Reviewer's report

Title: Clinical Validation of Robot Simulation of Toothbrushing - Comparative Plaque Removal Efficacy

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Reviewer: ISTVAN GERA

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Although there is very limited correlation between the level of supragingival oral hygiene and periodontal attachment loss, the supragingival biofilm is the most important etiologic factor for both gingivitis and periodontitis and on the other hand chronic gingivitis in the long term had been shown to be one of the risk factors for chronic periodontitis. Consequently efficient individual plaque control is a key preventive and therapeutic measure in dentistry and especially in periodontics. To day a great plethora of manual and electric toothbrushes are available on the market and also many different tooth brushing techniques are recommended by both dentists and dental hygienists. Every month newer and newer toothbrush heads and handles are introduced by manufacturers claiming significant advantage and benefits comparing to others.

Therefore authors’ major goals were very relevant to evaluate the efficacy of different toothbrushes and tooth brushing techniques and test if the in vivo situation can be simulated by robotic techniques because recently the new toothbrush design and development has mostly been based on in vitro robotic techniques evaluating the plaque removal efficacy and bristle kinetics in typodonts. Clinically this study is also relevant since most of the clinical and epidemiological studies proved the inadequate prevalence of daily tooth brushing and inferior efficacy of individual oral hygiene even in the developed industrialised countries.

In the clinical trial subjects after refraining from tooth brushing for three days prior the clinical plaque removal brushed their teeth #33-47 with three different techniques (horizontal, vertical and rotating) and two different toothbrushes each for 20s both buccally and orally after a 4 days washout intervals in three consecutive scenarios. Afterwards the clinical techniques were transferred to a 6-axis robot. Stained artificial teeth set up in typodonts were brushed at standard circumstances with the copied technique and movements on the same site of dental arch.

Reviewer is to raise a couple of concerns. First of all the phantom teeth according to the according to “ Fig. 3: Example of photographic documentation of the clinical programme (A-F) and the robot programme (G-I). A-C: stained plaque after 3-day plaque regrowth. D-F: same teeth, stained plaque after 20s of toothbrushing. G-I: typodont with simulated plaque after toothbrushing. “ the model was a gingival recession type of model with open interdental embrasure
spaces, while the subjects in the clinical studies were with healthy gum. The model teeth are rather to simulate a clinical situation comparable to the postoperative state after resective periodontal surgery. The other question is whether the applied stain on model teeth matched the baseline amount and extent of plaque on natural teeth. It is because the interproximal penetration of both manual and electric toothbrushes is one of the key issues to day, and the recently developed and introduced toothbrush design focusing on improving interproximal penetration of bristles it is crucial to simulate the correct in vivo situation. My question is if artificial teeth with open embrasure spaces and quasi gingival recession can correctly simulate the in vivo situation where subjects had healthy gum. All subjects in the study were young postgraduate dental students with presumable healthy gum. All data underwent statistical analysis and the results showed that the individual clinical cleaning patterns could have been correctly reproduced by robotic programmes, and the plaque removal efficacy showed a statistically significant difference for the two test brushes. The multivariate analysis confirmed the higher cleaning efficiency for anterior teeth and for the buccal sites. I dare to mention that in this statements are nothing new since every 4th year dental student knows that the plaque scores are the lowest on the buccal surface of front teeth the these areas can be cleaned the most irrespective of the used toothbrush and tooth brushing technique. The clinical and scientific relevance of this study and paper is to show a spatial copying technique that transfers the toothbrush movement in vivo to a computer that than can simulate the same movements in vitro on typodonts by robots. This robot driven technique is used to day in new toothbrush design, therefore it is import to assess how the robotic movement can simulate the real life.

Comments related to spelling. In the manuscript the spelling rules of the American English and British English is mixed, sometimes using the American and other times the British English grammatical and spelling in the same document- like: color (American spelling) and programme (British) or behavior (American) There are some other real spelling mistakes irrespective of the type of English, like: shilds vs. shields, or in the discussion wether vs. whether or specificity vs. specificity spacial vs. spatial The spelling should be adjusted the journal’s editorial recommendation, whether the American or British grammar and spelling is in use. Otherwise the composition and wording of the manuscript is correct at least as far as a non native English speaker reviewer can assess.

In summary: The question posed by the authors was defined and the presented and the methods appropriate and well described, but the used of typodont teeth and gum that did not match the healthy periodontal situation in questionable. The data were sound, but the conclusion was not very relevant. The manuscript adhered to the standards for reporting and data deposition. The discussion was balanced and the conclusion was based on their clinical and laboratory results, but the bottom-line of the message of this paper only is that individual tooth brushing movement can be accurately transferred to robots. Nothing new concerning authors’ statement that front teeth and buccal surfaces can be more effectively cleaned by manual toothbrush than the rest of the dentition. The limitations of the work were stated
The authors clearly acknowledged their work and the title and abstract accurately conveyed their findings. The writing is acceptable with some minute corrections for publication.

**Level of interest:** An article whose findings are important to those with closely related research interests.

**Quality of written English:** Acceptable.

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**
I declare that I have no competing interests.