THE EFFECT OF FISSURE MORPHOLOGY ON CARIES SEVERITY OF ADULTS IN NORTH IRAQ [+]

تاثير شكل الشقوق الطاحنه على شدة النخر عند البالغين في شمال العراق

Faraed D. Salman [*]

Abstract:

Background: The presence of pits and fissures are normal occurrence found in molars, premolars. They can be considered as areas with high susceptibility to caries lesion.

Materials and Methods: The extracted premolars were 655 for orthodontic purposes. Ekstrand clinical severity index (1995) was used to assess the severity of primary fissure occlusal caries. They were divided into 5 subgroups on the basis of fissure morphology (I, V, U, IK and Y types)(Nagano,1961). Thereafter, the teeth were sectioned into buccolingual direction in central fossa and microscopically analyzed by stereomicroscope (150× magnification).

Aim of study: The study was designed to examine the effect of fissure morphology on primary caries of occlusal fissures in premolars in North of Iraq.

Results : V– and IK– shaped fissures were found to have the maximum percentage (48% and 22.44%, respectively). Percentage was very poor for I (18.77%), Y (18.01%) and U (17.09%) types of fissure

Conclusions: V– and U– shapes have less severity of dental caries in comparison with I–, Y– and IK– types with increasing severity index scores.

Key words: Macro morphology, clinical severity index, primary fissure caries.

المستخلص:

ان وجود الوهاد والشقوق هو تكوين طبيعي في الطواحن والضواحك ،فهي تعتبر مناطق عالية لحدوث النخر.صممت هذه الدراسة لفحص تاثير شكل الشقوق الطاحنة على النخر الابتدائي في هذه الشقوق للضواحك في شمال العراق .تم استخدام مؤشرEkstrand(١٩٩٥) لقياس شدة النخرعلى السطوح الطاحنة. تم قلع (٦٥٥) ضاحك مستخدمة لغرض التقويم ،قسمت الاسنان الى خمس مجاميع حسب شكل الشقوق لمؤشر Nagano(1961). قطعت الاسنان في مركز الوحدة الدهليزية اللسانية ثم فحصت بالستيروميكروسكوب قوة تكبيره ١٥٠ مرة .اظهرت النتائج ان نوع الشقوق (V&IK) كان اعلى نسبة(٢٢,٤٤%&٤٨ %) على التوالي متبوعا ب (I) (١٨,٧٧%)، ((Y) ١٨,٠١) ثم (U) (١٧,٠٩%). ظهران الاشكال (U&V) تمتلك اقل شدة للنخر مقارنة ب (IK,I,Y) مع زيادة درجات شدة النخر مع عدم وجود فروقات معنوية لكلا الجنسين حسب توزيع اشكال الاخاديد المختلفة.

[+]**Received on 5/12/2010 , Accepted 30/1/2011 .**

[*]**Assistant Professor. Technical medical institute.**

Introduction:

Occlusal fissures are deep invaginations of enamel. Data on the decline of caries prevalence among young adults in most industrialized countries show a relative increase in the proportion of caries on the occlusal surfaces of posterior teeth [1]. The occlusal surfaces of permanent molars are designed more frequently than the proximal surfaces, 90% of all lesions in the first permanent molars have been found to be pit and fissure caries [2-8]. Majority of studies emphasized that the majority of pit and fissure caries occur within the first 4 years following eruption .They may continue through out adolescence (0.8% for premolars) 1-12 years after eruption [8]. Fissure caries is partly attributed to the extremely plaque retentive morphology of the fissure systems [9-11] .They can be classified according to the anatomical form into 5 types (V, U, I, IK, and Y types)[12] .The aims of modern dentistry should be preventive approach rather than invasive repair of the caries disease. On the basis of caries disease, lesion detection and early intervention, the primary goals of modern clinical management of caries are to inhibit the initiation of new lesions, to arrest the progression of established lesions and to enhance the natural process of lesion repair by remineralization [13].

The ideal diagnostic method should be safe for both patients and users, enabling lesion detection at an early stage. Also, it should be objective and quantitative, non invasive and cost–effective [14].

Aims of study:

1. To study the occurrence pattern of different types of occlusal fissure morphology involving central groove (but not including mesial and distal pits) in adult upper 1st premolars, patients age was 12-15 years old .
2. To compare between 5 shapes of fissure morphology in descending order according to the shape of the fissure in 4 different Governorates.
3. To correlate macroscopic scoring (clinical severity index) and histological extent into the dentin.i.e caries severity detected clinically and shape of fissure detected microscopically.
4. To find distribution pattern of fissure morphology according to gender in North of Iraq.

Materials and methods:

During the 40–months study period in college of dentistry in Mosul University (2006-2009), 655 randomly selected subjects attending Health Centers and Faculty of Dentistry of four NorthGovernorates,140Duhok(Azhadi,Zhanst,Khabat,Bahdinan,KazyMohamad,Matin,Shahidan,Sarhaldan,Malta,Shndokha,Barzan,Duhok),105Sulaimaniya(Sarchnar,KanyKurda,Peramerd,Rzgare,Bakhtya,Hamdy,Zhargata, Toy Malika,Kareza Wshka,Ali Kamal,Ibrahim Basha,Chwar Bagh), 250 Mosul(left &right side specialized health centers) and 160 Erbil (Shahidan, Zhyan, Azhadi,Malla Affandy,Kurdistan,Sultan Muthafar, Mamoon Dabagh,Nafae Akray,Layla Kasim, Mohamad Bajalan,Nazdar Bamarny). Each of which was due to have one premolar on average extraction for orthodontic reasons i.e we select one tooth only from each patient even if he has more than one tooth indicated for extraction..

Clinical criteria used to detect primary fissure carious lesions:

1. Premolars showed varying grades of dark discoloration in the depth of their fissures upon macroscopic examination by naked eye and prob.

2. Crack free premolars without any morphological defect other than caries.
3. Only teeth with a lesion were chosen, caries free teeth were excluded from the beginning of the examination fundamentally.

Diagnosis of pit and fissure caries:

This type of diagnosis based on tactile evaluation with an explorer and visual assessment of the enamel appearance of all pits and fissures on the occlusal surface of the tooth using a mouth mirror and adequate lighting (in vivo) [15]. This clinical examination was done by authors themselves traveling to other three governorates, examining 30-50 patients at each visit. Dentist friend helped authors by extraction, storage of teeth and transferring sample. Not all teeth samples collected at one time but at intervals according to the number of teeth collected. Ekstrand criteria of clinical severity index [15] for primary occlusal fissure carious lesions were used to confirm the suitability of the lesions for the study, unsuitable teeth were excluded from the examination like enamel hypoplasia as shown in Table (1).

Table (1): Clinical severity index for pofcl [15].

Score	Surface Description
0	Normal enamel translucency maintained after 5s of air drying
1	An opacity becomes visible after 5s air drying
2	An enamel opacity is visible without air drying
3	An enamel opacity is visible without air drying + localized surface destruction
4	Discoloration with or without localized surface destruction
5	Surface breakdown in opaque enamel
6	Surface breakdown in discolored opaque enamel
7	Enamel cavity reaching into dentin

Sample preparation:

After extraction, the teeth were cleaned with pumice and scaled by subgingival scaler to remove any debris on the surfaces of the teeth .

All the teeth specimens at each collection were embedded in block of cold cure acrylic and subjected to buccolingual sectioning by sectioning machine (trimmer). Bias in sectioning teeth were discarded those sectioned teeth and use only the teeth sectioned in right manner.

Microscopic examination of teeth:

Teeth were microscopically examined, using one section only of each tooth. (Stereomicroscope at College of Agriculture, University of Duhok) and sorted according to Nagano classification of fissure morphology [12] as shown in figure (1).

I Type	V type	U type	IK Type	Y Type

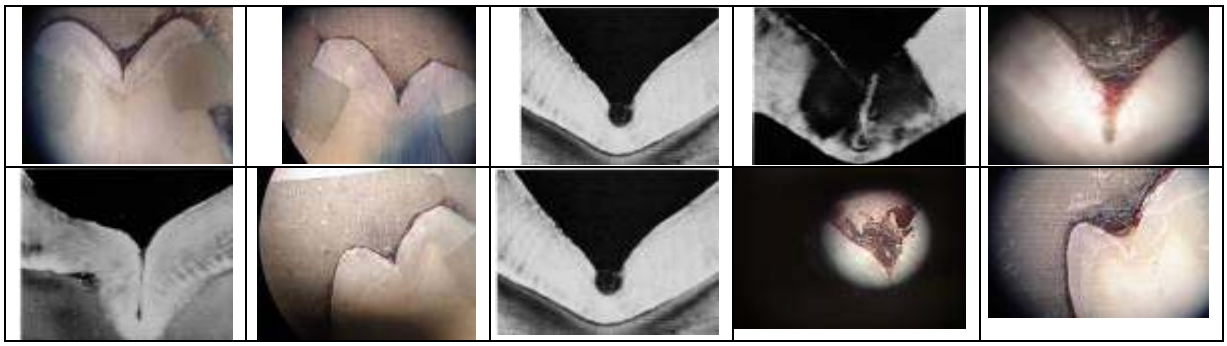

Figure (1): Different types of fissure morphology

Data collection and statistical analysis:

The specimens were grouped according to the different types of pits and fissures morphology. Duplicate examinations were made with an interval of 3 months of 50 randomly selected sections between dentist and prophesier in college of Agricultural (inter examiner variability) , in order to estimate the reproducibility of the sorting . The consistency of classifications of individual sections was 92% for fissure morphology and 85% for clinical severity index. Number and percentage were used to describe the results obtained. Fischer Freeman Halton test was used to find the relationships between parameters.

The difference in mean severity according to fissure morphology was found using Duncan's Multiple Range test and chi-square test. The results considered significant at $p \leq 0.05$.

Results:

This is the first study that concentrates on the correlation of histological section of teeth and clinical examination of pofcl in the Northern Governorates.

The percentage distribution of fissure types according to different Governorates as shown in table (2) revealed that V shape is the most prevalent one in Duhok, Mosul, Erbil, followed by IK type except for Sulaimaniya which revealed I type most prevalent followed by Y type. The same percentage distribution was shown for the total sample.

Table (2): Distribution of fissure types according to different Governorates

Governorate	Shape of the Fissure/ pits											
	V		U		Y		I		IK		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Duhok	45	32.14	17	12.14	23	16.42	18	12.90	37	26.42	140	21.37
Sulaimaniya	30	20.57	15	14.28	35	23.33	25	26.80	20	15.04	105	16.03
Mosul	60	24.0	55	22.0	30	12.0	50	20.0	55	22.0	250	38.16
Erbil	45	26.12	25	15.62	30	18.75	30	18.75	35	20.87	160	24.42
Total	180	48	112	17.09	118	18.01	123	18.77	147	22.44	655	99.98

Statistically, its not practical to analyze each caries severity score (0-7) separately in single group because the number of each group will be decreased and the statistical result will be weakened so it was gathered (1-2,3-5,6-7) [16].

Concerning the relationship between fissure morphology and caries severity, significant relationship exists at $p \leq 0.001$ for all.

Figures (2–5) showed mean severity of caries index according to fissure morphology for 4 Governorates revealed that the lowest values were recorded with those of V and U types while Y, I and IK types recorded higher values of severity with significant difference at $p \leq 0.05$.

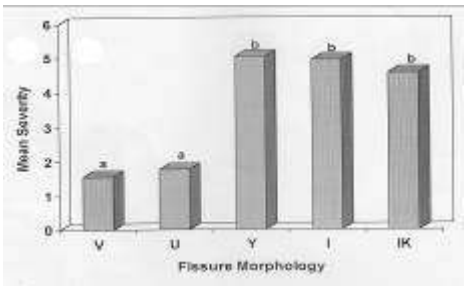

Figure (2): Mean severity according to fissure morphology in the sample of Duhok City

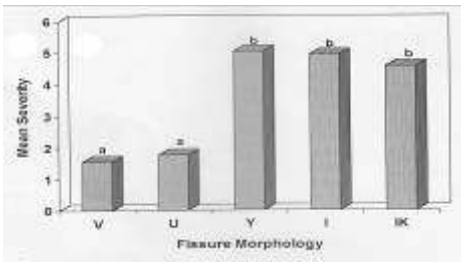

Figure (3): Mean severity according to fissure morphology in the sample of Sulaimaniya City

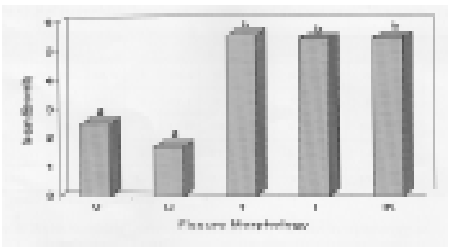

Figure (4): Mean severity according to fissure morphology in the sample of Mosul City

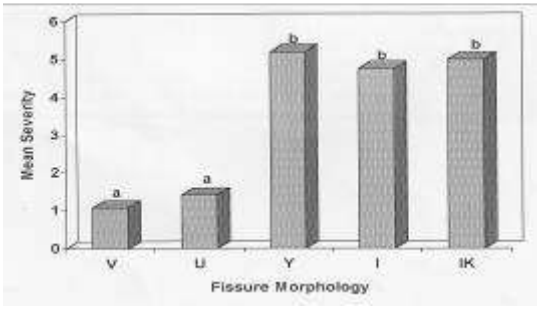

Figure (5): Mean severity according to fissure morphology in the sample of Erbil City

* Different letter on the bars mean significantly difference at $p \leq 0.05$.

For the total sample there was significant difference at $p \leq 0.001$ between fissure morphology and degree of severity as it is shown in Table (3).

Table (3): Relationships between severity and fissure morphology in the total sample.

Severity	Shape of the Fissure										*p*–value*
	V		U		Y		I		IK		
	No.	%	No.	%	No.	%	No.	%	No.	%	
0	63	35.0	32	28.6	0	0.0	0	0.0	0	0.0	< 0.001
1–2	68	37.8	52	46.4	8	6.8	13	10.6	14	9.5	
3–5	35	19.4	27	24.1	54	45.8	50	40.7	65	44.2	
6–7	14	7.8	1	0.9	56	47.5	60	48.8	68	46.3	
Total	180	100	112	100	118	100	123	100	147	100	

*chi- square test.

Distribution of fissure morphology according to gender in the four Governorates revealed no significant difference in the type of fissure morphology between males and females as shown in Tables (4-5).

Table (4): Distribution of fissure morphology according to sex in Duhok &Sulaimaniya city

Fissure types	Sex (Duhok)					Sex (Sulimaniya)				
	Males NO.	%	Females NO.	%	*P-value	Males NO	%	Females NO.	%	*P-value
V	20	31.7	25	32.5	0.596 (NS)	17	25.4	13	22.4	0.732 (NS)
U	9	14.3	8	10.4		7	10.4	8	13.8	
Y	11	17.5	12	15.6		16	23.9	19	32.8	
I	10	15.9	8	10.4		15	22.4	10	17.2	
IK	13	20.6	24	31.2		12	17.9	8	13.8	
Total	63	100	77	100		67	100	58	100	

Table (5): Distribution of fissure morphology according to sex in Mosul &Erbil city

Fissure types	Sex (Mosul)					Sex (Erbil)				
	Males NO.	%	Females NO.	%	*P-value	Males NO	%	Females NO.	%	*P-value
V	29	22.3	31	25.8	0.286 (NS)	21	24.7	24	30	0.515 (NS)
U	34	26.2	21	17.5		14	16.5	11	13.8	
Y	13	10	17	14.2		13	15.3	17	21.3	
I	29	22.3	21	17.5		15	17.6	15	18.8	
IK	25	19.2	30	25		22	25.9	13	16.3	
Total	130	100	120	100		85	100	80	100	

*NS= Not significant according to Chi- square test

Discussion:

Its well known that anatomy is genetic factor, there could be correlation between race factor and anatomical variation so further study is require to study race effect for other areas. Difficulties were present in gathering samples, references, linking between new variables in addition to the technical difficulties concerning the environment of work available and limitation of tools for this research. On the basis of our knowledge, this is the first wide study linking stereomicroscopic examination of teeth sections with the extensions of early lesions, in which a primary fissure carious lesion the caries confined to the fissures and grooves of the occlusal surfaces of teeth and is steadily mounting as the most prevalent primary lesion in children and adults [17].Most studies were done on distribution of fissure anatomy of molar teeth, no study had been found on distribution of fissure anatomy in premolars so we compare our results with that of molars.

As for the percentage distribution pattern of fissure morphology, the result of this study is in accordance with the findings of Nagano [12] and Gustafson [18]. But for the descending order of fissure types, Y–type occupies a higher percentage (18.01%) than that of Nagano classification (7%) which occupies the least percentage. In this study, U–type occupies the final order percentage (17.09%) with the same numerical result nearly. The reason for this increased susceptibility is the presence of pits and fissures in these surfaces [19,20]. Also, the unique occlusal pit and fissure caries distribution and progression could be explained by the particular plaque accumulation in relation to the tooth morphology [21].

For V–type which is almost shallow in most cases, caries starts from the bottom[18], this could be attributed to the shallow portions of grooves formed by walls joining under a wide angle of approximately 90–70° showed low susceptibility to decay with increasing index scores [18].

For U–type, caries starts half way down, its form is almost the same width from top to bottom, it is of medium depth, occupies the lowest percentage may be attributed to grooves

formed by angles smaller than about 70°. Initial decalcifications of enamel were rather common and usually started at the deepest point of the sulks since human teeth show a great variety of morphologic types [22].

For IK–type it occupies (22.44%); its form is extremely narrow slit associated with a large space at the bottom. As to the localization of the initial lesion in narrow fissures, a plug of plaque like material was occasionally observed closing the entrance of the fissure proper within which the production of considerable amount of acid might take place, whereas diffusion of substrate down the narrow fissure might be slow, resulting in the formation of less acid in the depth of the fissure than at its entrance so the deep narrow fissure may resist carious attack. This may lead to decrease caries severity scores [23].

For I–type (18.77%), it starts from the top, a deep fissure too narrow to allow impaction or diffusion of considerable amounts of substrate seems to be less liable to carious attack than one providing some space for plaque and debris to accumulate. This will lead to decrease severity of caries with increasing scores because pit and fissure caries represent a disease process that has an early onset [24]. The findings of fissure morphology are in accordance with those of other investigators derived from studies of single examinations of a great number of teeth [25-27].

The findings of this study are in accordance with that of Flaitz *et al*. [28] who stated that in laboratory studies comparing the clinical, and histological appearance of occlusal caries correlate well with the extent of histological involvement of occlusal surfaces by caries. Also it is in accordance with the study of Ekstrand who stated that there was a correlation between pock and morphology of fissures in 3rd molars [15,29]. Then stated that the total length of time since eruption (over one year) was found to be significantly associated with caries severity. The long time needed for full occlusion to occur, if ever, was correlated with deeper dentinal lesion [30].

Based on teeth sections, it was possible to observe that major sites for caries development are the fissures, what is supported by [10,12,25,31]So by using stereomicroscopic examination, it was found that there was significant relation between the initial stages of surface breakdown grade(1-3) which is crucial in accordance with that of Ekstrand [15].

The clinical implication of this observation was important that the extent of lesion could be detected by careful vision of the surface, narrow grooves would have most of the lesion at the entrance while wide grooves were wide enough for the base to be seen which could be controlled by brushing [15,30].

Another important factor to be influenced by the presence or absence of fissure caries relates to the methods of diagnosis of carious lesion. The high prevalence of caries in occlusal fissures and the less effectiveness of diagnostic methods in this area [32,33] posed an enormous problem to be solved. There is a need for additional research to improve the effectiveness of diagnostic methods in pits and fissures.

Conclusions:

Fissures such a V and U types are influenced directly by less severe caries lesion, in contrast to deep narrow fissures (IK, I and Y) influenced by moderate to severe carious lesion. So early diagnosis of dental caries and preventive measures are recommended to reduce caries rate in our population.

Suggestions:

1. This study can be extended to measure race factor.
2. This study can be extended to measure a maximum of truly sound surface (high specify) in clinical trials.
3. while in epidemiological studies, the detection is of truly affected surface (high sensitivity)

1. References:

1) Bratthall D, Hansel–Petersson G, Sundberg H. *Reasons for the caries decline: What do the experts believe?* Eur J Oral Sci. 104: 416-422, 1996.
2) Thomas MF, Ricketts DN, Wilson RF. *Occlusal caries diagnosis in molar teeth from bitewing and panoramic radiographs.* Primary Dent Care . 8: 63-69, 2001.
3) Greenwall AL, Johnsen D, Disantis TA, et al. *Longitudinal evaluation of caries patterns from the primary to the mixed dentition.* Pediatr Dent . 12: 278-282, 1990.
4) Geiger SB, Gulayev S, Weiss EI. *Improving fissure sealant quality: Mechanical preparation and filling level*. J Dent . 28: 407-412, 2000.
5) Hicks J, Garcia Godoy F, Donly K, et al. *Fluoride releasing restorative materials and secondary caries.* Dent Clin North Am . 46: 247-276, 2002.
6) Hatibovic–Kofman S, Butler SA, Sadek H. *Microleakage of three sealants following conventional, bur, and air–abrasion preparation of pits and fissures*. Int J Pediatr Dent . 11: 409-416, 2001.
7) Kidd EA. *Diagnostics a cornerstone of minimally invasive dentistry*. Pan Eur Festival Oral Sci . 2002.
8) Schulte A, Gente M, Pieper K. *Postoperative changes of electrical values in fissure enamel of premolars.* Caries Res . 33: 242-247, 1999.
9) Bossert WA. *The relation between the shape of the occlusal surfaces of molars and the prevalence of decay*. J Dent Res . 13: 125-128, 1933.
10) König KG. *Findings in serially sectioned teeth showing early fissure lesions*. Adv Fluor Res . 4: 73-79, 1966.
11) Juttl M. *Localization of carious lesions in occlusal pits and fissures of human premolars*. Scand J Dent Res . 91: 251-255, 1983b.
12) Nagano T. *Relation between the form of pit and fissure and the primary lesion of caries*. Dent Abstr. 6: 426, 1961.
13) Featherstone JD. The *caries balance: The basis for caries management by risk assessment*. Oral Health Prev Dent. 2(suppl 1): 259-264, 2004.
14) Heinrich–Weltzein R, Weerheijm KL, Kuhnisch J, Oehme T, Stosser L. *Clinical evaluation of visual, radiographic and laser fluorescence methods for detection of occlusal caries*. ASDC J Dent Child. 69(2): 127-132, 2002.
15) Ekstrand KR, *et al*. Relationship *between external and histologic features of progressive stages of caries in the occlusal fossa*. Caries Res . 29: 243-250, 1995.
١٦) القـــرشي احسان،كـــــاظم ،شريف *الطرائق المعلمية والطرائق اللامعلمية فـــــــي الاختبارات الاحصائية بمفـــــاهيم اساسية واختبارات الصدق والثبات*. ٩ : ١٢٠-١٢٨ ، ٢٠٠٧ .
17)Ten Cate JM. *What dental diseases are we facing in the new millennium: Some aspects of the research agenda.* Caries Res. 35(suppl 1): 2-5, 2001.
18)Gustafson G. *The histopathology of caries of human dental enamel with special reference of the division of the carious lesion into zones*. Acta Odontol Scand . 15: 13-55, 1957.
19) Bader JD, Shugars DA, Bonito AJ. *Systematic reviews of selected dental caries diagnostic and management methods*. J Dent Educ. 65: 960-968, 2001.

20) Nyvad B. *Microbial colonization of human tooth surfaces*. APMIS . 32(suppl 1): 1-45, 1993.
21) Carvalho JC, Thylstrup A, Ekstrand KR. *Results after 3 years of non–operative occlusal caries treatment of erupting permanent first molars.* Community Dent Oral Epidemiol. 20: 187-192, 1992.
22) Ekstrand KR, Ricketts DN, Kidd EA. Occlusal *caries: Pathology, diagnosis and logical management*. Dent update. 28: 380-387, 2001.
23) Ekstrand KR, Ricketts DN, Kidd EA. *Do occlusal carious lesions spread laterally at the enamel–dentin junction?* Clin Oral Invest. 2: 15-20, 1998.
24) Lussi A. *Comparison of different methods for the diagnosis of fissure caries without cavitation. Caries* Res. 27: 409-416, 1993.
25) Anderson M. *Risk assessment and epidemiology of dental caries:* Review of the literature. Pediatr Dent. 24: 377-385, 2002.
26) Jovanovski V, Lynch E. *Analysis of the morphology of oral structures from 3–D coordinate data*. Monogr Oral Sci . 17: 73-129, 2000.
27) Poorterman JH, Weerheijm KL, Groen HJ, et al. *Clinical and radiographic judgment of occlusal caries in adolescents*. Eur J Oral Sci . 108: 93-98, 2000.
28) Flaitz CM, Hicks MJ. *Radiographic, histologic and electronic comparison of occlusal caries: An in vitro study*. Pediatr dent. 8: 24-28, 1986.
29) Ekstrand KR, *et al*. *Morphometric analysis of occlusal groove–fossa system in mandibular third molar.* Scand J Dent Res. 99: 196-20, 1991.
30) Ekstrand KR, Bjørndal L. *Structural analysis of plaque and caries in relation to the morphology of the groove–fossa system on erupting mandibular third molars.* Caries Res. 31: 336-348, 1997a.
31) König KG. *Dental morphology in relation to caries resistance with special reference to fissures as susceptible areas*. J Dent Res. 42: 461-476, 1963.
32) Lussi A. *Validity of diagnostic and treatment decisions of fissure caries.* Caries Res. 25: 296-303, 1991.
33) El–Housseiny AA, Jamjoum H. *Evaluation of visual explorer and a laser device for detection of early occlusal caries.* J Clin Pediatr Dent. 26(1): 41-48, 2001.