Systematic Review and Meta Analysis of the Relative Effect on Plaque Index among Pediatric Patients Using Powered (Electric) versus Manual Toothbrushes

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BACKGROUND

Many randomized controlled trials (RCT) have evaluated the efficacy of powered or electric toothbrushes compared with manual or traditional toothbrushes to remove biofilm and plaque. These types of evidence have been used to develop previous systematic reviews to determine the efficacy of these two methods in improving oral health in adults. However, despite RCT and other clinical evidence comparing these methods in pediatric patients – no systematic reviews or meta analyses have been published in PubMed to validate these findings among this specific population subgroup. Based upon this information, the primary objective of this study is to perform an expanded systematic review and meta analysis to answer the clinical research question "Do pediatric patients (Population) using powered or electric toothbrushes (Intervention) compared with manual or traditional toothbrushes (Comparison) exhibit reduced plaque indices (Outcome)."

STUDY OBJECTIVE

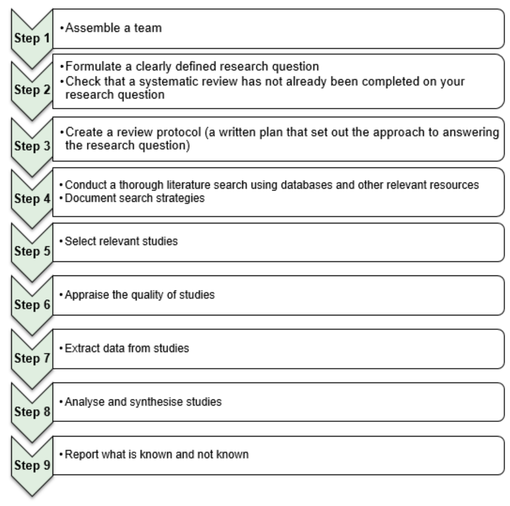
Based upon the lack of secondary evidence regarding this subpopulation, the primary objective of this study is to perform a systematic review and meta analysis using available RCT and observational trials among pediatric patients. This study was designed to follow the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

RESEARCH QUESTION

Research question: Does sufficient clinical evidence (randomized controlled trials) exist to develop recommendations or guidelines for the use manual versus electric toothbrushes among pediatric patients?

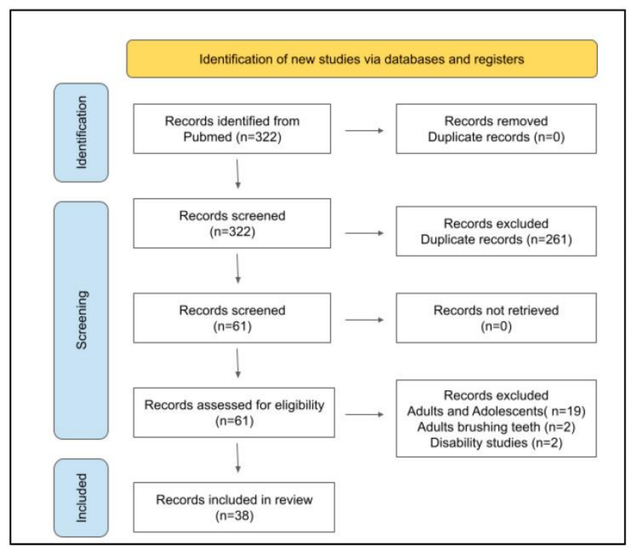
Null hypothesis: There is NOT sufficient clinical evidence to develop recommendations / guidelines for the use manual versus electric toothbrushes among pediatric patients.

Alternative hypothesis: There is sufficient clinical evidence to develop recommendations / guidelines for the use manual versus electric toothbrushes among pediatric patients



METHODS

- This research is considered IRB exempt, due to the retrospective nature of existing research and published data.
- Boolean search terms were used to search for relevant articles in PubMed. Search terms included the following using AND/OR operators: Pediatric, Electric toothbrush, Powered toothbrush, Manual toothbrush, Traditional toothbrush All relevant articles were imported into an online system (Rayyan.ai) for comparison and analysis by study authors (Pediatric Resident, Andy Graves and Faculty mentor, Karl Kingsley). Rayan.ai is a web-based tool to help researchers specifically working on Systematic Review and Meta analyses. Rayyan is a completely free tool developed to expedite the Systematic Review process by easing citation sharing and allowing comparison of decisions to include or exclude.
- A total of n=309 potential articles were identified. Inclusion criteria for selection required articles to include children (under the age of 18) and the comparison of both manual and electric toothbrushes. Exclusion criteria for selection included any articles focused exclusively on disabled children (where a caregiver was brushing their teeth), any study that did not include both manual and electric toothbrushes, and studies focused exclusively on adults.



PRISMA protocol flow diagram of the literature review. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, the search in PubMed yielded a total of n = 322 research papers. Application of the inclusion and exclusion criteria reduced the number of articles to n = 60 for full-text retrieval. Final review of these studies and outcome measures resulted in n = 38/322 or 11.8% included in this systematic review.

RESULTS

From the n=309 peer-reviewed studies identified, three independent abstract reviews were completed using blinding (Grahl, Graves, Kingsley). More than half (n=194/309 or 62.78%) were excluded by all three reviewers upon initial review. The remaining conflicts where one or two reviewers (n=67/309 or 21.68%) disagreed were resolved and excluded; The total number of studies excluded at the review stage was 261/309 or 84.5%. Studies marked for "inclusion" (n=48 or 15.5%) were compiled for further review and analysis and full texts have been retrieved. Final number of articles included (n=22 or 7.1% for non-orthodontic studies; n=5 or 1.6% for orthodontic studies) was n=27 or 8.7%.

Full texts for the "inclusion" studies (n=22) have revealed a strong reduction in plaque index scores among pediatric patients using electric toothbrushes - although other characteristics such as age, orthodontic brackets, and type of toothbrush may be confounding variables. Turesky Quigley Hein plaque index (TQH-PI) scores in RCT demonstrate additional reductions in plaque with electric (versus manual) toothbrushes ranging from -2.0 % to 42.2%; average 15.8% reduction. These results varied by study and are currently being analyzed by age group and toothbrush type, which may partially explain some of the differences and variability observed.

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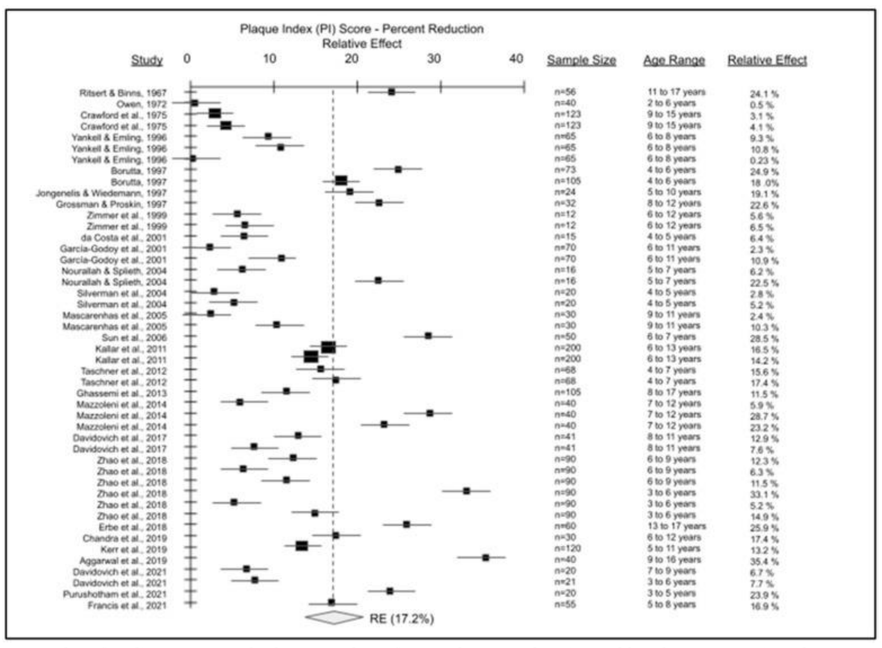
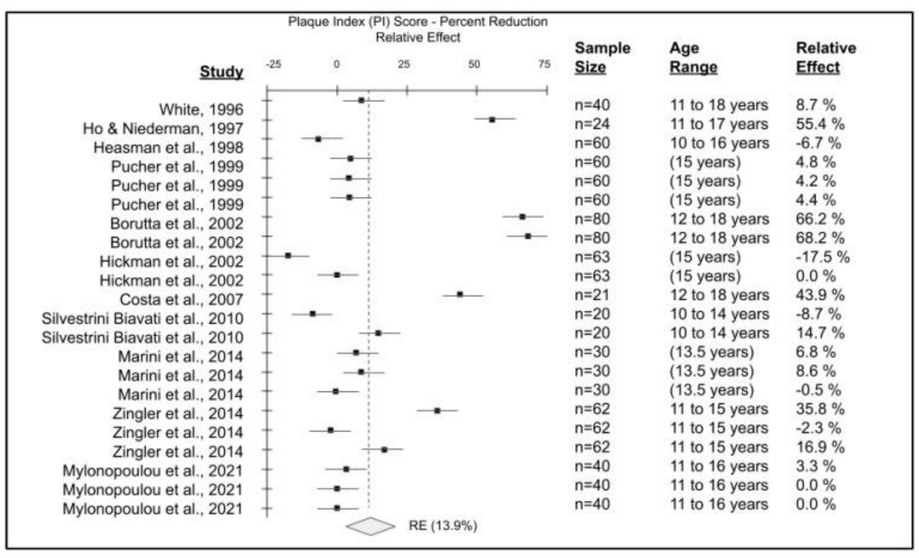


Forest plot of pediatric, non-orthodontic studies of manual versus electric toothbrushing comparing plaque index (PI). A total of 27 studies were evaluated with sample sizes ranging from n = 12 to n = 200 were plotted to determine an average reduction in plaque index or relative effect (RE) with electric toothbrush use of approximately 17.2%, p = 0.0073

Full texts for the "inclusion" studies with orthodontic brackets (n=5) have revealed an even more robust reduction in plaque index scores among pediatric patients using electric toothbrushes - although other characteristics such as age and type of toothbrush may be confounding variables. Turesky Quigley Hein plaque index (TQH-PI) scores in RCT demonstrate additional reductions in plaque with electric (versus manual) toothbrushes ranging from 3.8 % to 47%; average 24.9% reduction.. These results varied by study and are currently being analyzed by age group and toothbrush type, which may partially explain some of the differences and variability observed. Turesky Quigley Hein plaque index (TQH-PI) scores in RCT demonstrate additional reductions in plaque with electric (versus manual) toothbrushes ranging from 3.8 % to 47%; average 24.9% reduction.



Forest plot of pediatric, orthodontic studies of manual versus electric toothbrushing comparing plaque index (PI). A total of n = 11 studies were evaluated with sample sizes ranging from n = 20 to n = 80 were plotted to determine an average reduction in plaque index or relative effect (RE) with electric toothbrush use of approximately 13.9%, *p* = 0.035

CONCLUSIONS

To date, few studies have systematically reviewed all relevant evidence to evaluate the clinical question regarding the relative effect of electric versus manual toothbrushes to reduce plaque indices within the pediatric patient population. This review significantly increases the total number of subjects evaluated by nearly 1000.

This systematic review combines the results of multiple non-orthodontic and orthodontic studies to provide an updated and more expansive evaluation of the relative effectiveness of electric versus manual toothbrushes among pediatric patients. This analysis demonstrates the clinical utility of using electric toothbrushes among patients as young as two years of age—with strong evidence that these effects may be consistent up to age seventeen.

ACKNOWLEDGEMENTS

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