Characteristic of occlusal surfaces of first permanent molars in childhood

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Характеристика на оклузални повърхности на първи молари в детска възраст

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Summary

Introduction: *The use of dental operative microscope (DOM) is an innovative technology in the pediatric dental practice. The application of magnifying and other techniques for recording initial changes in fissures is very important for the early and accurate diagnosis of initial occlusal caries in order to apply the minimally invasive treatment approach.*

The ***purpose*** *of this study is to characterize the fissure macromorphology of the first permanent molars immediately after their eruption, using DOM and photo documentation.*

Materials and methods: *The study included 54 first molars without clinical evidence of pathological changes other than caries. Through a microscope and camera Nikon D5300 a photo was taken of the occlusal surface, following the rules of perpendicularity. Each photo was processed with program Adobe Photoshop.*

Results: *The results show that the occlusal area occupied by pits and fissures, measured in pixels, does not show statistically significant differences. The relative part of the area of pits and fissures on the occlusal surface is between 13.83 and 15, 39%.*

Conclusion: *Pits and fissures of children's molars occupy up to 1/5 of the area of the occlusal surface of molars, which is an essential part of the risky enamel surface for the development of caries in children with permanent molars, immediately after their eruption. This shows the importance of early diagnosis and management of initial caries in fissures due to its high prevalence in children.*

Резюме

Въведение*: Използването на дентален оперативен микроскоп (ДОМ) е иновативна технология в денталната практика. Използването на увеличителни и други техники за регистриране на начални промени във фисурите се указва много важно за ранна и точна диагностика на началния оклузален кариес, с цел прилагане на минимално инвазивния подход на лечение.*

Цел *на настоящето проучване е да се направи характеристика на фисурната*

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макроморфология на първите постоянни молари, непосредствено след пробива им.

Материал и методи: *В изследването бяха включени 54 първи молари без клинични данни за патологични промени различни от кариес. С помощта на микроскоп и фотоапарат Nikon D5300 беше направена фотоснимка на състоянието на оклузалната повърхност, като се спазваха правилата за перпендикулярност. Всяка снимка беше импортирана и обработена в програма Adobe Photoshop.*

Резултати: *Резултатите показват, че оклузалната площ заета от фоси и фисури, измерена в пиксели при различните групи зъби, не показва статистически значими разлики. Относителният дял от площта на фисурите и фосите по оклузалните повърхност е между 13,83 и 15, 39 %.*

Заключение: *Фосите и фисурите на детските молари заемат до 1/5 от площта на оклузалната повърхност на моларите, което е съществена част от рисковата емайлова повърхност за развитие на кариес при деца с постоянни молари, непосредствено след техния пробива. Това показва значението и важността на ранната диагностика и управление на началния кариес във фисурите поради високата му разпространеност при деца.*

The use of dental operative microscope (DOM) is an innovative technology in the dental practice, leading to new diagnostic and therapeutic strategies in dental medicine, including pediatric dental medicine [1, 2, 3].

The magnifying technique makes it possible to study in clinical conditions the occlusal anatomy of children's molars, which makes permanent teeth, immediately after appearing in the mouth, extremely risky for initial caries. Occlusal anatomy is diverse and highly retentive. Immediately after the eruption, the enamel at the bottom of the fissure is very thin, and in some areas it is completely missing and the lesion begins directly in the dentin [3, 4].

Studies on the relationship between the occupied by pits and fissures part of the occlusal dental surface show different results. According to some authors of the entire dental surface of molars, pits and fissures occupy only 3%, while occlusal caries occupy 70% of the total caries in children [3, 5]. This shows the importance of this dental morphology for childhood caries. The use of magnifying and other techniques for recording initial changes in fissures is important for the early and accurate diagnosis of initial occlusal caries in order to apply the minimal invasive treatment approach for the caries lesion in the enamel (therapeutic silanization, enameloplasty, etc.) [3], or in the dentin, where the fluorescent control for excavation can be also applied [6, 7].

The management of occlusal caries in newly erupted permanent teeth has its own specificity because caries affects the teeth very soon after the eruption [8, 9]. The occlusal surfaces of permanent first and second molars remain the sites of the tooth that are most commonly attacked and are the most risky localization for the development of carious lesions in childhood [10]. The main reasons for this are the complex macromorphology of the system of grooves, pits and fissures and the eruption stage associated with the involvement of the tooth in chewing function. These two reasons are cited as biological determinants of the development of occlusal caries because they are directly related to the accumulation of plaque and its difficult removal [11].

The **purpose** of this study is to characterize the fissure macromorphology of the first permanent molars immediately after their eruption.

To achieve this goal, we set the following **tasks:**

• To conduct a study of the dental status of children aged 7 - 8 years, selecting children with first molars without clinical data of dental caries;

• To document with photos the occlusal surface of the first permanent molars in the examined children to a certain standard;

• Perform a digital analysis of photographic specimens to determine the relative occupied area of pits and fissures of the first permanent molars.

Material and methods

Material

The subjects of the study were 60 children aged 7 - 8 years, of which 14 children were selected with first molars without pathological changes. Their inclusion in the study was after a preliminary explanation of the purpose of the study and after signing informed consent by their parents/guardians. A statement by KENIMUS №24/07.12.2018 was approved for the study.

Clinical examination

The study included 54 first molars of the children examined, meeting the following criteria:

- Clinical criteria for inclusion of the first permanent molars in the study:
  - molars without clinical evidence of pathological changes other than caries;
  - molars without clinical data for carious lesions at all pre-selection sites, according to Peneva M. diagnostic scale [12];
  - molars with a crown height greater than 5.5 mm. - close to or in occlusion;
- Clinical criteria for excluding the first permanent molars in the study:
  - molars with stained pits and fissures;
  - molars with fields of impaired transparency in pits and fissures;
  - molars with cavitation in the enamel;
  - molars with cavitation in dentin;
  - molars with sealants on their occlusal surfaces;
  - molars with restorations on their occlusal surfaces;
  - molars at an earlier stage of eruption.

For each of the first permanent molars examined, the diagnosis of each surface was made, after cleaning with a brush without paste, initially only with directional light and a clinical examination, and then a visual inspection of the occlusal surface was performed with a dental operating microscope (Semorr DOM 3000E) with a magnification of 8x, and the evaluation was recorded on the patient‘s medical card.

The height of the clinical crown was measured by a periodontal probe along the axial axis in the middle of the tooth crown. The data was written onto the patient‘s card.

Photo documentation

Through the microscope, using DSLR Nikon D5300, a photo was taken of the state of the occlusal surface, following the rules of perpendicularity - the camera lens being perpendicular to the image taken or to the mirror image.

Methods for measuring the fissure morphology of the examined occlusal surfaces

Each photo was imported into Adobe Photoshop (Fig. 1). The total area of the occlusal surface is coloured in the photograph with a colour of choice with “brush tool”. Selection of the color zone with the tool „Magic Wand Tool“ is done after that. The number of pixel are counted in the highlighted area using the analysis tools: Image -> Analysis -> Record Measurements. We have determined the area, which is measured in pixels.

In the same procedure, a new section of the occlusal surface is marked with pits and fissures and their area measured in pixels (Fig. 2);

• A mathematical analysis of the results is made and the percentage of grooves from the total area of the occlusal surface is determined.

The acquired data was statistically processed with the SPSS program (version 19, SPSS Inc., USA). A 95% confidence interval ($p < 0.05$) was chosen for the significance level rejecting the null hypothesis.

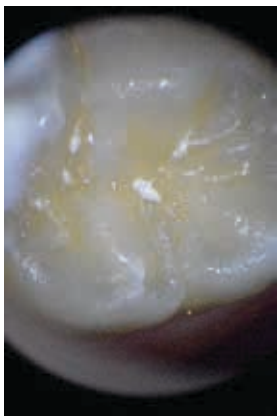

Fig. 1

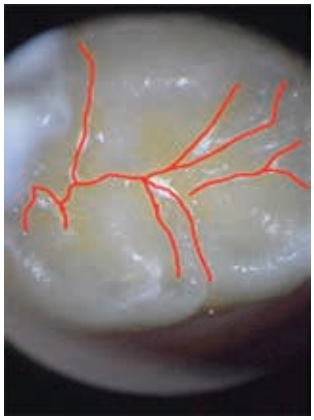

Fig. 2

Fig. 1 and 2 *Photo documentation*

Results

1. Distribution of the examined children by gender and age

The following tables present the distribution of children by gender and age.

Table 1. *Distribution of children by sex and age*

	7 year old		8 year old		Total	
	N	%	n	%	n	%
Girls	6	42,86	2	14,29	8	57,15
Boys	2	14,28	4	28,57	6	42,85
Total	8	57,14	6	42,86	14	100

The study involved 14 (54 teeth) children aged 7-8 years, and the gender distribution is almost even.

2. Degree of eruption of the first molars examined

The height of the clinical crown of the teeth examined is presented in the following table.

Table 2. *Height of the clinical crown of the molars by tooth groups*

Teeth	Eruption in mm		Independent t test
	n	Mean ± SP	
1 (16)	14	5,54 ± 0,30	$t_{1,2}$ = -1,191, p = 0,244 $t_{1,3}$ = -1,337, p = 0,194 $t_{1,4}$ = -1,667, p = 0,108 $t_{2,3}$ = -0,188, p = 0,853 $t_{2,4}$ = 0,000, p = 1,000 $t_{3,4}$ = 0,234, p = 0,817
2 (26)	14	5,71 ± 0,46	
3 (36)	12	5,75 ± 0,50	
4 (46)	14	5,71 ± 0,26	
Total	54	5,68 ± 0,38	

The table shows that the average crown eruption height of the tested molars in millimeters ranges from 5.54 mm to 5.75 mm. No significant difference in the degree of eruption was observed between the different molar groups (p>0.05). This is an important requirement for photographic images to be taken under standardized conditions while respecting the rules of perpendicularity - the camera lens is perpendicular to the surface taken or to the mirror image.

3. Photometric analysis of the occlusal macromorphology of the molars examined

The following table shows the mean values of the occlusal surfaces of the molars examined in pixels.

Table 3. *Area of the occlusal surface by tooth groups (in pixels)*

Teeth		Mean ± SP	Independent t test
1 (16)	14	3487045,86 ± 3436271,79	$t_{1,2}$ = 0,331 p = 0,743 $t_{1,3}$ = 0,909 p = 0,372 $t_{1,4}$ = 0,882 p = 0,386 $t_{2,3}$ = 0,689 p = 0,497 $t_{2,4}$ = 0,626 p = 0,537 $t_{3,4}$ = -0,109 p = 0,914
2 (26)	14	3103422,29 ± 2647203,57	
3 (36)	12	2453692,67 ± 2060924,54	
4 (46)	14	2541818,57 ± 2065289,13	
Total	54	2896494,85 ± 2552422,26	

The results show that the area of the occlusal surfaces is approximately the same for different groups of teeth (p>0.05). This gives reason to expect accurate and objective comparable data on the relative part of the area occupied by the fissures.

Table 4. *Area of fissures on occlusal surfaces of the teeth examined*

Tooth	Total area in pixels		Independent T test
	n	mean ± SP	
1 (16)	14	504487,00 ± 508888,02	$t_{1,2}$ = 0,446, p = 0,659 $t_{1,3}$ = 0,529, p = 0,602 $t_{1,4}$ = 0,901, p = 0,376 $t_{2,3}$ = 0,175, p = 0,880 $t_{2,4}$ = 0,582, p = 0,565 $t_{3,4}$ = 0,369, p = 0,715
2 (26)	14	432133,43 ± 330333,07	
3 (36)	12	411444,17 ± 361124,08	
4 (46)	14	365604,29 ± 271407,29	
Total	54	428417,22 ± 367938,12	

It is visible from the table that the occlusal area occupied by pits and fissures, measured in pixels at different tooth groups, does not show statistically significant differences (p> 0.05).

The following table shows the relative part of the area occupied by pits and fissures from the entire occlusal surface of the molars examined.

Table 5. *Relative part of fissure morphology related to the entire occlusal surface*

Tooth	Area of pits and fissures		Statistics
	n	% ± SP	
1 (16)	14	13,83 ± 2,26	$t_{1,2}$ = -1,433, p = 0,164 $t_{1,3}$ = -1,884, p = 0,072 $t_{1,4}$ = -0,881, p = 0,386 $t_{2,3}$ = 0,976, p = 0,584 $t_{2,4}$ = 0,721, p = 0,477 $t_{3,4}$ = 1,312, p = 0,202
2 (26)	14	14,97 ± 1,95	
3 (36)	12	15,39 ± 1,92	
4 (46)	14	14,48 ± 1,62	
Total	54	14,67 ± 1,94	

The relative part of the area of pits and fissures on the occlusal surface is between 13.83 and 15, 39%, with no significant differences between the upper and lower molars.

Discussion

In recent years, there has been an increase in the frequency of dental caries in developed countries due to lifestyle changes [13, 14]. In children, the percentage of caries occurring in fossi and fissures on the occlusal surface reaches and even exceeds 80% [15]. The occlusal surfaces of the permanent children‘s teeth immediately after the eruption are the most risky localization for the development of carious lesions, and the most frequently affected teeth are the first and second permanent molars [16]. According to a number of authors, the main reasons for this are the complex morphology of the occlusal surfaces, the eruption stage, and the varying degree of postoperative mineralization of the tooth surface [10, 11, 17].

Our study showed that the fissure macromorphology of the first permanent molars occupies an area of 14 - 15% of the occlusal surface. According to other studies, occlusal surfaces are only 12% of the total surface area of one molar, but occlusal caries is 90% of childhood caries [18].

The molars erupt with an „occlusal defect“ called deep fissure. This is the part of the enamel that is built last and accordingly the mineralization of the tooth in this zone is weaker [18]. In addition, the entrance to the deep fissure is usually narrow, and under it there is an extension of various shapes. This specific anatomy is a prerequisite for easy entry of food debris, microorganisms and formation of dental plaque [18]. The fibers of the toothbrush are practically unable to penetrate deep into these narrow spaces and practically do not remove the plaque accumulated [19]. For teeth in eruption, due to insufficient height of the erupting tooth, it does not participate in the chewing act and plaque formation is enhanced and unimpeded.

For these reasons, early diagnosis of occlusal caries and its active prevention are of crucial importance in childhood [17, 18, 20, 21].

Conclusion

Pits and fissures of children’s molars occupy up to 1/5 of the area of the occlusal surface of molars, which is an essential part of the risky enamel surface for the development of caries in children with permanent molars, immediately after their eruption. Various methods of treatment and prophylaxis are recommended in the literature, such as silanization, fluorine applications, nutrition and training tips and motivation in proper oral hygiene. However, all authors emphasize the importance of early diagnosis and management of initial caries in fissures due to its high prevalence in children.

Acknowledgement – This work was supported by the Council of Medical Science at Medical University of Sofia, Bulgaria under Infrastructure Project with Contract No. 207/12.12.2018

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