Clinical validation of robot tested toothbrushing of deciduous dentition

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Objectives: Computer-assisted planimetrical plaque assessment for clinically validated robot toothbrushing programmes of permanent dentition was developed (Gaengler et al. JDR 82 Spec. Iss., 3326). It was, consequently, the aim (i) to validate clinically a robot simulation of toothbrushing in deciduous teeth, and (ii) to develop and test a planimetrical plaque index for deciduous teeth.

Methods: Clinical study - After ethical approval a randomized, single (examiner) blind, single centre crossover study in 25 children aged 6-8 years using two different children’s toothbrushes A (Signal Junior) and B (Oral-B Stages 3) was executed. After 48h refraining from toothbrushing, the calibrated dentist brushed their teeth 72-85 (+46) horizontally under video-support, brushing-force 3.5 N, for 15s buccally and 15s lingually. Plaque was disclosed (Mira-2-Ton, Hager&Werken, Duisburg, Germany) and photo documented before and after brushing, assessed by two blinded examiners according to a new planimetrical index with 5 fields per smooth surface in deciduous teeth.

Robot study - All brushing conditions (movement, force, time, planimetrical fields) were transferred to a 6-axis-robot (Kawasaki, Japan), artificial deciduous teeth (Frasaco, Tettnang, Germany) were covered with plaque simulation substrate. After brushing with the toothbrushes A and B (n=7, a new toothbrush was used for every cycle) the teeth were transferred to the computer-assisted planimetrical plaque assessment device (percentage of plaque removal per field). Clinical vs. robot data were statistically evaluated (modified t-test, U-test, Wilcoxon test, p<0.05).

Results: Total clinical cleaning efficacy of toothbrush A and B was 71.5% and 74.6% (p=0.52), total robot brushing efficacy was 65.7% (A) and 77.6% (B) (p=0.03). Further investigation has shown that differences in mean values for robot brushing efficacy were influenced by 10 out of 79 planimetrical fields. In contrast to the clinical application the robot movements are exactly standardized and the 10 fields were due to their morphology less cleaned. Therefore, the robot demonstrates standardized brushing efficacy in morphologically complicated areas. At all other planimetrical fields the robot provided statistically the same results compared with clinical data.

Conclusions: The new planimetrical children’s plaque index demonstrates toothbrushing efficacy. The clinical outcome is well reproduced by the robot programme. Therefore, the robot test is recommended for rapid, reproducible laboratory testing of toothbrushes.

New planimetrical index fields in deciduous dentition and mixed dentition (Lang and Gaengler, 2012)

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