**Brazilian Research in Pediatric Dentistry and Integrated Clinic 2014, 14(2):107-114**
**DOI: http://dx.doi.org/10.4034/PBOCI.2014.142.05**
**ISSN 1519-0501**

**Original Article**

# Use of ICDAS-II Criteria in the Detection of Caries Lesion in Cleft Lip and Palate Patients

Luciana Lourenço Ribeiro Vitor[1], Isabela Ramalho Rodrigues[2], Bianca Zeponi Fernandes Mello[3], Cleide de Felício Carvalho Carrara[4], Vivian Agostino Biella Passos[5], Thais Marchini Oliveira[6]

[1]Master's Program in Rehabilitation Sciences of the Hospital for Rehabilitation of Craniofacial Anomalies, University of Sao Paulo, Bauru, SP, Brazil.
[2]School of Dentistry of Bauru, University of Sao Paulo, Bauru, SP, Brazil.
[3]Master's Program in Applied Dental Sciences, School of Dentistry, University of Sao Paulo, Bauru, SP, Brazil.
[4] Hospital for Rehabilitation of Craniofacial Anomalies, University of Sao Paulo, Bauru, SP, Brazil.
[5]Pedondontist at APAE, Bauru, SP, Brazil.
[6]Department of Pediatric Dentistry, Orthodontics and Collective Health of the School of Dentistry, University of Sao Paulo, Bauru, SP, Brazil.

These authors contributed equally to this work.

Author to whom correspondence should be addressed: Thais Marchini Oliveira, Faculdade de Odontologia de Bauru, Disciplina de Odontopediatria, Alameda Dr. Octávio Pinheiro Brisolla, 9-75 Bauru, São Paulo, 17012-901- Brasil. Phone: 55 14 32358224. Email: marchini@usp.br.

Academic Editors: Alessandro Leite Cavalcanti e Wilton Wilney Nascimento Padilha

Received: 13 June 2013 / Accepted: 6 November 2013 / Published: 10 June 2014

**Abstract**

**Objective:** To use the International Caries Detection and Assessment System (ICDAS-II) to evaluate the scores of different stages of caries lesion development in cleft lip and palate children. **Material and Methods:** Fifty cleft lip and palate children aged6-10 years at mixed dentition were selected. Two examiners, one after the other, performed the visual examination of dental surfaces. Firstly, the teeth were cleaned with the aid of pumice and water paste. The examination was carried out under the dental chair reflector, after air drying for 5 seconds with air-water syringe, and with the aid of a WHO probe. The sites comprising the sample were classified according to criteria proposed by ICDAS-II. **Results:** Ten children met the inclusion criteria. Twenty-five anterior teeth at the cleft area and 93 posterior teeth were assessed, totalizing 590 surfaces classified by ICDAS-II. Four hundred and ninety-four surfaces were scored as sound (code 0-0) regarding the Caries Lesion Condition. Only one surface was scored as partial sealant (code 1), according to the Tooth Surface Condition, but classified as sound regarding the Caries Lesion Condition (code 1-0). No surface exhibited stainless steel; porcelain, gold or porcelain fused to metal crowner veneer; lost or broken restoration; and temporary restoration (codes 5, 6, 7, and 8, respectively). **Conclusion:** ICDAS-II shows good performance in analyzing caries lesions through more specific assessment and more accurate examination, enabling the detection of caries lesion development at several stages.

**Keywords:** Dental caries; Cleft lip; Cleft palate.

**Introduction**

Currently, caries lesion detection at initial developmental stages is essential to adopt minimally invasive therapies favoring remineralization, which consequently leads to better caries treatment prognosis [1]. Traditional diagnosis methods, however, have shown many limitations. As dental caries is a multifactorial and dynamics process, its progression is very difficult to evaluate. Dental caries development is a continuous process and whenever possible one should assess caries stages representing the moment of dental structure loss.

Routinely in clinical practice, occlusal and approximal caries lesions have been detected through conventional visual-tactile and radiographic examinations. Notwithstanding, radiographic examination allows detecting alterations on dental surfaces at advanced stages. In addition, visual-tactile examination must be carried out under good light after tooth surface drying to better visualize caries lesions. However, since visual-tactile examination is a subjective method and depends on the dentist's clinical expertise, it has low reproducibility [2]. Accordingly, difficulties in the early detection and caries lesion depth assessment have motivated the development of new methods to aid this process.

Over the last years, efforts have been made to create a score system to establish international criteria for the visual detection of caries lesion and assessment of activities to be used in laboratorial, clinical and epidemiological studies and in the follow-up of patients at private and public clinical practice. Thus, a group of Cariologists has recently developed a standard system for dental caries detection called International Caries Detection and Assessment System (ICDAS). In 2003, they developed ICDAS-I, which aims at the visual examination on clean (without bacterial plaque) and carefully dried dental surface to allow identifying initial caries lesions. The use of WHO probe has been considered an auxiliary tool in some cases [3]. Later, the cariology research group modified this criterion by changing the order of scores to ensure that the increasing score also meant the severity progression of lesions, and developed theca's-II. Studies using ICDAS-II have shown reproducible results ranging from good to excellent and system validity to assess caries lesion activity [4-9].

ICDAS-II is the new paradigm for caries disease detection and assessment because it is a modern, uniform and universal system to be used in clinical practice, teaching and research. ICDAS Foundation accounts for the system development, reaching the consensus of a large number of international experts of Cariology, Clinical Investigation, Operative Dentistry, Pediatric Dentistry, Public Health and Epidemiology [8, 10].

This criterion states that after tooth cleaning and drying, the examiner classifies the tooth as sound, sealed, restored, with crown or without it. Subsequently, the tooth surfaces are scored in relation to the presence of caries lesion in an increasing order, ranging from sound surface to large dentine cavity [7,8,10]. The criteria aim to ensure coherence during the assessment of caries lesion prevalence. ICDAS-II code is composed of two numbers: the first number corresponds to the surface condition (sealed or restored); the second number corresponds to the caries lesion condition. All

these characteristics make ICDAS-II system an important adjuvant to enable coherent caries lesion analysis.

In 2007, a study evaluated the ICDAS-II system regarding pits and fissure caries [8] and concluded that even when the examiner does not have prior experience in epidemiological evaluation, ICDAS-II system exhibited reliability from good to excellent. Moreover, the system proved to have discriminatory validity and reliability in relation to general caries lesion severity, but ICDAS-II system was not capable of differentiating active from inactive lesions.

Another studies used ICDAS-II system to detect initial caries lesions (without cavities) in epidemiological research [11] and in studies associating the presence of caries disease with biological/social risk indicators [12-14].

Although researches have been conducted using ICDAS-II system, little is known on the validity and reliability involving deciduous/permanent dentition and occlusal/approximal surfaces in cleft lip and palate patients [11,12,15-17]. Thus, studies on clef lip and palate patients at different ages and dentitions are required.

The aim of this present study was to use ICDAS-II to evaluate the scores of different stages of caries lesion development in cleft lip and palate children.

**Material and Methods**

According to the ethical and legal principles, this study was submitted to and approved by the Institutional Review Board (Protocol no. 225/2011). Before examinations, children's parents/guardians were instructed about the research and signed the free and informed consent form. Only after, children underwent examination.

Fifty children aged 6-10 years at mixed dentition were selected at the Pediatric Dentistry Clinic of the Hospital for Rehabilitation of Craniofacial Anomalies-USP. Inclusion criteria included the presence of the permanent first molar fully erupted and absence of hypoplasias.

At first appointment, the following data were collected from patients: name, gender, address, telephone number, and parents/guardians' name.

Then, two examiners performed the visual-tactile examination of dental surfaces previously cleaned with the aid of dental floss and prophylaxis with pumice/water paste. Following, teeth were dried with the aid of air jet for 5 seconds and WHO probe. The surfaces of anterior teeth at the cleft area and posterior teeth were examined starting from the maxillary right posterior quadrant towards the next quadrant at clockwise direction. During examination, if a deciduous tooth occupied the same space of a permanent tooth, the latter was examined. When more than one caries lesion was present on the occlusal surface, the severest lesion was classified and recorded. The examiners classified the sample sites according to ICDAS-II criteria, using the following codes:

- First number referring to tooth surface condition:
    - (0) = sound: i.e. surface not restored or sealed
    - (1) = sealant, partial

- (2) = sealant, full
- (3) = tooth colored restoration
- (4) = Amalgam restoration
- (5) = Stainless steel crown
- (6) = Porcelain or gold or porcelain fused to metal crown or veneer
- (7) = Lost or broken restoration
- (8) = Temporary restoration

- Second number referring to caries lesion condition:
  - (0) = Sound
  - (1) = First visual change in enamel when viewed wet
  - (2) = Distinct visual change in enamel
  - (3) = Localized enamel breakdown
  - (4) = Underlying dentin shadow
  - (5) = Distinct cavity with visible dentine
  - (6) = Extensive cavity within visible dentine

Children underwent two examinations by two previously trained and calibrated examiners certified in ICDAS-II criteria, at the same moment, one after the other. To avoid induction of results and allow inter-examiner agreement, one examiner did not know the other examiner's codes.

**Results**

Ten children met the inclusion criteria. One hundred and eighteen children were examined including 25 anterior teeth at the cleft area and 93 posterior teeth, resulting in590 tooth surfaces classified by ICDAS-II system. Table 1 below shows the number and percentage of surfaces classified by ICDAS-II system.

**Table 1. Number and percentage of surfaces classified by ICDAS-II system.**

| Code | Surface number | Percentage |
|---|---|---|
| 0-0 | 494 | 83.73% |
| 0-1 | 19 | 3.22% |
| 0-2 | 17 | 2.88% |
| 0-3 | 1 | 0.17% |
| 0-4 | 1 | 0.17% |
| 0-5 | 5 | 0.85% |
| 0-6 | 14 | 2.37% |
| 1-0 | 1 | 0.17% |
| 2-0 | 9 | 1.52% |
| 3-0 | 13 | 2.20% |
| 3-2 | 2 | 0.34% |
| 3-4 | 1 | 0.17% |
| 4-0 | 13 | 2.20% |

Inter-examiner agreement Kappa = 0.67

Absent codes did not show percentage in this present study. Inter-examiner agreement was obtained through Kappa test = 0.67.

Five hundred and fifty-one surfaces were classified as score 0 of Tooth Surface Condition, that is, not restored or sealed. Of these, 494 surfaces were classified as sound according to the Caries Lesion Condition (code0-0), 19 surfaces as first visual change in enamel (code0-1); 17 surfaces as distinct visual change in enamel (code0-2); one surface as localized enamel breakdown (code0-3); one surface underlying dentin shadow (code0-4); 5 surfaces as distinct cavity with visible dentine (code0-5);and14 surfaces as extensive cavity within visible dentine (code0-6). Only one surface exhibited score 1 according to the Tooth surface Condition, that is, sealant (partial), which was classified as score 0 according to the Caries Lesion Condition (code1-0).

All surfaces(n=9) exhibiting score 2 as for the Tooth Surface Condition, that is sealant (full) were classified as score 0 as for the Caries Lesion Condition (code2-0). Concerning the score 3 of the Tooth Surface Condition (tooth colored restoration, n=16), 13 surfaces were classified as score 0 (sound) as for the Caries Lesion Condition (code3-0), two surfaces as score 2 (distinct visual change in enamel)(code3-2), and one as score 4 (underlying dentin shadow) (code3-4). Thirteen surfaces were classified as score 4 (amalgam restoration) as for the Tooth Surface Condition, and all of them were classified as score 0 (sound)as for the Caries Lesion Condition (code4-0). No surface exhibited either stainless steel crown; porcelain or gold or porcelain fused to metal crown or veneer; lost or broken restoration; or temporary restoration (codes 5, 6, 7 and 8 of the Tooth Surface Condition, respectively).

**Discussion**

Cleft lip and palate treatment should start just after birth and continue until adulthood, requiring an interdisciplinary and multidisciplinary team aiming solely to reach the best outcome as possible [18]. The rehabilitation of cleft lip and palate patients is directly related to the oral condition, a prerequisite to perform reparative surgeries requiring infection-free environment to obtain satisfactory results. Studies have reported high caries disease prevalence in cleft lip and palate individuals [19-21]. More accurate methods for correct dental caries lesion diagnosis would imply in reduced need for restorative treatment to remove the infection foci that may compromise reparative surgeries [20].

To detect occlusal and approximal caries lesions, conventional visual and radiographic examinations have been routinely used in clinical practice. Notwithstanding, radiographic examination is capable of detecting alterations on tooth surfaces at advanced stages [2]. Visual examination should be performed under light and after drying for better visualization of lesions. However, since visual-tactile examination is a subjective method and depends on the dentist's clinical expertise, it has low reproducibility [22].

Caries lesion detection and depth assessment has been one of the factors to be considered in diagnosis process and treatment. Aiming to aid in visual and radiographic examinations, new

methods have been developed and had their performance researched. The process of caries diagnosis depends on other factors else than lesion detection and depth assessment. Accordingly, patients' symptoms, past caries experience, saliva buffer capacity and etiological factors of caries disease such as sugar consumption and fluoride access should be evaluated [23].

Considering the aforementioned reasons, the difficulty found in the early caries lesion detection and depth assessment has motivated new methods to aid in this process [23]. ICDAS-II system is valid for caries prevalence because it analyses from white spots to deep cavities associated with tooth surface and caries lesions conditions.

In this study using ICDAS-II system, 590 surfaces were examined, resulting in 7 surfaces scored as caries in permanent teeth and 53 in deciduous teeth. Eleven surfaces were scored as caries in anterior teeth and 49 surfaces in posterior teeth. ICDAS-II system has been used in other researches aiming to include the detection of initial caries lesions (without cavities) in epidemiological studies [11] and studies associating the disease presence with biological/social risk indicators [12,14]. Moreover, this system is appropriate for examining both occlusal and approximal surfaces in deciduous teeth [13].

ICDAS-II analyses tooth surfaces through two numbers, which makes the analysis more specific because ICDAS-II scores take into consideration minimum alterations on the tooth structures, enabling a more detailed examination of caries lesions. In the present study, the findings demonstrated that the caries lesion condition thoroughly specifies the caries lesion depth.

One of the ICDAS-II system goals is to differentiate enamel lesions at different depths (lesions at the external half from those at the internal half of the enamel), considering surfaces with enamel translucency change after 5 seconds of drying as sound [24]. Expressive importance should be given to methods proposing to evaluate not only the severity but also the caries lesion activity because the latter is a parameter extremely associated with the disease progression and prognosis and guides treatment decision-making process(1). Authors have reported that caries lesion activity is a factor requiring evaluation, but the performance of methods in determining caries lesion activity must also be verified [23]. From the point of view of cleft lip and palate rehabilitation, the high number of surfaces classified as sound through ICDAS-II system is very promising.

Since the beginning, ICDAS-II system has been well-accepted both in clinical use and in vitro/in vivo studies(17). The performance of ICDAS-II system proved to be from good to excellent when compared with histologic method, considered as gold standard [23,25]. A study concluded that ICDAS-II system has better diagnosis potential than that of WHO criteria[26].

The data exhibited by the present study indicated that even when used by examiners without prior experience in epidemiological research, but trained and certified in the system, ICDAS-II showed good reliability because it is useful, easy-to-use, and has clearly defined criteria for caries detection through visual-tactile examination, results also found in other studies [9]. The authors concluded that with training and experience, general dentists can perform ICDAS-II system examination [9].

The pattern of caries disease has changed, requiring the redirection of oral health programs for caries lesion detection through the use of new diagnosis and assessment criteria. Prevention programs and the adoption of homogenous diagnosis criteria must be primarily designed and implemented [6]. The capacity of detecting caries lesion at initial stage has significant impact on the treatment decision-making process, improving the possibility of successful preventive measures. Caries lesion detection through ICDAS-II system may potentially support treatment decisions for occlusal surfaces [27-29].

Current decision-making process in caries disease treatment has been based on accurate disease diagnosis to ensure the best treatment for the patient. This premise is preponderantly important for cleft lip and palate patients, for whom the presence of caries lesions contraindicates reparative surgeries (20). Therefore, clinical studies on the follow-up of patients diagnosed through such methods should be encouraged in order to evaluate which clinical outcomes will be presented by patients undergoing such tests.

## Conclusion

ICDAS-II has good performance in the analysis of caries lesions through more specific assessment and more accurate examination, enabling the detection of the caries lesion development at several stages.

## References

1. Nyvad B. Diagnosis versus detection of caries. Caries Res 2004; 38(3):192-8.
2. Ricketts DN, Ekstrand KR, Kidd EA, Larsen T. Relating visual and radiographic ranked scoring systems for occlusal caries detection to histological and microbiological evidence. Oper Dent 2002; 27(3):231-7.
3. Pitts N. "ICDAS"--an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dent Health. 2004; 21(3):193-8.
4. Braga MM, Martignon S, Ekstrand KR, Ricketts DN, Imparato JC, Mendes FM. Parameters associated with active caries lesions assessed by two different visual scoring systems on occlusal surfaces of primary molars - a multilevel approach. Community Dent Oral Epidemiol 2010; 38(6):549-58.
5. Braga MM, Mendes FM, Ekstrand KR. Detection activity assessment and diagnosis of dental caries lesions. Dent Clin North America. 2010; 54(3):479-93.
6. Cadavid AS, Lince CM, Jaramillo MC. Dental caries in the primary dentition of a Colombian population according to the ICDAS criteria. Braz Oral Res 2010; 24(2):211-6.
7. Ekstrand KR, Martignon S, Ricketts DJ, Qvist V. Detection and activity assessment of primary coronal caries lesions: a methodologic study. Oper Dent 2007; 32(3):225-35.
8. Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, et al. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. Community Dent Oral Epidemiol 2007; 35(3):170-8.
9. Ormond C, Douglas G, Pitts N. The use of the International Caries Detection and Assessment System (ICDAS) in a National Health Service general dental practice as part of an oral health assessment. Prim Dent Care 2010; 17(4):153-59.
10. Ismail AI, Lim S, Sohn W. A transition scoring system of caries increment with adjustment of reversals in longitudinal study: evaluation using primary tooth surface data. Community Dent Oral Epidemiol 2011; 39(1):61-8.

11. Braga MM, Oliveira LB, Bonini GA, Bonecker M, Mendes FM. Feasibility of the International Caries Detection and Assessment System (ICDAS-II) in epidemiological surveys and comparability with standard World Health Organization criteria. Caries Res 2009; 43(4):245-9.
12. Ismail AI, Sohn W, Tellez M, Willem JM, Betz J, Lepkowski J. Risk indicators for dental caries using the International Caries Detection and Assessment System (ICDAS). Community Dent Oral Epidemiol 2008; 36(1):55-68.
13. Shoaib L, Deery C, Ricketts DN, Nugent ZJ. Validity and reproducibility of ICDAS II in primary teeth. Caries Res 2009; 43(6):442-8.
14. Sohn W, Ismail A, Amaya A, Lepkowski J. Determinants of dental care visits among low-income African-American children. J Am Dent Assoc 2007; 138(3):309-18; quiz 95-96, 98.
15. Braga MM, Mendes FM, Martignon S, Ricketts DN, Ekstrand KR. In vitro comparison of Nyvad's system and ICDAS-II with Lesion Activity Assessment for evaluation of severity and activity of occlusal caries lesions in primary teeth. Caries Res 2009; 43(5):405-12.
16. Diniz MB, Rodrigues JA, Hug I, Cordeiro Rde C, Lussi A. Reproducibility and accuracy of the ICDAS-II for occlusal caries detection. Community Dent Oral Epidemiol 2009; 37(5):399-404.
17. Jablonski-Momeni A, Stachniss V, Ricketts DN, Heinzel-Gutenbrunner M, Pieper K. Reproducibility and accuracy of the ICDAS-II for detection of occlusal caries in vitro. Caries Res 2008; 42(2):79-87.
18. Freitas JA, das Neves LT, de Almeida AL, Garib DG, Trindade-Suedam IK, Yaedu RY, et al. Rehabilitative treatment of cleft lip and palate: experience of the Hospital for Rehabilitation of Craniofacial Anomalies/USP (HRAC/USP)--Part 1: overall aspects. J Appl Oral Sci 2012; 20(1):9-15.
19. Britton KF, Welbury RR. Dental caries prevalence in children with cleft lip/palate aged between 6 months and 6 years in the West of Scotland. Eur Arch Paediatr Dent 2010; 11(5):236-41.
20. Freitas JA, Garib DG, Oliveira M, Lauris Rde C, Almeida AL, Neves LT, et al. Rehabilitative treatment of cleft lip and palate: experience of the Hospital for Rehabilitation of Craniofacial Anomalies-USP (HRAC-USP)--part 2: pediatric dentistry and orthodontics. J Appl Oral Sci 2012; 20(2):268-81.
21. King NM, Wong WL, Wong HM. Caries experience of chinese children with cleft lip and palate. Cleft Palate Craniofac J 2013; 50(4):448-55
22. Fung L, Smales R, Ngo H, Moun G. Diagnostic comparison of three groups of examiners using visual and laser fluorescence methods to detect occlusal caries in vitro. Aust Dent J 2004; 49(2):67-71; quiz 101.
23. Rodrigues JA, Hug I, Diniz MB, Lussi A. Performance of fluorescence methods, radiographic examination and ICDAS II on occlusal surfaces in vitro. Caries Res 2008; 42(4):297-304.
24. Ekstrand KR. Improving clinical visual detection--potential for caries clinical trials. J Dent Res 2004; 83 Spec No C:C67-71.
25. Pereira-Olivera S. Assessment of proximal caries lesions through microtomography, cone beam CT and digital radiographs [Thesis]. São Paulo: Faculdade de Odontologia da USP, Universidade de São Paulo; 2009.
26. Kuhnisch J, Berger S, Goddon I, Senkel H, Pitts N, Heinrich-Weltzien R. Occlusal caries detection in permanent molars according to WHO basic methods, ICDAS II and laser fluorescence measurements. Community Dent Oral Epidemiol 2008; 36(6):475-84.
27. Bonner BC, Bourgeois DM, Douglas GV, Chan K, Pitts NB. The feasibility of data collection in dental practices, using codes for the International Caries Detection and Assessment System (ICDAS), to allow European general dental practitioners to monitor dental caries at local, national, and international levels. Prim Dent Care 2011; 18(2):83-90.
28. Diniz MB, Lima LM, Eckert G, Zandona AG, Cordeiro RC, Pinto LS. In vitro evaluation of ICDAS and radiographic examination of occlusal surfaces and their association with treatment decisions. Oper Dent 2011; 36(2):133-42.
29. Nelson S, Eggertsson H, Powell B, Mandelaris J, Ntragatakis M, Richardson T, et al. Dental examiners consistency in applying the ICDAS criteria for a caries prevention community trial. Community Dent Health. 2011; 28(3):238-42.