Morphometric analysis of the occlusal surface: the influence on the prevalence of carious lesions

Fabiano Bassalobre Valera[1]
Thais Maria Freire Fernandes[2]
Rogério Emílio de Souza[3]
Rubens Carneiro Valera[4]
José Mondelli[5]

[1]*Graduated course on Dentistic – FOB-USP.*

[2]*Undergrauated course on Dentistic FOB-USP.*

[3]*Graduated course on Endodontcs FOB-USP.*

[4]*Professor, head of the Discipline of Dentistics – UNIP – Bauru.*

[5]*Professor, head of the Discipline of Dentistics – School of Dentistry of Bauru – FOB-USP.*

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ABSTRACT

The aim of this study was to test the two null hypotheses: (1) there is no morphological difference between molars and premolars in relation to the presence of pits and fissures; (2) there is no positive relation between the presence of pits and fissures and the prevalence of carious lesions. Twenty-two human teeth were used in this study, which were sectioned and evaluated for the presence of pits and fissures and the prevalence of carious lesions. The results showed that there were no difference between molars and premolars regarding to the presence of pits and fissures, and in general, a prevalence of 22.5% of pits and fissures. There were carious lesions in 92% of the pits and fissures and in 34% of the grooves and fossae areas. Despite the low prevalence of pits and fissures, there is a direct correlation between these and the presence absence of caries lesions.

KEY WORDS: occlusal caries; dental morphology; caries diagnosis

INTRODUCTION

Controversy and problems have arisen regarding the differentiation between pits and fissures in fossae and grooves. In 1923 Hyatt proposed in his article to restore all fissures even before the onset of caries lesion aiming to prevent its development. Controversy ensue mainly, according to Bodecker (1924), because of the misinterpretation of the term *fissurae*.

Mondelli et al. (2002) agree that grooves and fossulae are the natural anatomical details resulting from the coalescence of various developmental lobules, whereas fissures and pits are the deficient union among these lobules in the groove area and in the fossulae area, respectively.

According to Gillings and Buonocore (1961) the presence of pits and fissures is a normal occurance and can be found in molars and premolars and are considered as areas with high susceptibility to caries lesion (BOSSERT, 1933; KÖNIG, 1966; JUHL, 1983b).

Authors classify pits and fissures according to the anatomical form in classes (1) V-type, ample in the top and gradually narrowing to the base; (2) U-type, almost the same width from top to base; (3) I-type, a very narrow groove; (4) IK-type, a very narrow groove associated to a large space in the base (5) other types being the V-type more prevalent (NAGANO, 1961). This author has correlated type of pits and fissure to depth in which the V-type have a superficial or shallow depth, the U-type an average depth and the most of other types shows a marked depth.

There is a correlation between the type of tip and fissure and the zone of decay (NAGANO, 1961; KÖNIG, 1963; FERREIRA ZANDONÁ et al., 1998). In the tips and fissure of the V-type the caries lesions start from botton, from the half to bottom in the U-type and in the top of the pits and fissures in the I and IK types (NAGANO, 1961). According to Juhl (1983b) in premolars the majority (61%) of caries lesions start in the vase of tips and fissures bearing some difference when the sample includes molars since 3-D studies show differences in the morphology between these two groups of teeth (JUHL, 1983a).

Ekstrand et al. (1991) conducted a morphometric assessment of the groove-fossae system in third molars. The authors classified the presence of pits and fissures when the structural angle of the grove situated between two or more development lobules was less than or equal to 25°. They found just a prevalence of 18% of pits and fissures and, besides that, the region of the fossae was never classified as pit.

Based on the morphological difference between molars and premolars the aim of this study is to test the following null hypothesis: (1) there is no morphological difference between premolars and molars in what regards the presence of pits and fissures; (2) there is no positive correlation between the presence of pits and fissures to the prevalence of caries.

MATERIALS AND METHODS

The sample included randomly selected 22 extracted human permanent teeth (12 molars and 10 premolars). Those with structural defects and/or decayed for the most part destructed by caries were excluded. Teeth were submitted to prophylaxis with jets of water and sodium bicarbonate and individually stored in saline.

Obtaining the specimes

Teeth were cut with an Isomet 2000 (Buehler) cutter in the vestibulo-lingual sense in a serial way, obtaining specimens measuring approximately 500 micrometer. Each specimen was polished with water sanderpaper 600 and then each face of the dental fragment was photographed with a digital camera (D100-Nikon). The images were processed by a specific software (Adobe Photoshop 7.0.1) aiming to facilitate the classification of the caries lesions, whenever present. In cases of difficult diagnosis a reversal image was used, to a negative view, facilitating in this way the identification of small demineralization spots in the examined surface (VALERA, 2003).

Image analysis and classification of specimens

After image treatment it was determined the presence or absence of caries lesions in all images obtained, according of the following scores: (0) healthy; (1) enamel caries; (2) dentin caries. It was considered the presence of caries lesions both in dentin and enamel.

With the images and following the methodology proposed by Ekstrand et al. (1991), the specimens were classified accord-

ing to the grooves and fossae if the structural angle of the anatomical detail was localized between two (grooves) or more (fossae) lobules of development was greater than 25° and in pits and fissure, respectively, if the angle was less or equal to 25°. All angles were measured with a compass and the measurement was done by the same individual.

Statistical analysis

Firstly, it was evaluated the prevalence of pits and fissures for both types of teeth. It was also determined the prevalence of caries in them. It was also determined the prevalence of caries for these two teeth taking into consideration the presence or absence of pits and fissures.

Later, the specimens were grouped according to the presence or absence of pits and fissure and the prevalence of caries in these two groups was determined.

The results were analyzed in terms of the dependency or no dependency of the prevalence of caries to the presence of pits and fissure using the Chi square test (5% significance).

The study was submitted to analysis by the Committee on Ethics in research and was approved.

RESULTS

A total of 339 images that were analyzed according to the methods described above were obtained from the sections of 22 teeth. 82% (18 teeth: 8 premolars and 10 molars) out of the 22 teeth had at least one specimen with pit or fissure.

For the premolars the angles for assessment of the presence or not of pits or fissures varied from 2.5° to 168.5°. For the molars the variation ranged from 2° to 146°.

TABLE 1 shows the prevalence of pits and fissures as well as the presence or not of caries lesions in the premolars and molars. The lesions, if present, could be restricted to the enamel or even reach the dentin.

TABLE 1 – Morphometric characteristics and prevalence of caries in occlusal surfaces.

		Total	Healthy	Enemal caries	Dentin caries	Total caries
Premolars	Pits and fissures	21%	23%	23%	54%	77%
	Fossae and grooves	79%	66%	25,5%	8.5%	34%
Molars	Pits and fissures	23.5%	2%	24%	74%	98%
	Fossae and grooves	76.5%	66%	20.5%	13.5%	34%
Total	Pits and fissures	22.5%	8%	23%	69%	92%
	Fossae and grooves	77.5%	66%	22%	12%	34%

There was no statistically significant differences between the premolars and the molars regarding the presence or not of pits and fissures. Both for pre-molars and molars the prevalence of caries lesions was dependent of the occlusal morphometry, with a greater prevalence when pits and fissure were present.

Despite the similar morphometry, the prevalence of caries was greater, with significance, in molars than in premolars.

DISCUSSION

Despite the macromorphologic differences between premolars and molars, results supported the first hypothesis, since there was no difference with statistical significance between the occlusal morphometry of these two types of teeth. However, the molars were shown to have a greater prevalence of caries despite their position in the dental arch, which makes the performance of prophylatic procedures by patients difficult.

The prevalence of pits and fissures in the present study was similar to those reported by Ekstrad et al. (1991). Due to the low incidence of pits and fissures these researchers did not take into consideration their presence and considered the macromorphology of the occlusal surface as zones for possible development of caries lesions.

Considering that 82% of the analyzed teeth had at least one area with pit or fissure, one should pay attention once the results show that prevalence of caries is associated to the morphology of the occlusal surface, thus rejecting the second hypothesis. The presence of pits and fissures favored the onset and development of caries lesions in these surfaces, which is supported by the findings of Juhl (1983b).

A direct relation between the structural angle and the severity of the lesion was detected. The smaller the angle, the deeper caries lesion, what corroborates the finding by Ekstrand et al. (1987).

Although there is no correlation between the presence of pits and fissures and their depth (EKSTRAND et al., 1991), the high prevalence of caries in such structural "defects" make all deep pits and fissures develop caries lesion compromising the dentin tissue. This fact is related to the small width of the enamel in the apical part of the pits and fissures and the dentin tissue, in which even small demineralization compromises the dentin.

Some authors suggest that the onset and progression of caries is related to the macromorphololgy of the occlusal surface (CARVALHO et al, 1989; EKSTRAND et al. 1995) being the central fossae of the permanent molars the site of greater prevalence of caries. However, based on the serial sections, its was possible to observe that major sites for caries development are the pits and fissures, what is supported by Gustafoson (1957), Nagano (1961) and König (1963 e 1966).

Another important factor to be influenced by the presence or absence of pits and fissures relates to the method of diagnosis of caries lesion. The high prevalence of caries in pits and fissures and the lesser effectiveness of diagnostic methods in this area (LUSSI, 1991; ELHOUSSEINY; JAMJOUM, 2001) posed an enormous problem to be solved. There is need for additional research to improve the effectiveness of diagnostic methods in pits and fissures.

CONCLUSION

The low prevalence of pits and fissures influenced directly the presence or nopresence of caries lesions. A careful clinical analysis of the occlusal anatomy can lead to plans of treatment more in line with the real status of the surface, resulting most of the time in preservation of dental tissue by preventive measures.

REFERENCES

1. BODECKER, C. F. Microscopic study of enamel fissures with reference to their operative treatment. *D. Cosmos*, v. 66, p. 1054-1067, 1924.
2. BOSSERT, W. A. The relation between the shape of the occlusal surfaces of molars and the prevalence of decay. *J. Dent. Res.*, v. 13, p. 125-128, 1933.
3. CARVALHO, J. C. et al. Dental plaque and caries on occlusal surfaces of first permanent molars in relation to stage of eruption. *J. Dent. Res.*, v. 68, n. 5, p. 773-779, 1989.
4. EKSTRAND, K. et al. Light microscope study of the effect of probing in occlusal surfaces. *Caries Res.*, v. 21, p. 368-374, 1987.
5. EKSTRAND, K. R. et al. Morphometric analysis of occlusal groove-fossa-system in mandibular third molar. *Scand. J. Dent. Res.*, v. 99, p. 196-204, 1991.
6. EKSTRAND, K. R. et al. Relationship between external and histologic features of progressive stages of caries in the occlusal fossa. *Caries Res.*, v. 29, p. 243-250, 1995.
7. EL-HOUSSEINY, A. A.; JAMJOUM, H. Evaluation of visual, explorer, and a laser device for detection of early occlusal caries. *J. Clin. Pediatr. Dent.*, v. 26, n. 1, p. 41-48, 2001.
8. FERREIRA ZANDONÁ, A. G. et al. An in vitro comparison between laser fluorescence and visual examination for detection of demineralization in occlusal pits and fissures. *Caries Res.*, v. 32, p. 210-218, 1998.
9. GILLINGS, B.; BUONOCORE, M. Thickness of enamel at the base of pits and fissures in human molars and bicuspids. *J. Dent. Res.*, v. 40, n. 1, p. 119-133, 1961.
10. GUSTAFSON, G. The histopathology of caries of human dental enamel, with special reference of the division of the carious lesion into zones. *Acta Odont. Scand.*, v. 15, p. 13-55, 1957.
11. HYATT, T. P. Prophylactic Odontotomy. *D. Cosmos*, v. 65, p. 234, 1923.
12. JUHL, M. Three-dimensional replicas of pit and fissure morphology in human teeth. *Scand. J. Dent. Res.*, v. 91, p. 90-95, 1983.

13. JUHL, M. Localization of carious lesions in occlusal pits and fissures of human premolars. *Scand. J. Dent. Res.*, v. 91, p. 251-215, 1983.
14. KÖNIG, K. G. Dental morphology in relation to caries resistance with special reference to fissures as susceptible areas. *J. Dent. Res.*, v. 42, p. 461-476.
15. KÖNIG, K. G. Findings in serially sectioned teeth showing early fissure lesions. *Adv. Fluor Res.*, v. 4, p. 73-79, 1966.
16. LUSSI, A. Validity of diagnostic and treatment decisions of fissure caries. *Caries Res.*, v. 25, p. 296-303, 1991.
17. MONDELLI, J. et al. *Dentística* – procedimentos pré-clínicos. 1. ed. São Paulo: Santos, 2002. 265 p.
18. NAGANO, T. Relation between the form of pit and fissure and the primary lesion of caries. *Shikwa Gakuho*, v. 60, p. 80-90, 1960.
19. VALERA, F. B. *Comparação entre a inspeção visual, radiografia interproximal e a fluorescência a laser em relação ao diagnóstico de lesões cariosas oclusais e a determinação do plano de tratamento.* 2003. 88p. Dissertação (Mestrado)–Faculdade de Odontologia de Araçatuba, Universidade Estadual Paulista, Araçatuba, 2003.

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