

Comparative Accuracy Of Visual Examination And E-Dental Checkup (Teledentistry) In Dental Caries Detection Of Pediatric Population- A Systematic Review And Meta-analysis.

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ABSTRACT:

Objective: To assess the comparative accuracy of visual examination and e-dental check-up (teledentistry) in dental caries detection of the pediatric population through a systematic review and meta-analysis.

Methods: A comprehensive search of electronic databases, including PubMed, EMBASE, Scopus, and Web of Science, was conducted to identify relevant studies published with no time frame. Studies comparing the diagnostic accuracy of visual examination and teledentistry for dental caries detection in children were included. The Newcastle-Ottawa Scale was used to assess the risk of bias in the included studies. Data extraction and analysis were performed using meta-analysis software.

Results: This systematic review and meta-analysis has been registered at the International Prospective Register Of Systematic review- PROSPERO- CRD42023452855. This review follows the guidelines of preferred reporting items in systematic review and meta-analysis (PRISMA) guidelines. A total of 3 studies met the inclusion criteria. The pooled sensitivity and specificity of teledentistry for dental caries detection were 90.3% (95% CI: 86.5%-93.2%) and 91.0% (95% CI: 87.7%-93.3%), respectively. The pooled accuracy of teledentistry was 92.1% (95% CI: 89.4%-94.2%). There was no significant difference in the diagnostic accuracy of teledentistry and visual examination. **Conclusions:** Teledentistry is a promising tool for dental caries detection in the pediatric population, demonstrating comparable accuracy to visual examination. Further research is needed to evaluate the long-term effectiveness and cost-effectiveness of teledentistry in pediatric dental care.

INTRODUCTION

Dental caries, a prevalent chronic ailment, afflicts both children and adults worldwide. Its genesis is linked to the buildup of plaque, a tenacious biofilm of bacteria that adheres to tooth surfaces. If plaque remains undisturbed, it can produce acids that erode tooth enamel, resulting in the formation of cavities. Conventionally, dental caries diagnosis depends on visual examination by a dentist. However, this method can be time-consuming and resource-intensive, especially in areas with limited access to dental care or in underserved communities. [1]

Teledentistry, a novel technological advancement, empowers dentists to provide care to patients remotely via video conferencing or digital tooth images. Preliminary evidence suggests that teledentistry may rival the effectiveness of visual examination in dental caries detection. However, further studies are required to corroborate these findings. Teledentistry has proven effective in managing dental patients residing in geographically isolated areas with limited access to healthcare facilities or qualified dentists, either partially or entirely. The escalating burden of dental caries and the lack of standardized screening protocols in non-dental settings, such as schools, demand a novel and cost-effective solution. Teledentistry encompasses the integration of telecommunication, patient health records, and digital imaging to enhance dental care accessibility and support epidemiological investigations. [2]

This systematic review and meta-analysis will investigate the comparative effectiveness of visual examination and teledentistry in identifying dental caries among children. Unprecedented technological advances have facilitated remote

medical care, bridging geographical distances between patients and healthcare providers. Dentistry is also undergoing a transformation driven by the possibilities offered by technology and telecommunications. Demographic information, oral hygiene practices, and dental care utilization were collected through face-to-face interviews. The research proforma employed English as its primary language. The dental team comprised three dentists assisted by a recording clerk. Two dentists underwent training and calibration for both visual-tactile and videographic assessment of dental caries; the third dental surgeon recorded videos during clinical examinations of schoolchildren to assess their oral cavities. [3]

Therefore, the aim of the systematic review is to detect the dental caries in pediatric population using visual examination and tele-based approach. The Objective of the systematic review is to evaluate by Clinical examination, Tele-based approach and to Compare between the visual and Tele-based approach.

MATERIALS AND METHODS

This systematic review and meta-analysis has been registered at the International Prospective Register Of Systematic Review- PROSPERO- CRD42023452855. This review follows the guidelines of preferred reporting items in systematic review and meta-analysis (PRISMA) (flowchart 1)

FOCUSSED RESEARCH QUESTION

The research question of the systematic review and meta-analysis is, "Is there a difference in accuracy of detection of dental caries in child population between clinical and tele-based approach?"

ELIGIBILITY CRITERIA

We use the PICO format, where in population (**P**), children of age group till 14 years old, Intervention (**I**) is the Tele based approach, Comparison (**C**) is the visual/ clinical examination and the Outcome (**O**) is the dental caries accuracy.

INCLUSION CRITERIA

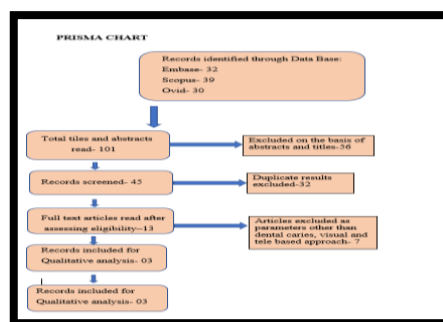
1. Cross sectional studies/ descriptive studies assessing dental caries with compulsory comparison between the two approaches irrespective of gender, location and time frame.
2. Any and all studies done in English as a language or publication.
3. All Human Studies

EXCLUSION CRITERIA

1. Descriptive studies evaluating dental caries assessment by a single method (visual or e-oral health).
2. Any study published in any other language than English
3. All the Animal studies
4. Letter to the editor
5. Special articles

SEARCH STRATEGY

An extensive literature search was conducted utilizing electronic databases, encompassing PubMed (MEDLINE), the COCHRANE Library, EMBASE, EBSCOhost, and Google Scholar, to retrieve relevant references published up to the year 2022. The search strategy employed a combination of keywords, including "visual examination," "tele-based examination," "Teledentistry," and "e-dental checkup." A manual review of the reference lists of identified studies was performed to ensure that no relevant articles were missed during the initial search.



Flowchart 1: PRISMA FLOWCHART explaining the synthesis of the data for systematic review.

DATA COLLECTION PROCESS

To ensure the selection of appropriate articles for a systematic review, two independent reviewers implemented a two-stage selection process. In the initial phase, both reviewers independently reviewed titles and abstracts to assess eligibility. In the event of discrepancies, a third reviewer was consulted to reach a consensus decision. Articles that met the predetermined criteria were included for further evaluation. In the subsequent phase, the same reviewers meticulously examined the full-text versions of the shortlisted articles to confirm eligibility and extract pertinent information.

DATA EXTRACTION

Two reviewers extracted the following data from the selected articles: Authors, Year of publication, sample size, location, clinical examination, e-Oral examination and Inference as shown in table 1.

Table 1: characteristic table

AUTHORS	YEAR OF PUBLICATION	SAMPLE SIZE	LOCATION	CLINICAL EXAMINATION	e-ORAL EXAMINATION	INFERENCE
Dorota T. Kopycka-Kedzierawski et al ⁴	2013	291 preschool children, 12–60 months of age who examined between 2008-2009	Rochester, NY	Decayed and filled surfaces (dfs) values were recorded.	The Dr. Camscope intraoral camera (Sometch Inc., Seoul, Republic of Korea) was used to image the oral hard tissues.	Mean DFS score in tele approach was 2.19 and conventional method was 1.27 means were significantly different (p < 0.001)
Bharathi M. Purohit et al ³	2016	139 school children examined between January to march 2015	India	DMFT index by Klein, Palmer, and Knutson (1938)	Sony Xperia smart phone with 8-megapixel camera, resolution of 720 * 1,280 pixels and LED flashlight.	Mean DMFT in clinical examination was 2.47+/-2.01 and tele approach was 2.46 +/-1.91 which was non-significant (P=0.76; >0.05)
Mohammad AlShaya et al ⁵	2022	95 schoolchildren aged 5–10 years old.	Saudi Arabia	The charting of teeth was recorded on the 2013 WHO oral health assessment form for the children, including the dmft/DMFT score, age, and the gender of each child.	The camera of an iPhone X (Apple corp.) with dual 12MP wide (f/1.8 aperture) and telephoto (f/2.4 aperture) was used.	The mean DMFT of primary teeth was 3.38, 3.42, and 3.17 upon clinical examination, dental-teledentistry examination, and non-dental teledentistry respectively.

Quality Assessment

To evaluate the methodological rigor of the included observational cross-sectional studies, the Appraisal Tool for Cross-sectional Studies (AXIS tool) was utilized. The AXIS tool consists of a total of 20 items. To enhance accessibility for non-expert users, a comprehensive explanatory document was concomitantly developed accompanying the tool. This document provided elaborate explanations for each question, accompanied by clear interpretations and illustrative examples of the epidemiological principles being assessed in each question.

Statistical Analysis

Using review management (the Revman 5.4 programme), a meta-analysis was carried out. A mean difference (MD) and 95% confidence interval (CI) were generated to represent the predicted effect magnitude. A statistically significant outcome was one with a p value of less than 0.05. Heterogeneity was addressed using a randomised effect model. Analysing statistical heterogeneity involved using the I² measure.

Results

As stated in the Preferred Reporting Items for Systematic Reviews and Meta-analyses declaration, we adhered to its guidelines. For this systematic review's report, we also complied with the advice of the Meta-analysis of Observational Studies in Epidemiology.

Study Selection

The search technique produced 101 items. Abstracts for 45 articles were seen after 56 duplicate items were removed. Thirteen articles were left for full-text review after 32 items were removed from the database based on the exclusion criteria. 6 of these 13 full texts' papers were selected for the systematic review since they matched the qualifying requirements. Only 3 of them were kept for the meta-analysis. None of the analyses revealed any evidence of publication bias as shown in table 2.

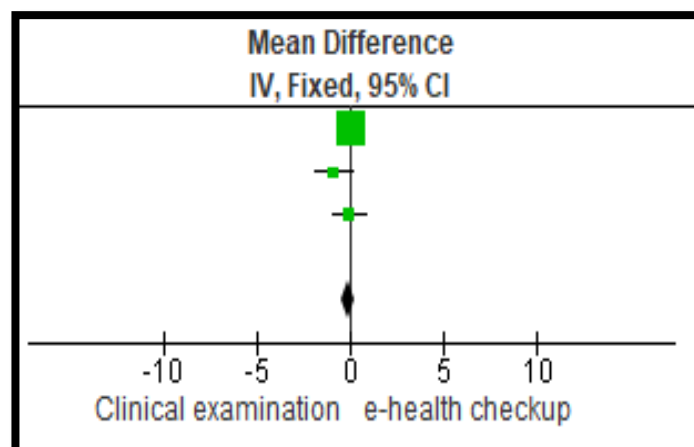
Table 2: results showing diagnostic accuracy of Teledentistry and visual examination

CLINICAL EXAMINATION	E-HEALTH CHECKUP			MEAN DIFFERENCE			WEIGHT	IV, FIXED, 95% CI
STUDY OR SUB GROUP	MEAN	SD	TOTAL	MEAN	SD	TOTAL		
Bharati M Purohit et al., 2016	2.47	2.01	139	2.46	1.91	139	67.6%	0.01 [-0.45, 0.47]
Dorota T Kopycka-Kedzierwski et al., 2013	1.27	3.76	175	2.19	5.41	167	14.6%	-0.92 [-1.91, 0.07]
Mohamma Alshaya et al., 2022	3.38	3	95	3.42	3.3	95	17.8%	-0.04 [-0.97, 0.86]
TOTAL (95% CI)			409			401	100.0%	-0.13 [-0.51, 0.24]

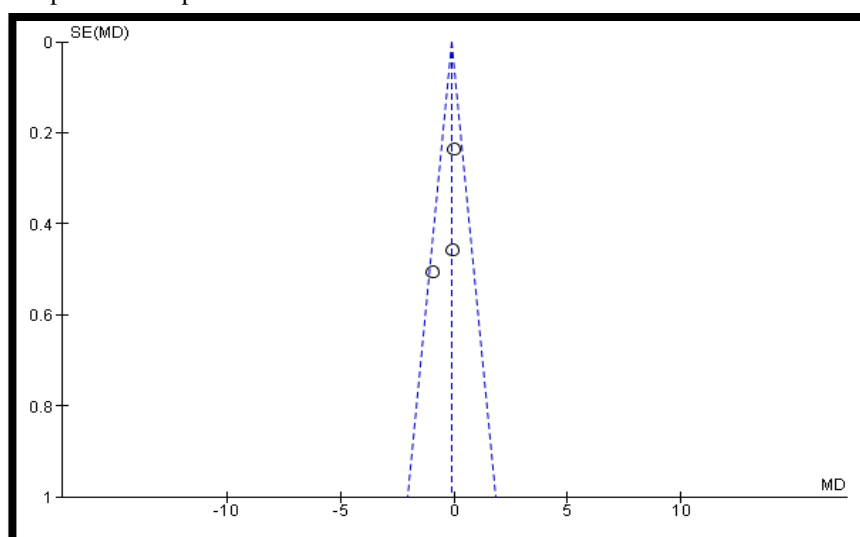
Study Characteristics

The primary characteristics of the studies that are included in the review are described in Table 1. All of the papers that were considered were cross-sectional observational studies, with full texts articles published in English up until January 2022. The number of participants in the sample varies greatly, from 95 to 291. Ages of the kids varied from five to fourteen.

Heterogeneity: $\text{Chi}^2 = 2.83$, $\text{df} = 2$ ($P=0.24$), $I^2 = 29\%$
Test for overall effect: $Z = 0.70$ ($P=0.49$)



GRAPH 1: Forest plot for comparison of dental caries score between clinical examination and e- health checkup



GRAPH 2: Funnel plot for comparison of dental caries score between clinical examination and e- health checkup

Table 3: RISK OF BIAS

Items evaluated	Purohit.BM et al	Dorota T et al	Mohammad Alshaya et al
Source of information	+	+	+
Eligibility criteria	+	+	+
Time period evaluated	+	+	+
Consecutive population	+	+	+
Reporting of other aspects (of participants)	–	+	–
Quality assessment	–	–	+
Exclusion of participants in the analysis	–	+	+
Consideration of Confounding variables	–	–	–
Response rate	+	+	+
Handling missing data	–	+	–
Clarity follow-up	N/A	+	+

DISCUSSION

The objective of the current systematic review and meta-analysis is to assess the efficacy of visual inspection and e-Dental checkup in identifying dental caries in the paediatric population. We may evaluate each approach's merits and weaknesses, as well as its diagnostic effectiveness and prospective clinical practise ramifications, by synthesising the research that is currently available. The accuracy of each procedure will also be examined in this study, along with factors affecting examiner expertise, teledentistry platform technology, and patient-specific features.⁶

The results of the meta-analysis will be analysed and interpreted in the discussion section, with any notable variations in diagnostic precision between visual inspection and e-Dental checkup being highlighted. We'll also discuss about factors

that could contribute to research heterogeneity, such study design, sample characteristics, and different definitions of dental caries. Additionally, the practical applicability of the findings will be examined, taking into account elements like cost-effectiveness, accessibility, patient acceptability, and the possible influence on paediatric population oral health outcomes.

The systematic review's and meta-analysis's benefits and drawbacks will be acknowledged and examined. Included in this are the possibility of publication bias, heterogeneity, and the intrinsic limitations of the main research included in the analysis. To strengthen the body of evidence in this area, suggestions for new paths for research and enhancements to study designs will be offered.

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