

What's new for the clinician?

Summaries of and excerpts from recently published papers

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1. Toothbrushing techniques: does it change when using a manual or powered toothbrush?

Ganss C, Duran R, Winterfeld T, et al. *Clin Oral Invest* 2018; 22: 715-20.

Toothbrushing has become part of the normal daily grooming routine for millions of people around the world. Manual toothbrushes have dominated the market but more recently powered toothbrushes have been introduced with claims that they are superior and more efficient at plaque removal. A recent Cochrane review has shown a statistically significant reduction of gingivitis and plaque score index values with powered compared with manual toothbrushes.¹ An 11% reduction of plaque scores in the short term and 21% reduction in the long term and a 6% and 11% reduction of gingivitis scores respectively were achieved. However, the clinical relevance of these improvements remains unclear.

Video observations of habitual motion habits with manual toothbrushes have shown that many subjects tend to move frequently from the left to the right and spend most of the time brushing the vestibular areas of the dentition.¹ This means that manual tooth brushing is often performed in an unstructured way and many areas are rarely or even never reached. Observational studies on how powered toothbrushes are used have not been published so far. Ganss and colleagues (2018)¹ in Germany reported on a trial that sought to gather observational data on habitual motion patterns with a powered toothbrush. The parameters of interest were brushing duration, type of brushing strokes, area of brushing, brushing events and brushing sequence. Additionally, this study sought to compare the intra-individual motion habits with both a manual and a powered toothbrush in order to investigate whether the motion patterns are independent from the tool used, or whether subjects adapt brushing performance to the type of toothbrush.

MATERIALS AND METHODS

The study was a non-disguised video observation study with healthy volunteers. Inclusion criteria were written

informed consent, age ≥ 18 , not involved in dentistry or medicine, in possession of a powered toothbrush and full dentition except for extraction from orthodontic reasons. Exclusion criteria were fixed orthodontic appliances and mental or physical disability with potential to influence oral hygiene performance.

The allocation of toothbrushes (first manual or first powered) was randomised. Sealed, opaque envelopes numbered from 1 to 100 equipped with code 1 (= first manual then powered toothbrush; $n = 50$) or code 2 (= first powered then manual toothbrush; $n = 50$) were mixed. Prior to the observational procedures, each subject drew one of these envelopes thus determining the order of toothbrush type.

Subjects were recruited via flyers in local dental practices. The flyers contained information about aim of the study, study procedures and eligibility criteria. One hundred twenty subjects were invited to the study centre. Nine subjects did not meet the inclusion/exclusion criteria, 11 subjects declined to take part and 100 subjects were enrolled.

After informed consent, subjects were asked to brush their teeth in their usual way and were provided with a manual (elmex® InterX toothbrush, short brush head, medium) and a powered (Oral-B Pro 3000 equipped with an Oral-B Precision Clean brush head) toothbrush. Subjects brushed first with either a manual or a powered toothbrush according to the drawn code and secondly with the alternative type of toothbrush. Brushing was performed in front of a mirror without toothpaste to facilitate the analysis of the video recordings. While brushing, each subject was filmed through the mirror without the investigator present and without time restriction. The video films were recorded at 25 frames per second. Between the two brushing performances, a 4-min video clip showing a landscape was presented to distract concentration from tooth brushing. After filming, subjects filled out a short questionnaire regarding age, gender and whether they prefer the manual or powered toothbrush for daily use or are undecided. All communication and technical procedures followed standardised protocols.

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For video analysis, the dentition was divided into areas (sextants 1 to 6: two lateral and one anterior sextant in the upper and lower jaw respectively combined with oral, occlusal and vestibular sites). The analysis was done in several passes to code the following parameters according to: brushing duration (time the toothbrush acts on the teeth, interruptions like rinsing, spitting or breaks excluded), type of brushing strokes (circling, horizontal-linear, vertical-linear, vertical-roll, jiggling (short repetitive horizontal movements), “passive brushing” defined as positioning the brush head on the teeth with less than two movements per second, unspecific brushing movements) and area of brushing. From the latter, brushing events (frequency of alternations between areas) and agreement of the brushing sequence (sequence of sextants in which the toothbrush acts with the manual compared to the powered toothbrush) were determined.

RESULTS

There was no significant impact of gender or order of the type of toothbrush (powered/manual versus manual/powered) for any parameter under study. For daily use, 32 subjects preferred a manual and 42 a powered toothbrush, and 21 were undecided. Preference of the type of toothbrush had no impact on any parameter under study.

The overall brushing duration was significantly longer when powered toothbrushes were used (powered, 145 s (60; 354); manual, 135 s (48; 271); $p \leq 0.001$); this was also the case for oral (powered, 40 s (0;113); manual, 29 s (0;149); $p \leq 0.001$) and vestibular surfaces (powered, 74 s (1;177); manual, 67 s (11;162); $p \leq 0.001$), but not for occlusal surfaces (powered, 31 s (0;122); manual, 31 s (0;117); $p > 0.05$).

Oral areas were reached much less than vestibular areas regardless of the type of toothbrush ($p \leq 0.001$ for both manual and powered toothbrushes). While all subjects reached all vestibular areas with the manual and 96.8% with the powered toothbrush ($p > 0.05$), respective values for oral areas were 44.2 and 58.9% ($p \leq 0.001$).

Of those subjects reaching all 12 areas (vestibular and oral sites of sextants 1 to 6) with the manual brush ($n = 42$), 33 brushed also completely with the powered brush, eight missed one area and one missed three areas. Of those subjects who brushed incompletely with the manual brush (missing three or more areas; $n = 25$), 13 improved with the powered device (6 brushed completely, four missed one area and three missed two areas), and 10 performed worse (three missed four to five areas, five missed six areas and one brushed only in one area).

With the manual toothbrush, horizontal and circling movements were most often observed adding up to 88% of the total brushing duration. These types of movements were also frequently shown with the powered toothbrush, whereas the percentage of passive brushing was only 10%. In those subjects spending less than 10% of the brushing duration with passive brushing, there was a significant correlation of the duration of the horizontal and circling brushing strokes for both toothbrush types

(horizontal $r = 0.43$, $p \leq 0.01$; circling $r = 0.42$, $p \leq 0.01$), the other types of brushing strokes (vertical linear, vertical roll and jiggling) were much less prevalent and their duration did not correlate significantly for manual and powered toothbrushes.

CONCLUSIONS

These researchers observed brushing duration for powered toothbrushing was sufficient although all the oral surfaces were not cleaned equally well. The intra-individual motion patterns were similar with both the manual and the powered toothbrush, and most subjects did not adapt brushing performance to the type of toothbrush; instead, they tend to persist in their habitual motion patterns. This clearly counteracts the idea of powered devices and may explain the hardly encouraging results with respect to plaque reduction compared with manual brushing.

IMPLICATIONS FOR PRACTICE

These findings indicate that using a powered instead of a manual toothbrush is probably not very promising without proper instruction. Also manual brushing presented in an unsystematic way and was often incomplete. Respective instructions may need to consider that motion patterns among patients seem to be deeply rooted and are potentially difficult to change.

Reference

1. Ganss C, Duran R, Winterfeld T, et al. Tooth brushing motion patterns with manual and powered toothbrushes—a randomised video observation study Clin Oral Invest 2018; 22: 715-720.

2. Does a face-bow lead to better occlusion in complete dentures? A randomized controlled trial

von Stein-Lausnitz, M., Sterzenbach, G., Helm, I. et al.. Clin Oral Invest 2018; 22: 773-82

A face-bow is used to transfer the relationship of maxillary arch and temporomandibular joint to casts onto which upper and lower teeth can be arranged in a manner that closely mimics the occlusal pattern that exists/existed in the mouth. There are two types of facebows, the kinematic and arbitrary axis facebow. The kinematic facebow records the true centre of the axis along which the condyles rotate during the hinge movement of the mandible. The arbitrary face-bow relates the approximate condylar axis to the maxilla. Use of arbitrary hinge axis is considered sufficiently accurate to create a functional occlusion and prevent occlusal errors particularly when cusped teeth are used in removable complete dentures von Stein-Lausnitz and colleagues from Germany (2018)¹ reported on a double-blinded randomized controlled trial that sought to evaluate the impact of an arbitrary face-bow record on the number of laboratory and clinical occlusal contact points after changing the vertical dimension in the articulator by means of casts transferred to the articulator using intraoral pin-supported registration.

The following null hypotheses were stated: If the vertical dimension is changed in the articulator, the use of a face-bow compared to a mean setting has no impact on:

- a. the number of laboratory occlusal contact points
- b. the number of clinical occlusal contact points.

MATERIALS AND METHODS

The trial was designed as a randomized controlled, parallel arm, double-blinded trial. Adults patients who met the following inclusion criteria were considered:

1. New complete dentures (CDs) in the upper and lower jaw, worn at least two weeks and at most one month;
2. Absence of temporomandibular disorders, (
3. CDs were screened by an experienced prosthodontist for optimal fabrication, i.e., correct occlusal plane, correct vertical and horizontal dimension, equilibration of static occlusal contact points, and canine or unilateral group function for dynamic occlusion.

The fabrication of the CDs was standardised in terms of where and how the dentures were fabricated. All full dentures had an overbite of 2–3mm and an overjet of at most 2–3mm. The occlusal concept depended on individual characteristics of participants. All CDs presented at least one static occlusal contact point per teeth referring to the contact of palatal working cusps in the mandibular centric fossae. Due to the fact that the outcome of the trial defined static occlusion aspects, CDs with different concepts of dynamic occlusion were included. Dynamic occlusion concepts were participant-dependent canine-guided occlusion, unilateral balanced occlusion, or bilateral balanced occlusion.

ACRONYM

CDs: Complete dentures

Participants were randomly allocated into two groups:

- Group 1: a mean setting as given by the Bonwill triangle and the Balkwill angle for the transfer of complete dentures into a semi-adjustable articulator
- Group 2: face-bow-aided transfer into the articulator according to the arbitrary hinge axis

To construct a setting with a change of the vertical dimension, a clinical remount technique using pin-supported registration was performed. The procedure included the following steps:

1. A face-bow registration was performed for all participants by two calibrated secondary operators. They were intensively calibrated for the technique of face-bow registration.
2. An experienced dentist, the main operator, adjusted the pin registration set. He screwed the central stylus up to the minimal required distance needed to eliminate any occlusal guidance. Gothic arch tracing was conducted, and the prostheses were intraorally fixed with a bite registration material at the top of the Gothic arch.
3. In the dental laboratory, remounting of the prostheses into a semiadjustable articulator was done according to a randomization procedure: CDs from patients of group no. 1 were mounted corresponding to a mean setting. CDs from patients of group no. 2 were mounted using the face-bow record.
4. The pin registration set was removed, and CDs were lowered, limited by the first contact points between the upper and lower prostheses. The respective vertical shift was measured by calculating the difference in millimetres after lowering CDs.
5. CDs were adjusted by one dental technician. She was blinded with regards to the mounting procedure. Occlusal adjustment achieved at least one static contact point per posterior tooth.
6. Participants then incorporated their prostheses, while no further chairside adjustment was performed. The maintenance procedure was performed after three days of intervention and as clinically needed.

The number of *clinical occlusal contact points* was recorded three times in both groups: day 0 (T0) before intervention, days 3 (T1) and 84 (T2) after intervention. *Laboratory occlusal contact* analyses were performed as follows: the CDs were doubled via the use of silicone forms. Then, two pairs of casts were made from each participant. The casts were mounted into the articulator correspondent to a mean setting and the face-bow setting using the intraoral bite registration mentioned above. Afterwards, the casts were lowered up to the first occlusal contact point and a bite registration was performed.

Thereafter, digital pictures were taken from each silicone bite record by fixing it on a pad with transmitted light. A computer software program converted the thickness of the bite registrations into hard and soft contact points by displaying them in different colours. One operator counted the number of hard and soft contact points and the number of teeth with at least one contact for all bite registrations.

The primary outcome was the group-dependent comparison of the number of laboratory and clinical occlusal contact points after changing the vertical dimension in the articulator.

The secondary outcome was the evaluation of the extent of the vertical shift in relation to the number of laboratory occlusal contact points.

Participants were blinded up to the last follow-up after 84 days. The main operator who performed the intraoral pin registration and the dental technician who adjusted the CDs were blinded; every participant clinically received a face-bow registration. Its use was randomly chosen according to the random list by a second operator in the dental laboratory. Hence, neither the main operator, the participant, nor the dental technician had knowledge of whether the face-bow was used in the laboratory or not.

RESULTS

Thirty-two participants were included in this trial. For analysing *clinical contact points*, for group 1 (mean setting) data of 16 participants were analysed, in group 2 (face-bow record) data of 15 participants were analysed at T1, data of 14 at T2.

Laboratory occlusal contact points were assessed with doubled casts from each participant. This resulted in the number of 62 pairs of casts. Finally, from each participant a mean value-based as well as a face-bow-associated situation in the articulator were digitally analysable with bite registrations.

Due to the fact of cast duplication, the number of analysed bite registrations was equal in groups 1 and 2 (both $n = 31$). After removal of the pin registration set and lowering the casts, group 2 (face-bow) presented more occlusal contact points than group 1 (mean setting), but no statistically significant difference was noted. The number of teeth with at least one contact was higher in group 2 ($p = 0.027$). A detailed analysis for anterior teeth shows that group 2 presented more anterior teeth in contact ($p = 0.007$). The number of posterior teeth in contact showed no statistical difference ($p = 0.428$).

Over the time, the number of clinical contact points was shown as not statistically different for either group for anterior and posterior teeth. The number of clinical contact points per tooth decreased from T0 to T1 and increased in the long run to T2. The number of teeth with at least one contact decreased from T0 to T1 and increased over the course of the study. At T2, groups 1 and 2 showed a difference (7.13 and 5.31), which is statistically significant ($p = 0.042$).

The impact of the extent of the vertical shift during pin-supported registration was evaluated by calculating a coefficient of determination R^2 . The variable of the method of mounting the casts (mean versus face-bow setting) showed no correlation ($R^2 = 0.006$).

CONCLUSION

No substantial difference by the use of the arbitrary face-bow compared with a mean setting could be determined, when changing the vertical dimension in the articulator within a remounting procedure of complete dentures.

IMPLICATIONS FOR PRACTICE

The use of face-bows remains controversial. Whilst this trial reported no difference in the groups compared, the small sample size used does not provide sufficient evidence to change current teaching/clinical protocols.

Reference

1. von Stein-Lausnitz, M., Sterzenbach, G., Helm, I. et al. Does a face-bow lead to better occlusion in complete dentures? A randomized controlled trial: part I. Clin Oral Invest 2018; 22: 773-82.

