De Morais *et al*. (16) reported that children with higher dmft/DMFT scores had larger median particle sizes, thus lesser chewing performance. Similarly, Su *et al*. (17) showed that there was a relationship between tooth decay and chewing performance and chewing cycles in preschool children. It is known that children can develop behaviors such as increased chewing time, a unilateral chewing pattern, refusing certain foods, and turning to softer foods in the presence of tooth decay (13).

FD is a mathematical analysis method with which irregular and complex body structures can be evaluated. FD analysis can be viewed as a measure of the disorder of many physi-

Table 2: *Comparisons of the study groups in terms of ROI values.*

ROI	Bilateral Carious			Non-Carious			Unilateral Carious			p value
	Mean FD±SD	Median	(Min-Max)	Mean FD ± SD	Median	(Min-Max)	Mean FD±SD	Median	(Min-Max)	
Right Condyle	1.43±0.09	1.45	(1.14-1.58)	1.45±0.07	1.46	(1.22-1.56)	1.43±0.11	1.46	(1.11-1.79)	0,661[a]
Right Gonial	1.36±0.10	1.36	(1.03-1.54)	1.37±0.10	1.37	(1.14-1.54)	1.34±0.11	1.33	(1.11-1.69)	0,655[b]
Right Ramus	1.36±0.15	1.38	(1.04-1.59)	1.36±0.16	1.42	(1.03-1.56)	1.34±0.15	1.35	(1.02-1.56)	0,670[a]
Left Condyle	1.41±0.11	1.42	(1.12-1.59)	1.44±0.08	1.47	(1.24-1.57)	1.44±0.08	1.45	(1.22-1.59)	0,645[a]
Left Gonial	1.32±0.12	1.34	(1.00-1.56)	1.37±0.13	1.40	(1.09-1.59)	1.35±0.13	1.37	(1.03-1.55)	0,181[a]
Left Ramus	1.36±0.12	1.37	(1.05-1.56)	1.37±0.11	1.39	(1.13-1.56)	1.36±0.11	1.37	(1.05-1.56)	0,938[b]
Total Condyle	1.42±0.10	1.43	(1.12-1.59)	1.44±0.08	1.46	(1.22-1.57)	1.43±0.10	1.45	(1.11-1.79)	0,429[a]
Total Gonial	1.34±0.11	1.35	(1.00-1.56)	1.37±0.11	1.39	(1.09-1.59)	1.35±0.12	1.34	(1.03-1.69)	0,291[a]
Total Ramus	1.36±0.14	1.37	(1.04-1.59)	1.36±0.14	1.40	(1.03-1.56)	1.35±0.14	1.37	(1.02-1.56)	0,807[a]

FD: Fractal dimension; SD: Standard deviation; Min: Minimum, Max: Maximum; a Kruskal-Wallis test; b One-way ANOVA

Table 3: *Correlation between FD values and age of patients.*

ROI	Bilateral carious				Non-carious			
	Mean FD±SD	Med (Min-Max)	r	p-value	Mean FD±SD	Med (Min-Max)	r	p-value
Right Condyle	1.43±0.09	1.45 (1.14-1.58)	-0.42	0.007*	145±0.07	1.46 (122-1.56)	0.04	0.786
Right Gonial	1.36±0.10	1.36 (1.03-1.54)	-0.24	0.132	1.37±0.10	1.37 (1.14-1.54)	0.22	0.168
Right Ramus	1.36±0.15	1.38 (1.04-1.59)	-0.37	0.017*	1.36±0.16	1.42 (1.03-1.56)	0.04	0.787
Left Condyle	1.41±0.11	1.42 (1.12-1.59)	-0.27	0.092	1.44±0.08	1.47 (1.24-1.57)	-0.11	0.475
Left Gonial	1.32±0.12	1.34 (1.00-1.56)	-0.10	0.504	1.37±0.13	1.40 (1.09-1.59)	-0.02	0.865
Left Ramus	1.36±0.12	1.37 (1.05-1.56)	-0.45	0.004*	1.37±0.11	1.39 (1.13-1.56)	0.18	0.268

FD: Fractal dimension; SD: Standard deviation; Min: Minimum, Max: Maximum; r: Spearman's correlation coefficient; * p<0.05; statistically significant

Table 4: *Relationship between FD values of the study groups according to the presence of dentin caries.*

	ROI	C-F		C-M		p	NC-F		NC-M		p	Total C		Total NC		p
		Mean±SD	**Med**	**Mean±SD**	**Med**		**Mean±SD**	**Med**	**Mean±SD**	**Med**		**Mean±SD**	**Median**	**Mean±SD**	**Med**	
Unilateral carious	Condyle	1.43±0.12	1.42	1.43±0.10	1.48	0.698[a]	1.42±0.09	1.42	1.45±0.08	1.46	0.412[b]	1.43±0.11	1.46	1.44±0.08	1.45	0.525[c]
	Gonial	1.33±0.11	1.32	1.36±0.12	1.35	0.327[a]	1.36±0.13	1.35	1.35±0.14	1.39	0.887[b]	1.34±0.11	1.33	1.35±0.13	1.37	0.914[c]
	Ramus	1.34±0.14	1.35	1.33±0.17	1.35	0.847[b]	1.35±0.11	1.36	1.38±0.12	1.42	0.265[a]	1.34±0.15	1.35	1.36±0.11	1.37	0.490[c]
		R-F		**R-M**			**L-F**		**L-M**			**Total R**		**Total L**		
Bilateral carious	Condyle	1.42±0.11	1.43	1.44±0.08	1.46	0.504[b]	1.42±0.11	1.43	1.41±0.11	1.41	0.849[b]	1.43±0.09	1.45	1.41±0.11	1.42	0.519[d]
	Gonial	1.36±0.10	1.37	1.36±0.10	1.35	0.974[b]	1.34±0.13	1.36	1.30±0.11	1.34	0.339[b]	1.36±0.10	1.36	1.32±0.12	1.34	0.066[d]
	Ramus	1.36±0.15	1.38	1.35±0.15	1.38	0.716[b]	1.37±0.13	1.38	1.34±0.12	1.36	0.476[b]	1.36±0.15	1.38	1.36±0.12	1.37	0.973[c]
Non-carious	Condyle	1.46±0.08	1.47	1.44±0.06	1.44	0.201[a]	1.43±0.07	1.46	1.44±0.10	1.47	0.717[b]	1.45±0.07	1.46	1.44±0.09	1.47	0.468[c]
	Gonial	1.38±0.07	1.40	1.35±0.12	1.35	0.311[b]	1.34±0.11	1.38	1.39±0.13	1.41	0.231[a]	1.37±0.10	1.37	1.37±0.13	1.40	0.952[d]
	Ramus	1.35±0.16	1.41	1.38±0.16	1.47	0.414[a]	1.37±0.11	1.36	1.37±0.11	1.40	0.936[b]	1.36±0.16	1.42	1.37±0.11	1.39	0.898[c]

Right: R; Left: L; Carious: C; Non-carious: NC; Female: F; Male: MSD: Standard deviation; FD: Fractal dimension; a Mann-Whitney U test; b Independent samples t-test; c Wilcoxon signed sequence test; d Paired samples t-test

cal processes. When the examined body structure becomes complex, the FD value increases and decreases when it becomes simpler (18). FD analysis is a non-invasive method, obtained through quantitative analysis of processed images. Standardization of the obtained images is of great importance for the accuracy of the method (19). In recent years, FD analysis has been used in many studies investigating bone structures (12,18-20). In this study, standardized digital panoramic radiography images were used. Trabecular bone is more determinant in evaluating changes in bone structure because it has a higher metabolic activity compared with cortical bone (21). For this reason, we were cautious to include no tissue other than trabecular bone in the ROIs determined in our study. Also, because age-related factors have a great effect on the structure of trabecular bone, the age range was kept narrow (18). Yasar and Akgünlü (7) used FD analysis to investigate differences in the trabecular structure of toothed areas and edentulous regions. According to their results, the low FD values of the toothed areas correlated with the fact that these regions had a more organized trabecular structure to resist the mechanical force transmitted to the jawbone via the teeth (7). By contrast, in a study in which Wilding *et al*. (22) evaluated toothed areas and edentulous regions using FD analysis, the authors emphasized that the FD values of the toothed regions were higher than the toothless regions. However, traditional radiographs and dried mandibles were used in this study. In patients with unilateral caries, it can be expected that the trabecular structure would change due to the decrease in the chewing efficiency and the force transmitted to the jawbone due to the decrease in the inter-arch occlusal contact area on the carious side, a change in the trabecular structure, and lower FD values in the non-carious area compared with the carious area. Statistically, no significant difference was found between the FD values of the ROIs determined on the right and left in this patient group in our study. The reason for this situation could be that the changes in chewing performance as a result of caries were not intense enough to change bone trabeculation.

Gülec *et al*. (18) evaluated the trabecular bone formation in the jawbone in patients with and without bruxism using FD analysis performed on digital panoramic radiographs. According to their results, the FD values of bruxers were lower than in the non-bruxer group. This was attributed to the resorptive changes that occurred due to the excessive forces transmitted to the jawbone. The authors also reported that the reason for achieving a statistically significant result only on the right side in the bruxer group might be the unilateral chewing pattern that developed due to the larger amount of caries and/or restorations on the left sides of the patients. In our study, no statistically significant difference was found when the FD values of the determined ROIs of the individuals with and without caries on both sides were compared. However, bruxism is a condition characterized by excessive activity of masticatory muscles, so the force transmitted to the jawbone is greater (23). Although the maximum force and application time applied in patients with bruxism are higher, the applied force and application time is lower with normal chewing, and the maximum bite force is generally not used during usual chewing (24,25). The force applied to the posterior during chewing is 2-12 kg (20-120 N) depending on the type of food in healthy individuals, whereas this value can reach up to 22-26 kg (220-260 N) in bruxism (25). It is also known that children aged 8-11 years have lesser chewing performance (26). The force transmitted to the jawbone during normal chewing in children may not cause any changes in trabeculation. However, because the chewing efficiency increases with age, the relation of average FD values of group 3 with age was found statistically significant in our study. A negative correlation was found between age and mean FD values in the right condyle, right ramus, and left ramus regions. No statistically significant relationship was found between sex and mean FD values.

The lack of clinical examinations is a limitation of this study. More studies are needed to evaluate the effects of chewing on growth and development using objective parameters. Another limitation of this study is that the post hoc power analysis results were 16%, the results should be evaluated carefully because the sample size is insufficient. The reason for the low number of patients obtained in the retrospective screening was the classification of patients aged 8-13 years only according to the level of caries in the permanent first molars. The inclusion criteria depended on many parameters, such as the expectation that there will be no caries in other teeth and the patient's systemic health. For this reason, it can be suggested to enrich the study by increasing the sample size in new studies.

Conclusion

According to the results of our study, there is no relationship between tooth decay and trabeculation of the jawbone in children aged 8 to 13 years.

Türkçe Özet: *Çocuk Hastalarda Diş Çürüğü ile Trabeküler Kemik Yapısı Arasındaki İlişkinin Fraktal Analiz Yöntemi ile Değerlendirilmesi: Retrospektif Çalışma. Amaç: Çiğneme hareketi, stomatognatik sistemin büyümesi ve gelişmesi üzerinde etkilere sahiptir. Çiğneme üzerine etkisi olduğu bilinen diş çürüğü, çene kemiğine iletilen mekanik kuvvetler üzerindeki dolaylı etkisinden dolayı çene kemiğini etkileyebilir. Bu çalışmada çocuklarda büyüme ve gelişme süreçlerinde diş çürüğü ile çene kemiği trabekülasyonu arasındaki ilişkinin fraktal boyut (FB) analizi yöntemi ile değerlendirilmesi amaçlanmıştır. Gereç ve Yöntem: Çalışmaya katılan toplam 120 hasta üç gruba ayrıldı. Gruplar; Grup 1: Derin dentin çürüğü / apikal rarefiye osteiti olmayan 40 hasta, Grup 2: Sağ veya sol tarafta derin dentin çürüğü / apikal rarefiye osteiti olan 40 hasta ve Grup 3: sağ ve sol tarafta derin dentin çürüklü hasta / apikal rarefiye osteit, bulunan 40 hasta olacak şekilde belirlendi. Seçilen hastaların dijital panoramik görüntüleri FB analizi ile değerlendirildi. Bulgular: Gruplar arasındaki FB analizi istatistiksel olarak anlamlı değildi (p> 0.05). Grup içi değerlendirmede yaş ve cinsiyet faktörleri istatistiksel olarak anlamlı bulunmadı (p> 0.05). Grup 3'te sağ kondil (r = -0.42; p <0.05), sağ ramus (r = -0.37; p <0.05) ve sol ramus (r = -0.45; p <0.05) FB değerleri ile yaş arasında negatif korelasyon bulundu. Sonuç: 8-13 yaş arası çocuklarda diş çürüğü ile çene kemiğinin trabekülasyonu arasında bir ilişki yoktur. Anhtar Kelimeler: Diş çürükleri, fraktal, kemik, mandibula; radyoloji.*

Ethics Committee Approval: This study was reviewed and approved by the Recep Tayyip Erdoğan University Clinical Studies Ethics Committee (2020/127).

Informed Consent: Participants provided informed constent.

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Author contributions: DNG participated in designing the study. DNG participated in generating the data for the study. SME participated in gathering the data for the study. SA participated in the analysis of the data. SA wrote the majority of the original draft of the paper. DNG, TEK participated in writing the paper. DNG has had access to all of the raw data of the study. SME has reviewed the pertinent raw data on which the results and conclusions of this study are based. SME have approved the final version of this paper. DNG, SME guarantee that all individuals who meet the Journal's authorship criteria are included as authors of this paper.

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