

Validity Assessment of Wooden Spatula and Toothpick as an Alternative for Detection of Dental Caries in the Indian School Setting

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ABSTRACT

Objective: The objective of the study was to assess sensitivity and specificity of wooden spatula and toothpick (WT) as an alternative to mouth mirror and probe (MP) for detection of dental caries in schoolchildren.

Materials and methods: A cross-sectional study was done among schoolchildren. A trained and calibrated examiner examined dental caries in all children by using a mouth mirror and community periodontal index (CPI) probe using these criteria under natural light. After a week children were reexamined for dental caries by a wooden spatula and toothpick. The sensitivity, specificity, positive predictive value, negative predictive value, false-positive rate, and false-negative rate of wooden spatula and toothpick examination were calculated using mouth mirror and CPI probe examination as the standard method.

Results: The sensitivity of wooden spatula and toothpick examination in deciduous, mixed, and permanent dentition was found to be 97.2, 94.4, and 84.7% respectively.

Conclusion: Wooden spatula and toothpick examination can be used as an alternative to traditional mouth mirror and probe examination to detect dental caries in schoolchildren.

Keywords: Schoolchildren, Toothpick, Validity, Wooden spatula.

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INTRODUCTION

Determining the prevalence of dental caries is a necessary step for health care planners to identify resources needed for dental services in the community and to provide preventive and curative services to combat dental health problems. Field surveys of cross-sectional design are important tools to describe the status of dental problems in the community.¹⁻³

The visuotactile method has been widely used for detection of dental caries in field surveys with the help of mouth mirror and dental probe.⁴ Three important functions of dental mirror are allowing indirect vision by the dentist, reflecting light onto desired surfaces, and retraction of soft tissues.⁵ The use of a sharp dental probe in the detection and diagnosis of carious lesions has been long discussed, being controversial since several years. Clinicians trust on it as an adjunct to their visual assessment. Historically, coherence of a sharp instrument gently forced into a pit or fissure was thought to correlate with the presence of caries. So, detection of dental caries was laying on the catch of the instrument on the occlusal surface.⁶ Dental probe also helps to remove food debris that may mask the caries lesion.⁷

In recent years, the use of the metallic probes with sharp tips for caries detection has been discouraged.⁶ The practice is believed to add little to the diagnostic process,⁸ and it is further believed that it might cause iatrogenic damage to the enamel surface, thus promoting caries initiation or progression. It has been shown that the sharp metallic probes can damage the tooth structure irreversibly, rendering a sound and remineralizable subsurface lesion as a cavitated lesion.^{6,9} According to Pitts,¹⁰ the potential for such iatrogenic damage from the use of a sharp explorer in a visuotactile method, combined with the lack of any evidence of any additional diagnostic benefit, contraindicates sharp instruments for the diagnosis of dental caries. Sharp instruments also possess the risk of intraoral transmission of *Streptococcus mutans*.¹¹ Wooden spatula and toothpick carry relatively low risk of intraoral transmission of *S. mutans* than metallic instruments

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because dental examination with wooden spatula and toothpick is mostly visible and use of toothpick is only for removing debris from tooth surface. On the contrary, dental examination with metallic instrument is entirely visuotactile and while exploring dental caries, contact time of instrument with tooth surface is more. Increased contact time favors sticking of more bacteria to instruments.

Additionally public health risks associated with the use of these reusable instruments include spread of infection, corrosion, rusting, and examinee apprehension, specifically children. These instruments are expensive and carry extra cost for handling and sterilization. It is preferable to use nonmetallic, cheap, and disposable instruments to overcome these problems.¹²

Dental caries is one of the most prevalent chronic childhood diseases worldwide and a major public health problem.¹³⁻¹⁶ Dental caries can affect a child's eating habits and nutritional intake, potentially influencing growth and early childhood development and school readiness. Pain and infection from dental caries lead to poor school attendance and problems in eating, speaking, and learning.¹³ Regular screening of the children for dental caries provides a basis for estimation of present oral health status and its future needs for development of national and regional oral health programs and for planning appropriate numbers and types of personnel for oral care.

School setting provides catchment area to screen children.^{15,17} The oral examination in school setting is usually done with the help of mouth mirror and metallic dental probe.¹² In a large school setting, more number of instruments are required to screen the children. If the number of instruments is limited, it should be sterilized again and the process is time consuming. Also reusable instrument may pose some public health risks, especially in developing countries, as mentioned earlier. Ultimately it forms an expensive component especially for underdeveloped and developing countries. So there is need to develop cost-effective, valid, and noninvasive disposable alternative. Keeping this in mind, this study was undertaken to assess validity of wooden spatula and toothpick examination as an alternative to mouth mirror and probe examination for detection of dental caries in schoolchildren.

The objectives of the study were to assess:

- Sensitivity and specificity of wooden spatula and toothpick examination as an alternative to mouth mirror and probe for detection of dental caries in schoolchildren.
- Positive predictive value, negative predictive value, false-positive rate, and false-negative rate of wooden spatula and toothpick examination as an alternative to mouth mirror and probe for detection of dental caries in schoolchildren.

MATERIALS AND METHODS

A cross-sectional study was conducted in April 2012 at G.B. Convent School, Bhopal, India, to assess validity of wooden spatula and toothpick as an alternative for detection of dental caries in school setting. All children belonging to three age groups (3–5, 10–12, and 14–16 years) and studying in different classes at G.B. Convent School, Bhopal, India, were screened with mouth mirror and CPI probe for dental caries. After that those who had dental caries were reexamined by wooden spatula and toothpick.

A total of 669 schoolchildren were screened with mouth mirror and CPI probe. Finally, 315 who had dental caries were reexamined with the help of wooden spatula and toothpick. Children having pain in tooth, severely crowded dentition, difficulty in opening of the mouth, undergoing fixed orthodontic treatment, fluorosis or some serious systemic illness, and those who were uncooperative were not included in the study.

Before starting the study, ethical clearance was obtained from People's College of Dental Sciences and Research Centre. Permission from school authority and written consent from children's parents to conduct the study was also taken. Before conducting the survey, the training and calibration of examiner was done. The intra- and interexaminer reliability values were calculated for wooden spatula and toothpick and mouth mirror and CPI probe examinations separately using the kappa test. The intraexaminer reliability values of 0.86 and 0.90 and the interexaminer reliability values of 0.84 and 0.88 for WT examination and MP examination were obtained. The recorder's performance was also found to be satisfactory.

A written protocol for the survey was prepared, which included objectives, materials, and methods to be used, sampling methods, and a provisional timetable of main activities. The survey was scheduled in the month of April 2012. On an average 60 to 70 subjects were examined per day. The clinical examination was carried out using aseptic precautions. All the instruments were used once in a day and were autoclaved afterward for next use. Disposable gloves and mouth masks were used. Wooden spatulas and toothpicks were used as disposables.

At first, the examination was carried out by using a dental mirror and CPI probe, and then by employing wooden spatula and toothpick under natural light. The children who were absent on the day the examinations were being conducted had their exams on another day. An interval of 1 week was kept between two types of examinations for the memory of the examiner to fade about the findings of the mouth mirror and probe examination before he undertook the wooden spatula and toothpick examination.

The World Health Organization diagnostic criteria were followed for detection of dental caries.² The decayed, missing, and filled teeth (DMFT) index value for permanent and decayed filled tooth (dft) index value for deciduous teeth were retrieved to record dental caries in both types of examinations. In wooden spatula and toothpick examination the detection of caries was based on the presence of an open cavity on any surface of tooth being examined. Discoloration on the marginal ridge and the adjoining area was assumed to indicate a proximal carious lesion underneath. The various codes which were entered into the boxes of a specially designed recording form included tooth with no decay (N), decayed tooth (D/d), filled tooth (F/f), and tooth missing because of caries (M).

During mouth mirror and probe examination, subjects were seated in a plastic chair with high backrest facing the window while the examiner was standing in front of the chair. A dental mirror (plain mouth mirror) was used to retract cheeks and lips and also for indirect visualization of teeth in the upper dental arch, to improve illumination of teeth by reflecting light on them. A CPI probe was used for detecting catch and removing food debris from the tooth surfaces and finally to confirm "caries into dentin" by sensing softness at the base of an occlusal cavity or in the wall of a proximal cavity. Sterilized sets of mouth mirror and CPI probe were used for examining children and all instruments were thoroughly cleaned, disinfected, and autoclaved before they were reused.

Wooden spatula and toothpick examination was performed under similar conditions. However, while conducting this examination the back of the examinee's head was positioned to rest against the rounded upper edge of the back rest of the chair, with an extended neck and the face facing upward. This adjustment was done for easy examination of teeth in the upper jaw. During examination of lower teeth, the subjects were seated in a normal straight position with the lower jaw almost parallel to the ground. Wooden tongue spatula was used to retract cheeks, lips, and tongue for better field of vision. With the help of toothpick food debris was removed from tooth surfaces which is capable of masking the carious lesion. Wooden spatulas and toothpicks were used as disposables.

In both types of examination, teeth were examined in a clockwise direction, taking a start from the last tooth in the right upper quadrant of the oral cavity and ending with the last one in the right lower quadrant. The mesial surface of every tooth was examined first followed by occlusal/incisal, distal, labial/buccal, and finally lingual/palatal.

Data were entered and analyzed by using the Statistical Package for the Social Sciences version 17.0.

Sensitivity, specificity, positive predictive value, negative predictive value, false-positive rate, and false-negative rate of the wooden spatula and toothpick examination were calculated using mouth mirror and CPI probe examination as the standard method.

RESULTS

A total of 669 children were examined for dental caries and were classified according to age in three groups of 3 to 5, 10 to 12, and 14 to 16 years respectively. Of the total, 358 (53.51%) were boys and 311 (46.48%) were girls (Table 1).

Out of total 669 children, 315 (47.08%) were noted to be caries positive in the three age groups having deciduous, mixed, and permanent dentitions (Table 2).

Total teeth examined in deciduous, mixed, and permanent dentition were 2,026, 2,604, and 2,922 respectively, out of which 1,640 deciduous, 2,302 mixed, and 2,575 permanent teeth were detected by mouth mirror and dental probe examination (Table 3).

Total teeth examined in deciduous, mixed, and permanent dentition were 2,026, 2,604, and 2,922 respectively, out of which 377 deciduous, 292 mixed, and 303 permanent teeth were detected carious by wooden spatula and toothpick examination (Table 4).

Table 1: Distribution of study population according to age groups and gender

Age	Boys	Girls	Total
3–5	115 (51.57%)	108 (48.43%)	223
10–12	110 (54.73%)	91 (45.27%)	201
14–16	133 (54.29%)	112 (45.71%)	245
Total	358 (53.51%)	311 (46.48%)	669

Table 2: Distribution of study population according to dentition status

Dentition	Caries-free children	Children with caries	Mean DMFT/dft	Mean D/d	Mean M	Mean F/f
Deciduous	119	104	1.793	1.73	–	0.0627
Mixed	97	105	1 (DMFT) 0.54 (dft)	0.985 0.512	0.0298	0.015 0.0199
Permanent	139	106	1.48	1.41	0.028	0.044
Total	355	315				

Table 3: Distribution of sound and decayed teeth among study population by mouth mirror and CPI probe examination

Dentition	Number of sound teeth	Number of carious teeth	Total number of teeth
Deciduous	1,640	386	2,026
Mixed	2,302	302	2,604
Permanent	2,575	347	2,922

Table 4: Distribution of sound and decayed teeth among study population by wooden spatula and toothpick examination

Dentition	Number of sound teeth	Number of carious teeth	Total number of teeth
Deciduous	1,649	377	2,026
Mixed	2,312	292	2,604
Permanent	2,619	303	2,922

Table 6: Screening test result for mixed dentition

Wooden spatula and toothpick examination	Mouth mirror and probe examination		Total
	Caries +ve	Caries -ve	
Caries +ve	285	7	292
Caries -ve	17	2,295	2,312
Total	302	2,302	2,604

Sensitivity, 94.4%; specificity, 99.7%; false negative, 5.6%; false positive, 0.3%; positive predictive value, 97.6%; negative predictive value, 99.3%.

The sensitivity and specificity of wooden spatula and toothpick examination for deciduous dentition were 97.2 and 99.9% respectively (Table 5).

The false positive and false negative of wooden spatula and toothpick examination for deciduous dentition were 0.1 and 2.8% respectively. The positive predictive value and negative predictive value of wooden spatula and toothpick examination for deciduous dentition were 99.5 and 99.3% respectively (Table 5).

The sensitivity and specificity of wooden spatula and toothpick examination for mixed dentition were 94.4 and 99.7% respectively (Table 6).

The false positive and false negative of wooden spatula and toothpick examination for mixed dentition were 0.3 and 5.6% respectively (Table 6).

The positive predictive value and negative predictive value of wooden spatula and toothpick examination for mixed dentition were 97.6 and 99.3% respectively (Table 6).

The sensitivity and specificity of wooden spatula and toothpick examination for permanent dentition were 84.7 and 99.7% respectively (Table 7).

The false positive and false negative of wooden spatula and toothpick examination for permanent dentition were 0.3 and 15.3% respectively. The positive predictive value and negative predictive value of wooden spatula and toothpick examination for permanent dentition were 97.0 and 98.0% respectively (Table 7).

DISCUSSION

The screening of dental caries with reusable metallic instruments poses some public health risks, especially in developing countries and also forms an expensive component of dental care.¹² The present study was designed to overcome these problems and to develop a valid, disposable, noninvasive, and cost-effective alternative.

Table 5: Screening test result for deciduous dentition

Wooden spatula and toothpick examination	Mouth mirror and probe examination		Total
	Caries +ve	Caries -ve	
Caries +ve	375	2	377
Caries -ve	11	1,638	1,649
Total	386	1,640	2,026

Sensitivity, 97.2%; specificity, 99.9%; false negative, 2.8%; false positive, 0.1%; positive predictive value, 99.5%; negative predictive value, 99.3%

Table 7: Screening test result for permanent dentition

Wooden spatula and toothpick examination	Mouth mirror and probe examination		Total
	Caries +ve	Caries -ve	
Caries +ve	294	9	303
Caries -ve	53	2,566	2,619
Total	347	2,575	2,922

Sensitivity, 84.7%; specificity, 99.7%; false negative, 15.3%; false positive, 0.3%; positive predictive value, 97.0%; negative predictive value, 98.0%.

The results of this study reflected potential for using wooden spatula and toothpick examination as an alternative to mouth mirror and metallic probe examination. The sensitivity of wooden spatula and toothpick examination for deciduous and mixed dentitions was almost the same as that of mirror probe examination. However, in case of permanent dentition, the value was comparatively lower. The variation in sensitivity with different types of dentition may be due to the size of the oral cavity. In younger children with deciduous dentition, the examination of posterior teeth was easier than in children with mixed dentition and permanent dentition. Similar results were reported in a study conducted by Haleem et al¹² in Pakistan.

The sensitivity of wooden spatula and toothpick examination for deciduous dentition was highest with negligible false-positive rate. This shows that the method can be more useful to detect dental caries in younger children with primary dentition who may feel less anxious and fearful while undergoing examination because after seeing metallic instrument they may become more fearful and sometimes can refuse for dental examination while with wooden spatula and toothpick examination fear quotient is less. The specificity of the wooden spatula and toothpick examination in deciduous, mixed, and permanent dentition was 99.9, 99.7 and 99.7% respectively. The results are similar to the study conducted in Pakistan.¹²

The false-negative rate of wooden spatula and toothpick examination in deciduous, mixed, and permanent dentition was 2.8, 5.6 and 15.3% respectively. That means this much percentages of deciduous, mixed, and permanent teeth were actually carious but detected sound or noncarious by wooden spatula and toothpick examination, ultimately leading to slight underestimation of

dental caries. However, these misdiagnosed carious teeth will be diagnosed correctly in succeeding examinations, if screening is done regularly with wooden spatula and toothpick in schoolchildren. Similar results are reported by Haleem et al.¹²

Assaf et al¹⁸ conducted a study among two groups of schoolchildren with low and moderate caries prevalence in Brazil to compare different caries diagnostic methods. Three types of epidemiological dental examinations for dental caries were performed in a group of forty-four 12-year-old Brazilian schoolchildren: one with the use of a tongue blade; the second with dental mirror and CPI dental probe (visual/tactile); and the third with the help of dental mirror alone (visual). All three types of examinations were performed with or without diagnostic adjuncts (previous dental brushing and/or dental drying) in a schoolyard under natural light. These examinations were succeeded by examinations carried out in a clinical dental setting under artificial light and with the help of a dental mirror and CPI probe. Prior to the examination dental prophylaxis and drying of teeth using compressed air were done. The study depicted that the visual/tactile method of dental examination with or without diagnostic adjuncts in both groups gave the best result when conducted in a school setting for diagnosing cavitated carious lesions. The visual method with previous dental brushing also produced satisfactory results in the moderate prevalence group. The blade method even when used with diagnostic adjuncts was the least satisfactory in detecting cavitated lesions, which is in contradiction with the findings of the present study.

In the present study before dental examination, dental drying and toothbrushing was not done. However, CPI probe in mouth mirror and probe examination and toothpick in wooden spatula and toothpick examination were used for removing food debris from tooth surfaces during examination. Although the carious cavities were detected by direct visualization of teeth, an attempt was made to improve the visibility by retracting soft tissues with tongue spatula and also by adjusting the head of the subjects during examination of upper teeth. The other important modification in current study is the use of toothpick for removing food debris. These changes might be responsible for higher sensitivity of wooden spatula examination in the present study.

In developing countries like India for large school setting where number of schoolchildren is more and screening for dental caries is to be done in a single day or two, we need more number of reusable instruments (mouth mirror and probe). If we are having limited number of reusable instruments, it takes time to sterilize these instruments again and again and sometimes in

hurry instruments may remain unsterilized. In this situation wooden spatula and toothpick examination is very useful to screen schoolchildren for dental caries.

Despite being promising, the study has few limitations. In this study only the subjects with dental caries were reexamined with wooden spatula and toothpick, so the examiner may have intentionally searched for caries. However, this does not leave a lower relevance to the study. The diagnosis of hidden or occult caries is difficult,^{19,20} during the examination there may also be an underestimation of proximal caries. Accurate diagnosis of dental caries is more challenging and highly subjective with the visual/tactile method. So the values of sensitivity, specificity, positive predictive value, negative predictive value, false-positive rate, and false-negative rate obtained are comparative rather than absolute.

CONCLUSION

Taking into consideration the substantial cost of mouth mirror and probe, their use as disposables cannot be justified. The study presents important results especially in the context to underdeveloped and developing countries. Wooden spatula and toothpick being disposable reduces few of the public health risks associated with mouth mirror and probe examination. The extra cost of handling and sterilization, and corrosion and rusting of the metal instruments are few of the factors that make their efficacy questionable. So based on the findings of the present study it can be concluded that wooden spatula and toothpick examination can provide an alternative to traditional mouth mirror and probe examination for detecting dental caries in schoolchildren.

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