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Plaque flow around clearance copings - an in-vitro study

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Introduction and Aim of the Study

In vitro and in vivo studies demonstrated that so-called clearance copings (occlusal clearance 0.3mm, lateral clearance 0.03mm) have potential as overdenture abutments specially in cases of severely mutilated dental arches. The aim of the study was to evaluate the influence of two different designs of clearance copings and bases of the prostheses on the plaque flow at the margins of the copings.

Materials and Methods

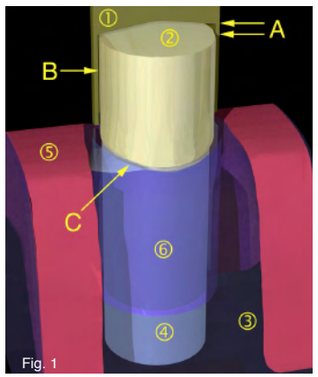

Fig. 1

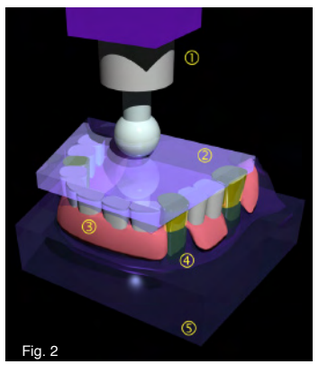

Fig. 2

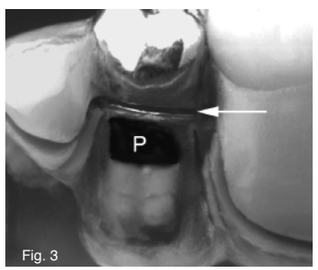

Fig. 3

Two identical models simulating a lower jaw with 3 prepared teeth served as in-vitro samples. The finishing lines of the preparations were made with a chamfer at the gingival level (CC) on one model, in contrast to no chamfer (C0) on the second. Fig. 1 displays one model of the artificial abutments and part of the denture bearing tissues:

1 Outer part
2 Inner part } of the telescopic crown
3 PMMA-Model (transparent)
4 Root
5 Resilient silicon layer (0.3mm/50N)
6 Periodontal pocket (PP) (2, 4, 6mm)
A Occlusal clearance (0.3mm)
B Lateral clearance (0.03mm)
C Periodontal pocket (width: 0.2mm)

Experimental setup (Fig. 2)

Natural plaque cultivated on agar plates was applied on the copings to obtain a plaque-index (PI) of 2-3 (Silness & Löe, 1964).

Load of the dentures was employed by a pneumatic piston (1) of a fatigue loading device (F=50N, interval=1Hz) via a metal plate (2), in order to have the denture (3) settle by 0.3mm. In the regions of the interrupted buccal flange (4) of the denture the transparent PMMA model (5) allows an observation of the plaque-distribution inside the periodontal pocket.

The number of *chewing cycles* necessary for the *plaque* (PI 2, 3) to reach the bottom of the simulated periodontal pocket with a *depth* of 2,4 or 6mm was recorded.

Fig. 3 shows the distribution of plaque at the telescopic crown on 47 (CC) after loading. The PI was 3 and PP amounted to 4mm. By this, the plaque (P) was pushed down to the bottom of the periodontal pocket after 52 cycles. The arrow indicates the finishing line at the gingival level and the clearance of the denture in the vertical direction (see also Fig. 1).

This experiment was repeated after the *denture vault* was removed at the lingual region of the abutments.

Statistics

Statistical evaluation of the data was conducted using StatView 5.0 (ANOVA: $\alpha = 0.001$; post hoc-test after Bonferroni/Dunn).

Results

The plaque flow at the margin of both designs of copings (CC, C0) correlated significantly with the PI as well as with the depth of the periodontal pocket. The results were as follows:

Chamfer (CC) vs *no chamfer (C0)* with *lingual* denture vault (LVC)

Tab. 1

4mm PP	C0 + PI 2 (32.6±6.7)	C0 + PI 3 (15.3±4.0)
CC + PI 2 (120)	p<0.0001	p<0.0001
CC + PI 3 (50.7±8.3)	p<0.0001	p<0.0001

Tab. 2

6mm PP	C0 + PI 2 (120)	C0 + PI 3 (40.3 ± 4.0)
CC + PI 2 (120)	n.s.	p<0.0001
CC + PI 3 (120)	n.s.	p<0.0001

The number of cycles necessary for the plaque to reach the bottom of PP=4mm at PI 2 (for CC >120; for C0 32.6±6.7) as well as PI 3 (for CC 50.7±8.3; for C0 15.3±4.0) was significantly ($p<0.001$) higher in cases of copings *with* chamfer than *without*. The comparison of CC+LV0 and C0+LV0 revealed the same p-values as described in Tables 1, 2.

Chamfer and lingual denture vault (LVC) vs *Chamfer without lingual* denture vault (LV0)

Tab. 3

4mm PP	LV0 + PI 2 (38.9±6.4)	LV0 + PI 3 (35.3±6.1)
LVC + PI 2 (120)	p<0.0001	p<0.0001
LVC + PI 3 (50.7±8.3)	p<0.0001	p<0.0001

Tab. 4

6mm PP	LV0 + PI 2 (120)	LV0 + PI 3 (120)
LVC + PI 2 (120)	n.s.	n.s.
LVC + PI 3 (120)	n.s.	n.s.

At PP=4mm, the removal of the lingual vault (LV0) significantly ($p<0.001$) decreased the number of cycles for CC and C0 in the presence of plaque (PI 2 and 3) (CC: Table 3, 4). In addition, at PP=6mm, LV0 decreased significantly for C0 ($p<0.001$). The other p-values remained the same.

Discussion

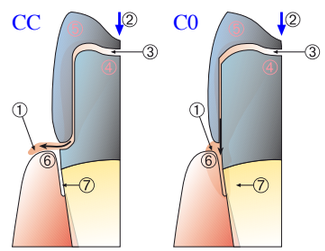

Fig. 4a

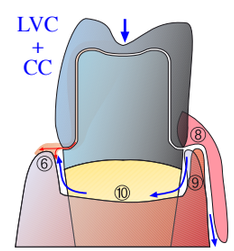

Fig. 4b

Fig. 4a shows the flow of the plaque-saliva mixture (1) under occlusal load (2). The plaque is located inside the occlusal and horizontal free-way space (3) between the inner (4) and outer part (5) of the coping. The flow at CC by-passes the entrance of the periodontal pocket (6). In contrast, in case of C0 the movement of the outer part drives the flow of plaque and saliva directly into the periodontal pocket (7).

Under occlusal load, the lingual vault (8) of the denture (LVC) induces a compression of the resilient „gingival margin" (9). This causes a flow of plaque from the oral to the buccal site of the PP (10). At the buccal entrance of PP (6) a collision of the flow into and out of the PP can be observed, which reduces the plaque flow into the PP. In case of LV0 **no** fluid flow inside the PP can be observed. Therefore, the flow of plaque into the PP is increased.

Conclusions

Under occlusal load, the plaque around clearance copings is driven in a non-vertical direction over the entrance of the periodontal sulcus.

In cases of poor plaque accumulation around the copings, the removal of the oral vault has no negative effects on the periodontal hygiene.

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