Original Article

Comparative Evaluation of Caries Status in Primary and Permanent Molars in 7–8-year-old Schoolchildren of Shimla Using Caries Assessment Spectrum and Treatment Index

Divya Doneria, Seema Thakur, Parul Singhal, Deepak Chauhan, Cheranjeevi Jayam, Anika Uppal

Department of Pedodontics, H. P. Government Dental College, Shimla, Himachal Pradesh, India

Abstract

Background: A new epidemiological index is introduced for full assessment of dental caries which is known as caries assessment spectrum and treatment (CAST). "Spectrum" is considered backbone of this index as it covers from no lesion to advanced stage progression of caries. We aimed to evaluate and compare the status of caries in primary and permanent molars of 7–8-year-old schoolchildren of Shimla using CAST index and to find if any correlation exists between the status of caries in evaluated teeth. **Methods:** Three hundred and one schoolchildren with age group of 7–8 years were selected from schools in Shimla. CAST codes were determined for primary molars and first permanent molars. The distribution of CAST codes in the examined molars is correlated with the help of Spearman's rank correlation coefficient. The level of statistical significance was established at $P < 0.05$. The intraexaminer reliability was determined by the unweighted kappa coefficient. **Results:** Caries was assessed in 6.3%–12.3% of the permanent molars in contrast to primary molars, in which caries was near about 50%. The correlation was stronger for first and second deciduous molars for the right side of the mouth than the left side ($r = 0.293$ and 0.257 in the maxilla and 0.503 and 0.319 in the mandible [$P < 0.001$], respectively, while correlation for teeth in opposite jaws was moderate [$r = 0.20$–0.47]). The intraexaminer reliability was examined ($k = 0.90$ for the primary and 0.85 for permanent molars). **Conclusion:** The correlation between primary and permanent molars regarding the caries status in primary molars is weak while strongest correlation was present on the right side of the mouth for first and second deciduous molars. The study also showed the applicability of the CAST index in epidemiological surveys.

Keywords: *Caries status, caries assessment spectrum and treatment index, children*

Introduction

Dental caries is considered as a common health problem worldwide, so it requires the attention of researchers for newer approaches for its diagnosis, prevention, and treatment.[1] Marked global rise in the dental caries was reported in various countries over last two decades.[2] Hence, a continuous eye over epidemiological status of caries is required. Earlier, the decayed, missed, and filled teeth (DMFT) index was recommended for assessing caries status of a population. However, this index does not demonstrate the severity of decay, so the system known as the International Caries Detection and Assessment System (ICDAS) classification was developed. It classified the progressive stages of caries histologically extending into the tooth tissues. Yet, this classification is an evidence-based and conservative approach, but it does not assess the conditions such as application of sealants and restorations present within the tooth. Similarly, it does not assess caries progression in advanced condition which involves pulp and tooth loss.[3,4] As this system examines for early clinical visible sign of the caries, so ICDAS II has lesser discrimination power in epidemiological surveys because chances for the overestimation of dental caries experience are there.[5] This system also requires dry tooth surfaces and double checking of tooth which makes surveys more time consuming and costly.

For severe caries stages, the PUFA index covers severe decay in teeth with visible pulpal involvement, fistula, ulceration, and abscess.[6] For epidemiological surveys, there is necessity for a simpler index which should have full process of caries. Frencken introduced the caries assessment spectrum

Address for correspondence:
Dr. Divya Doneria, Room No. 301, Department of Pedodontics, H. P. Government Dental College, Shimla, Himachal Pradesh, India. E-mail: dr.divyadoneriya86@gmail.com

Access this article online

Website: www.contempclindent.org

DOI: 10.4103/ccd.ccd_886_16

Quick Response Code:

How to cite this article: Doneria D, Thakur S, Singhal P, Chauhan D, Jayam C, Uppal A. Comparative evaluation of caries status in primary and permanent molars in 7–8-year-old schoolchildren of shimla using caries assessment spectrum and treatment index. Contemp Clin Dent 2017;8:128-33.

and treatment (CAST) index which assesses dental caries progression, absence of caries, caries protection by sealant and treatment by restoration for carious lesions in enamel and dentine, and pulpal involvement with or without abscess. CAST codes have been developed in such a way that increase in codes corresponds with progress in the consequences of the dental caries process. It also records a restored tooth as sound and functioning tooth.[4]

Components of the ICDAS II and PUFA indices are assembled in CAST index. DMF score can be obtained from the CAST score, thus retains the use of DMF scores. The CAST index has been assessed for the face, content validity, and its reproducibility.

Methods

The study aimed to assess the caries status of molars in children of Shimla city. It is a cross-sectional study carried out in Shimla city, Himachal Pradesh, in May–June 2015 after getting the ethical clearance from the Institutional Ethical Committee. For this, schools from four administrative zones of the city, i.e., Shimla municipal, Dhalli, Tutu, and New Shimla city were randomly selected. Using CAST index, the data regarding the caries level of primary and permanent molars in 7–8-year-old children were obtained. Consent from parents or care providers was obtained. A total of 419 children of this age group were examined. Inclusion criteria were that all four permanent molars should be erupted fully. Whereas if any of the premolars erupted, then the participant is excluded as it is difficult to determine that its primary antecedaneous tooth was lost due to normal exfoliation or extraction because of caries. Hence, 118 participants were excluded from the study, and 301 children undergone the final examination. The minimum sample size was determined to be 245 participants.

Dental examination

The dental examination was done by examiner after a training session. This training session comprised the theoretical and practical components. The study of the literature provided by the authors of the CAST index comprised the theoretical part, whereas the practical part includes dental examination of ten children each day in two sessions. Evaluation of teeth was done according to the CAST codes shown in Table 1 which covers the full extent of caries stages, i.e. from a sound surface to pulpal and periapical inflammation and tooth loss due to caries. The codes are arranged in hierarchical order. During examination, an artificial light (torch) was used in school rooms. Brushing was done by all children before the examination. Each tooth surface was examined with a dental mirror and CPI probe (a periodontal probe ending with a 0.5-mm ball) which removed dental plaque or debris if present even after brushing.

A form was developed for this study shown in Figure 1, in which the score of each tooth's surface was recorded. If same surface was having two conditions, the higher score was recorded, for example, a filling in one pit and an enamel lesion in another is present, then score for enamel lesion was given. Then, for further analysis, the highest code for each tooth was taken. For the intraexaminer reliability, about 5% of the evaluated population was reexamined.

Statistical analysis

The prevalence of each CAST codes in first and second primary and first permanent molars was evaluated. The correlation of the distribution of CAST codes between adjacent first and second primary molars, second primary and first permanent molars, the contralateral molar teeth from each side of the dental arch, and the molars located in the opposite arches was evaluated by the Spearman's rank correlation coefficient. The intraexaminer reliability was calculated by the unweighted kappa coefficient.

Results

For the intraexaminer reliability, the unweighted kappa value was 0.90 for the primary molars and 0.845 for permanent ones which showed substantial level of agreement. Figure 2 shows the percentage of study sample distributed according to the CAST code for primary and permanent dentition separately. In deciduous teeth, pulpal involvement (code 6) or serious morbidity was present in approximately one-fifth of the participants. In another one-fifth of participants, a dentine cavitation (code 5) was present. Enamel lesion or discolored dentin (codes 3–4) was present in quarter of the participants. In 9% of participants, right lower primary molars were lost due to caries (code 8). For permanent teeth, no change, fissure sealants, or restored teeth (89.2%) were most prevalent. Caries was observed in 6.3% of upper molars and 12.3% of lower molars in initial stage. No tooth scored the category 8 and 9 in permanent teeth.

Table 2 depicts the distribution of CAST codes in the examined molars. Figure 2 shows the distribution of molar teeth according to CAST codes. Codes 0–2 denote healthy tooth, code 3 shows teeth with reversible premorbidity, codes 4 and 5 show teeth with morbidity, codes 6 and 7 show serious morbidity, and code 8 shows mortality in teeth, respectively. In permanent molars, caries was observed in 6.3%–12.3%, but most teeth had codes 3 and 4 which demonstrate the noncavitation level. Only half of examined primary molars were healthy with codes 0–2, and in about 15%–23% of primary teeth, initial enamel lesion was recorded. Mostly extension of caries in dentine was observed for both first and second primary molars. First primary molars were presented with serious morbidity followed by second primary molars.

Table 3 shows the results of the Spearman's correlation test where the *P* values are given. A strong correlation exists between caries stages in primary second and permanent

Table 1: Caries Assessment Spectrum and Treatment codes and descriptions in an hierarchical order

Characteristic	Code	Description	Example
Sound	0	No visible evidence of distinct caries lesion	
Sealant	1	Pits and fissures are at least partially covered with sealants material	
Restoration	2	Cavity is restoredwith an (in) direct restorative material	
Enamel	3	Distinct change in enamel only. A clear caries related discoloration is visible, with or without localised enamel breakdown	
Dentin	4	Internal caries relatedin dentine. The discoloured dentin is visible through enamel which may or may not exhibit a visible localised enamel breakdown	
	5	Distinct cavitation in dentin. The Pulpchamber isintact	
Pulp	6	Pulp involvement ordistinct cavitation reaching the pulp chamber or only root fragmentsarepresent	
Abscess/Fistula	7	A pus containing swelling or a pus releasing sinus tract related to a tooth with pulpal involvement	
Lost	8	The tooth has been removed due to dental caries	

first molars in the right and left sides of the dental arch. For permanent molars, the rank correlation coefficient (r) from left to right side was 0.378 for the maxilla and 0.570 for the mandible. While in primary molars, for left to right side, the correlation was strong with value >0.50. For first and second primary teeth, stronger correlation was for the right side than for the left side of the oral cavity with *r* was 0.293 and 0.257 in the upper arch and 0.503 and 0.319

in the lower arch, respectively. For the adjacent primary and permanent molars, a weak correlation was observed with *r* values <0.3. When teeth situated in opposite jaws were observed, the correlations were ranged from weak to moderate with *r* between 0.20 and 0.47.

Discussion

For epidemiological studies, a caries index is required which should consist of all caries stages. Among all indices, the CAST index comprises complete assessment of caries progression levels in a simple hierarchical manner and a new approach for restored teeth to be considered as sound teeth. CAST index is considered a better index than DMF for epidemiological studies because it provides more detailed information on caries prevalence. When compared to ICDAS, its use is less costly and time consuming. In this regard, further more studies are required. This study shows good intraexaminer reliability for primary and permanent dentition which supports CAST as an epidemiological tool for surveys. The lower kappa value obtained with the examined teeth is similar with those of Baginska *et al*. and de Souza *et al*.[7,8]

Our study reported a high prevalence of caries in deciduous molars in Shimla city which is in agreement with previously reported data by Bhardwaj *et al*. They included 5-year-old schoolchildren of Shimla city in their study.[9] In another survey at Kangra district of Himachal Pradesh, in which oral health status of children in the age group of 5–12 years was assessed. In the age group of 5–8 years, they reported 56.8% of caries prevalence which is slight more than our study.[10] The reason can be that molars are specifically examined in our study while they examined all teeth present. Age group of 7–8 years was not specifically a part of survey earlier within Shimla city. In our study, the percentage of caries-free primary molars was 51.5%, while for first permanent molars, 89.7% of participants are having these teeth caries free. It was also observed that 14.28% of primary molars were in serious stage of pulpal involvement or presence of root fragments while only 0.6% of permanent molars suffered such morbidity. Such dental negligence has been observed worldwide in context with deciduous dentition.[11-15] A positive correlation was previously reported between DMFT level and PUFA index showing the consequences of severe dental caries.[6,16]

In our study, the correlation of status of molars is emphasized because at the age of 7–8 years, anterior teeth are in the state of exchange. Hence, the exclusion of incisors and canines in this study provided us a homogeneous sample of population. Other authors also followed the same approach.[17,18] It was also observed that the prevalence of cavitated lesions was more in primary molars, especially second molars and lower first molars than in permanent molars which is in accordance with the results of study by Honkala *et al*.[17] They observed that the enamel lesions with ICDAS code 2 were most prevalent on occlusal surfaces of first permanent molars while dentine lesions in Estonian children were prevalent for lower second primary molars. Baginska[7] assessed primary and permanent molars by the CAST index in 7–8-year-old Polish children. He also found more cavitated lesions with respect to primary molars. It can be explained as at the age of 7–8 years, the exposure time for permanent teeth to causative agents of dental caries is very less to induce the development of cavitated dentinal lesions. Moreover, primary teeth are more susceptible for the event of pulpitis due to thin dentine and large pulp chambers.[19] The frequency of dental recalls is determined by the severity of caries through the tooth tissues.[20] In the present study, the percentage of teeth showing serious morbidity and mortality (CAST code 8) was high for second lower

Table 2: Distribution of Caries Assessment Spectrum and Treatment codes in evaluated molar teeth

	0	1	2	3	4	5	6	7	8
16	90.7	0.3	1.3	6.4		1.0	0.3		
26	94.0	0.3	0.3	4.4	0.3		0.7		
36	84.0		2.3	12.3		0.7	0.7		
46	84.0		1.0	12.3	0.3	1.7	0.7		
55	51.0		3.7	22.7	11.3	3.3	7.4	0.3	0.3
65	51.7	0.6	2.3	23.0	7.3	5.0	7.7	1.7	0.7
75	43.0	0.7	7.3	21.0	2.7	7.3	12.0	0.3	5.7
85	42.3		4.3	19.0	8.3	7.0	11.3	0.7	7.0
54	55.0		3.7	16.3	4.7	3.7	15.3		1.3
64	55.3		1.7	15.0	6.0	8.0	13.7		0.3
74	43.3		1.0	21.7	9.7	7.3	13.3		3.7
84	45.0		3.7	23.3	7.7	8.7	10.0		1.7

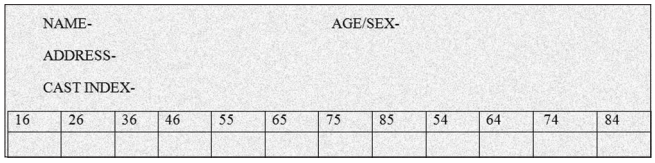

Figure 1: Form in which Caries Assessment Spectrum and Treatment codes are recorded for evaluated molars

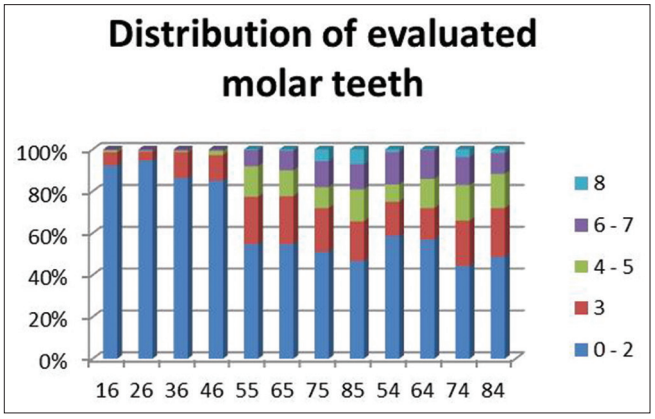

Figure 2: Distribution of molar teeth according to assigned codes of CAST index

Table 3: The correlations of Caries Assessment Spectrum and Treatment codes in evaluated molar teeth (Spearman's correlation coefficient)

	r	*P*
16/26	0.378	0.000
46/36	0.570	0.000
55/65	0.602	0.000
85/75	0.566	0.000
54/64	0.598	0.000
84/74	0.422	0.000
16/55	0.202	0.000
26/65	0.072	0.216
36/75	0.184	0.001
46/85	0.184	0.001
55/54	0.293	0.000
65/64	0.257	0.000
75/74	0.319	0.000
85/84	0.503	0.000
16/46	0.206	0.000
26/36	0.474	0.000
55/85	0.417	0.000
54/84	0.251	0.000
65/75	0.384	0.000
64/74	0.068	0.243

primary molars which is in accordance of many previous studies[14,21,22] but in contrast with the study of Baginska and Stokowska where high percentage of first primary molars was reported for the same.[16]

Findings which reveal the high risk of caries occurrence in the evaluated children population of Shimla city were high prevalence of enamel caries, percentage of sealants <1% in permanent molars, and more cavitated lesions in primary dentition which predisposed permanent dentition for caries. Among permanent molars, 12.3% of lower molars were having enamel lesions (CAST code 3). These precavitated lesions act as inducing factor for further cavitation.[23] Imperative screenings should be done at the age of 6 and for subsequent years so that participants with the highest risk for caries in a population can be detected, and preventive measures can be used.[24] Occlusal surfaces, fissures, and buccal pits of permanent molars are more susceptible for the development of caries.[25] In this population, a very low fraction of teeth with pit and fissure sealants was there which was another factor showing the high risk of caries. Less than 1% of evaluated permanent teeth in children were sealed with sealants which is major difference from the fraction of permanent teeth having enamel (precavitated) lesions. This finding is reflecting strong need of pit and fissure sealants in the evaluated population. Sharma *et al.* also reported that in 5–8 years' age group of children in Nagrota Bagwan of Kangra, Himachal Pradesh, the need of pits and fissure sealants among all treatment needs is highest and near about 50%.[10] For high-risk population, pit and fissure sealants are advised.[26,27] However, advice for pits and fissures sealing, technique used, and the material used as a sealant is clinical decision so varies among clinicians.[28] Development of cavities in the permanent dentition can be depicted by caries status in primary molars.[29,30] Steiner *et al*.[23] found that high increase in caries in the permanent dentition in the age of 7 and 8 years when primary molars were previously involved. According to Gray *et al*.,[29] if three or more carious deciduous molars are present at the age of 5, high caries experience can be predicted in the permanent teeth at the age of 7. Skeie *et al*.[30] established relationship between caries in two sets of dentition and concluded that if primary second molars have involvement of two surfaces by caries at the age of 5, it is a predictor of caries status for next 5 years.

This study assessed caries distribution with regard to the full spectrum of progression of the caries process by CAST index. A strong correlation was found between contralateral molars measured by the CAST index in both primary and permanent dentitions. A symmetrical caries pattern was also seen for teeth in the upper and lower arches which is similar to previous reports.[20,31] We found that the correlations between CAST codes recorded in adjacent primary molars were stronger for the right side of the mouth, both in the maxilla and the mandible, which can be explained due to accumulative caries pattern.[32] This is in contrast to findings of Baginska, in which CAST index is used to find correlation between carious molars. While weak correlations were assessed between caries status in first permanent and second primary molars which is similar to the findings of Baginska *et al*. and Honkala and Behbehani.[7,11] This can be due to less frequency of CAST codes 5–8 in permanent teeth. Although CAST presents a clear picture of a premorbidity stage that reveals a need of preventive actions as it is new instrument for caries assessment, longitudinal studies will require more efforts to imply this index. In this population, there is a need for a prospective study to find whether the poor condition of deciduous molars affected the status of permanent teeth. Further studies for this age group are also advocated as assessment of age group of 7–8 years will give direction for preventive measures to be taken.

Clinical practitioners can have better accuracy during a dental examination if the information regarding the caries pattern is provided.[33] Caries pattern in a population can give estimation of risk of spread of deep dentinal cavities and its consequences.

Conclusion

The weak correlation was found between primary and permanent molars in this population regarding the distribution of caries. However, strongest correlation was found between first and second deciduous molars on the right side of the oral cavity. The study also showed the effectiveness of the CAST index in epidemiological surveys.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Bowen WH, Tabak LA. Cariology for the Nineties. Rochester, N.Y.: Rochester University Press; 1993. p. 1-10.
2. Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. Am J Dent 2009;22:3-8.
3. Pitts NB, Ekstrand KR; ICDAS Foundation. International Caries Detection and Assessment System (ICDAS) and its International Caries Classification and Management System (ICCMS)-methods for staging of the caries process and enabling dentists to manage caries. Community Dent Oral Epidemiol 2013;41:e41-52.
4. Frencken JE, de Amorim RG, Faber J, Leal SC. The Caries Assessment Spectrum and Treatment (CAST) index: Rational and development. Int Dent J 2011;61:117-23.
5. de Amorim RG, Figueiredo MJ, Leal SC, Mulder J, Frencken JE. Caries experience in a child population in a deprived area of Brazil, using ICDAS II. Clin Oral Investig 2012;16:513-20.
6. Monse B, Heinrich-Weltzien R, Benzian H, Holmgren C, van Palenstein Helderman W. PUFA – An index of clinical consequences of untreated dental caries. Community Dent Oral Epidemiol 2010;38:77-82.
7. Baginska J, Rodakowska E, Milewski R, Kierklo A. Dental caries in primary and permanent molars in 7-8-year-old schoolchildren evaluated with Caries Assessment Spectrum and Treatment (CAST) index. BMC Oral Health 2014;14:74.
8. de Souza AL, Bronkhorst EM, Creugers NH, Leal SC, Frencken JE. The Caries Assessment Spectrum and Treatment (CAST) instrument: Its reproducibility in clinical studies. Int Dent J 2014;64:187-94.
9. Bhardwaj VK, Vaid S, Chug A, Jhingta P, Negi N, Sharma D. Prevalence of dental caries among five-year-old school children in Shimla city, Himachal Pradesh. Eur J Gen Dent 2012;1:34-8.
10. Sharma A, Bansal P, Grover A, Sharma S, Sharma A. Oral health status and treatment needs among primary school going children in Nagrota Bagwan block of Kangra, Himachal Pradesh. J Indian Soc Periodontol 2014;18:762-6.
11. Honkala E, Behbehani JM. What's new in the benefits of restoring primary teeth? Med Princ Pract 2013;22:207-8.
12. Grewal H, Verma M, Kumar A. Prevalence of dental caries and treatment needs in the rural child population of Nainital District, Uttaranchal. J Indian Soc Pedod Prev Dent 2009;27:224-6.
13. Matulaitiene ZK, Zemaitiene M, Zemgulyte S, Milciuviene S. Changes in dental caries and oral hygiene among 7-8 year-old schoolchildren in different regions of Lithuania 1983-2009. Stomatologija 2012;14:53-9.
14. Zhang S, Liu J, Lo EC, Chu CH. Dental caries status of Dai preschool children in Yunnan Provence, China. BMC Oral Health 2014;14:16.
15. Zhang S, Liu J, Lo EC, Chu CH. Dental caries status of Bulang preschool children Southwest China. BMC Oral Health 2013;13:68.
16. Baginska J, Stokowska W. Pulpal involvement-roots-sepsis index: A new method for describing the clinical consequences of untreated dental caries. Med Princ Pract 2013;22:555-60.
17. Honkala E, Runnel R, Honkala S, Olak J, Vahlberg T, Saag M, *et al.* Measuring dental caries in the mixed dentition by ICDAS. Int J Dent 2011;2011:150424.
18. Stephenson J. A model for the analysis of caries occurrence in primary molar tooth surfaces. Caries Res 2012;46:452-9.
19. Lynch RJ. The primary and mixed dentition, post-eruptive enamel maturation and dental caries: A review. Int Dent J 2013;63 Suppl 2:3-13.
20. Sheiham A, Sabbah W. Using universal patterns of caries for planning and evaluating dental care. Caries Res 2010;44:141-50.
21. Elfrink ME, Veerkamp JS, Kalsbeek H. Caries pattern in primary molars in Dutch 5-year-old children. Eur Arch Paediatr Dent 2006;7:236-40.
22. Wyne AH. Caries prevalence, severity, and pattern in preschool children. J Contemp Dent Pract 2008;9:24-31.
23. Steiner M, Helfenstein U, Marthaler TM. Dental predictors of high caries increment in children. J Dent Res 1992;71:1926-33.
24. Masood M, Yusof N, Hassan MI, Jaafar N. Assessment of dental caries predictors in 6-year-old school children-results from 5-year retrospective cohort study. BMC Public Health 2012;12:989.
25. Batchelor PA, Sheiham A. Grouping of tooth surfaces by susceptibility to caries: A study in 5-16 year-old children. BMC Oral Health 2004;4:2.
26. Berger S, Goddon I, Chen CM, Senkel H, Hickel R, Stösser L, *et al.* Are pit and fissure sealants needed in children with a higher caries risk? Clin Oral Investig 2010;14:613-20.
27. Oulis CJ, Berdouses ED, Mamai-Homata E, Polychronopoulou A. Prevalence of sealants in relation to dental caries on the permanent molars of 12 and 15-year-old Greek adolescents. A national pathfinder survey. BMC Public Health 2011;11:100.
28. Courson F, Velly AM, Droz D, Lupi-Pégurier L, Muller-Bolla M. Clinical decision on pit and fissure sealing according to the occlusal morphology. A descriptive study. Eur J Paediatr Dent 2011;12:43-9.
29. Gray MM, Marchment MD, Anderson RJ. The relationship between caries experience in the deciduous molars at 5 years and in first permanent molars of the same child at 7 years. Community Dent Health 1991;8:3-7.
30. Skeie MS, Raadal M, Strand GV, Espelid I. The relationship between caries in the primary dentition at 5 years of age and permanent dentition at 10 years of age – A longitudinal study. Int J Paediatr Dent 2006;16:152-60.
31. Burnside G, Pine CM, Williamson PR. Modelling the bilateral symmetry of caries incidence. Caries Res 2008;42:291-6.
32. Hujoel PP, Lamont RJ, DeRouen TA, Davis S, Leroux BG. Within-subject coronal caries distribution patterns: An evaluation of randomness with respect to the midline. J Dent Res 1994;73:1575-80.
33. Vanobbergen J, Lesaffre E, García-Zattera MJ, Jara A, Martens L, Declerck D. Caries patterns in primary dentition in 3-, 5- and 7-year-old children: Spatial correlation and preventive consequences. Caries Res 2007;41:16-25.