Three dimensional observation of the occlusal grooves in the maxillary first and second deciduous molars with micro-CT

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Abstract The purpose of this study was clarify the morphological condition of occlusal grooves in the maxillary first and second deciduous molars with micro-CT. We took photographs of the maxillary deciduous molars using a micro-CT device and reconstructed the three-dimensional image of the anatomical crown using a three-dimensional visualization and measurement software. For observation and measurement of the occlusal grooves, two-dimensional sliced images were generated 10 images at each groove. On the generated two-dimensional sliced images, we measured the occlusal angle, the depth of the occlusal groove and the enamel thickness at its bottom. The sites which showed smallest angle were distal portions of the central groove in maxillary first deciduous molar, and lingual groove in maxillary second deciduous molar. The occlusal groove in maxillary second deciduous molar was deeper than that of maxillary first deciduous molar in all sites examined, except for distal portion of the central groove. The enamel thickness in maxillary second deciduous molars tended to have thicker enamel than that of first deciduous molars. In maxillary first deciduous molars, most of the occlusal grooves exhibited the shape classified into type P. Whereas in maxillary second deciduous molars, the ratio of type P was relatively low, especially, lingual grooves consisted of type V, whose angle was less than 90 degree, type U and type I, which had the shape looked like a stick. Distal portion of the central groove of maxillary first deciduous molar, and lingual groove of maxillary second deciduous molar tend to be the initiation and predilection sites of dental caries due to the anatomical features of their occlusal fissures. Moreover, it is preferable to apply pit and fissure sealant into the occlusal fissures containing this region at an early point of the treatment.

Key words
Maxillary deciduous molar,
Micro-CT,
Occlusal grooves

Introduction

It has been well known that the occlusal surfaces of deciduous molars have various types of grooves. Since different occlusal grooves have different shapes of occlusal fissures, it is extremely important to evaluate the values of occlusal angle, depth and enamel thickness in the individual grooves and fully understand their characteristics; in order to perform dental caries examination and diagnosis, restorative treatment, and dental caries prevention, including pit and fissure sealant and tooth-brushing instruction. Especially, the dentists have to give a careful examination to the site, which has a relatively small occlusal angle and the deep groove, wherein the application of pit and fissure sealant at an early point of treatment is needed, because it is a likely site for dental caries due to an insufficient tooth-brushing.

To date, there have been some reports on the morphology of fissures in the occlusal surface of deciduous molars[1–24]. In these studies, however, the

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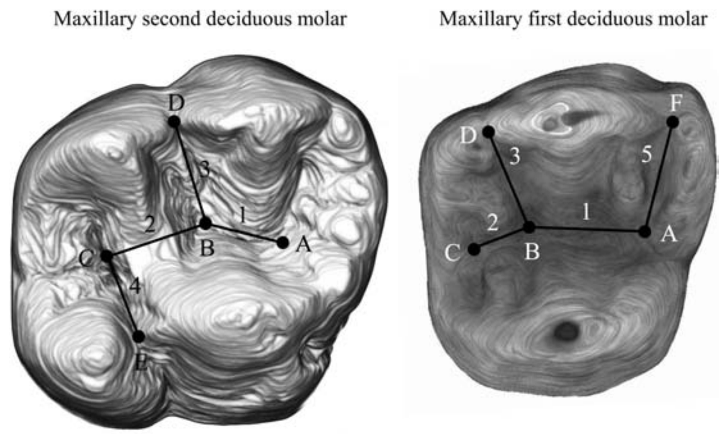


A: Bottom of the mesial pit
B: Bottom of the central pit
C: Bottom of the distal pit
D: Buccal occlusal margin of the buccal groove
E: Lingual occlusal margin of the lingual groove
F: Buccal occlusal margin of the mesiobuccal triangular groove

1: Mesial portion of the central groove (A-B)
2: Distal portion of the central groove (C-B)
3: Buccal groove (D-B)
4: Lingual groove (E-C)
5: Mesiobuccal triangular groove (F-A)

Fig. 1 Measurement regions

specimens only can be examined from fixed direction, because polished sections or thin sections of resin-embedded extracted teeth were used. Moreover, it is impossible to perform fully serial observation, because some portions of the specimen were lost in the sectioning process. Also, it is impossible to evaluate the correlation among morphologies of multiple occlusal fissures in a single tooth.

Therefore, in the present study, we performed three-dimensional observations of the morphology of occlusal grooves in the maxillary first and second deciduous molars using micro focus x-ray computerized tomography (micro-CT), a method with which non-destructive observation, with high resolution, at any directions are allowed.

Materials and Methods

The specimens were maxillary first deciduous molars and maxillary second deciduous molars possessed by Department of Pediatric Dentistry, Tokyo Dental College, which were extracted from Japanese children in their successional replacement periods, after obtaining informed consent of children themselves and their parents. A total of 40 teeth; consists of 20 maxillary first deciduous molars with three-cusp pattern (mesiobuccal, distobuccal and lingual cusps) and 20 maxillary second deciduous molars with four-cusp pattern (mesiobuccal, distobuccal, mesiolingual and distolingual cusps), which were chosen according to Nishimura's classification criteria[18] of occlusal patterns, were used in the study. For selection of the specimens, teeth; which showed any signs of dental caries, hypoplasia, anomalies of shape, severe attrition or physiological root resorption reaching to the pulp chamber, were excluded. These specimens were scanned by using micro-CT, KMS-755 (Kasimura Inc., Japan) at a tube voltage of 45 kV, tube current of 90 mA, and magnification of $\times$4.0. By the back projection method, approximately 600 two-dimensional sliced images were created from the raw data obtained, using a software (MultiBP, Imagescript). Prior to the scanning, either one of bucco-lingual and mesio-distal axes of the tooth specimen was set perpendicular to the rotating platform of the micro-CT machine, according to the method described by Sugiyama[25] and Yagi[26,27]. Some changes, such as noise elimination and contrast adjustment, were made on the sliced images by using Photoshop™ 6.0 (Adobe Systems Inc.,

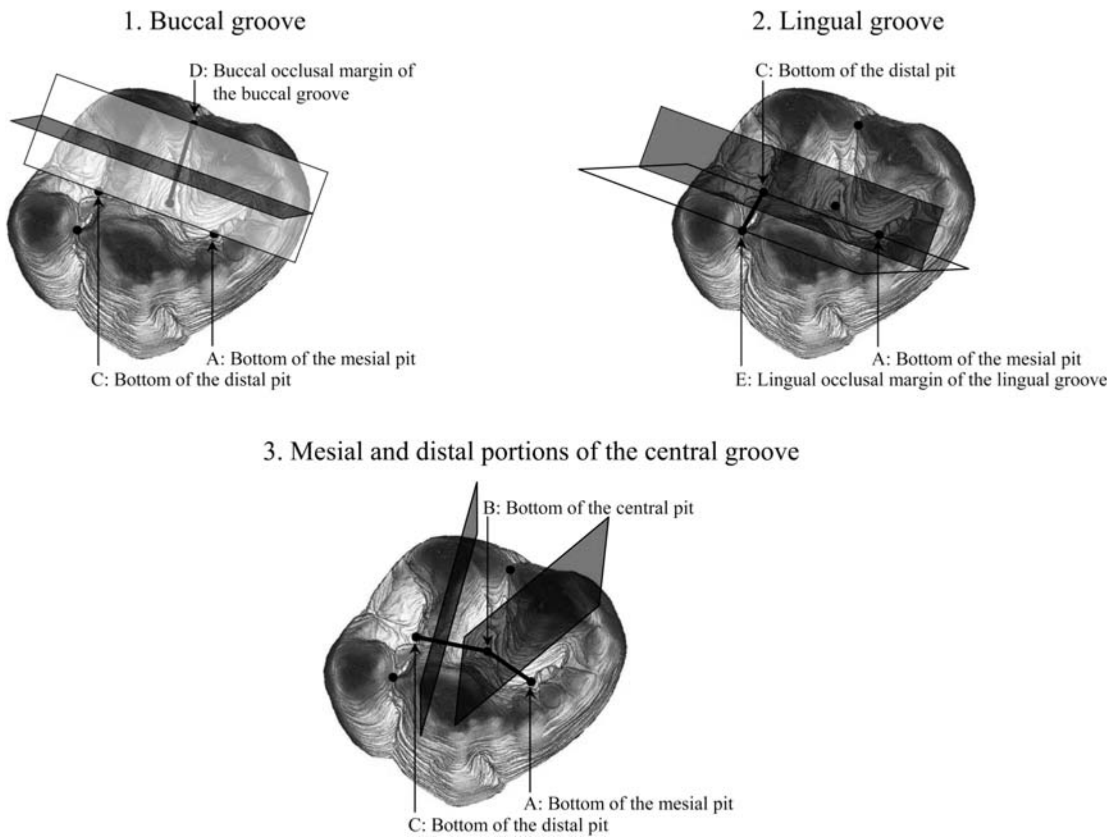


Fig. 2 Procedures for generation of two-dimensional sliced images

California, USA) according to the method described by Suto[28]. Then, three-dimensional images of anatomical features of the crown were reconstructed from these sliced images using 3D visualization and measurement software VoxBlast™ ver. 3.0 (VayTec Inc., Iowa, USA).

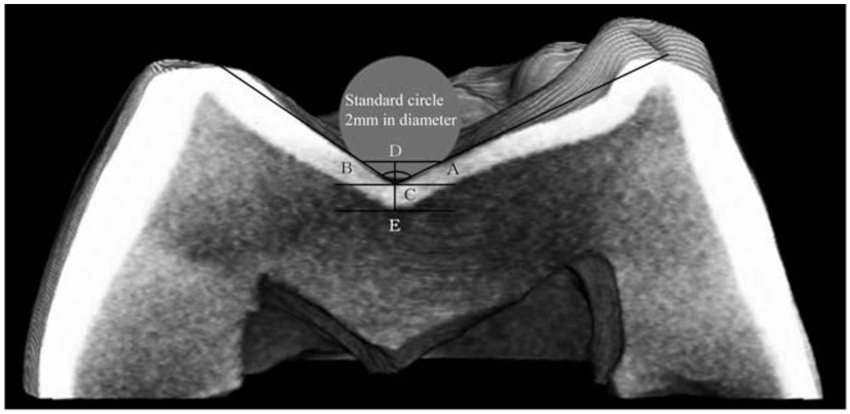
The three-dimensional images obtained by the above mentioned methods were used for the measurement and observation of the following parameters.

Measurement of the occlusal angle and depth of the occlusal groove, and the enamel thickness at the bottom of the occlusal groove

Ten two-dimensional slices at equal intervals for a total of 8 points, including 4 points in the maxillary first deciduous molars (mesial portion of the central groove, distal portion of the central groove, buccal groove, and mesiobuccal triangular groove) and 4 points in the maxillary second deciduous molars (mesial portion of the central groove, distal portion of the central groove, buccal groove, and lingual groove) were obtained, and then, the measurements of the angle and depth of the occlusal groove and the enamel thickness at the bottom of the occlusal groove and observation of the shape of the occlusal groove were performed (Fig. 1).

For buccal groove; a plane perpendicular to the plane, containing 3 points consisting of buccal occlusal margin, mesial pit, and distal pit of the buccal groove, which is also at right angle to the buccal groove was generated (Fig. 2-1). For mesiobuccal triangular groove; a plane perpendicular to the plane, containing 3 points consisting of buccal occlusal margin, mesial pit, and distal pit of the mesiobuccal triangular groove, which is also at right angle to the mesiobuccal triangular groove was generated. For lingual groove; a plane perpendicular to the plane, containing 3 points consisting of lingual occlusal margin, mesial pit, and distal pit of the lingual groove, which is also at right angle to the lingual groove was generated (Fig. 2-2). For mesial portion of the central groove and distal portion of the central groove, a plane parallel to the crown axis and perpendicular to the groove was generated (Fig. 2-3).

On the generated two-dimensional images, we



A: Point on the standard circle making contact with the internal oblique plane of the lingual cusp
B: Point on the standard circle making contact with the internal oblique plane of the buccal cusp
C: Bottom of the occlusal groove
E: Enamel-dentin junction

∠ACB: Occlusal angle of the occlusal groove
CD: Depth of the occlusal groove
CE: Enamel thickness of the bottom of the occlusal groove

Fig. 3 Measurement method on the two-dimensional sliced image

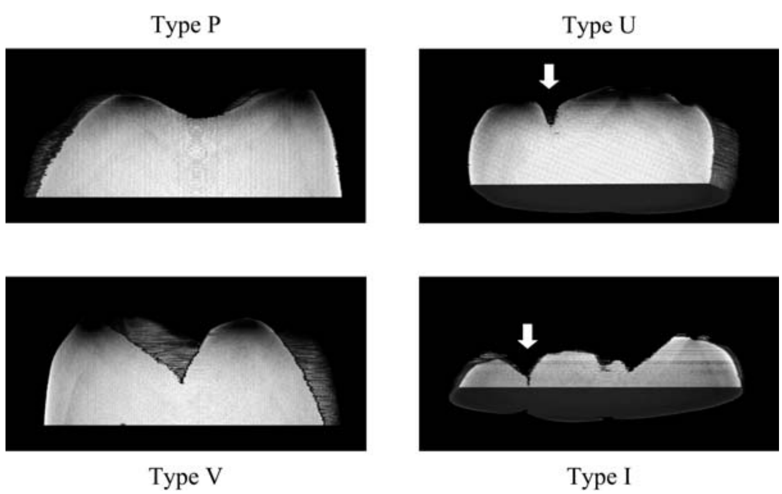


Fig. 4 Classification of the shape of the occlusal groove

measured the occlusal angle of the occlusal groove, the depth of the occlusal groove and the enamel thickness at its bottom, using a standard circle of 2.0 mm in diameter, according to the method described by Fejerskov *et al.*[29] (Fig. 3). In brief, points on the standard circle making contact with the 2 internal oblique planes of the cusp were designated A and B, and the bottom of the occlusal groove was designated C. The internal angle formed between BA and BC was defined as the occlusal angle. A straight line from C crossing the line AB at the right angle was drawn, and the crossing point was designated D. And the distance from C to D was defined as the depth of the occlusal groove. The intersection of the extension of CD with the enamel-dentine junction was designated E, and the distance from C to E was defined as the enamel thickness at the bottom of the occlusal groove. Depth of the grooves and enamel thickness were calculated from the distance which was expressed

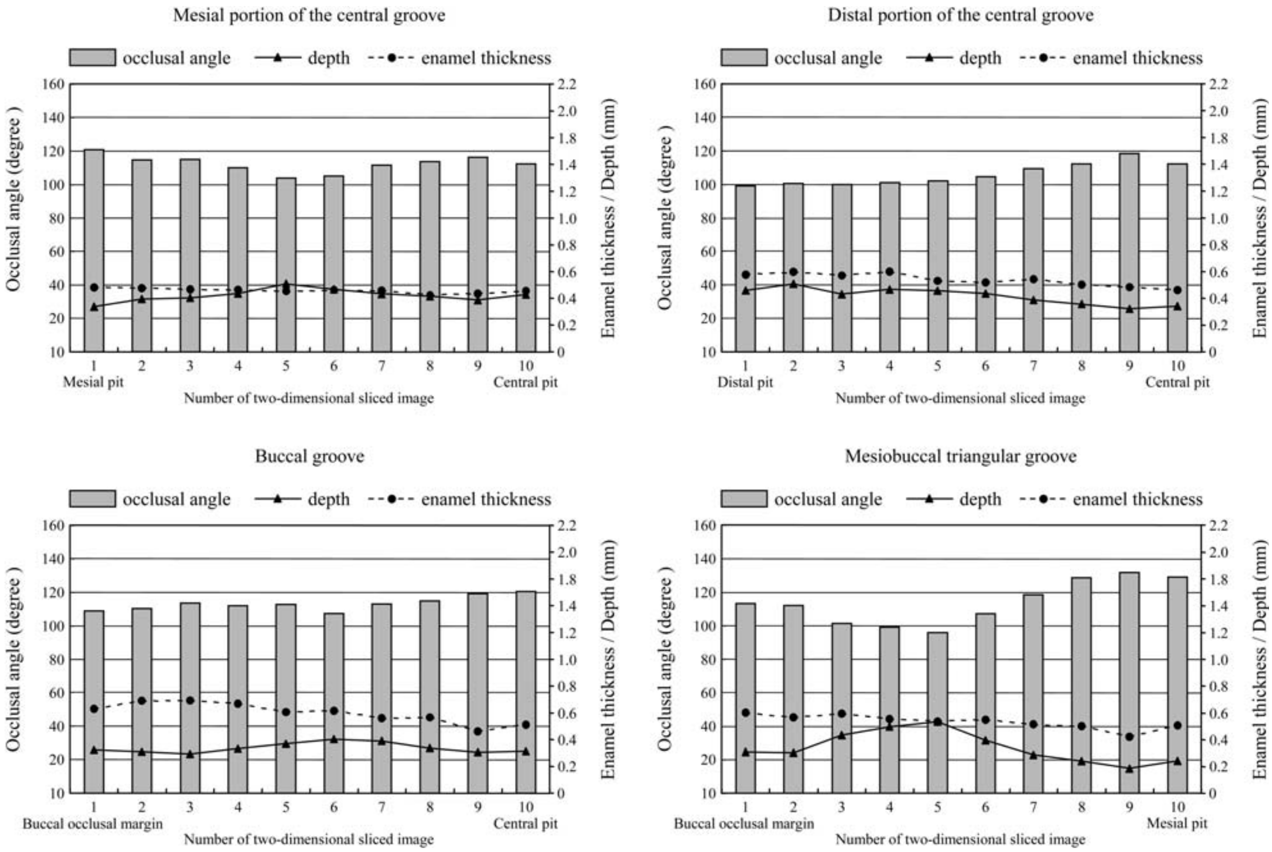


Fig. 5 The occlusal angle, the depth and the enamel thickness at its bottom of the occlusal grooves in the maxillary first deciduous molar

in pixels, using the value of 0.0165 mm/pixel[30].

Observation of the shape of the occlusal groove

Observation of the shape of the occlusal groove was made using the obtained sliced images after classifying them into following 4 types based on the criteria described by Hattori[8]: P type, in which the opening of the occlusal groove was wide, and the angle between both sides of the occlusal groove was 90° or more; the V type, in which the occlusal groove was V-shaped, i.e., the opening of the occlusal groove was relatively wide, but the angle between both sides of the occlusal groove was less than 90°; the type U, in which the opening of the occlusal groove was relatively wide continuously to the bottom of the groove, forming a U-shaped groove; and the I type, in which the width of the occlusal groove was narrower than the U type, and the occlusal groove looked like a stick (Fig. 4).

Statistical analyses

Average and standard deviation of the occlusal angle and depth and enamel thickness of the occlusal groove were calculated and the comparison for each parameter was made within the same type of tooth, using a multiple-comparison method (Tukey Kramer test) after applying two-way ANOVA. Chi-square test was also performed to compare the distribution of 4 types of grooves in each tooth. A P value of not more than 5% was considered statistically significant (StatView® Ver. 5.0, SAS Institute Inc., USA.).

This study was conducted with the approval by the Ethical Committee of Tokyo Dental College (#22).

Results

Occlusal angle of the occlusal groove

1) Maxillary first deciduous molars

The values tended to increase gradually from occlusal margin toward inside in all sites of occlusal grooves, although the values were variable in slice #3 through #6 in mesial portion of the central groove and mesiobuccal triangular groove (Fig. 5).

Table 1 Occlusal groove dimensions of maxillary first and second deciduous molars

		Occlusal angle		Depth		Enamel thickness	
		n	mean ± S.D. (degree)	n	mean ± S.D. (mm)	n	mean ± S.D. (mm)
Maxillary deciduous first molar	Mesial portion of the central groove	200	112.68 ± 15.49	200	1.41 ± 0.31	200	0.46 ± 0.10
	Distal portion of the central groove	200	106.08 ± 20.95	200	1.41 ± 0.19	200	0.54 ± 0.14
	Buccal groove	200	113.50 ± 17.21	200	1.33 ± 0.15	200	0.60 ± 0.16
	Mesiobuccal triangular groove	200	112.21 ± 24.08	200	1.35 ± 0.22	200	0.54 ± 0.13
Maxillary deciduous second molar	Mesial portion of the central groove	200	102.17 ± 23.24	200	1.47 ± 0.26	200	1.10 ± 0.44
	Distal portion of the central groove	200	113.92 ± 26.00	200	1.35 ± 0.22	200	1.04 ± 0.39
	Buccal groove	200	99.47 ± 26.13	200	1.45 ± 0.27	200	1.02 ± 0.45
	Lingual groove	200	76.40 ± 25.13	200	1.80 ± 0.35	200	1.27 ± 0.50

Table 2 Multi-comparison test of occlusal groove dimensions on maxillary first deciduous molars

	Occlusal angle			Depth			Enamel thickness		
Occlusal grooves	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove
Mesial portion of the central groove	—			—			—		
Distal portion of the central groove	*	—		NS	—		*	—	
Buccal groove	NS	*	—	*	*	—	*	*	—
Mesiobuccal triangular groove	NS	*	NS	*	NS	NS	*	NS	*

Tukey Kramer test, *: $P<0.05$. NS: non significance.

The rank order of mean values of occlusal angle was as follows: buccal groove (113.5 ± 17.21 degree) > mesial portion of the central groove (112.68 ± 15.49 degree) > mesiobuccal triangular groove (112.21 ± 24.08 degree) > distal portion of the central groove (106.08 ± 20.95 degree) (Table 1).

There were significant differences between distal portion and mesial portion of the central grooves, distal portion of the central groove and buccal groove, distal portion of the central groove and mesiobuccal triangular groove (Table 2).

2) Maxillary second deciduous molars

No apparent differences were observed in mesial portion of the central groove, buccal and lingual grooves. However, the values were variable in slice #3 through #7, in mesial portion of the central groove (Fig. 6).

The rank order of mean values of occlusal angle was as follows: distal portion of the central groove (113.92 ± 26.00 degree) > mesial portion of the central groove (102.17 ± 23.24 degree) > buccal groove (99.47 ± 26.13 degree) > lingual groove (76.40 ± 25.13 degree) (Table 1).

There were significant differences between lingual and buccal grooves, lingual groove and distal portion of the central groove, lingual groove and mesial portion of the central groove, distal portion of the central groove and buccal groove, distal and mesial portions of the central groove (Table 3).

3) Comparison between maxillary first and second deciduous molars

Maxillary second deciduous molars tended to have smaller occlusal angles than those of first deciduous molars, especially, significant differences between maxillary first and second deciduous molars were observed in mesial portions of the central groove,

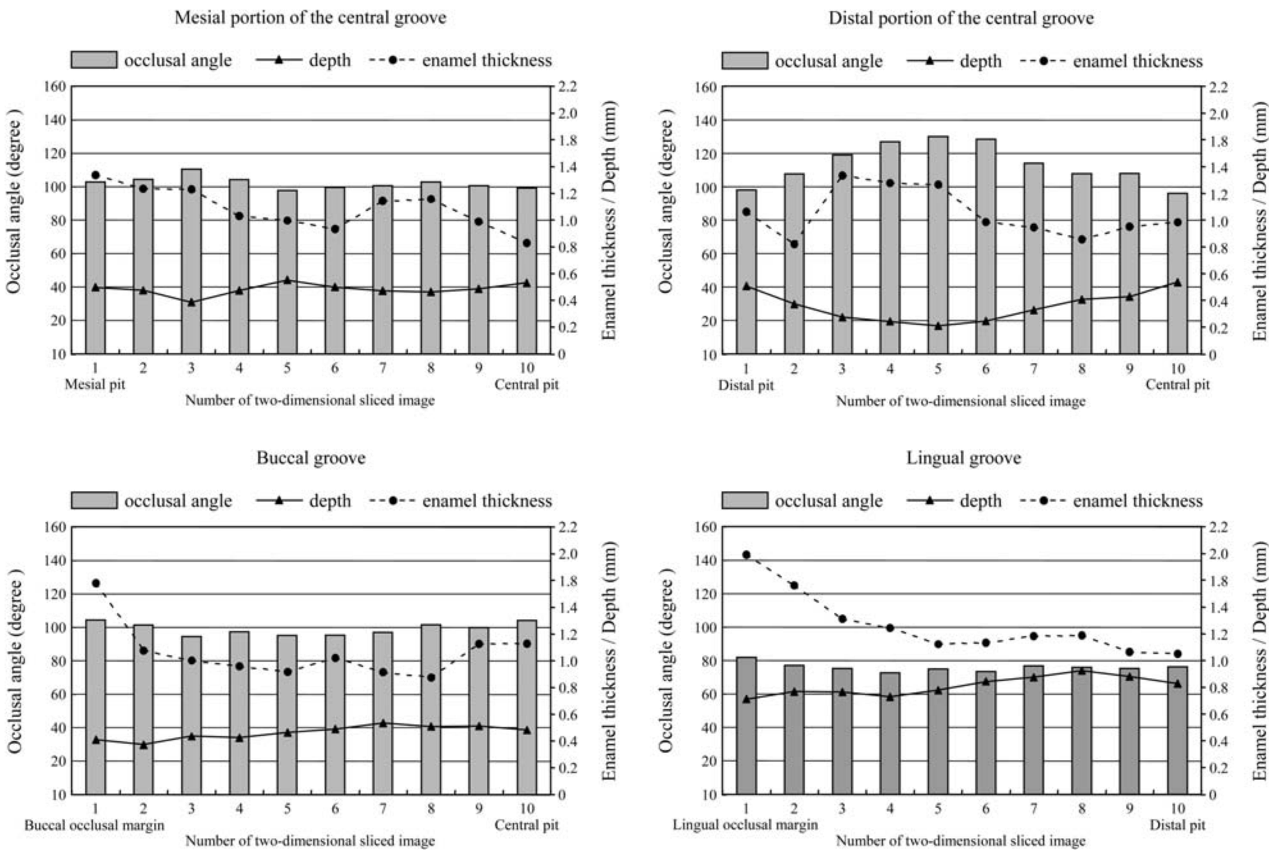


Fig. 6 The occlusal angle, the depth and the enamel thickness at its bottom of the occlusal grooves in the maxillary second deciduous molar

Table 3 Multi-comparison test of occlusal groove dimensions on maxillary second deciduous molars

Occlusal grooves	Occlusal angle			Depth			Enamel thickness		
	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove	Mesial portion of the central groove	Distal portion of the central groove	Buccal groove
Mesial portion of the central groove	—			—			—		
Distal portion of the central groove	*	—		*	—		NS	—	
Buccal groove	NS	*	—	NS	*	—	NS	NS	—
Lingual groove	*	*	*	*	*	*	NS	*	*

Tukey Kramer test, *: $P<0.05$. NS: non significance.

buccal and lingual grooves (Fig. 7).

Depth of the occlusal groove

1) Maxillary first deciduous molars

The values tended to decrease gradually from occlusal margin toward inside in all sites of occlusal grooves, although the values were variable in slice #3 through #6, in mesial portion of the central groove and mesiobuccal triangular groove (Fig. 5).

The rank order of mean values of depth was

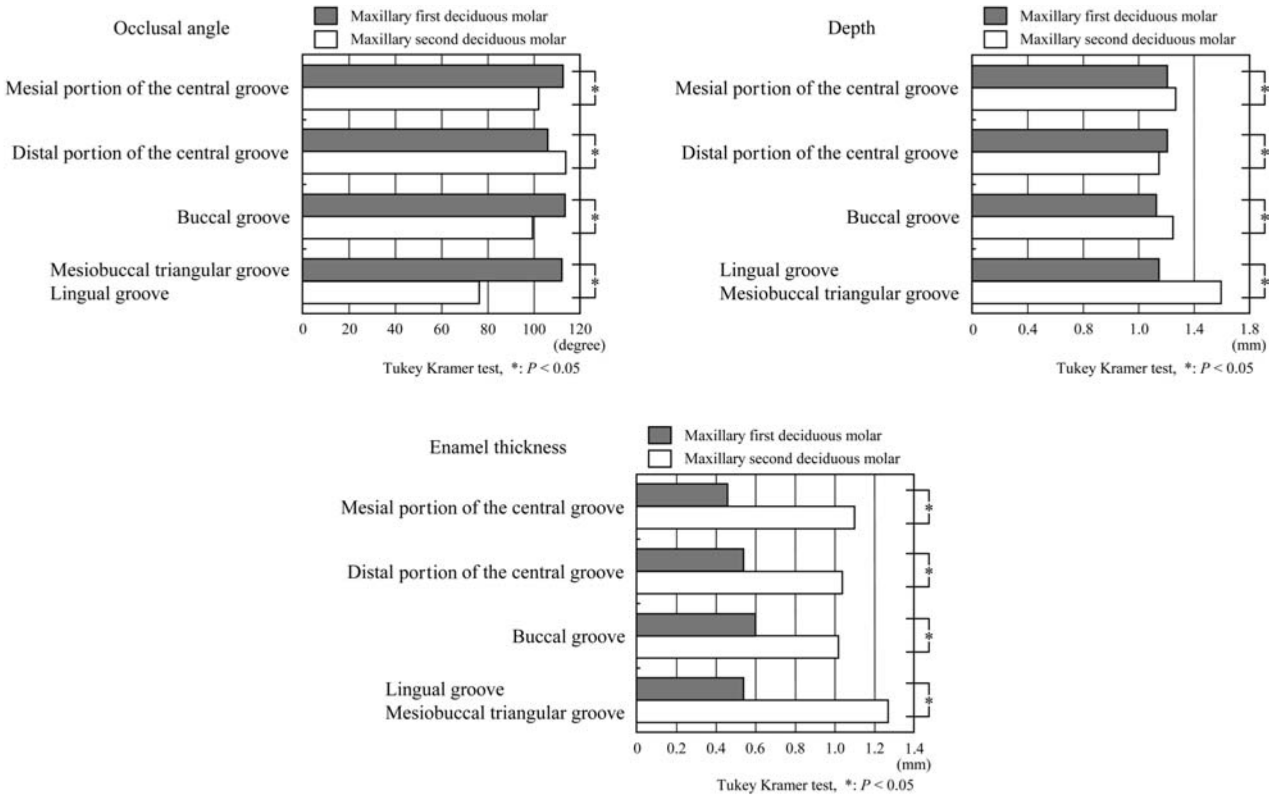


Fig. 7 Comparison between maxillary first and second deciduous molars on the occlusal angle, the depth of the occlusal groove and the enamel thickness at its bottom

as follows: mesial portion of the central groove (1.41 ± 0.31 mm) and distal portion of the central groove (1.41 ± 0.19 mm) > mesiobuccal triangular groove (1.35 ± 0.22 mm) > buccal groove (1.33 ± 0.15 mm) (Table 1).

There were significant differences between mesial portion of the central groove and buccal groove, mesial portion of the central groove and mesiobuccal triangular groove (Table 2).

2) Maxillary second deciduous molars

No apparent differences were observed in mesial portion of the central groove, buccal and lingual grooves. However, the values were variable in slice #3 through #7, in distal portion of the central groove (Fig. 6).

The rank order of mean values of occlusal angle was as follows: lingual groove (1.80 ± 0.35 mm) > mesial portion of the central groove (1.47 ± 0.26 mm) > buccal groove (1.45 ± 0.27 mm) > distal portion of the central groove (1.35 ± 0.22 mm) (Table 1).

There were significant differences between lingual and buccal grooves, lingual groove and distal portion of the central groove, lingual groove and mesial portion of the central groove, distal portion of the central groove and buccal groove, distal and mesial portions of the central groove (Table 3).

3) Comparison between maxillary first and second deciduous molars

Maxillary second deciduous molars tended to have larger depth values than those of first deciduous molars, especially, significant differences between maxillary first and second deciduous molars were observed in mesial portions of the central groove, buccal and lingual grooves (Fig. 7).

Enamel thickness at the bottom of the occlusal groove

1) Maxillary first deciduous molars

The values tended to decrease gradually from occlusal margin toward inside in all sites of occlusal grooves (Fig. 5).

The rank order of mean values of enamel thickness was as follows: buccal groove (0.60 ± 0.16 mm) > distal portion of the central groove

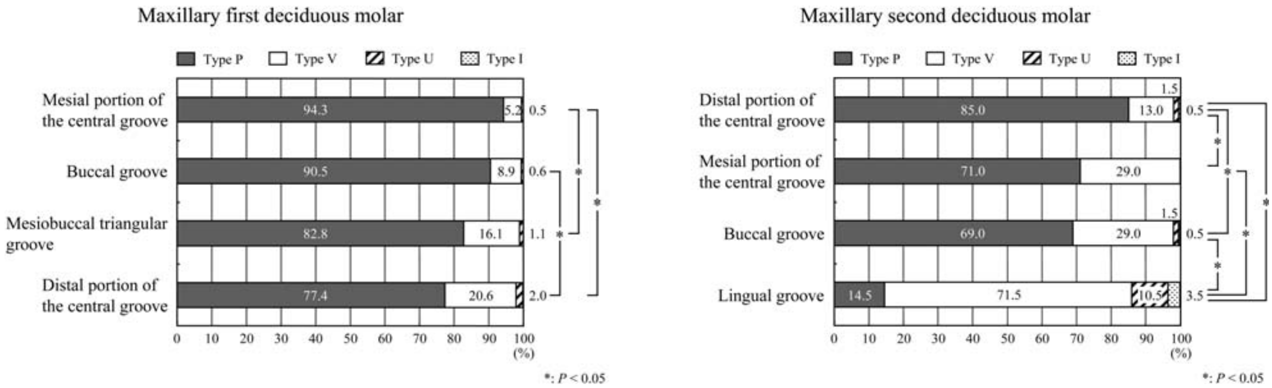


Fig. 8 Distribution of the shape of the occlusal groove on maxillary first and second deciduous molars

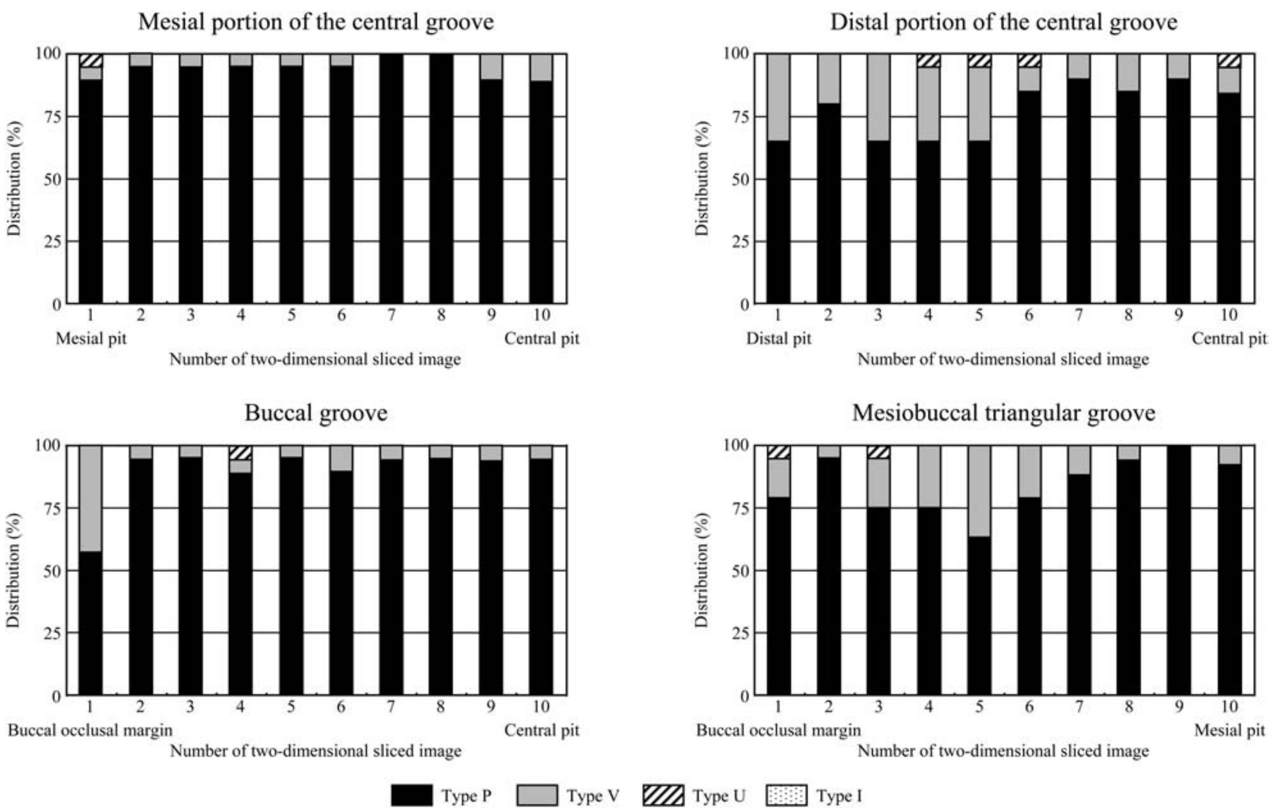


Fig. 9 Distribution of the shape of the occlusal groove on maxillary first molars

(0.54 ± 0.14 mm) = mesiobuccal triangular groove (0.54 ± 0.13 mm) > mesial portion of the central groove (0.46 ± 0.10 mm) (Table 1).

There were significant differences between mesial and distal portions of the central groove, mesial portion of the central groove and buccal groove, mesial portion of the central groove and mesiobuccal triangular groove, distal portion of the central groove and buccal groove, mesiobuccal triangular groove and buccal groove (Table 2).

2) Maxillary second deciduous molars

The values tended to decrease gradually from occlusal margin toward inside in mesial portion of the central groove, buccal and lingual grooves. The values were variable in slice #3 through #7, in distal portion of the central groove (Fig. 6).

The rank order of mean values of enamel

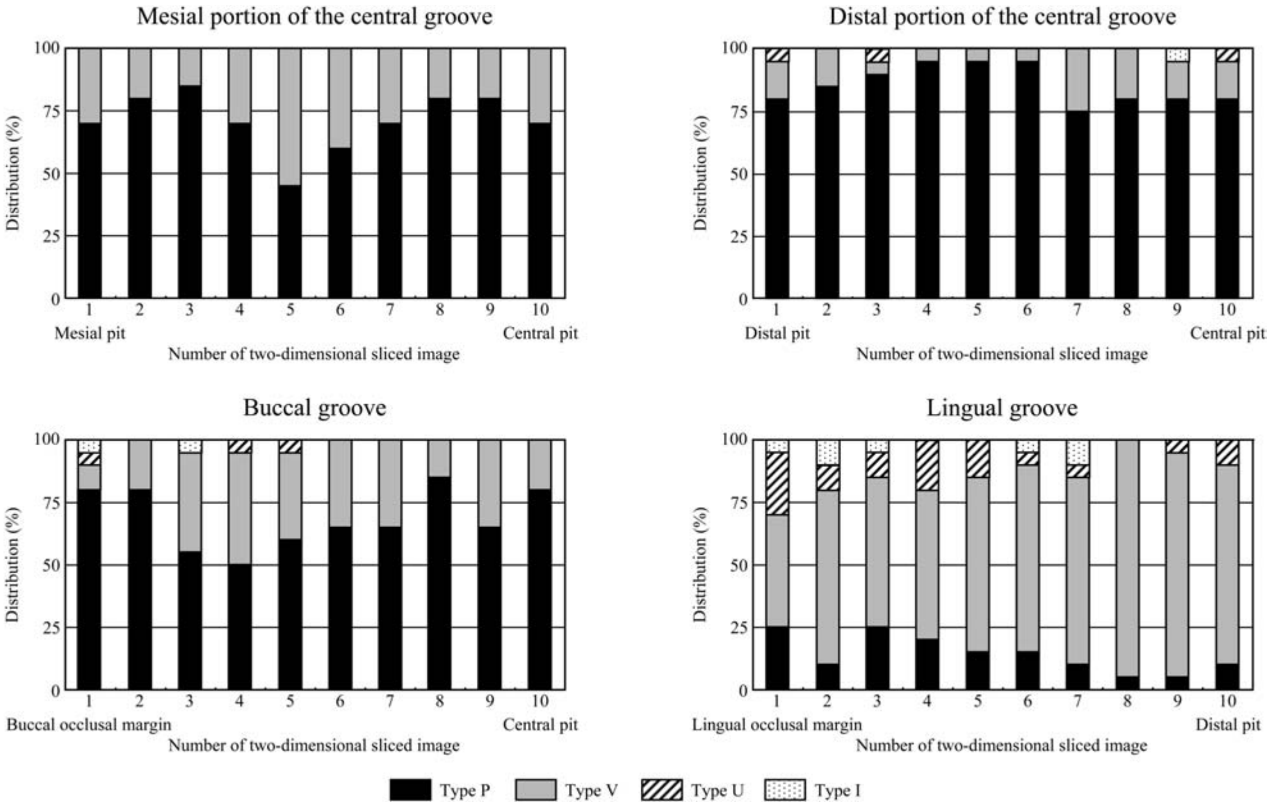


Fig. 10 Distribution of the shape of the occlusal groove on maxillary second deciduous molars

thickness was as follows: lingual groove (1.27 ± 0.50 mm) > mesial portion of the central groove (1.10 ± 0.44 mm) > distal portion of the central groove (1.04 ± 0.39 mm) > buccal groove (1.02 ± 0.45 mm) (Table 1).

There were significant differences between lingual and buccal grooves, lingual groove and distal portion of the central groove (Table 3).

3) Comparison between maxillary first and second deciduous molars

Maxillary second deciduous molars tended to have thicker enamel than that of first deciduous molars, significant differences between maxillary first and second deciduous molars were observed in mesial and distal portions of the central groove, buccal and lingual grooves (Fig. 7).

Observation of the shape of the occlusal groove

Figure 8 and Figs. 9, 10 show the incidence rates of occlusal fissures in the different types of occlusal grooves, and the incidence rates of different shapes of occlusal fissures in the different sections of occlusal grooves, in 2 types of teeth specimens; respectively.

1) Maxillary first deciduous molars

The incidence rates of occlusal fissures in the different types of occlusal grooves showed that most of the occlusal fissures exhibited the shape which was classified in type P, followed by type V, Type U in all types of occlusal grooves, and type I was not observed in any types of groove. The rank order of the incidence rate of type P was as follows: mesial portion of the central groove (94.3%) > buccal groove (90.5%) > mesiobuccal triangular groove (82.8%) > distal portion of the central groove (77.4%). Incidence rates of type V were 5.2%, 8.9%, 16.1% and 20.6% in mesiobuccal triangular groove, buccal groove, mesiobuccal triangular groove and distal portion of the central groove, respectively. Only a small incidence of type U, which was between 0.5% and 2.0%, in each type of groove was observed (Fig. 8).

There were significant differences between mesial portion of the central groove and mesiobuccal triangular groove, mesial portion of the central groove and distal portion of the central groove, buccal groove and distal portion of the central groove.

The incidence rates of different shapes of occlusal fissures in the different sections of occlusal grooves showed that type P was observed most frequently (57.1–100%) in all sections of mesial- and distal portions of central grooves, buccal groove, and mesiobuccal triangular groove; which was higher than any other types of shape. The incidence rates of type V and type U (5.0–36.8%) were higher at the sites close to distal pit in the distal portion of the central groove and the site close to buccal occlusal margin in mesiobuccal triangular groove, compared to the corresponding sections in any other types of grooves (Fig. 9).

2) Maxillary second deciduous molars

The incidence rates of occlusal fissures in the different types of occlusal grooves showed that most of the occlusal fissures exhibited the shape which was classified in type P, followed by type V and type U; in mesial portion of the central groove, distal portion of the central groove and buccal groove. The incidence rate of type I was small in distal portion of the central groove and buccal groove, and not observed in mesial portion of the central groove. In buccal grooves, the incidence rate of type V was the highest, which was followed by type P, type U and type I. The rank order of the incidence rate of type P was as follows: distal portion of the central groove (85.0%) > mesial portion of the central groove (71.0%) > buccal groove (69.0%) > lingual groove (14.5%). Incidence rate of type V was highest in lingual groove (71.5%). Incidence rates of type U were 10.5% in lingual groove and 1.5% in distal portion of the central groove and buccal groove. Incidence rate of type I was 3.5% in lingual groove and 0.5% in distal portion of the central groove and buccal groove, but not observed in mesial portion of the central groove (Fig. 8).

There were significant differences between distal portion of the central groove and mesial portion of the central groove, distal portion of the central groove and buccal groove, distal portion of the central groove and lingual groove, mesial portion of the central groove and lingual groove, buccal groove and lingual groove.

The incidence rates of different shapes of occlusal fissures in the different sections of occlusal grooves showed that type P was observed most frequently (45.0–95.0%) in all sections of mesial- and distal portions of central grooves, buccal groove; which was higher than any other types of shape. On the other hand, in lingual grooves, the incidence rates of type V (45.0–95.0%) were highest in all the sections examined. And in the sections close to lingual occlusal margin, types U and I were observed more frequently (Fig. 10).

3) Comparison between maxillary first deciduous molar and maxillary second deciduous molar

The incidence rates of type P in maxillary second deciduous molar were lower than those of maxillary first deciduous molar, in all types of occlusal grooves; whereas the incidence rates of type V, type U and type I in maxillary second deciduous molar were higher than those of maxillary first deciduous molar. These tendencies were more prominent in lingual grooves.

Discussion

Observation of the occlusal groove using micro-CT

In this study, we were able to observe the specimens three-dimensionally, in non-destructive manner, at any desired points and in more detail. To date, micro-CT was used to observe only the internal structures of oral-maxillo region, which possess complicated anatomical features[31–37]. However, in the present study, we confirmed that it was possible to observe the anatomical features of teeth using micro-CT, and this method was extremely useful to obtain the basal information on the three-dimensional architecture.

Occlusal angle of the occlusal groove

Although there have been many reports investigating the occlusal angle of the occlusal groove, most of them were on the permanent teeth[29,38–40] and less was known about the deciduous molars[10–12,17,22–24]. Bossert[40] have reported the relationship between dental caries and occlusal angle, showing that caries incidence rate increased as the occlusal angle decreased. Ogita[41] and Yamada[42] have reported that the sites exhibited highest incidence rate of caries were distal pits, in the (69.0%) and in the maxillary second deciduous molar (97.0%). In the present study, the sites which showed smallest angle were distal portions of the central groove in maxillary first deciduous molar, and lingual groove in maxillary second deciduous molar. Therefore, there seems to be the relationship between the smaller occlusal angle and higher incidence of dental caries, both in distal portion of distal portions of the central groove of maxillary first deciduous molar and lingual groove of maxillary second deciduous molar.

Depth of the occlusal groove

There have been only a few reports on the depth of the occlusal groove in deciduous molars. Hattori[8] and Yamada[43] had reported on the depth of occlusal groove relative to the enamel thickness after classifying them into type S, type M and type D, and showed that type S was seen more frequently than the other types in maxillary first deciduous molar, and types M and D in maxillary second deciduous molar. Moreover, the authors mentioned that the occlusal groove in maxillary second deciduous molar tended to be deeper than that of maxillary first deciduous molar.

In this study, the results showed that the occlusal groove in maxillary second deciduous molar was deeper than that of maxillary first deciduous molar in all sites examined, except for distal portion of the central groove. It seemed likely that the oblique ridge[18] artificially affected the accuracy of the measurement in distal portion of the central groove of maxillary second deciduous molar.

Enamel thickness at the bottom of the occlusal groove

Matsui[44] had reported that the enamel thickness of deciduous molar was 0.45–0.89 mm and 0.60–1.07 mm in maxillary first and second deciduous molar, respectively. Tsuzuki[45] had reported that the thickness was 0.46–0.91 mm and 0.84–1.30 mm in maxillary first and second deciduous molar, respectively. Goto *et al.*[17] had reported that the thickness was 0.40–0.65 mm and 0.64–0.92 mm in maxillary first and second deciduous molar, respectively. The absolute values obtained in the present study (first deciduous molar: 0.46–0.60 mm, second deciduous molar: 1.02–1.27 mm) were quite similar to the values shown in the above mentioned reports, and the tendency of thicker enamel in second deciduous molar in comparison with first deciduous molar was confirmed.

Cavity preparation in the area deeper than enamel-dentine junction in deciduous molars is considered to be at high risk of dental pulp exposure; since the pulp cavity is larger with respect to the size of dental crown, pulp horn enters deeper inside the dentine, and hard tissue is thinner in the deciduous teeth compared to permanent teeth.

Therefore, the values of enamel thickness obtained in the present study are considered to provide an important guideline for the cavity preparation in deciduous molars.

Observation of the shape of the occlusal fissures

In maxillary first deciduous molars, most of the occlusal grooves (77.4–94.3%) exhibited the shape classified into type P, whose occlusal angle was greater than 90 degree. Whereas in maxillary second deciduous molars, the ratio of type P was relatively low (14.5–85.0%), especially, lingual grooves consisted of type V, whose angle was less than 90 degree (71.5%), type U (10.5%) and type I, which had the shape looked like a stick (3.5%). Taken together with the fact that lingual grooves were deepest and had smallest occlusal angle among all the types of occlusal grooves, it was suggested that lingual grooves were the initiation and predilection sites of dental caries.

Since the occlusal fissures of lingual groove in the second deciduous molar are deeper and their occlusal angle is smaller significantly in comparison to the other fissures, it is preferable to apply pit and fissure sealant into lingual grooves at an early point of the treatment, or to perform restorative treatment only in lingual grooves.

Points to keep in mind in dental treatment with consideration on the occlusal groove anatomy

In the treatment of dental caries of deciduous molar, detailed anatomical evaluation of distal portion of the central groove of maxillary first deciduous molar, and lingual groove of maxillary second deciduous molar is necessary, because these sites tend to be the initiation and predilection sites of dental caries due to the anatomical features of their occlusal fissures. Moreover, it is preferable to apply pit and fissure sealant into the occlusal fissures containing this region at an early point of the treatment.

In the treatment of early stage of caries, in which the erosion is restricted to pits and/or fissures, the dentists are encouraged to treat only the diseased part, and perform the minimal intervention which keeps the healthy teeth untreated, without following the 5 principles postulated by Black[46].

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