Availability and Content Analysis of Smartphone Applications on Conservative Dentistry and Endodontics Using Mobile Application Rating Scale (MARS)

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Abstract

Purpose of Review A large number of smartphone applications bring with it cluttering and distorted information. Hence, the aim of this review was to critically evaluate conservative dentistry and endodontics apps among mobile phone apps. Furthermore, the objective was to assess the quality of apps using the Mobile App Rating Scale (MARS). Mobile applications were explored on the Apple App Store (AAS) and Google Play Store (GPS), using search terms and content analysis done using the MARS rating scale which is divided into three categories: app overall quality, app subjective quality, and app specific quality. Statistical analysis used Pearson’s correlations analyzed correlations between app scores and downloads/ratings and ANOVA, to analyze any differences between app focus and mean scores.

Recent Findings Overall MARS scores ranged from 2 to 4.68 with a mean (SD) of 3.40 (0.79). The highest mean score in engagement (4.8/5) and highest esthetic mean score (4.6/5) were noted with an app named “Denticalc.” The highest functionality score (4.88/5) and information domain (4.7/5) belonged to the “AAE Endocase” app. A positive correlation was seen among average user rating score with app subjective mean score and overall mean scores.

Summary To improve the overall quality of apps, developers must take into account both engaging and necessary features with high-quality, evidence-based information.

Keywords Dental caries · mHealth · Mobile app · Mobile health · Oral health

Introduction

Mobile phones are the most ubiquitously available of all electronic devices in current times with three-fourths of the world’s population owning a mobile phone [1•]. Smartphone applications (apps) that can be downloaded on these phones can be remarkably beneficial in dentistry, in diagnosis, and prevention, as a substantial amount of diagnosis requires visual examination, and that most of the dental diseases are preventable through self-management [1•, 2•]. Students use a few apps for references as well as for preparing for competitive exams. There are apps to be used as for guiding patients on dental diseases and some, about available dentists in their vicinity. Few practice management apps assist in appointment scheduling, and a few have advices on procedures/medications, thereby saving a great deal of time for dental practitioners [3, 4, 5•, 6•]. Apps also act as an easy and effortless way to convey important information to the public that too with minimal capital involvement and at the convenience of targeted audience. Hence, we presume
that mobile phones are a promising approach for reaching the public to deliver relatively free oral health education and promotion apps as well as assisting professionals in their diagnosis and decipher competitive exams [7, 8]. In many countries like India and USA, legislations have permitted the use of telemedicine so as to use apps for healthcare provision and prevention [9•].

However, the major shortcomings of apps are misinformation and enormous number leading to cluttering and distorted information. What is more, there are no universal guidelines that keep a check on their quality. Though there are many apps for conservative dentistry and endodontics, barely any information is available on their contents and efficiency. Furthermore, rankings in app stores are extremely unstable and mostly based on app usability alone.

Hence, to address this gap in the literature and apprise future oral health developments, the aim of the present review was to critically evaluate conservative dentistry and endodontic apps among mobile phone apps. The objective was to assess the quality of apps using the Mobile Application Rating Scale (MARS).

MARS is a simple index and has a combinative measure of app quality indicators of engagement, functionality, esthetics, and information quality, besides the app subjective quality [10•]. By using MARS scale, we intend to assess the content and usability of each app and analyze the features in terms of engagement, functionality, esthetics, and information quality of conservative dentistry and endodontic apps.

Materials and Methods

Our study was registered with KH-IEC 313–2021 Institutional ethics committee and had devised a method of review where we provide an overview of smartphone applications designed for conservative dentistry and endodontics through application stores: Google Play Store and Apple App Store of mobile platforms Android and Apple, respectively.

Search Strategy

Mobile applications were explored on the Apple App Store (AAS) and Google Play Store (GPS), using the following search terms, “endodontics,” “conservative dentistry,” “dental filling,” “dental caries,” “tooth filling,” “root canal treatment,” “cavity,” “caries,” “restorative dentistry,” “restoration,” and “dental restoration.” We restricted our search to applications released or updated for conservative dentistry and endodontics till 30 June 2022 and carefully selected applications based on their title, app description, and its functions related to conservative dentistry and endodontics and then completed content analysis of those mobile apps.

Inclusion and Exclusion Criteria

Apps that intended to provide knowledge on conservative dentistry and endodontics available for use in English were included in the search. Irrelevant apps (i.e., gaming apps, tooth brushing timer apps, and apps not in English) were removed. Duplicate apps, including earlier versions, were also removed. Apps with both “lite” and “full” versions were considered as separate since information available would be different in both. The remaining apps were then downloaded and reviewed through comprehensive assessment independently by two reviewers both based in India and with access to these applications.

General Characteristics of Apps

All qualified apps after the inclusion criteria were downloaded on the Android (Galaxy Note 10 Lite) and the iOS platform (iPhone 6S). General characteristics of the apps, including the app name, app developer, date of last update, platform (Google Play Store or Apple App Store), cost, star rating, affiliations, target population, and focus of app adapted from the classification section of MARS tool [10•].

Quality Assessment of the Apps

Data was extracted from each app, and content analysis was done using the MARS rating scale [10•]. The MARS evaluation tool is divided into three categories: app overall quality, app subjective quality, and app specific quality. Engagement, functionality, esthetics, information, and subjective quality of mobile apps were measured using 23 questions. In addition, there are six final app specific questions that can be tailored to represent the target health behavior/function of the application/study. The mean scores for each of the four subscales (engagement, functionality, esthetics, and information) were calculated, and the mean scores of those subsections, used to rate the total quality score of the app ranged from zero to five. Hence, the overall score on these subscales would range from zero to five, and we would develop an average score by dividing the total sum score by four, i.e., four domains. The app subjective quality section and app specific section was calculated similarly. These, however, were regarded separate from the app quality score. Reviewers underwent training in the use of MARS using video named “The Mobile App Rating Scale (MARS) and its Application to the Development of a Youth” available on the Centre for Technology and Behavioral Health Seminar series public domain [11] which was followed by review practice of an app separately by two reviewers and scores evaluated to assess consensus. Disagreements were discussed with a third
reviewer from whom clarifications were sought to ensure full comprehension of scale [10•].

Statistical Analysis

Interrater agreement between two raters was computed using Kendall’s coefficient of concordance. Pearson’s correlations analyzed correlations between app scores (total score app-quality/mean score) and downloads/ratings. ANOVA was performed to analyze any differences between app focus and mean scores (overall MARS score, app subjective mean score, and app specific mean score) with a p value of <0.05 considered as significant.

Results

Our search with the selected keywords in Google Play Store and Apple App Store to retrieve apps for Android and iOS platforms resulted in 381 conservative dentistry and endodontics related apps. These apps were screened for eligibility after removing the duplicates which were present as the apps were obtained from two different platforms. The screening process was done based on the inclusion and exclusion criteria. After the process was carried out, only 37 apps met our criteria and were included in this review. Figure 1 depicts an overview of the selection process and categories for exclusion. Majority of the apps were excluded because they were not pertaining to usable information related to conservative dentistry and endodontics; few were games, few were online dental products stores, and few were not available in English.

Overview of Characteristics of Apps

Out of the 37 selected apps, 16 apps (43%) were targeted for patients, 14 (38%) were aimed to be used by dental professionals, and 7 (19%) were aimed for dental students’ use (Fig. 2). It was also noted that out of these 37 apps, 30 apps (81%) were completely free to be used in their maximum potential, whereas the remaining 7 apps (19%) had payments to be made for upgrading them to the version which gave full access to its contents and usability.

![Flowchart of apps identification through systematic screening of available apps for conservative dentistry and endodontics](image-url)
Of the 37 selected apps, 11 of them (30%) were focussed only on conservative dentistry (restorative aspect), 7 of them (19%) were exclusively for endodontics, and 19 of them (51%) were focussed both on conservative dentistry as well as endodontics. Eighteen apps out of the chosen 37 were available only on Android mobile platform (Google-based mobile platform), 2 apps (5%) were available exclusively on iOS mobile platform (developed for Apple devices), and 17 apps (46%) were available on both Android as well as iOS platforms.

As far as star rating was concerned, it was again noted that more than half of the selected apps were not rated by users. Of the total 37 apps under analysis, 22 (59%) were not rated in the app store. Out of the available ratings present, the maximum rating noted was 4.9/5, the least was 3.0/5, and the average rating was 4.04/5. Majority of apps, 17 (46%) had their country of origin not revealed on app stores. Four (11%) confirmed their origin from the USA, 4 (11%) from the UK, 3 (8%) of Indian origin, and 1 app each from Singapore, Switzerland, Kingdom of Saudi Arabia, Australia, Georgia, Belgium, Germany, and Spain (Fig. 3).

The focus of majority of apps was noted to be information distribution (60%), followed by clinical assistance for dental professionals (16%), apps for patient demonstration purposes (8%), self-assessment apps (8%), and clinic record management (5%) with few of them having multiple foci present (Fig. 4).

**Evaluation Analysis of Apps by MARS**

All apps ($n = 37$) were evaluated and rated by two evaluators independently. Kendall’s coefficient of concordance showed a good agreement between two evaluators (0.83).
Table 1 gives a general description of the chosen apps. Overall MARS scores ranged from 2 to 4.68 with a mean (std. deviation) of 3.40 (0.79). Table 2 describes the rated apps along with their country of origin, developer titles, available platforms for functioning, app ratings, focus, and if their upgraded versions were free or paid. Table 3 represents the ratings made by the evaluators as per MARS scale which are marked based on engagement, functionality, esthetics, and information. It also shows the app overall score, app subjective mean score, and app specific mean score of the included apps as per MARS scale.

The highest engagement mean score (4.8/5) and highest esthetic mean score (4.6/5) were noted with an app named “Denticalc.” The highest average score in functionality (4.88/5) as well as in information domain (4.7/5) belonged to the app named “AAE Endocase.” Overall app quality mean score was highest (4.42/5) for the app “AAE Endocase” and least (2/5) for the app named “Dental Shade Navigator.” Overall app subjective quality mean score was highest (4.75/5) for the app named “EndoApp,” and the least (1/5) was noted for two apps, namely, “Dental Shade Navigator” and “Dentistry ProConsult” (Table 3). In the app-specific domain, 2 apps, namely, “EndoApp” and “All dental disorders” scored the highest (5). “Intact tooth app” bore the least score (1/5) in the app-specific domain.

Moving onto the quality appraisal of apps, 26 (70%) were considered to be of a high quality, determined by reaching the minimum overall MARS threshold score of 3.0 out of 5.0. MARS quality rating for each of the 26 apps found that 21 (81%) apps scored above 3.0 in all 4 subscales of MARS scale. The results also did not indicate that any single item in either of the 4 MARS subscales stood out. App quality assessments and ratings using MARS also revealed that the mean overall MARS score obtained was 3.40 of 5. Out of 37 apps, 10 apps (27%) had a score above and equal to 4, most of which were from the information dissemination categories, whereas 11 apps (30%) had a score of less than 3 (Table 3).

One-way ANOVA was done to measure any difference in the mean scores (overall MARS score, app subjective mean score, and app specific mean score) and the target areas (conservative dentistry, endodontics, or both). Significant differences are found in the app subjective mean scores among target areas. Tukey’s post-hoc revealed a significantly higher scores for conservative dentistry apps compared to endodontic apps (Table 4).

Pearson product-moment correlation was run to determine the relationship between average user rating and overall MARS score. There was a moderate, positive correlation between average user rating and overall MARS score, which was statistically significant ($r = 0.385, n = 37, p = 0.027$). Implying that, average user ratings were correlating with the MARS scores, whereas no correlation was seen between the overall MARS score and the number of downloads ($r = 0.272, n = 37, p = 0.08$).

A significant, moderate, positive correlation was found between app subjective mean score and average user rating score ($r = 0.483, n = 37, p = 0.047$). But there was no correlation between number of downloads and app subjective mean score ($r = 0.315, n = 28, p = 0.051$).

**Discussion**

Thirty-seven apps were identified by this review as being useful for learning more about conservative dentistry and endodontics via mobile applications or apps. In this review, most of them focussed on information distribution (60%), followed by clinical assistance (16%), and patient education (8%). More than half (26/37, 70%) of the apps were considered high quality (based on the overall MARS) across all 4 subscales of MARS.

Information distribution apps mainly focussed in providing knowledge and awareness to dental professionals, dental students, and patients as well, whereas clinical assistance apps enabled dental health professionals in aiding to assess and manage various clinical scenarios giving rise to a more predictable and reality-based decision, thereby concentrating on enhancing prognosis, minimizing unforced injury, and lowering the risk of potential consequences. The apps we looked at showed above-average quality overall. The average score was found to be the highest in functionality subscale.
| Sl No | App name                                   | Country            | Developer                | Platform       | Last update  | App rating | Focus                                                                 | Cost–upgrade version |
|-------|--------------------------------------------|--------------------|--------------------------|----------------|--------------|------------|----------------------------------------------------------------------|----------------------|
| 1     | Cariogram – Caries Risk Assessment         | Singapore         | AppBites                | Android, iOS   | 13-Oct-2019 | N/A        | Self-assessment                                                       | free                 |
| 2     | CavSim – Dental Cavity Preps (Paid)        | England            | Light Arc Studio        | Android, iOS   | 26-Nov-2014 | N/A        | Information distribution                                              | paid                 |
| 3     | CavSim – Dental Cavity Preps (Trial)       | England            | Light Arc Studio        | Android, iOS   | 26-Nov-2014 | 3.7/5      | Information distribution                                              | paid                 |
| 4     | Dental diagnosis and patient education aid – Dentalk | N/A | Educational-Hub | Android, iOS | 11-Dec-2018 | 3.0/5      | Information distribution                                              | free                 |
| 5     | MI Dentistry CRA                           | N/A                | echodononto             | Android, iOS   | 31-Oct-2020 | N/A        | Self-assessment                                                       | free                 |
| 6     | Tooth Decay Advice                         | N/A                | moreFlow                | Android        | 7-Apr-2018  | N/A        | Information distribution                                              | free                 |
| 7     | AAE EndoCase                               | USA                | American Association of Endodontists | Android, iOS | 01-Mar-2020 | N/A        | Clinical assistance, Search for dentists                             | free                 |
| 8     | EndoApp                                    | N/A                | Equipe EndoApp          | Android        | 30-Dec-2019 | N/A        | Information distribution                                              | free                 |
| 9     | Xpert’s RCT                                | Switzerland        | Abbott                   | Android, iOS   | 16-Jul-2020 | N/A        | Patient demonstration purposes                                        | free                 |
| 10    | Endolit                                    | N/A                | Adham Abdel Azim        | Android, iOS   | 29-Jul-2022 | 4.5/5      | Information distribution                                              | free                 |
| 11    | All dental disorders                       | N/A                | Sangurabi                | Android        | 24-Aug-2020 | N/A        | Information distribution                                              | free                 |
| 12    | Basic dental surgery                       | N/A                | Salina Akter            | Android        | 20-Dec-2017 | 4.9/5      | Information distribution                                              | free                 |
| 13    | Dental Plus                                | Kingdom of Saudi Arabia | Dental Plus            | Android        | 18-Apr-2021 | N/A        | Information distribution                                              | free                 |
| 14    | Dental school                              | India              | Harshjeet expo          | Android        | 20-Jun-2022 | 3.6/5      | Information distribution                                              | paid                 |
| 15    | Dental Simulator                           | N/A                | Gamescamp               | Android, iOS   | 15-Jul-2022 | 3.3/5      | Information distribution                                              | paid                 |
| 16    | Denteach                                   | N/A                | IHApps                   | Android        | 21-May-2017 | 4.6/5      | Information distribution                                              | paid                 |
| 17    | Learn Dentistry                            | USA                | SuperSimple Video       | Android        | 16-May-2020 | 3.3/5      | Information distribution                                              | free                 |
| 18    | Cavity Guide                               | N/A                | Everyone Learning Apps  | Android        | 28-May-2020 | N/A        | Information distribution                                              | free                 |
| 19    | Dental caries tips                         | N/A                | Free Apps For Everyone  | Android        | 28-May-2020 | N/A        | Information distribution                                              | free                 |
| 20    | Dentist G                                  | India              | Gaurav Dixit            | Android        | 27-Mar-2017 | N/A        | Information distribution                                              | free                 |
| 21    | Dental Shade Navigator                     | N/A                | Pantelis Kouros          | Android, iOS   | 28-Sept-2020 | N/A        | Clinical assistance                                                   | free                 |
| 22    | Intact tooth                               | United Kingdom     | AddWare Europe Ltd      | Android        | 13-June-2022 | N/A        | Clinical record management, Clinical assistance                       | free                 |
| 23    | Oral hygiene and dental care               | N/A                | Fumo                     | Android        | 12-Apr-2020 | N/A        | Information distribution                                              | free                 |
| 24    | Quick Dental Guide                         | N/A                | Dr.SKY                   | Android        | 09-Oct-2020 | 4.5/5      | Information distribution                                              | free                 |
| 25    | Tooth SOS                                  | USA                | International Association of Dental Traumatology | Android, iOS | 24-Nov-2021 | 4.2/5      | Information distribution, Self-assessment                             | free                 |
| 26    | Treatment of tooth decay                   | N/A                | Digital Planete Space    | Android        | 1-June-2018  | N/A        | Information distribution                                              | free                 |
| 27    | Dental Desk                                | India              | Sanket Palkar           | Android        | 8-April-2015 | N/A        | Information distribution                                              | free                 |
but the least average scores were of the information subscale followed by engagement. This demonstrates how most apps prioritize their functionality over quality of information they present and the features that make the app equally compelling and crucial for a larger user base. In addition, only 5 out of the 37 apps evaluated had features that overlapped (information distribution with patient demonstration purposes and clinic record management). This was carried out to encourage widespread use of the app.

Quality Appraisal of Apps

MARS was used to evaluate the 37 English language apps, and the results showed a range of mean ratings from 2.0 to 4.68 which belonged to the “Dental Shade Navigator” and “Denticalc,” respectively (out of 5). No app received the overall score maximum score of 5. EndoApp, Denticalc, and GC Restorative Guides were the only 3 apps who obtained a score of 4 and above (out of 5) in all the 4 subscales of the MARS evaluation scale, demonstrating that it is possible to create apps that it is able to provide good information and be esthetically appealing. Therefore, our review indicates an opportunity for future high-quality app development that addresses a range of dental concerns and alongside a consideration for improving the quality of information as well as engaging features to support this target population. The functionality subscale obtained the largest score, which dealt mainly with the performance of app functioning, app usage ease, navigation within various screens of the app, and the gestural designs used for interactions within the app to toggle between screens. Also, the least score was found to be for the information subscales, which were evaluated based on the description in app store, specific goals of an app, quality and quantity of information provided, visual information quality, and app source credibility along with evidence-based approach in developing the app. This showed that considerations need to be given while designing such apps. The main concern was evaluating and assessing the quality of information along with representing it in an apt manner so that it could be of maximum benefit to the intended target population.

The engagement and esthetic scores were lower in other researches employing MARS for quality assessment (Mobile Applications for Management of Tinnitus).

| Sl No | App name                  | Country    | Developer                        | Platform   | Last update    | App rating | Focus                                                                 | Cost–upgrade version |
|------|---------------------------|------------|----------------------------------|------------|---------------|------------|----------------------------------------------------------------------|---------------------|
| 28   | Endoprep app              | Australia  | Dental Sciences Australia Pty Ltd | Android, iOS | 21-June-2022  | 4.5/5      | Information distribution, Clinical assistance                       | free                |
| 29   | Denticalc                 | United Kingdom | DentiCalc                   | Android, iOS | 30-Mar-2021   | 4.5/5      | Information distribution, Clinic record management                 | paid                |
| 30   | Dentistry ProConsult      | Georgia    | Augusta University            | Android, iOS | 12-May-2011   | 4.0/5      | Information distribution                                            | free                |
| 31   | Dentistry Today—Events, Live videos | N/A      | Dentistry Today Inc         | Android, iOS | 11-Jan-2020   | N/A        | Clinical news source                                                | free                |
| 32   | GC Restorative Guides     | Belgium    | GC Europe NV                  | iOS        | 10-Feb-2021   | 3.4/5      | Clinical assistance                                                  | free                |
| 33   | Denthelp                  | N/A        | Denthelp As                   | Android     | 19-Mar-2021   | N/A        | Information distribution                                            | paid                |
| 34   | Precision Endodontics—FAQ with video | USA | Accelerate Marketing Inc -     | iOS        | 8-Nov-2016    | N/A        | Information distribution, Patient demonstration purposes          | free                |
| 35   | DentalNavi/Dental Navigator | Germany | Dr.Jean Bausch GmbH & Co.KG | Android, iOS | 14-Apr-2016   | N/A        | Information distribution, Patient demonstration purposes          | free                |
| 36   | Ingle Odonto              | Spain      | Target Tecnologia             | Android     | 19-Feb-2021   | N/A        | Clinical assistance                                                  | free                |
| 37   | Dental clinical mastery   | USA        | Higher Learning Technologies Inc | Android, iOS | 26-Jul-2022 | 4.6/5      | Information distribution                                            | free                |

N/A, not available
and Apps for Asthma Management [13]), indicating that this element is less taken into account in the design of health management apps. Regarding our outcome, it shows that in chronic dental diseases like caries or dental abscess formations, which need both immediate as well as elective intervention, engagement and information sections were given less importance compared to esthetics or functionality scores. This needs to be improved in the upcoming versions and in newer apps. For instance, in apps such as “learn dentistry” and “dental school,” advertisements were displayed while navigating from one page to another. This made usability not only cumbersome but also very frustrating as skipping ads to view usable content consumed the majority time spent while using the app. Another example is that of the app “Dentist G” whose navigation sequence is confusing. The app opens initially into a screen displaying “baby teeth” and “adult teeth” as available options following which it leads you to a page

| Sl. No | App Name | Engagement | Functionality | Esthetics | Information | App overall score | App subjective mean score | App specific mean score |
|-------|----------|------------|---------------|-----------|-------------|-------------------|--------------------------|------------------------|
| 1     | Cariogram – Caries Risk Assessment | 3.3 | 4 | 2.67 | 2.98 | 3.33 | 2.5 | 4.4 |
| 2     | CavSim – Dental Cavity Preps | 3.6 | 4.5 | 4.33 | 2.5 | 3.73 | 2.25 | 2 |
| 3     | CavSim – Dental cavity trial | 3.6 | 4.5 | 4.33 | 2.5 | 3.73 | 2.25 | 2 |
| 4     | Dental diagnosis and patient education aid – Dentalk | 3.8 | 3.5 | 4.00 | 3.67 | 3.74 | 4 | 4.4 |
| 5     | MI Dentistry CRA | 3.8 | 4 | 3.83 | 3.82 | 3.92 | 3.62 | 4 |
| 6     | Tooth Decay Advice | 2.8 | 3.63 | 3.17 | 2.01 | 2.60 | 1.38 | 3.6 |
| 7     | AAE EndoCase | 4.4 | 4.88 | 3.83 | 4.70 | 4.42 | 4.25 | 4.4 |
| 8     | EndoApp | 4 | 4.25 | 4.33 | 4.16 | 4.40 | 4.75 | 5 |
| 9     | Xpert’s RCT | 2.5 | 2.63 | 2.00 | 2.18 | 2.22 | 1.25 | 1.25 |
| 10    | Endolit | 4.2 | 3.5 | 3.67 | 3.86 | 3.62 | 4.5 | 3.5 |
| 11    | All dental disorders | 3.3 | 4.25 | 3.17 | 4.04 | 4.17 | 3.62 | 5 |
| 12    | Basic dental surgery | 2.5 | 3.25 | 2.67 | 2.98 | 3.40 | 2.63 | 3 |
| 13    | Dental Plus | 4 | 3.75 | 4.00 | 2.64 | 2.98 | 3.13 | 4.5 |
| 14    | Dental school | 3.1 | 2.5 | 2.67 | 2.67 | 3.01 | 1.88 | 3 |
| 15    | Dental Simulator | 4.2 | 3.88 | 4.50 | 3.95 | 3.72 | 4.5 | 3 |
| 16    | Denteach | 3.9 | 4.5 | 4.17 | 3.65 | 3.77 | 3.88 | 3.25 |
| 17    | Learn Dentistry | 1.9 | 3.5 | 2.17 | 2.24 | 2.11 | 1.88 | 3.25 |
| 18    | Cavity Guide | 1.8 | 3.125 | 2.33 | 2.12 | 2.62 | 1.13 | 2.25 |
| 19    | Dental caries tips—Dental caries guide | 2 | 3.25 | 2.50 | 2.18 | 2.31 | 1.63 | 2.25 |
| 20    | Dentist G | 3.5 | 3.88 | 3.67 | 4.05 | 4.27 | 4.13 | 3.75 |
| 21    | Dental Shade Navigator | 2.4 | 1.75 | 2.00 | 1.83 | 2.00 | 1 | 2 |
| 22    | Intact tooth | 3 | 2.5 | 2.67 | 2.00 | 2.54 | 1.75 | 1 |
| 23    | Oral hygiene and dental care | 2.1 | 3 | 2.33 | 2.23 | 2.67 | 2 | 3 |
| 24    | Quick Dental Guide | 3.3 | 3.875 | 3.83 | 4.25 | 4.21 | 3.88 | 4.25 |
| 25    | Tooth SOS | 3.6 | 4 | 4.00 | 4.50 | 4.03 | 4.25 | 4.25 |
| 26    | Treatment of tooth decay | 2.2 | 3.5 | 2.00 | 2.16 | 2.65 | 1.5 | 1.5 |
| 27    | Dental Desk | 3.8 | 5 | 4.00 | 4.00 | 4.20 | 3.75 | 3.6 |
| 28    | Endoprep app | 3.8 | 4.25 | 4.00 | 4.00 | 4.01 | 4.25 | 3.25 |
| 29    | Denticalc | 4.8 | 4.75 | 4.67 | 4.50 | 4.68 | 5 | 4.6 |
| 30    | Dentistry ProConsult | 1.8 | 1.8 | 1.80 | 1.80 | 2.4 | 1 | 3 |
| 31    | Dentistry Today—Events, Live videos | 3.6 | 3.6 | 3.60 | 3.60 | 3.6 | 4 | 4 |
| 32    | GC Restorative Guides | 4.4 | 4.4 | 4.40 | 4.40 | 4.2 | 3.5 | 4 |
| 33    | Denthel | 3.6 | 3.6 | 3.60 | 3.60 | 3.3 | 3.75 | 4 |
| 34    | Precision Endodontics—FAQ with video | 3 | 3 | 3.00 | 3.00 | 3.1 | 2.75 | 4 |
| 35    | DentalNavi/Dental Navigator | 3.6 | 3.6 | 3.60 | 3.60 | 3.5 | 4 | 4 |
| 36    | Ingle Odonto | 3.2 | 3.2 | 3.20 | 3.20 | 3.3 | 4 | 4 |
| 37    | Dental clinical mastery | 3.6 | 3.6 | 3.60 | 3.60 | 3.5 | 3 | 4 |
where there are neither directions to navigate further nor provides any information. The information contained in the app has to be organized so that users are aware what the app can provide. A similar observation was made with another app named “Intact tooth” in which data in the app are highly unorganized and the app upon opening just leads to a page with no navigations or aid on how to access to information held in it. We later found out that the information was summarized on the left-hand side under various headings which had to be combed for. “Dentist G” also had pictures that were not stretched according to scale giving rise to less esthetic presentation to the user. This could have been avoided by careful graphical assessment and adjustments. We also came across another app named “DenTeach” which required internet connection even to navigate through the various pages of the app as though whole app was being accessed on cloud storage. This in turn decreased the fluidity in usage of app, leading to the users having to wait for each page to load and then obtain or access the required information offered by the app. Yet, another graphical discontent was noted with the app, “Oral Hygiene and dental care,” which consisted of variable font sizes within the same paragraph. This often led to a displeasing experience as we had to constantly resize the content as we were scrolling down while accessing the data provided in the app. The app named “Xpert’s RCT” also had a troubled navigation sequence. It always opened with the camera on/live, and the camera remained active even while showing demonstrating the app videos which did not clearly serve any purpose and was noted as a pointless function as far as the functionality of app was concerned.

It is noteworthy to notice that several nations are developing mobile health infrastructure to make health advisory and information easily accessible to patients and the general population. To improve the overall quality of apps, developers must take into account both engaging and necessary features with high-quality, evidence-based information. The declining average information and engagement scores point to possible areas that could use improvement. To determine whether using these applications has a good impact on the user and improves their knowledge and attitudes about oral hygiene, more research should be done in the countries where these apps are used. This can aid both dental professionals as well as patients in being aware of availing better dental services when required.

### Strengths and Limitations

This review was the first to identify and assess available English mobile apps in the field of conservative dentistry and endodontics. Both the Apple mobile operating system as well as Android platforms were used to try out apps. Since our review offers a thorough evaluation of all mobile apps across both popular mobile platforms, determining the key scientific features of mobile applications that should be used in design and engagement is still extremely important to ensure that the right information is delivered to the public health community. Given that this review is the first to examine applications related to endodontics and conservative dentistry, it felt like the best course of action to look at the applications that people are currently using for their oral health and concerns in the beginning. The MARS scale’s psychometric qualities have been demonstrated to be valid and reliable; therefore, using this tool gives our review profound strength [10•].

For the purpose of planning future research, it is important to take into account the limitations of this review. We only had access to 37 English language apps despite the fact that there are many other nations’ app stores offering many more search-related apps. A handful of them required registration in order to use the app, phone numbers, or country code which limited the usage of them to only certain countries. Apps changes and updates are dynamic. Many of the apps assessed may have been upgraded to newer versions since the MARS evaluation was conducted. The results of this research could be affected by updates to the most recent versions since new functionality could have been added or esthetic components could have been modified which can

### Table 4 One-way ANOVA performed to note differences in the mean scores (overall MARS score, app subjective mean score, and app specific mean score) and the focus areas

|                          | Sum of squares | df | Mean square | F    | Sig   |
|--------------------------|----------------|----|-------------|------|-------|
| Overall MARS score       |                |    |             |      |       |
| Between groups           | 2.074          | 2  | 1.037       | 1.813| .179  |
| Within groups            | 19.452         | 34 | .572        |      |       |
| Total                    | 21.527         | 36 |             |      |       |
| App subjective mean score|                |    |             |      |       |
| Between groups           | 14.027         | 2  | 7.013       | 6.089| .005* |
| Within groups            | 39.162         | 34 | 1.152       |      |       |
| Total                    | 53.189         | 36 |             |      |       |
| App specific mean score  |                |    |             |      |       |
| Between groups           | 4.515          | 2  | 2.257       | 2.246| .121  |
| Within groups            | 34.172         | 34 | 1.005       |      |       |
| Total                    | 38.687         | 36 |             |      |       |

*Significant at p value <0.05
bring about a change in the results evaluation to this given point. The likelihood is unavoidable given how quickly apps are created and modified. Additionally, given the scope of the review, we did not include end-user assessments of these apps, which may vary from our evaluation of apps. Finally, since the number of downloads for a single app may vary across locations and depend on particular laws and rules, this should not be used as the only indicator of an app’s quality.

**Conclusion**

Smartphone applications have the power to better provide patients with preventive and clinical care while also limiting the spread of myths about dental problems and effective treatment alternatives. The spread of quality information and knowledge through smartphone applications for conservative dentistry and endodontics is sparse.

Further well-designed clinical trials to determine the clinical efficacy of apps should be undertaken. These clinical trials should have a clear clinical question with a good study design and be a randomized controlled trial where possible, with defined measurable health outcomes and a complementary economic evaluation. Clinical effectiveness shown through improvements in measurable health outcomes will facilitate a more widespread adoption of such useful apps and other effective apps in clinical practice. The quality of information that is disseminated using these mobile applications has to be thoroughly assessed by the developers as well as the collaborators to prevent the spread of misinformation to the general public.

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**Declarations**

**Informed Consent**  Not applicable.

**Conflicts of Interest**  The authors declare no competing interests.

**Human and Animal Rights**  Not applicable.

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