

Individualization of brushing-vibrating plaque control by lamellar full-mouth device Unique



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Objectives:

Biophysical lamellar brushing actions demonstrated effective plaque control in clinically validated robot testing at coronal and occlusal planimetric fields/tooth (PPI, oPPI; Gaengler et al. 2021). Aim was to test (i) individual full-mouth lamellar pieces, compare (ii) with Philips Sonicare and assess (iii) different brushing time with same robot programme using clinically validated plaque simulation.

Material and Methods:

Serial oral hygiene lamellar toothbrush Unique (BLBR 202001, Grünwald, Germany) is offered with 3 mouthpieces S, M, L.
Robot brushed replicated human KaVo teeth in anatomic position coated with plaque simulation (Pepin et al. 2020), occlusal force 7.5 N, vibration 120Hz, manual movements transversally, vertically, sagittally, 60s, foam Nanosaar BLB031-34 (BLBR, Grünwald, Germany) - 7 cycles per mouthpiece. Control PhilipsSonicare DiamondClean (SensitiveHead, Drachten, Netherlands) brushed with special robot programme, 120s according to recommendations.
Unique mouthpiece M brushed teeth with foam for 30s, 45s, 60s and 120s. Computer-assisted plaque assessment at coronal fields - 4 sites/ tooth with 4 risk areas (next to gumline, in-between) - revealed plaque removal in percentage per field/area. Data underwent statistical analysis (independent two-sample t-test).

Results:

Foam-filled mouthpieces executed combined brushing-vibrating plaque removal action with chewing motions and manual motions in consecutive transversal, vertical and sagittal directions. UniqueM as best fitting device brushes, consequently, at hidden areas highly significantly better ($p < 0.01$) than Unique. Unique MOA demonstrates equality in total plaque removal in comparison to Philips, with highly significantly better results ($p < 0.001$) at lingual areas and - in contrast - harmonic means around 4 sites of all single teeth. Optimal plaque removal was achieved with 60s (95% smooth surfaces, 67% next to gumline, 50% in-between) with 30s results not acceptable, 45s results sub-optimal.

Conclusions:

Best fitting mouthpiece, optimal brushing time and novel foam are crucial to elicit the unique brushing-vibrating lamellar Mechanism of Action MOA.
Optimal plaque control in clinically validated robot testing constitutes clinical testing in RCTs.

References:

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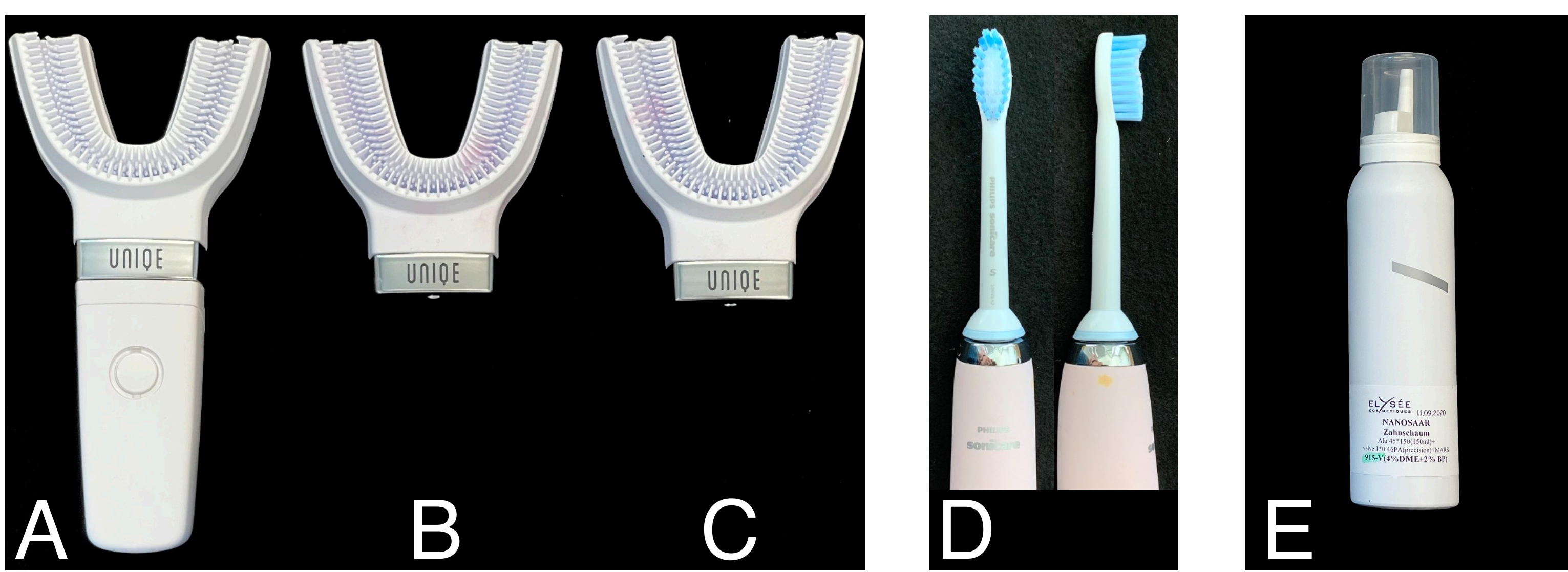


Fig. 1:
A - Unique Serial Product BLBR202001 with S-Mouthpiece
B - Unique M-Mouthpiece
C - Unique L-Mouthpiece
D - Philips Sonicare Diamond Clean with Sensitive Head
E - Dentifrice foams NANOSAAR

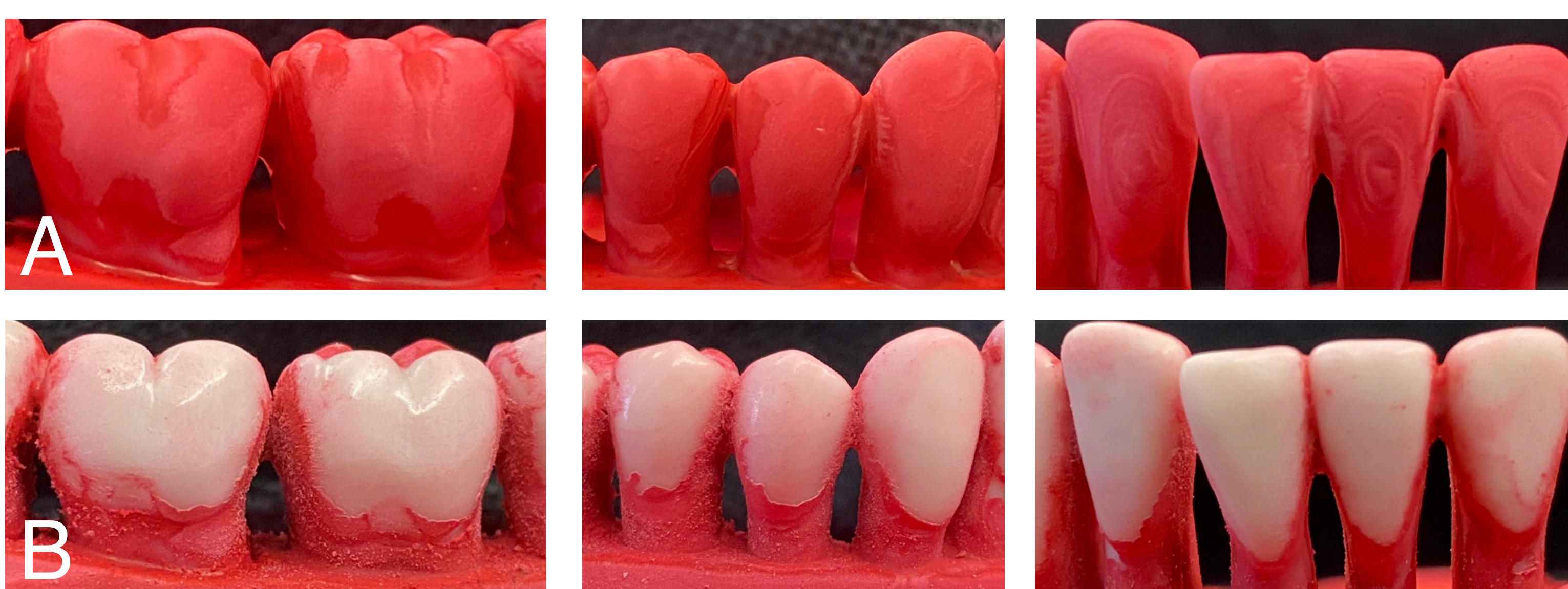


Fig. 2:
A - Stained organic plaque simulation
B - Post brushing examples (Pepin et al. 2020)

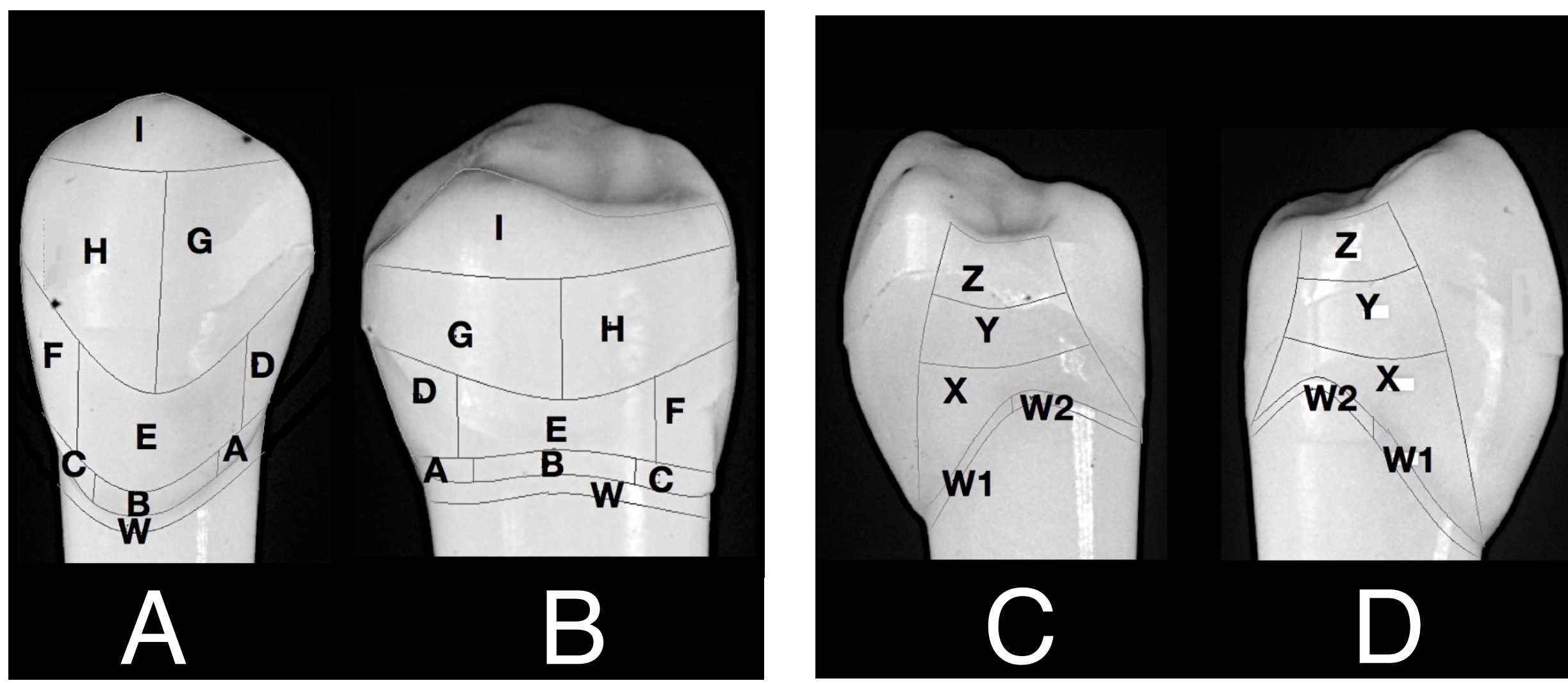


Fig. 3:
Planimetric fields at tooth crowns and roots of smooth surfaces (A,B) and mesially (C) and distally (D) in-between the teeth for plaque assessment in percentages per field, per risk area or per tooth site with automated plaque planimetry APP according to the Planimetric Plaque Index PPI (Lang et al., 2011)

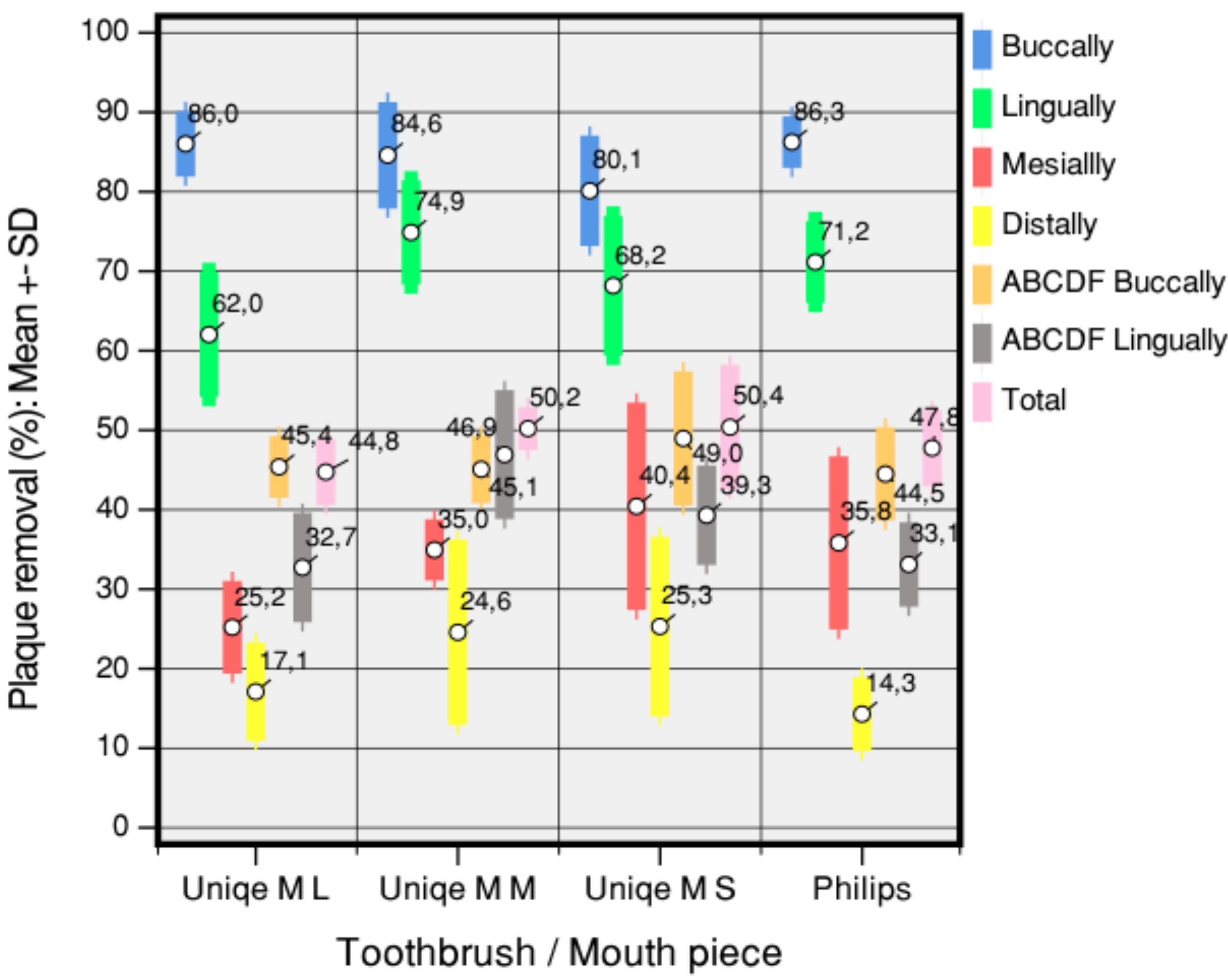


Fig. 4 : Error bars of plaque removal buccally (towards the cheek), lingually (towards the tongue), mesially (anterior, in-between the teeth), distally (posterior, in-between the teeth), at buccal and lingual risk fields ABCDF (next to the gum line) and total for the four tested toothbrushes/ mouth pieces

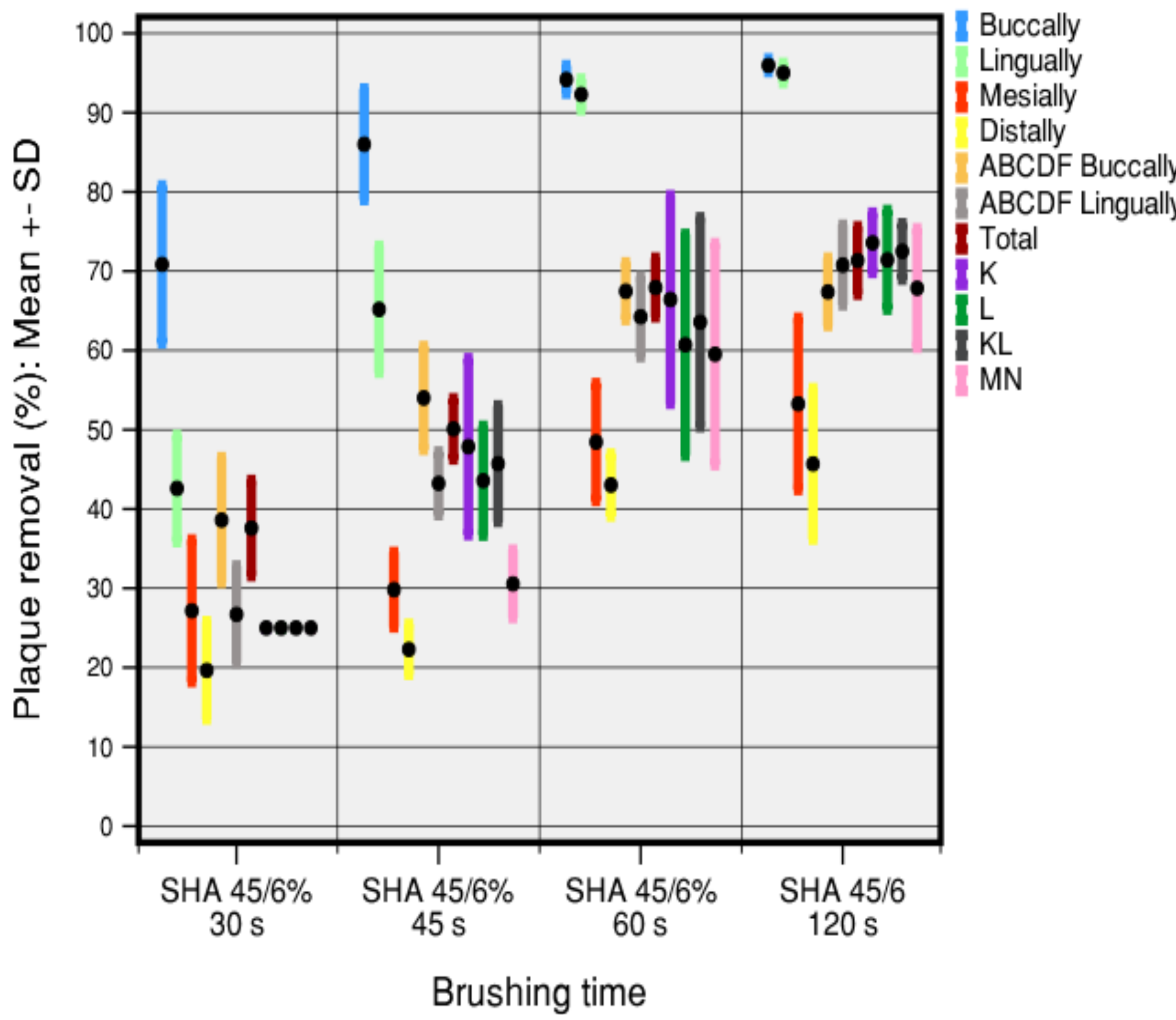


Fig. 5 : Error bars of plaque removal buccally (towards the cheek), lingually (towards the tongue), mesially (anterior, in-between the teeth), distally (posterior, in-between the teeth), at buccal and lingual risk fields ABCDF (next to the gum line), total and at occlusal surfaces with planimetric fields KL at premolars and KLMN at molars for the four tested brushing times

Tab. 1 and 2: t-test of cleaning efficacy (% plaque removal):
Multiple contrasts of the four toothbrushes
t = test statistic of t-test; df = degrees of freedom; p = significance value
* significant ($p \leq 0.05$)
** very significant ($p \leq 0.01$)
*** highly significant ($p \leq 0.001$)
yellow marking = not significant using Bonferroni correction

| Contrast | Tooth surface | t-Test | | | Mean difference |
|--------------------------|----------------|----------|-------|-------|-----------------|
| | | t | df | p | |
| Unique M L vs Unique M M | Buccally | 0.484 | 12 | 0.637 | 1.44 |
| | Lingually | -3.32*** | 12 | 0.006 | -12.85 |
| | Mesially | -3.493** | 11 | 0.006 | -9.74 |
| | Distally | -1.500 | 12 | 0.159 | -7.47 |
| | ABCD Buccally | 0.133 | 11 | 0.897 | 0.30 |
| | ABCD Lingually | -2.53*** | 12 | 0.024 | -14.30 |
| | Total | -2.743** | 11 | 0.019 | -9.45 |
| Unique M L vs Unique M S | Buccally | 1.939 | 12 | 0.076 | 5.91 |
| | Lingually | -1.378 | 12 | 0.193 | -6.15 |
| | Mesially | -2.620** | 8.296 | 0.022 | -15.22 |
| | Distally | -1.685 | 12 | 0.118 | -8.20 |
| | ABCD Buccally | -1.020 | 12 | 0.328 | -3.58 |
| | ABCD Lingually | -1.869 | 12 | 0.086 | -5.56 |
| | Total | -1.682 | 12 | 0.118 | -5.63 |
| Unique M L vs Philips | Buccally | -0.159 | 35 | 0.875 | -0.20 |
| | Lingually | -9.81*** | 35 | 0.001 | -9.12 |
| | Mesially | -2.479** | 35 | 0.018 | -10.61 |
| | Distally | 1.368 | 34 | 0.183 | 2.82 |
| | ABCD Buccally | 0.381 | 35 | 0.706 | 0.89 |
| | ABCD Lingually | -0.164 | 35 | 0.870 | -0.28 |
| | Total | -1.535 | 35 | 0.134 | -3.01 |

| Contrast | Tooth surface | t-Test | | | Mean difference |
|--------------------------|----------------|----------|--------|-------|-----------------|
| | | t | df | p | |
| Unique M M vs Unique M S | Buccally | 1.228 | 12 | 0.243 | 4.47 |
| | Lingually | 1.617 | 12 | 0.152 | 6.71 |
| | Mesially | -1.059 | 7.184 | 0.304 | -5.48 |
| | Distally | -0.119 | 12 | 0.907 | -0.73 |
| | ABCD Buccally | -1.017 | 11 | 0.331 | -0.73 |
| | ABCD Lingually | 1.973 | 12 | 0.072 | 7.63 |
| | Total | -0.057 | 7.612 | 0.956 | -0.18 |
| Unique M M vs Philips | Buccally | -0.640 | 6.668 | 0.544 | -1.65 |
| | Lingually | 1.644 | 35 | 0.109 | 3.73 |
| | Mesially | -0.343 | 23.561 | 0.734 | -0.87 |
| | Distally | 2.296 | 6.463 | 0.058 | 10.29 |
| | ABCD Buccally | 0.234 | 34 | 0.818 | 0.59 |
| | ABCD Lingually | 5.588*** | 35 | 0.000 | 13.81 |
| | Total | 1.207 | 34 | 0.238 | 2.44 |
| Unique M S vs Philips | Buccally | 0.282 | 6.621 | 0.789 | 6.13 |
| | Lingually | -1.194 | 35 | 0.240 | -2.97 |
| | Mesially | 0.973 | 35 | 0.337 | 4.61 |
| | Distally | 2.525** | 6.491 | 0.042 | 11.02 |
| | ABCD Buccally | 1.670 | 35 | 0.104 | 4.47 |
| | ABCD Lingually | 2.862** | 35 | 0.011 | 6.17 |
| | Total | 1.153 | 35 | 0.257 | 2.62 |