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Review Article

Effect of smart electric toothbrush on controlling plaque accumulation- A systematic review

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ABSTRACT:

Aim: The purpose of the study was to analyse and appraise the efficacy and effect of smart electric toothbrush on controlling plaque accumulation. **Methods and methodology:** An analysis was conducted on randomized clinical trials (RCTs) on a duration of 3months to evaluate the effectiveness of the electric toothbrush pointing plaque reduction and removal. This is an examiner blinded, randomized, parallel group study which was performed on participants aged between 20-30 with no fixed appliance. The participants were instructed to abstain from oral hygiene aids since the examination completes. The oral hygiene index was performed with paired T test. **Results:** After 24 days of examination a total of 30 participants were selected including 20 female and 10 male contestants. The use of smart electric toothbrush showed plaque accumulation reduction. The adversity of calculus formation was found to be reduced and the plaque scores showed 20-25% difference with the former value. There was reasonable-quality information suggesting little to no fluctuation in adverse events. **Conclusion:** It is therefore concluded that smart electric toothbrush has advantages showing efficacy of controlling a decent percentage of plaque accumulation and reducing the gingival inflammatory conditions to a minimum level. **Keywords:** dental plaque, electric toothbrush, oral hygiene, plaque accumulation, clinical trial

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INTRODUCTION

Periodontal diseases mainly periodontitis, a major oral health concern, is a condition which refers to the inflammation of periodontal ligament fibers and periodontium, which surrounds the tooth. This condition is prompted by microbial organisms surviving in oral cavity. As plaque accumulates, the microbial ecology of the local atmosphere changes in character, which can elicit a pathologic change in the environment. Variations in the compositional grades of oral microbes (streptococcus, lactobacillus, detected staphylococcus) have been across periodontally weak and ailing patients^[1]. The primary macroscopic appearance of an inflammatory state is gingivitis; particularly; edematous, discolored, or bleeding gingival tissue. This is an imperative symptomatic phase for the patient, as it can be transient.

Among oral ailments, dental caries and **periodontal disorders** are the most common and significant oral

health problems ^[2]. Adults are the only group of people who are able to retain their tooth properly in position. And yet, they manifest features of periodontitis like plaque accumulation and gingivitis. Reversing the condition of periodontitis before it exerts significant changes in teeth is very important. The improvisation of oral health is vital with thorough daily plaque control. With suitable intervention and treatment, gingival tissues can be re-established to a healthy state. If not, the disease may get progressed and leads to substantial damage to periodontium thereby putting the tooth at risk.^[3,4]

Because of those mentioned reasons, plaque removal became a daily routine and an essential to be followed of. The mainstay of eradicating plaque and reversing gingivitis is by choosing correct toothbrush, following appropriate brushing techniques and use of other aids^[4]. Frankly, a majority of individuals do not achieve thorough brushing with a basic manual brush and therefore gingivitis incidence rates are high

worldwide. Electric toothbrushes and brush head conformations have been designed so as to impart greater disruption of plaque and to ingress the areas that harbor plaque and are associated with increased bleeding and ailment.

Novel oscillating-rotating smart toothbrush has been introduced in order to achieve advanced cleaning, compliance and brushing expertise. Converting patients from conventional toothbrush to smart electric toothbrush is a common recommended choice. Smart brush having contour similar to tooth can easily succeed in removing tiny packets of plaque remaining between teeth^[4,5]. With micro-vibrations energy is directed to the bristles for effective plaque deletion. Furthermore, the smart toothbrush has motor which initiates brush head motions, which can't be exceeded by manual toothbrush.

MATERIALS AND METHODOLOGY OBJECTIVES OF THE STUDY

This was a prospective, randomized, examinerblinded, single centered, parallel group study to examine the efficacy of smart electric toothbrush for reducing plaque accumulation and thereby avoiding the chances of acquiring gingivitis. The powered brush was used for minimum 2minutes twice daily in their respective modes of active and inactive state.

ELIGIBILITY CRITERIA

Data were included from human sources from RCTs; (1) till 3 months which remained controlled and randomized, parallel group, examiner blinded, (2) give an account on the effects on plaque, gingivitis

following an intervention with control groups, (3) stood examiner based.

The participants were communicated regarding restraining from other oral hygiene aids usage. All participants were addressed with the thorough explanations and were signed a written consent priorly to be enrolled in the trial^[5].

STUDY SUBJECTS

Eligible participants were between 20-30yrs of age with minimum of 20-25 teeth present and no fixed appliances. Suitable contestants were to produce an informed consent and follow study as planned. The study was conducted among people maintaining good oral hygiene, including, non-smokers, non-alcoholics and those who aren't practicing flossing. They were graded based on the outcomes of gingival examinations and oral hygiene index. Candidates were asked to refrain from using oral hygiene measures till the end of the examination. The study contestants were those who exhibit moderate levels of gingivitis and plaque score less than 1.8. Subjects having any oral conditions such as grossly decayed tooth, heavy load of calculus, xerostomia, drug induced gingival inflammation were excluded from the study^[5,6,7]. The exclusion criteria also included contestants with physical disabilities for performing basic oral hygiene practices, and those who have history of silicone allergy. Participants list didn't include those who are pursuing dental profession either. Applicants were provided kits with allotted treatment products (smart electric brush along with dentifrice) and were given instructions for usage, verbal and written

Figure 1: flow diagram depicts the number of studies identified, screened, eligibility evaluated, excluded, and in the systematic review



STUDY DESIGN

The primary objective of the study was to understand the efficacy of smart toothbrush in removing and controlling plaque accumulation. Participants after restraining from oral hygiene measures were initially examined for changes in the gingival and total oral health. The study design included educating participants the proper way of smart brush usage and not following any other oral hygiene measures. Chi square test was used for comparing the oral hygiene index^[6,7]. Contestants were advised to stain plaque with disclosing solution, by means of cotton pellet. The participants were asked to brush in their respective mode for at least 2-4 minutes using dentifrice with the help of a mirror. The objective of the study was to observe the safety, the efficacy on dipping gingivitis (inflammation and bleeding), supragingival plaque for 24days. All products were used along with fluoride-containing toothpaste. The primary terminus is the comparison of gingival status at day24.Furthermore, an analysis comparing the percentage of subjects with reduced gingival inflammation, gingival bleeding, reduced plaque, with predefined reduction values, were planned.

DATA COLLECTION

Data evaluations were accomplished by experienced examiners who were put up blinded at the time of group apportionment. The data collection included the list of students' name, age, treatment, and review visits. The contestants after successfully using the smart toothbrush in their respective modes, showed the pre-brushing and post-brushing variations in the oral hygiene status. Gingival status was analyzed with gingival index^[7]. The participants were unaware of the plaque indexes which were obtained by the blinded examiner.

RESULTS

A total of 30 students were selected which included 20 females and 10 male contestants. The plaque scores varied between 2.12 to 2.15. Participants who used smart electric toothbrush for 24 days showed reduction in the plaque accumulation but no significant changes were noted^[7,8]. The difference in plaque index comparing maxilla as well as mandible showed no significant changes in plaque reduction (P=0.584 and P=0.543). Similarly there was no change in the index when the anteriors and posteriors in maxilla and mandible were compared (P=0.974 and P=0.973).

| Author name | Year | Patient selection | Duration | Preparation | Intervention |
|----------------------|------|-------------------|----------|----------------------------------|----------------------|
| D. Lazarescu, | 2003 | 45 preclinical | 2 weeks | Analyze the efficacy of the | Reduction in plaque |
| S.Boccanaela, et al | | dental students | | power toothbrush to control | accumulation and |
| [3] | | | | plaque with two commonly | scores were assessed |
| | | | | used manual toothbrushes | |
| Mark S. Putt', | 2001 | 33 adult | 21 days | Compare the effect on plaque | Plaque accumulation |
| Jeffery L. | | partcipants | | and gingival health of two | were reduced and |
| Milleman' [6] | | | | electric toothbrushes with | scores were assessed |
| | | | | different mechanical methods | |
| | | | | of brushing action | |
| van der Weijden | 2002 | 66 non dental | 7 months | Evaluate the effect of an | Plaque accumulation |
| GA, Timmerman | | students | | electrically active toothbrush | were reduced and |
| MF [7] | | | | on established plaque and | scores were assessed |
| | | | | gingivitis | |
| Sheikh-Al- | 2014 | 12 partcipants | 4 days | Compare the efficacy of | Plaque reduction and |
| Eslamian, Seyedeh | | aged between 21- | | dental plaque removal using a | scores were assessed |
| Mahsa [10] | | 30 | | manual and an electric | |
| | | | | toothbrush. | |
| Grender, Julie et al | 2020 | 2165 partcipants | 3 months | Compare the effects of | Plaque reduction was |
| [15] | | in 16 parallel | | oscillating-rotating, sonic, and | evident |
| | | groups | | manual toothbrushes on | |
| | | | | plaque and gingival health | |
| | | | | after multiple uses | |

 Table 1: Characteristics of intervention of the study

Table 2: summary of plaque and gingivitis dataModified Gingival Index (MGI)

| Examination day | Examination | Mean score | Difference | Significance |
|-----------------|-------------|------------|------------|--------------|
| 0 day | Entry | 1.50 *07 | - | 0.850 |
| 5 days | Baseline | 2.20*05 | - | 0.770 |
| 12 days | 2 weeks | 1.65*06 | 4% | 0.655 |
| 18 days | 3 weeks | 1.47*25 | 2% | 0.555 |
| 24 days | 4 weeks | 1.25*15 | 2% | 0.350 |

| Just Diversing Intern (IDI) | | | | | | |
|-----------------------------|-------------|------------|------------|--------------|--|--|
| Examination day | Examination | Mean score | Difference | Significance | | |
| 0 day | Entry | 0.15*09 | - | 0.590 | | |
| 5 days | Baseline | 0.71*05 | - | 0.695 | | |
| 12 days | 2 weeks | 0.34*08 | 5% | 0.565 | | |
| 18 days | 3 weeks | 0.25*05 | 3% | 0.455 | | |
| 24 days | 4 weeks | 0.16*09 | 2% | 0.300 | | |

Table 3: Angular Bleeding Index (ABI)

Gingival inflammation: Employing different subject bleeding marks, the study presented that those with standard generalized or localised inflammation had better chances of transitioning to mostly healthy status with the use of an electric toothbrush. The electric toothbrush proved lessening of gingivitis through the whole scale including localized, generalized, and healthy conditions with least gingival inflammation. Plaque& calculus: The adversity of calculus formation was found to be lower with the use of electric toothbrush. The plaque scores showed a difference of 20-25% with the former plaque scores before using this toothbrush ^[9,10,11].

| Table 4: Assessment of | bias i | in the | study |
|------------------------|--------|--------|-------|
|------------------------|--------|--------|-------|

| Auste in Abbebbilient of Ship III the Study | | | | | | |
|--|-----------------|---------------------------|-----------------------------|------------------------|-----------------------|---------------------|
| Author (year) | Random sequence | Allocation concealment | Blinding of participants | Blinding of outcome | Incomplete outcome | Selective reporting |
| | generation | | and personal | assessment | data | |
| D. Lazarescu, S.Boccanalae [3] | _ | + | + | _ | _ | _ |
| Mark S Putt, Jeffery L [6] 2001 | _ | + | + | + | - | _ |
| Van der Weijden GA, Timmerman MF et al [7] 2002 | _ | _ | + | + | _ | _ |
| Sheik-Al-Eslamain, Seyedeh Mahsa [10] 2014 | _ | - | + | + | + | - |
| Grender, Julie et al [15] 2020 | - | + | + | + | - | _ |

+ Low risk of bias, - High risk of bias, ? Unclear risk of bias

DISCUSSION

The objective of this study is to understand the efficacy of smart electric toothbrush to control the accumulation of plaque. In a population of contestants having mild to moderate gingivitis, the execution of a home use, high frequency and high amplitude powered toothbrush was statistically significant in reducing gingival inflammation, bleeding gums and supragingival plaque. Application of powered toothbrush was for two to three weeks and was regarded safe for use and is able to report a clinically measurable effect on the health and plaque status of the gingiva in subjects compared toothbrushing^[11].

Powered toothbrushes may deliver numerous benefits for the patient which may stump up their effects. Primarily, the motor that pushes brush head wave does at a frequency that considerably surpasses what could be convincingly accomplished through manual brushing. Secondarily, the regulation and control features of powered toothbrushes help make sure both a detailed and a complete brushing happenstance^[12]. Thirdly, the power brushing command line interface is designed for easy handling. The subject has to place the brush head alongside the gingival margin and softly slide it throughout the teeth, with no definite usage maneuvers or handiness necessities required. It is important to note that the population of subjects encompassed in the study displayed at least mild clinically evident gingivitis, with at least moderate stages of supragingival plaque following a rationally little plaque regrowth period. In unsettling biofilm and decreasing the plaque, the study conclusions exhibited that gingival inflammation can be successfully treated following the introduction of powered toothbrushing ^[12,13].With sufficient education and training to understand that efforts intended at avoidance of progression, joined with the correct home care tools, the patient has the chance to be efficacious in attaining and management of oral health.

By observing at a sub-region examination, however, it was considered that extensive brushing period was desired for "difficult-to-reach" posterior interproximal areas to experience parallel ranks of plaque lessening as straightforwardly accessed areas, like anterior dentition. A clinical reference to changeover a patient from manual to electric tooth brushing is frequently done with the determination that such an evolution will help patients in enlightening the efforts to eradicate plaque^[14,15,16].By doing so, the clinical manifestation of gingivitis is also estimated to improve.

Overall, the rationality is that established plaque regulator thru compliance easiness of use, and powered brush head gesture features on these devices benefit to create and uphold a supplementary health associated biofilm, thereby dropping the inflammatory reaction in the host.

CONCLUSION

The study comes to a conclusion that the usage of smart electric toothbrush has the ability to reduce the accumulation of plaque and reduce gingivitis to a certain extent. Using the electric toothbrush twice daily for 2 minutes has shown the reduction in the plaque aggregation. Using the smart electric toothbrush has shown to have better outcomes.

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