Scientific Article

Occlusal Fossae Depth of Permanent First Molars Assessed by Visual Examination: An In Vitro Approach

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Abstract: ***Purpose:*** *Sealant placement commonly is employed in molars with deep fissures to protect the teeth from occlusal caries. Some have advocated the same preventive approach for deep occlusal fossae in permanent molars. The decision of whether or not to place a sealant depends largely on the dentist's assessment of the depth of the occlusal fossae. The purposes of this in vitro study were to: (1) evaluate the morphology and determine the actual depth of occlusal fossae from newly erupted permanent first molars; (2) compare them with depth assessments obtained from visual examination, and (3) characterize how pediatric dentists look at the occlusal surfaces to assess fossae depth.* ***Methods:*** *Fossa depth of 48 intact permanent molars was measured by a computerized micromeasurement system (Michigan Laser Digitizer) and compared with the depth assessed during a bench-top examination conducted by a panel of pediatric dentists.* ***Results:*** *The computerized and visual measurements were positively and significantly correlated (r=0.64, P<.001). Agreement as measured by the Kappa statistic was moderate (κ=0.46; 95% confidence interval=0.22-0.71; P<.001).* ***Conclusion:*** *Pediatric dentists' perception of fossa depth in permanent molars correlates moderately well with the actual fossa depth. (Pediatr Dent 2008;30:19-24) Received December 13, 2006 / Last Revision March 36 , 2007 / Revision Accepted March 28, 2007.*

KEYWORDS: FISSURE, FOSSA, FOSSAE, SEALANT

Dentists often make the decision to place sealants in permanent molars based on the perceived depth of the occlusal fissures.[1,2] The rationale for and efficacy of sealant placement have been studied and reviewed extensively.[3-8] A 1995 study by Heller supported the concept of risk-based sealant application.[7] Their study found that, although the occlusal surfaces on molars with incipient caries benefited from sealants, sound surfaces on molars were unlikely to become decayed over time and, thus, benefited little from the preventive treatment. Feigal has hypothesized that an examination of tooth morphology, caries history, fluoride history, and oral hygiene by an experienced clinician affords the best risk assessment for sealant placement.[9] In general, if the fissures are deep, placement of a sealant may be indicated to prevent occlusal caries. It remains to be ascertained whether or not actual fissure or fossa depth correlates well with the depth as determined by a dentist's visual examination.

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In a clinical evaluation of the dental anatomy of a permanent first molar, fissures and fossae are often confused. A fossa is an irregular, rounded depression or concavity found on the tooth's surface.[10] Central fossae are found on the occlusal surface of molars and are formed by the convergence of ridges terminating at a central point in the bottom of the depression (angle of fossae) where there is a junction of grooves, forming a pit. The grooves are the result of the coalescence between the developing lobules during the process of enamel formation.[11] When this coalescence is complete, the result is shallow grooves; however, when the coalescence is incomplete, deep gaps or deep grooves result. Under these circumstances, the grooves are designated "fissures" or "fissured grooves."[11]

Ekstrand and associates assessed the relationship between the morphology of the groove-fossa system and the histological features of caries and whether the morphology of the converging ridges (interlobal grooves) influences micro-organism viability.[12,13] Microradiographs of fissure-like and groove-like interlobal enamel grooves and their contents were examined. They concluded that the internal morphology of the interlobal grooves influences the conditions for bacterial growth and this determines the location for caries progression within the groove fossa system. Low caries activity at the deepest portion of the grooves implies a low level of bacterial viability in these sites.[12]

In a recent study conducted by Cruvinel and associates, 20 pediatric dentists' visual assessments of occlusal fossae depth

of 48 sound third molars was compared with the actual fissure depth as measured by a computerized cone-bean tomography. [14] It was found that the specialists "were not able to correctly classify by clinical analysis the groove-fossa system depth of third molars (r=0.23, P=.103)." The same authors reported a high negative correlation (r=-0.77, P<.01) between the angle of converging ridges and fissure depth. Consequently, it can be determined that the more acute the fossae angle, the deeper the fissure.

If fossae are particularly deep and resemble a deep fissure, then placement of a sealant may be indicated. If so, the accuracy of the clinician's visual measurement of fossae depth is essential for determining the need for sealant treatment. At present, data on the actual fossae depth of permanent first molars are limited.

The purposes of this *in vitro* study were to: (1) evaluate the morphology and the actual depth of occlusal fossae from newly erupted permanent first molars; (2) compare them with depth assessments obtained from visual examination; and (3) characterize how pediatric dentists look at the occlusal surfaces to assess fossae depth.

Methods

This study's sample consisted of 48 subjects, 6- to 8-year-old children living in Brasilia, Brazil, who received regular checkups at the Municipal Dental Health Center of Brasilia, DF. The study was approved by the Committee of Ethics, University of Brasilia College of Medicine, Brasilia, DF, Brazil. Parents/legal guardians signed informed consent documents. The patients/parents received no compensation. The inclusion criteria were: (1) the presence of newly erupted permanent first molars (maxillary or mandibular) with no contact with the opposing tooth; and (2) no signs of decalcification or caries.

Dental impressions were obtained from the first 48 patients who met these criteria and whose parents granted permission to participate. A sample size of 48 is convenient for the Q-sort method.

Impressions were obtained with a polyester elastomeric base material (Impregum F, 3M-ESPE, St. Paul, Minn) in disposable trays. Impressions were poured immediately in improved dental stone (Kerr Vel-Mix stone, Kerr Manufacturing Co., Inkster, Mich). The stone casts were separated from their impression material, trimmed, identified, and individually coded for assessment (Figure 1).

A panel of 17 pediatric dentists (14 men and 3 women) recruited from the faculty and alumni of the graduate pediatric dentistry program of the University of Michigan School of Dentistry, Ann Arbor, Mich., were asked to assess fossae depth by visual exam only. The panel had an average experience of 14.2 years (median and mode=12±10.4 SD) in the field of pediatric dentistry.

The panel was asked to evaluate the molar casts according to the occlusal fossae depth from the shallowest to the deepest using the Stephenson Q-sort method.[15] This technique "employs a progressive forced-choice winnowing and enables the evaluator to make fine comparative judgments that can be expressed on a 9-point scale" (Figure 1).[16] This rating system was designed originally for a sample size of 96 and has a correlation in the range of 0.81 to 0.88 between replications.[16,17] More recently, it has been employed as a rating technique for different sample sizes (29, 48, and 51) where a group of objects had to be sorted, assuming the rater was congruent and consistent.[18-21]

Each cast was scored by the 17 panelists; the average of these scores was used for comparison with actual depths. To test the panelists' reliability, each was asked to re-evaluate the casts 2 weeks later. A short questionnaire (8 questions) was

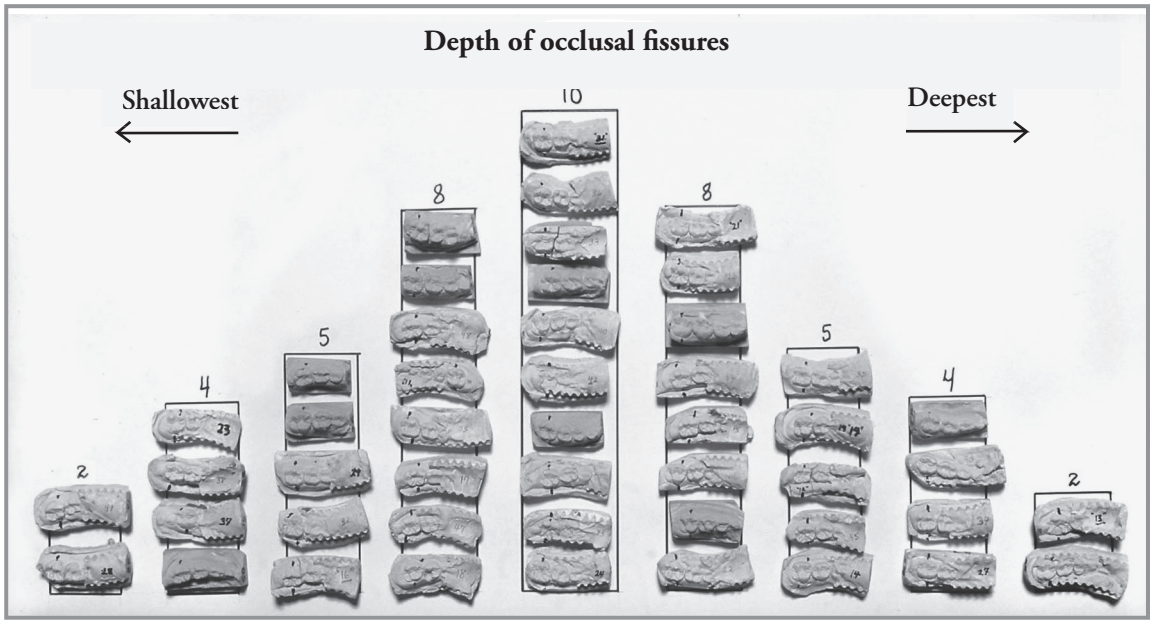

Figure 1. Q-sort model array. Each model was given a score according to its grouping on the quasi-normal distribution that the Q-sort produces.

given to each panelist immediately after the first evaluation session. The purpose of the questionnaire was to characterize how pediatric dentists look at occlusal surfaces of molars to assess fossae depth. Questions were asked in 3 groups:

1. An attempt was made to identify the criteria for the ratings "shallow," "moderate," or "deep" (visual appearance, angles, or excessive fissure morphology).
2. The site used as a reference for classification (angles of cusps, the cusp tip, or inclination of the cusps' slopes).
3. Criteria used to determine depth—actual base of the "fissure" or the angle of the ridges as it approaches the base.

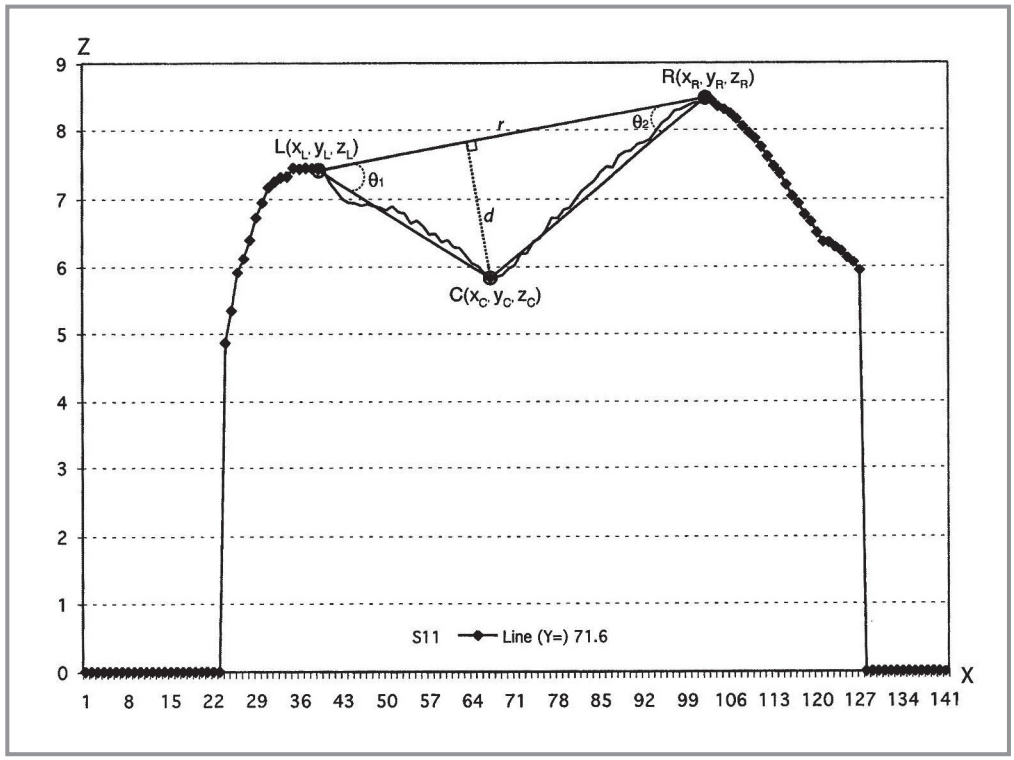

Figure 2. A computerized dental cast cut at the tips of buccal and lingual cusps of a molar. The Michigan Laser Digitizer measures the surface of the object in a 3D graphic mode. It collects X, Y, and Z coordinate values from over several thousand data points on the surface of the object. d = depth of fossa.

The measurement of the actual fossae depths was accomplished with a computerized 3-dimensional digitizer ("Michigan Laser Digitizer," Chesapeake Laser System, Lanhan, Md). It uses a gallium arsenide laser with a wavelength of 780 nanometers to measure an object's surface.[22,23] Software developed for the system permits plotting of the sample in a 3-D graphic mode, thereby providing linear surface computations for each of the 3 lines of data collected. Data points were collected from the cusp tip down the cusp incline and through the occlusal fossae to the opposite cuspal incline and cusp tip. The data were collected as X, Y, and Z coordinates for points at 100 mm intervals on the sample surface. The data were collected from 3 passes over the tooth's surface, with each pass separated by 700 mm

An area representing the deepest fossa on the occlusal surface was selected for digitization (Figure 2). A line was constructed between the tips of the buccal and lingual cusps. A line perpendicular to this cuspal line was extended to the depth of the fossa to establish a measure of fossa depth. An angle constructed from the deepest point in the fossae and the tips of the buccal and lingual cusps formed a measure of fossa angulation. To avoid any misreading by the digitizer, 3 passes over the tooth's surface separated by 0.7 mm were carried out and the mean was used as the actual depth and angle measurements.

Statistical analyses were performed with a commercial program (Statistical Package for Social Sciences, v. 14.0, SPSS, Chicago, Ill). For inferential statistics, a probability by chance of less than .05 was considered statistically significant.

Results

Descriptive statistics—means, standard deviations (SD), and ranges—for the digitizer laser measurements are summarized in the Table. For the 24 maxillary and 24 mandibular permanent first molars, the mean occlusal depth was 2.05 mm; the median and mode were 2.05 and 1.23 mm, respectively. For fossa angle, the mean was 102.1°; the median and mode were 109.45° and 100°, respectively. On a 0 to 9 scale for a sample of 48, Q-sort scores have a built-in mean of 4 and a standard deviation of 1.23. Intraobserver agreement was measured by the Pearson product-moment coefficient of linear correlation (r=0.95, P<.01). Interpanelist agreement was measured by intraclass correlation (r=0.93, P<.001).

Table. DESCRIPTIVE STATISTICS FOR LASER MEASUREMENTS OF PERMANENT MOLAR FOSSA DEPTH AND ANGLE

Measure	Statistics		
	Mean±(SD)	Minimum	Maximum
Actual depth (mm)	2.0 ± 0.3	1.2	2.6
Actual angle (°)	102.1 ± 7.8	88.8	120.8

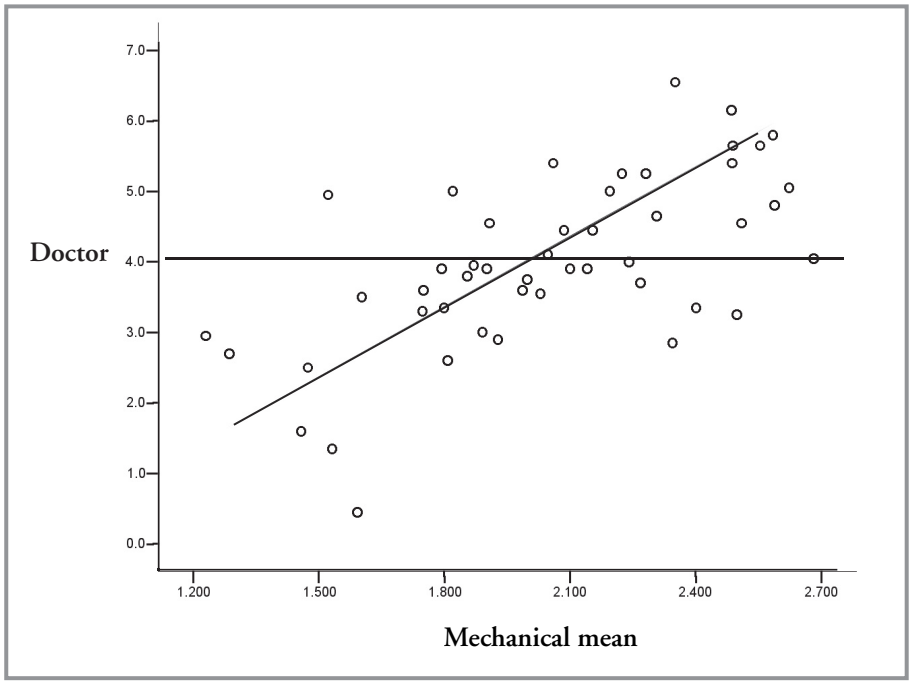

Figure 3. Relationship between pediatric dentist Q-sort scores and the actual fossa depth measured by the Michigan Laser Digitizer (mm), r=0.637, P<.001.

The strength of the relationship between Q-sort scores and the computerized measurement was moderately strong, as evidenced by Pearson product-moment coefficient of linear correlation (r=0.64, P<.001; Figure 3).

To assess the agreement of fossa depth in 3 levels—shallow, moderate, and deep—between Q-sort scores and actual measurements, a normal fossa-depth distribution was assumed. One standard deviation above and below the mean would find about 65% of the teeth between 1.68 and 2.42 mm. As a result, for fossae depth, the following 3 categories were adopted: (1) shallow (<1.68 mm); (2) moderate (1.68-2.42 mm); and (3) deep (>2.42 mm). Similarly, using 1 standard deviation above and below the mean for Q-sort scores, the following 3 categories were defined: (1) shallow (<2.77 mm); (2) moderate (2.77-5.23 mm); and (3) deep (>5.23 mm). An evaluation of agreement between these 2 sets of scores by way of Cohen's kappa statistic showed moderate agreement (K=0.46; 95% confidence interval [CI]=0.22-0.71; P<.001).

To assess a potential confounding by years of practice experience, the panel of 17 pediatric dentists (who had from 1 to 33 years in practice) was divided into 3 subgroups according to years in practice: (a) 1-5 years; (2) 9-15 years; and (3) 25-33 years. In conjunction with the 3 categories of fossa depth, a 3x3 contingency table was created. Because of small expected values, a generalized linear model (**GLM**) and linear mixed model (**LMM**) were used to estimate years in practice as a confounding factor. The GLM and LMM tests showed that number of years of practice experience was not a significant confounder (P=1.0 and P=.916, respectively).

The questionnaire responses demonstrated that 69% of pediatric dentists evaluate fossa depth by the angles of the cusps' slopes and 54% were influenced by the depth of the morphology and tips of the cusps.

Discussion

Visual assessment of fossae depth is a subjective approach whose accuracy is open to question. For example, Cruvinel,[14] Fung et al,[24] and Cardoso et al[25] argue that years of practice experience may be a confounding factor in assessing fossae depth. In the present study, however, the number of years of practice experience did not have a significant impact (GLM and LMM, P=1.0 and P=.916) on the assessment of fossa depth. Moreover, the panel was also reliable, as confirmed by the second reading of dental casts 2 weeks later (agreement; r=0.95, P<.001).

Furthermore, the panelists did not seem to have any difficulty in sorting the dental casts. The Q-sort method,[15,21] although subjective, is commonly used among orthodontists, epidemiologists,[18-20] physicians,[17,26] and psychologists.[15,21] A short training session (2 minutes) in how to use the method enabled them to progressively assess the deep and shallow fossae depths of the various stone casts.

The stone cast was a replica of the tooth dimension and morphology. All casts were constructed with reliable material, and the impressions were poured immediately to minimize distortion. The Michigan Laser Digitizer, as shown in other studies, is reliable in assessing tooth morphology in 3 dimensions.[22,23] The senior investigator selected the 2 cusps that were to be measured by the laser digitizer. To eliminate potential selection bias, 2 other investigators repeated the same exercise and agreed with the points selected by the senior investigator.

Although tooth morphology is a prime consideration for tooth selection, it is clear that fissure morphology as well as other factors are important in deciding which teeth should be sealed.[27] Risk-based sealant treatment, for example, is advocated by a number of expert clinicians.[9,28,29] Nevertheless, the present study agrees with others that most pediatric dentists (70%) assess fossae depth by the angles of the cusps' slopes and less so by an overview of the tooth's morphology.[12,30] This study, therefore, argues that visual examination by pediatric dental specialists provides an estimate of fossae depth upon which a decision to employ sealants can be based.

The present sample of 48 study casts, although representative of the pediatric population with intact molars, would be unwieldy if larger: the scores' validity (i.e., the ability to

predict the criterion) presumably has good correlation with samples of varied sizes.[18-21] Also, the Q-sort method is a well-accepted technique for assigning numerical scores to subjective judgments. For example, it is used as a gold standard method in many orthodontic studies of treatment need, treatment outcome, and overall improvement.[19,31-34]

Given the results of this *in vitro* study, a possible next step would be an *in vivo* investigation using not only pediatric dentists but also panels of allied health professionals, including school nurses and hygienists. An *in vivo* validation might permit auxiliary dental personal to become key providers in statewide sealant programs.

Conclusions

Based on this study's results, the following conclusions can be made:

1. Visual assessment of fossa depth (shallow, moderate, and deep) by a panel of pediatric dentists demonstrated moderately good correlation with the actual values.
2. Given the assumption that only molars with deep fossae should be sealed, the present *in vitro* study argues that pediatric dentists can judge fossa depth well enough by eye to determine which teeth should be sealed.

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Abstract of the Scientific Literature

Toddler Eating Problems

The aim of this study was to evaluate the range of eating behaviors seen in toddlers, the child feeding behaviors of their parents, the prevalence of parentally perceived eating problems, and how these relate to the child's behavior, food preferences and growth. Four hundred fifty-five parent-child dyads were longitudinally evaluated at 6 weeks, 4, 8, 12 and 30 months by questionnaires. Specific areas evaluated were eating problems, eating and feeding behaviors, preferences of foods and food types, and drinking patterns. Eighty-nine (20%) of all parents surveyed perceived that their child had eating problems that ranged from 'poor eater' and 'faddy eater' to both. Fifty-eight (13%) had sought professional help from a public health nurse for the perceived eating disorder. Four hundred thirty-eight (97%) had sweet drinks at least once a day. It was noted that the extent to which milk displaced food in child preference and intake was statistically significant (p<.001). Children perceived by parents to have an eating problem were significantly lighter and shorter. No significant relationship was noted with socioeconomic or educational variables.

Comments: *This report underscores that there is a subset of children whose parents believe that they have eating irregularities, with parents more likely to remove food as punishment for picky eating behaviors. This study, however, did not correlate parental perception of eating problems with a clinical diagnosis.* ***ST***

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Wright CM, Parkinson KN, Shipton D, Drewett RF. How do toddler eating problems relate to their eating behavior, food preferences, and growth? Pediatrics 2007;120:e1069-75.

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