ORIGINAL RESEARCH

Comparing Expansion of Maxillary Antrum between Periapical Surgery and Extraction of Permanent Maxillary First Molar in Pediatric Patients Using CBCT

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Abstract

Aim: To compare the expansion of maxillary antrum between periapical surgery and extraction of permanent maxillary first molar in pediatric patients using cone-beam computed tomography (CBCT).

Materials and methods: In this study, 136 participants in the age-group of 11–18 years were included. The participants were divided into two groups. Group A consisted of patients who underwent extraction of the permanent maxillary first molars. Group B consisted of patients who underwent endodontic microsurgery in the periapical area. Group A included 68 participants while group B also included 68 study subjects. The expansion of the maxillary antrum was obtained after evaluating the change in volume of maxillary antrum at 6 months and 24 months in relation to the volume of maxillary antrum at the time of the procedure (baseline). For calculating the volume of the maxillary antrum, three parameters were taken into consideration. These parameters were an anteroposterior (AP) dimension, mesiodistal dimension (MD), and superoinferior (SI) dimension. Cone-beam computed tomography was used for carrying out these measurements with the help of Dolphin software.

Results: An expansion of 675.27 ± 32 mm^3 was observed in group A between baseline and 6 months of extraction, while the expansion of 765.47 ± 24 mm^3 was observed between 6 months and 24 months of extraction. This intragroup difference was statistically significant ($p = 0.001$). On the other hand, an expansion of 652.28 ± 43 mm^3 was observed in group B between baseline and 6 months after periapical surgery and expansion of 969.43 ± 12 mm^3 was observed between 6 months and 24 months after periapical endodontic surgery. This intragroup difference was statistically significant. In the control group, an expansion of 152.11 ± 12.101 mm^3 was observed between baseline and 6 months after procedures while an expansion of 347.01 ± 6.781 mm^3 was observed between 6 months and 24 months of procedures. The intragroup difference was significant statistically.

Conclusion: In this study, expansion of maxillary antrum was observed in both extraction of the maxillary permanent first molar in pediatric patients and the periapical endodontic surgery, and the expansion of maxillary antrum was more in cases of periapical endodontic surgery; however, the difference was non-significant statistically.

Clinical significance: Maxillary antrum expansion is clinically important during maxillary permanent tooth extraction or endodontic periapical surgery in pediatric patients because the growth of maxillary bones is in the growing stage in these patients. There are certain limitations of conventional two-dimensional (2D) radiographic techniques such as shortening, elongation, and superimposition of images. Recently, three-dimensional technique (3D) such as CBCT has been introduced in which these disadvantages have been eliminated.

Keywords: Cone-beam computed tomography, Expansion, Extraction, Maxillary antrum periapical surgery.

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Introduction

The enlargement of the paranasal antrum starts at the time of birth and proceed further as the facial bones develop. The first paranasal antrum to develop is the maxillary antrum. The development of maxillary antrum starts in the 20th week of intrauterine life. The size of the maxillary antrum reaches its peak at the age of 12–14 years and it ceases to develop further after the emergence of maxillary third molars. A multitude of factors, particularly, genetics and disuse shortening, can influence antrum pneumatization. Environmental variables, genetic abnormalities, and pathogens can all impact the overall size of the maxillary antrum.[1,2]

The extraction of the maxillary molar teeth in pediatric patients results in the dimensional changes with bone loss of the antrum floor. The rapid bone destruction can extend to the alveolar process, moreover, the bone does not regenerate to the preoperative level. Bone height can decrease alongside maxillary antrum extension into the alveolar process. The maxillary antrum may be accidentally opened during difficult tooth extractions.[3,4]

The surgical technique which is carried out for the treatment of the non-vital teeth having pathology in the area around the

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root apex is considered endodontic surgery. This surgical method is also indicated when the possibility of carrying out non-surgical endodontic management is very low or nil. The main motive of this surgical process is to remove the pathology present in the area around the root apex.[5,6] Besides this surgical process also involve cutting of the end of the root followed by the retrograde filling of the resected end of the root.

It should be kept in mind that preservation of the anatomical and physiological integrity of the maxillary antrum is also important.[7] This is due to the important functions being carried out by the maxillary antrum. Some of these functions include reducing the weight of the skull, moistening the air breathed in and out, providing resonance to the human voice and acting as the first line of defense of the immune system of the body.

There are certain limitations of conventional 2D radiographic techniques such as shortening, elongation, and superimposition of images. Recently, 3D technique such as CBCT has been introduced in which these disadvantages have been eliminated. Cone-beam computed tomography imaging provides information about the object in all three planes. It can therefore be used to measure the AP dimension, buccolingual dimension as well as the SI dimensions of maxillary antrum. The measurements of various distances in CBCT are carried out with the help of advanced software which gives accurate figures. Cone-beam computed tomography imaging does not exhibit unnecessary superimposition, elongation, and shortening of images. These features are not usually observed in 2D imaging.

Maxillary antrum expansion is clinically important during tooth extraction or endodontic periapical surgery in pediatric patients because the growth of maxillary bones is in the growing stage in these patients.[8] There has been no study conducted in the past, as per the knowledge of the authors, which have compared the expansion of maxillary antrum after extraction and endodontic periapical surgery of maxillary permanent first molar in pediatric patients. Therefore, the present study was performed to carry out a comparison between the extraction of permanent maxillary first molar and endodontic periapical surgery involving permanent maxillary first molar in pediatric patients using CBCT.

Materials and Methods

Study Design

This study was a prospective case–control study carried out at a dental hospital in Dehradun, Uttarakhand, India. In this study, 136 participants were included. The participants were in the age-group of 10–18 years. The study was carried out over a span of 30 months from November 2019 to April 2022. The participants were included after obtaining informed consent from the participants and their parents/guardians. The participants were selected from the patients seeking dental treatment for permanent maxillary first molars at a dental hospital. Institutional Ethical Committee (IEC) approval number was UKD-2022/146. The participants were divided into two groups. Group A consisted of patients who underwent extraction of the permanent maxillary first molars. Group B consisted of patients who underwent endodontic microsurgery in the periapical area. Both Groups A and B included 68 participants each.

Sample Size Calculation

Utilizing the proposed formula (http://power and sample size.com/HyLown Consulting LLC, Atlanta, GA), a total sample size of 136 was calculated with 68 teeth in each group. The sample size was calculated for an alpha error of 5% and a statistical power at 95%.

The sample calculation was calculated as

$$n = \frac{Z_\alpha^{\,2}\sigma^2}{d^2}$$

where Z_α is the standard table value for 95% CI, σ is the standard deviation, and d is the precision, which is equal to 10% of mean. Substituting these values, the sample size determined was $n = 136$. Hence, there will be $n/2 = 68$ samples in each group.

Only those participants were included in which treatment was carried out in only one permanent maxillary first molar and contralateral teeth in the same arch were normal.

Inclusion Criteria for Group A

- The carious teeth which cannot be managed by endodontic therapy and required extraction.
- Treatment was carried out in only one permanent maxillary first molar and contralateral teeth in the same arch were normal.

Exclusion Criteria for Group A

- History of the previous diseases of the maxillary antrum.
- History of developmental disturbances of the face.

Inclusion Criteria for Group B

- The carious permanent maxillary first molar which can be managed by surgical endodontics in the periapical area.
- Treatment was carried out in only one permanent maxillary first molar and contralateral teeth in the same arch were normal.

Exclusion Criteria for Group B

- History of the previous diseases of the maxillary antrum.
- History of developmental disturbances of the face.

Case–Control Study

The participants included in both groups were such that the clinical procedures (extraction or periapical surgery) were carried in only one permanent molar in one side of maxillary arch, i.e., either left side or right side of maxillary arch and permanent molar on other contralateral side of maxilla was normal. This normal permanent first molar on the contralateral side was kept as control while the permanent first molar which underwent clinical procedures were case.

Endodontic Therapy

Scaling and root planing followed by root canal treatment was carried out in all the affected teeth using standard protocol by the same clinician. Once the obturation of teeth was completed, study subjects were recalled after 24–48 hours.

Surgical Procedure

Anesthesia of the area isolated for the surgical procedure was provided with the help of an adequate nerve block. The anesthetic agent used for nerve block was 2% lignocaine with adrenalin having a concentration of 1:80000. The surgical procedure started with the placement of a crevicular incision which was followed by two releasing vertical incisions. A periosteal elevator was used for reflection of the full thickness flap in such a way that there was

Source of support: Nil

Conflict of interest: None

easy access to the area around the root apex after the removal of sufficient bone of the cortical plates. While there was the removal of bone from cortical plates, care was taken that the area of bone removal was irrigated with normal saline constantly. There was proper curettage of the area around the root apex to remove the pathology along with epithelial lining if present. After that, there was resection of the end of the root up to 3 mm. There was the preparation of cavity at the end of the root and MTA was used for filling of this cavity at the end of the root.

Extraction Technique

Proper clinical history and clinical examination were carried out. Local anesthesia was achieved through the proper infiltration. Periosteal flap was raised with the help of periosteal elevator. Extraction was carried out with least trauma. Hemostasis was achieved properly. Post-extraction instructions were given. Patient was recalled after 7 days for the follow-up.

Measurement of Dimensions of Maxillary Antrum in CBCT

Cone-beam computed tomography examination was carried out at baseline, 6 months and 24 months after the clinical procedures. The measurements of the dimensions of the maxillary antrum was carried out in all three directions, namely, AP, MD, and SI dimensions (Figs 1 to 3). To carry out these measurements, specific anatomical landmarks were considered as the reference points and distance between these reference points were calculated. All the measurements in CBCT examination were carried out by same oral and maxillofacial radiologist who was completely unaware of the study protocol. The measurements were carried out for the maxillary antrum in the area where the clinical procedures were carried out as well as the contralateral side with normal teeth taken as control. The parameters of CBCT were adjusted at 75 kVp, 10 mA, and 6-inch field of view (FOV) according to the pediatric age of the study subjects.

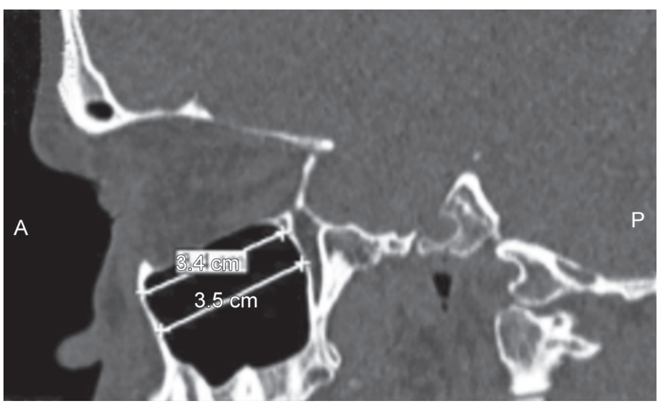

Fig. 1: Sagittal section of maxillary antrum CBCT image showing maximum AP dimension

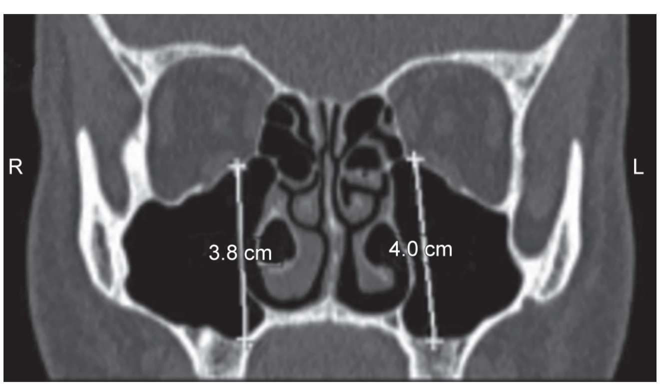

Fig. 2: Coronal section of maxillary antrum CBCT image showing maximum SI dimension

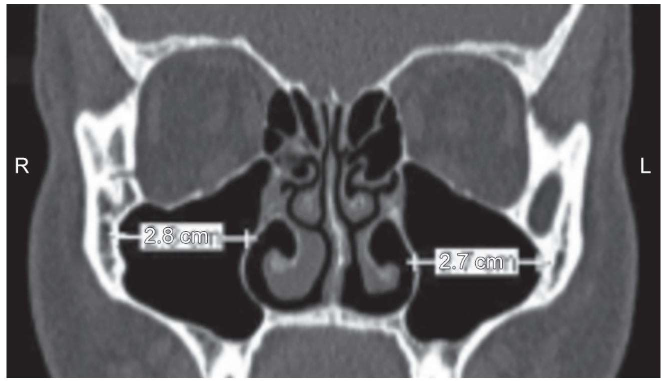

Fig. 3: Coronal section of maxillary antrum CBCT image showing maximum MD dimension

- Sagittal reconstructed image was used to calculate the AP dimension as the maximum distance between the point at the most anterior location and the point at the most posterior location (Fig. 1).
- Coronal reconstructed image of CBCT was used to analyze the SI dimension as the maximum distance between the point at the highest location of the maxillary antrum and the point at the lowest location of the maxillary antrum (Fig. 2).
- Mesiodistal dimension was analyzed in the coronal reconstructed image as the maximum perpendicular distance between the medial wall and outermost point of the lateral wall of the lateral process of the maxillary antrum (Fig. 3).

Methodology Used for Calculation of Expansion of Maxillary Antrum

The volume of the maxillary antrum was calculated with the help of a mathematically proven formula of $AP \times MD \times SI \times 0.52$.[9]

Technique of Evaluation of Expansion of Maxillary Antrum

The volume of the maxillary antrum was calculated at the time of clinical procedures, 6 months and 24 months after clinical procedure. The difference in volume of maxillary antrum at 6 months and 24 months with respect to the volume of the maxillary antrum at the time of procedures was calculated. If the difference was positive, it was considered that there was increase in volume. This increase in volume was considered as the amount of expansion of maxillary antrum.

Statistical Analysis

The data collected were placed in an MS excel sheet and SPSS software, version 22, was used for carrying out statistical analysis. Spearman's Rho correlation tests, Mann–Whitney *U* tests and Shapiro–Wilk tests were used for carrying out these statistical analyses. The data was expressed as means and medians of the study groups. The confidence interval (CI) was adjusted at 95% and $p \leq 0.05$ was labelled to be statistically significant.

Results

In this study, 136 participants were included and both groups A and B consisted of 68 participants each. The data related to the distribution of participants according to age and gender is represented in Table 1. There were participants in the age-group of 11–17 years. The percentage of males was slightly greater than females in both groups. However, the difference in terms of gender distribution and age distribution between the two groups was non-significant statistically.

The data regarding the values of different parameters of maxillary antrum at the time of procedures are present in Table 2. It was observed that the intergroup difference was non-significant statistically. Besides the intragroup difference among boys and girls was also non-significant statistically for all parameters including AP, MD, and SI dimensions.

There was an evaluation of these parameters at 6 months and 24 months after carrying out the procedures. It was observed that the values of the AP dimension were slightly greater in group B in comparison with group A while values of MD dimension and SI dimension was slightly lower in group B as compared with group A. The values of the dimensions of the maxillary antrum in the control group are also mentioned (Tables 3 and 4).

It was observed that the volume of the maxillary antrum was 3,881.64 ± 30.213 mm^3 and 3,538.56 ± 21.467 mm^3 in boys and girls, respectively, in group A at baseline. On the other hand, it was 3,618.44 ± 31.578 mm^3 and 3,413.56 ± 30.767 mm^3 in boys and girls of group B, respectively, at baseline. The values of volume of the maxillary antrum in the control group were 3,619.82 ± 23.241 and 3,579.33 ± 27.432 in boys and girls, respectively.

Table 1: Distribution of participants according to age and gender

Age (years)	*Group A*			*Group B*			*p*
	Male	*Female*	*Total*	*Male*	*Female*	*Total*	
11	21.36%	14.21%	18.4%	21.42%	14.36%	18.3%	
12	24.54%	16.31%	21.1%	23.6%	17.34%	21.2%	
13	17.61%	36.21%	25.1%	18.51%	36.31%	25.0%	
14	14.32%	16.47%	15.2%	14.74%	16.21%	15.3%	0.021
15	13.21%	14.63%	13.3%	14.31%	14.42%	13.2%	
16	5.81%	4.21%	5.0%	5.29%	4.31%	5.2%	
17	2.52%	0%	1.8%	2.43%	0%	1.8%	

Table 2: Measurements of the parameters of maxillary antrum at the baseline

Dimension	*Gender*	*Group A*	*Group B*	*Control*	*B*
AP (mm ± SD)	Boys	20.65 ± 2.25	20.76 ± 2.32	20.56 ± 2.31	0.315
	Girls	20.12 ± 1.31	20.23 ± 1.75	20.33 ± 1.74	
	A	0.222	0.311	0.323	
MD (mm ± SD)	Boys	16.72 ± 1.43	16.61 ± 1.11	16.72 ± 1.13	0.213
	Girls	16.81 ± 1.11	16.12 ± 1.32	16.31 ± 1.37	
	A	0.102	0.439	0.447	
SI (mm ± SD)	Boys	21.62 ± 2.24	20.18 ± 1.11	20.25 ± 1.21	0.412
	Girls	20.12 ± 2.25	20.13 ± 2.31	20.23 ± 2.34	
	A	0.121	0.303	0.406	

A: Inragroup *p*-value; *B*: Intergroup *p*-value

Table 3: Measurements of the parameters of maxillary antrum at 6 months after procedures

Dimension	*Gender*	*Group A*	*Group B*	*Control*	*B*
AP (mm ± SD)	Boys	21.62 ± 2.26	21.77 ± 2.33	20.76 ± 2.31	0.426
	Girls	21.23 ± 1.42	20.34 ± 1.86	20.33 ± 1.78	
	A	0.333	0.422	0.323	
MD (mm ± SD)	Boys	17.83 ± 1.54	17.72 ± 1.21	16.92 ± 1.13	0.213
	Girls	17.92 ± 1.21	17.23 ± 1.42	16.41 ± 1.37	
	A	0.131	0.539	0.447	
SI (mm ± SD)	Boys	22.73 ± 2.31	21.29 ± 1.21	20.65 ± 1.21	0.523
	Girls	21.33 ± 2.25	21.21 ± 2.42	20.73 ± 2.34	
	A	0.121	0.303	0.406	

A: Inragroup *p*-value; *B*: Intergroup *p*-value

The values of volume of maxillary antrum increased to 4,556.27 ± 31.313 mm^3 and 4,219.70 ± 31.213 mm^3 in boys and girls, respectively, in group A at 6 months after the procedures. Similarly in group B, the volume of maxillary antrum increased to 4,270.72 ± 32.213 mm^3 and 3,865.27 ± 31.201 mm^3 in boys and girls, respectively. The volume of the maxillary antrum increased to 3,771.93 ± 35.342 mm^3 and 3,596.23 ± 43.213 mm^3 in boys and girls, respectively, in the control group.

Again at 24 months of procedures, the values of volume of maxillary antrum increased to 5,321.74 ± 30.424 mm^3 and 5,083.50 ± 30.301 mm^3, respectively, in group A while values of volume of maxillary antrum increased to 5,240.15 ± 30.421 mm^3 and 4,745.97 ± 30.310 mm^3 in boys and girls, respectively, in group B. The volume of the maxillary antrum in boys and girls in the control group was 4,118.94 ± 42.123 and 4,013.98 ± 23.124 mm^3, respectively (Table 5).

When there was an analysis of the increase in the volume of the maxillary antrum (expansion of maxillary antrum) at baseline, 6 months and 24 months of dental procedures then an expansion of 675.27 ± 32 mm^3 was observed in group A between baseline and 6 months of extraction, while expansion of 765.47 ± 24 mm^3 was observed between 6 months and 24 months of extraction. This intragroup difference was statistically significant (p = 0.001). On the other hand, an expansion of 652.28 ± 43 mm^3 was observed in group B between baseline and 6 months after periapical surgery and expansion of 969.43 ± 12 mm^3 was observed between 6 months and 24 months after periapical endodontic surgery. This intragroup difference was statistically significant. In the control group, an expansion of 152.11 ± 12.101 mm^3 was observed between baseline and 6 months after procedures while an expansion of 347.01 ± 6.781 mm^3 was observed between 6 months and 24 months of procedures. The intragroup difference was significant statistically.

When the intergroup analysis was carried out, it was observed that there was an increased expansion of maxillary antrum after both extractions as well as periapical surgery of maxillary permanent first molar in comparison with control teeth but the difference was not statistically significant on comparison between the two groups. However, the expansion was slightly greater in patients who underwent endodontic surgery (Table 6).

Table 4: Measurements of the parameters of maxillary antrum at 24 months after procedures

Dimension	*Gender*	*Group A*	*Group B*	*Control*	*B*
AP (mm ± SD)	Boys	22.73 ± 2.37	22.89 ± 2.43	21.56 ± 2.31	0.426
	Girls	22.31 ± 2.51	21.34 ± 1.87	20.93 ± 1.74	
	A	0.051	0.061	0.323	
MD (mm ± SD)	Boys	18.91 ± 1.63	18.83 ± 1.32	17.12 ± 1.13	0.213
	Girls	18.71 ± 1.32	18.34 ± 1.53	17.21 ± 1.37	
	A	0.242	0.648	0.447	
SI (mm ± SD)	Boys	23.81 ± 2.42	23.38 ± 1.32	21.46 ± 1.21	0.523
	Girls	23.42 ± 2.36	23.32 ± 2.53	21.43 ± 2.34	
	A	0.231	0.414	0.406	

A: Inragroup *p*-value; *B*: Intergroup *p*-value

Table 5: Data showing volume of maxillary antrum at 0, 6, and 24 months after procedures

Volume	*Gender*	*Group A*	*Group B*	*Control*	*B*
0 months (mm^3 ± SD)	Boys	3,881.64 ± 30.213	3,618.44 ± 31.578	3,619.82 ± 23.241	0.526
	Girls	3,538.56 ± 21.467	3,413.56 ± 30.767	3,579.33 ± 27.432	
	A	0.231	0.432		
6 months (mm^3 ± SD)	Boys	4,556.27 ± 31.313	4,270.72 ± 32.213	3,771.93 ± 35.342	0.313
	Girls	4,219.70 ± 31.213	3,865.27 ± 31.201	3,596.23 ± 43.213	
	A	0.112	0.764		
24 months (mm^3 ± SD)	Boys	5,321.74 ± 30.424	5,240.15 ± 30.421	4,118.94 ± 42.123	0.623
	Girls	5,083.50 ± 30.301	4,745.97 ± 30.310	4,013.98 ± 23.124	
	A	0.104	0.304		

A: Inragroup *p*-value; *B*: Intergroup *p*-value

Table 6: Data showing the expansion of maxillary antrum according to time in groups A and B (Mann–Whitney *U* test)

	Maxillary antrum expansion mean ± SD (median)			
Time (months)	*Group A*	*Group B*	*Control*	*B*
0–6	675.27 ± 32.121	652.28 ± 43.2314	152.11 ± 12.101	
6–24	765.47 ± 24.241	969.43 ± 12.562	347.01 ± 6.781	0.071
A	0.001*	0.004*	0.002*	

*Statistically significant; *A*: Inragroup *p*-value; *B*: Intergroup *p*-value

Discussion

This study was carried out to analyze and compare the expansion of the maxillary antrum in both extraction and periapical endodontic surgery in maxillary permanent first molar in pediatric patients. No study has been conducted in the past according to the knowledge of authors which has compared expansion of maxillary antrum in the extraction of maxillary permanent first molar and periapical surgery. In this study expansion of maxillary antrum was observed in both extractions of the maxillary permanent first molar in pediatric patients as well as the periapical endodontic surgery in comparison with the control teeth. It was further observed that the expansion of maxillary antrum was more in cases of periapical endodontic surgery; however, the difference was non-significant statistically. A study was conducted by Sharan and Madjar in which they observed that volume of the maxillary antrum increased on the extraction of more than one posterior tooth.[10]

In this study, expansion of maxillary antrum after extraction of one permanent posterior teeth of the maxilla was studied and it was observed that there was an expansion of maxillary antrum in comparison with the control teeth. A study was conducted by Tolstunov et al.[11,12] in which they observed that expansion of maxillary antrum is more in old aged edentulous patients. An inverse correlation between sinus pneumatization (SP) and mean maxillary bone volume (MMBV) was observed. Although many other clinical criteria are important (bone quality, alveolar crest anatomy, etc.), the results of this CBCT radiographic study indicate that in many maxillary edentulous cases, the existing bone quantity (volume) can be sufficient for a full-arch maxillary implant treatment with at least four implants without the additional trauma or expense of bone grafts and sinus lifts. A variety of implant treatment options can be proposed based on maxillary bone availability and bone-to-sinus interrelationship. It appears that with age and edentulism, the amount of available maxillary bone is steadily decreasing.

In our study, the expansion of maxillary antrum was more in duration from 6 months to 24 months in comparison to the duration of 0–6 months.[11] Schropp et al. conducted a study and found that there is a significant expansion of maxillary antrum after extraction of the single tooth in the maxillary posterior region.[12]

The results were following the results of the present study in which there was an expansion of the maxillary antrum after extraction of a single posterior tooth in the maxillary posterior region. Some previous studies have been shown that the expansion of the maxillary antrum is greater on the extraction of the second permanent molar as compared with the maxillary permanent molars.[13] Wehrbein and Diedrich[14,15] carried out another study to conclude that the quantity of expansion of maxillary antrum after extraction of maxillary permanent first molar is significantly correlated with the projected length of roots of the maxillary antrum.

In this study, the impact of extraction and periapical endodontic surgery on the volume of the maxillary antrum was evaluated in only one permanent maxillary molar in children. To understand the effect on the expansion of the maxillary antrum, an evaluation was carried out in normal contralateral teeth along with the affected tooth. This study documented the effect of only one upper first molar extraction on the expansion of the maxillary antrum in children. Both dentate and edentulous sites of each patient were evaluated. Clinicians need to investigate how the maxillary first molar is related to the maxillary antrum as an essential aspect of treatment planning carried out before carrying out extraction and endodontic surgery in the maxillary posterior region.[16,17]

In this study, CBCT was used to evaluate the expansion of the maxillary antrum. The previous studies have used panoramic imaging for the evaluation of expansion of the maxillary antrum. However, there was a certain limitation with these imaging techniques.[18,19] These techniques were 2D imaging techniques and were unable to give proper information about 3D of maxillary antrum including AP, MD, and SI dimensions and, consequently, the exact information about the volume change was not obtained.[20,21] Cone-beam computed tomography is a 3D technology that provides all information about these 3D of maxillary antrum and change in volume. Further, the measurements in CBCT are more accurate because of no elongation, shortening, and superimposition of image.[22,23]

It is believed that the most appropriate age for the shedding of the maxillary first permanent molars is 8–9 years before the emergence of maxillary permanent second molars. The incidence of premature emergence of maxillary second molars may result in the establishment of premature contact of the maxillary second molar with the second premolar.[24,25] In the present research, the age of most of the participants was corresponding to the duration between the eruption of maxillary first molar and the emergence of the second maxillary permanent molar. If a maxillary permanent first molar is extracted during this duration, then there can be disturbances in normal occlusion such as partial closure of space, tilting of the adjacent teeth in the mesial and distal direction, etc.[26,27]

There can be a supraeruption of the molars in the opposing arch. Further, there can be atrophy of the alveolar ridge. Therefore, the preservation of the maxillary permanent molar becomes a requirement. Surgery at the periapical area is another treatment option that is usually applied in adult patients.[28,29] In pediatric patients, endodontic surgery at the periapical area can be also carried out but the space available in the maxillary arch is low as compared with adult patients. Further, there is ongoing growth and development of the maxillary bone along with the maxillary antrum. It has been also advocated that atraumatic extraction of the maxillary permanent first molar can reduce the expansion of the maxillary antrum.[30]

It is, therefore, necessary to evaluate the expansion of the maxillary antrum after periapical endodontic surgery. This study will give an important insight into treatment planning of maxillary permanent first molar in pediatric patients regarding the expansion of maxillary antrum. This is the implication of this study.

There were some limitations of this study. Cone-beam computed tomography examination in pediatric patients increases the risk of extra radiation exposure.[31] Use of CBCT for the examination at three different durations made this study very expensive and as a result, the sample size was small. More studies with larger sample size should be carried out in the future.

Conclusion

In this study, the expansion of maxillary antrum was observed in both extraction of the maxillary permanent first molar in pediatric patients as well as the periapical endodontic surgery and the expansion of maxillary antrum was more in cases of periapical endodontic surgery; however, the difference was non-significant statistically.

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