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Usefulness of smartphone based communication in improving oral hygiene in patients undergoing orthodontic treatment: Systematic review and meta-analysis

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***Abstract*---**The Digital revolution has led to a paradigm shift in industries including health care. Difficulty to clean between the teeth, lack of motivation and dietary factors are significantly associated with dental caries in patients undergoing orthodontic treatment. This study assessed the effectiveness of mobile phone applications in improving oral hygiene care and oral health outcomes in patients undergoing fixed orthodontic treatment. Within the available evidence, a recommendation can be made for the use of mobile applications in the orthodontic process care.

***Keywords*---**dental plaque, gingival index, orthodontics, reminder systems, smartphone, text messaging, plaque index.

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Introduction

Oral health is considered as the gateway to the systemic health. Once we start ignoring oral health it will leave a dreadful impact to the patients during the pre-operative Orthodontic procedures as well as post Orthodontic treatment which most of the times lead to local and systemic problems.(1) Many studies have been done and have confirmed that bad oral health during the Orthodontic treatment will cause white spot lesions, caries, resorption of root, mobility of teeth and poor gingival and periodontal health.(2) Thus, this educational component helps people to take in their hands the share of authority for their own oral health (1). Smartphone are easily portable devices that are capable for "e-mail", "text messages", "video viewing", and "wireless internet access". Today in 21st Century the total number of Smart phone users is way above 3 billion and is predicted to grow more that hundred million in the coming years. It is therefore, undeniable that in today's time smart phones have been the greatest invention that has helped the society. It is incontrovertible that Smartphone technology has yielded many benefits for society.

Smart phones and Smartphone based applications that are related to oral health are very easily available to the people, but due to lack of awareness there is failure of implementation of these.(3) Therefore, it becomes very necessary to understand the proper functioning of the oral hygiene improvement applications for oral health care professionals to understand how to use Smartphone and related applications in improving oral hygiene. Many Orthodontic patients, especially adults and young patients, are frequent users of Smartphone technology and usually favour communicating via text messages, WhatsApp messages, and Facebook reminders, YouTube notifications for communication or reminders. And these notifications can easily be sent to the patients after their appointments while sitting in the Orthodontic clinic.(3) With its introduction it has become easier to communicate with the patient. Several clinical trials have been performed, out of which one clinical trial concluded that sending of text messages directly to the patients undergoing Orthodontic patients and reminding them of the importance of maintaining oral health helps in improving plaque removal from teeth. Another clinical trial conducted by Scheerman et al concluded that adult patients undergoing fixed Orthodontic mechanotherapy have improved their oral health when the verbal care instructions were added to the Smartphone based applications.(4)

Several literatures have shown that Smartphone based reminder therapies have been an effective tool for improving the general hygiene. However, there is little literature that concludes the beneficial effect of mobile phone in improving oral health of the patients that are undergoing Orthodontic treatment. Therefore, this systematic review and meta-analysis is aimed to evaluate all the available literature regarding the usefulness of Smartphone based applications on improving the plaque index, gingival index, and tooth brushing habits, its effect on mouth rinsing and flossing and white spot lesion development in patients who are undergoing fixed or removable Orthodontic treatment.(5)

Objective

To know the scientific evidence about the influence of smart phone-based applications on plaque index, gingival index, bleeding index, tooth brushing technique (frequency and duration) and fluoride mouth rinse use and appearance of white spots in patients undergoing fixed Orthodontic treatment.

Materials and Method

Randomized clinical trials were searched in the electronic databases “Pub Med” and “Scopus”. The software “Review Manager” was used for the meta-analysis and risk of bias. While searching the electronic databases no limitations were made on the type of language used and the publication date

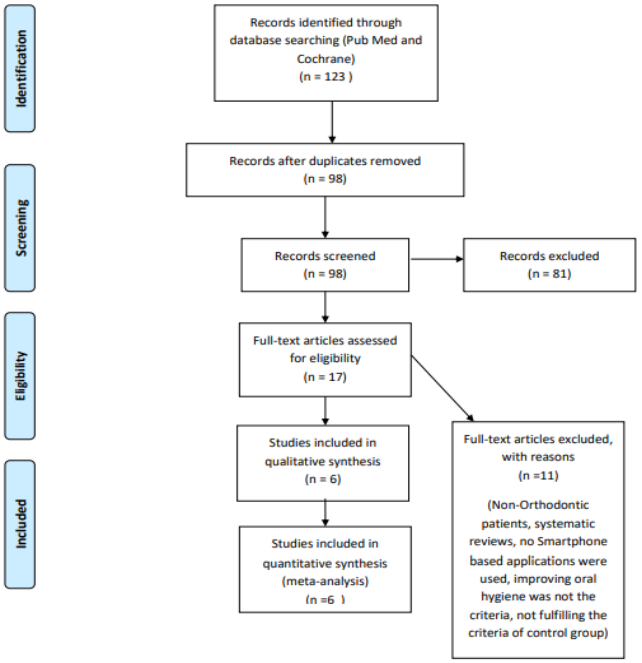
Selection criteria

We included Randomised Controlled Trials (RCTs) of parallel, block randomisation, computer based, stratified randomisation and split-mouth design, involving patients undergoing Orthodontic treatment. Studies had to compare the influence of Smartphone based application in improving oral hygiene when compared to patients receiving usual verbal care and the patients must fall in the age group of 10-30 years.

Data collection

123 studies were found, out of which only 6 RCTs fulfilled the inclusion criteria and were put through for the analysis.

Figure 1. Study flow diagram.



Results

This review found high-quality evidence that the smart phone-based application plays a particularly important role in encouraging patients undergoing fixed Orthodontic treatment to maintain and improve oral hygiene particularly the gingival health. However, further studies should be organized to re-check the diversity and effectiveness of the individual reminder systems. Although the included studies failed to elaborate the periodicity for sending the text messages or any other reminder system used, however it is believable that shorter or lesser is the duration in between the reminders, more favorable are the results.

Discussion

6 studies were included in this review. These studies evaluated the possible outcome of Smartphone based applications and usual verbal care in improving the oral hygiene of patients undergoing fixed Orthodontic treatment. Of the six RCT taken for this systematic review and meta- analysis, four studies have used text messages as the reminder to improve patient's oral health. This can be because the text message is a more distinct tool than any other reminder therapies, which makes the communication more professional without involving ones sentiments. In one of the studies, by Scheerman et al (5), using White Teeth App, a program aimed to promote oral health in adult patients undergoing Orthodontic treatment, and only one RCT by Zotti et al (3) included in this systematic review used Smartphone specific video tutorial and text messages in a WhatsApp based chat room.

The plaque index is a way to estimate oral health and also the compliance of the Orthodontic patients. All the studies included in this systematic review assessed the plaque index in all periods. All the included studies with the 12 months follow up showed statistical improvement of plaque scores in Smart phone users. Plaque scores were reduced in other intervals as well, but were not significant statistically. Gingival index is also a particularly important tool in determining the condition of periodontal health. The studies that are included in this Systematic review assessed the gingival index in periods. It was concluded that the gingival index was improved significantly in a 12 month follow up period. In other follow up intervals, it was noticed that the gingival index reduced in the experimental group when compared to the control group but was not statistically significant.

White spot lesions (WSLs) are the areas of demineralization that appear on the tooth surface due to poor oral hygiene. It has been reported in various studies that the WSLs appear more in patients undergoing Orthodontic treatment which makes it clinically significant. The eligible studies of this systematic review showed that initially there was no significant difference between the intervention and control group, and it significantly decreased after third month in the intervention group. This can be explained by the time required for the WSLs to manifest in the oral cavity clinically. Therefore, encouraging and reinforcing the40 Orthodontic patients by the Smartphone based applications have proved to be a valuable tool in reducing the occurrence of WSLs, however, more studies need to be done.

Caries is an irreversible damage to the tooth structure due to accumulation of cariogenic bacteria (mostly plaque) on the tooth surface. With Orthodontic appliances the accumulation of plaque and hence caries becomes quite common. One out of six studies included in the systematic review concluded the effectiveness of smart phone-based application in decreasing the incidence of caries. Dental hygiene with Orthodontics demands more time and care. An effective way of improving or maintaining oral hygiene should include productive and easily available home care products for removing plaque, especially in areas that are not easily accessible. Toothbrushes, fluorinated mouth wash and inter proximal brushing have been evaluated in the wide range of world population and has been proved to be an effective method to control plaque in Orthodontic patients.

However, in this systematic review the effect of smart phone-based application on maintaining oral hygiene using these convenient home care products was not significant. In general, our results were concordant with those of previous systematic reviews. Igor Felipe Pereira Limaet al (6) in 2018 conducted a systematic Review and meta-Analysis" on 7 articles to identify the effectiveness of reminder therapy on "plaque index, gingival index, and white spots" in patients undergoing fixed Orthodontic mechanotherapy and concluded that "reminder therapy" is an essential tool and can help in decreasing the plaque and gingival indices and may contribute to the reduction of "plaque and gingival indices". It and can also reduce the incidence of "white spot lesions" in patients undergoing fixed Orthodontic treatment. In Systematic Review and Meta-analysis done by Mohammed H et al (7) in 2018 using Fourteen randomised controlled trials on the usefulness of reminder therapy in improving the oral health and patients

compliance in patients undergoing Orthodontic treatment concluded that there is positive effect of reminders on oral hygiene and appointment adherence in Orthodontic patients. George Jones et al (8) in 2018, in their Systematic Review and Meta-analysis on the usefulness of smart phone based reminder therapy for improving oral hygiene and compliance of patients undergoing Orthodontic treatment concluded that reminders played a significant role in maintaining oral hygiene and appointment adherence in Orthodontic patients.42 A systematic literature review was conducted by Frank J.Schwebel et al (9) in 2018.

Conclusion

This review concluded that the reminder therapy using SMS plays a significant role in improving patients' oral health and compliance. Further research for the development of patient-centered applications for patient safety, clinical decision making, and increasing their effectiveness in the treatment of orthodontic patients are required.

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