BR-54

BASIC RESEARCH

In-vitro comparative study of bacterial growth on grooved and smooth healing abutments.

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Abstract

Objectives. The aim of this in-vitro study was to evaluate the growth of 2 bacterial strains (*Fusobacterium nucleatum* and *Porphyromonas gingivalis*) onto healing abutments, with 2 different surface macro-morphology: completely smooth vs groove-marked.

Materials & Methods. Twenty, 5mm-high implant healing abutments were equally divided into two groups: I: smooth surface, II: groove-marked. *F. nucleatum* and *P. gingivalis* bacteria were cultured anaerobically on five sterilized healing abutments of each type for 48 hours at 37°C yielding four experimental groups. Subsequently, abutments were examined under scanning electron microscopy. Attached bacteria were counted on the four vertical quarters of the grooved abutments and the most 2 coronal millimeters of smooth abutments. Results were statistically analyzed by two-way ANOVA after application of square root transformation for normal distribution.

Results. Bacterial counts in the marking (grooved) areas of the abutments were 20 times greater for *P. gingivalis* and 100 times greater for *F. nucleatum* compared with the smooth surfaces of the abutments ($P \leq 0.0001$).

Conclusion. Bacterial adherence of both strains was significantly enhanced in the grooves of the marked healing abutments, while very few bacteria adhered to the smooth zones between grooves and the smooth surface of the non-grooved abutments.

Background and Aim

Healing abutments are usually placed on dental implants either immediately following their insertion or at the time of their exposure to the oral cavity.

Although these healing abutments are likely to remain in place for only a short time, they are exposed to bacterial colonization in the oral cavity. The abutment surface characteristics may have a relevant role in promoting or delaying plaque accumulation, which could have an effect on the peri-implant soft tissues.(1,2)

The aim of this in-vitro study was to evaluate and compare adhesion of these 2 strains of known perio-pathogenic bacteria (*Fusobacterium nucleatum* and *Porphyromonas gingivalis*) onto healing abutments, from the same manufacturer, made

of the same titanium alloy, but with different surface macro-morphology: one completely smooth and the other, CNC machine-grooved for depth measurement.

Methods and Materials

The study comprised of twenty, Titanium implant-healing abutments (AlphaBio Tec LTD, Petach Tikva, Israel), divided into two groups: Group I: flat healing abutments with machined surface (Fig 1); Group II: healing abutments with marked (grooved) surface (Fig 2).

Bacterial culturing conditions :Cultured bacteria strains were *Fusobacterium nucleatum* (Becton, Dickinson and Company, USA) and *Porphyromonas gingivalis* (OXOID LTD, Basingstoke, Hampshire, England). Each of these strains was cultured on five smooth surface and five grooved healing abutments. Sterilized abutments were immersed in a 96- well microtiter plate (Nunc, Copenhagen, Denmark).Bacterial suspension was added to each well and plates incubated for 48 hours at 37°C under anaerobic conditions. Following: abutments were examined in SEM (x2500).

Attached bacteria were counted on the four vertical quarters of the grooved abutments, separating smooth and groove areas and on the coronal 2 millimeters of the smooth abutments (surface area of 958 μm^2 for each quarter) using Image J 1.4 software (NIH Bethesda, Maryland USA).

Results were statistically analyzed by two-way ANOVA after square root transformation was applied for normal distribution.

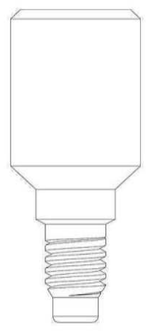


Fig 1
smooth healing abutment

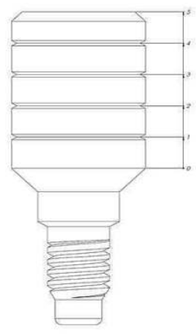
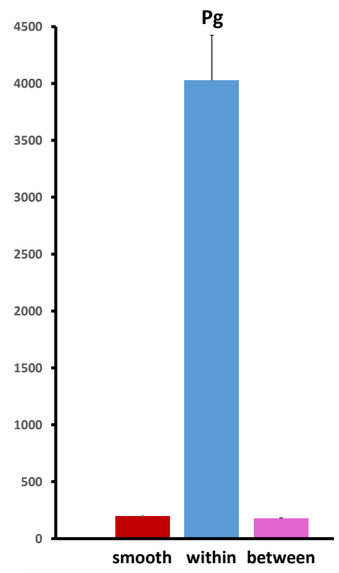


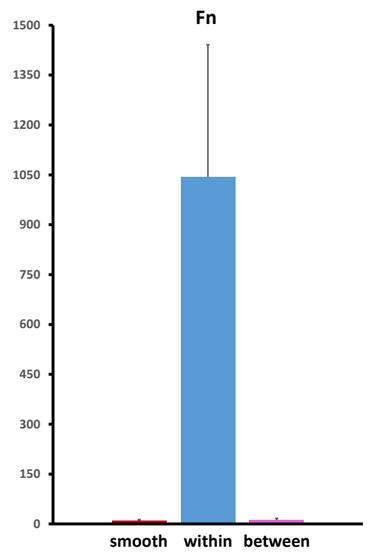
Fig 2
grooved healing abutment

Results

- Examples of smooth and grooved surfaces of the abutments seen under SEM are shown in figures 3-5. Evident is that bacterial adherence is much more pronounced in the groove areas of the abutments compared to the smoth between the grooves and to the machined smooth abutment
- Results of bacterial counts are presented in Graphs 1 (*Fn*) , and 2 (*Pg*). Bacterial counts for both strains were similar on the smooth areas between the grooves of the marked healing abutments and the totally smooth healing abutments. Second, bacterial adherence of *F.n.* to all surfaces was considerably greater than that of *P.g.* Third and most important, total bacterial counts for both strains in the groove areas were significantly higher ($p \leq 0.0001$) compared with those in the smooth areas. The mean *P. g.* count was ~20-times greater and that of *F. n.* was over 100-times larger in the grooves compared with the smooth surfaces.

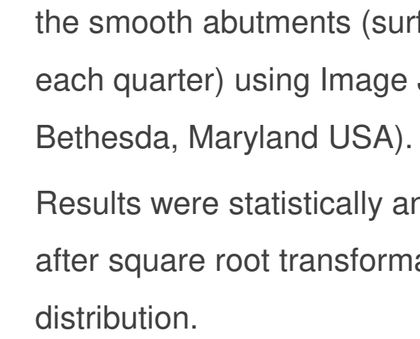


Graph 1 : adherence of Pg



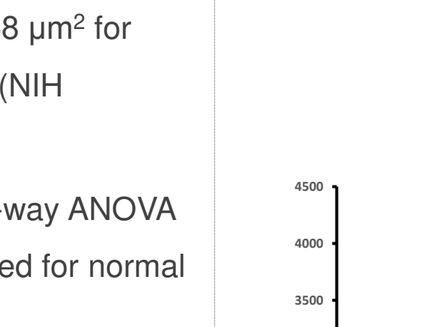
Graph 1 : adherence of Fn

SEM Photographs of bacterial adhesion to grooved and smooth healing abutment (X2500)



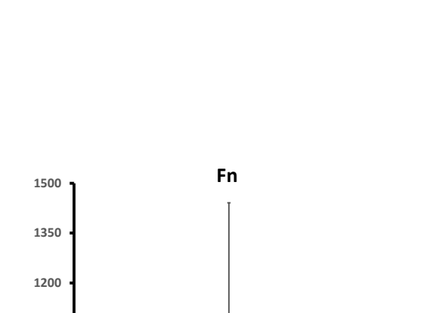
Fn

***Pg* (below) *and* *Fn* (above) in the smooth (dark) and grooved (bright) part : larger bacterial colonization in the groove.**



Fn

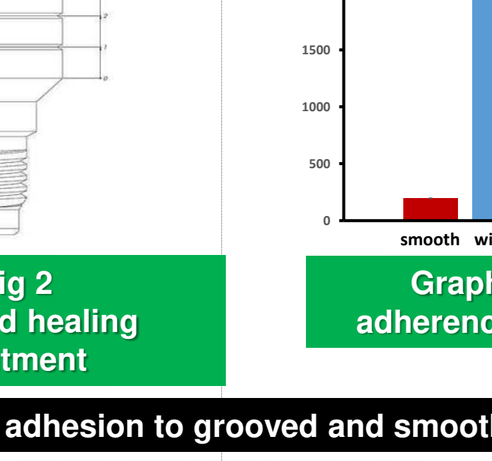
High number of *Fn* (above) and *Pg* (below) within the grooved area of the healing cap.



Fn

***Fn* (above) *and Pg* (below) on smooth surface. Note low bacteria numbers. Scratches are from CNC knife.**

Pg



Pg

Pg

Conclusions

Within the limitations of this in vitro study, we can conclude that grooves marked on healing abutments significantly enhance adherence of *Porphyromonas gingivalis* and *Fusobacterial nucleatum* when compared to machined smooth healing abutments.

Further studies are still needed to elucidate the clinical relevance of these findings.

References

1. Quirynen, M., Bollen, C.M., Papaioannou, W., van Eldere, J., van Steenberghe, D. (1996) The influence of titanium abutments surface roughness on plaque accumulation and gingivitis: short-term observations. *International Journal of Oral Maxillofacial Implants* 11:169–178

2. Teughels, W., Van Assche, N., Sliepen, I., Quirynen, M. (2006) Effect of material characteristics and/or surface topography on biofilm development. *Clinical Oral Implants Research* 17(suppl 2):68–81.

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