ORIGINAL PAPER

RJME
Romanian Journal of Morphology & Embryology
http://www.rjme.ro/

Pontic morphology as local risk factor in root decay and periodontal disease

MAGDALENA NATALIA DINA[1)], RUXANDRA MĂRGĂRIT[2)], OANA CELLA ANDREI[3)]

[1)] *PhD candidate, Department of Removable Prosthodontics*

[2)] *Department of Restorative Odontotherapy*

[3)] *Department of Removable Prosthodontics*

Faculty of Dentistry, "Carol Davila" University of Medicine and Pharmacy, Bucharest

Abstract

Introduction: In absence of treatment, old single edentulous spaces are subjected to progressively decrease in length due to tilting and rotation of the teeth situated mesial and distal. Lately when these spaces are prosthetically restored with a bridge and these teeth are becoming abutments, sanitizing of the prosthetic restoration is achieved with difficulty, the space between the pontic and the gingival surface becoming an area rich in pathogens that can cause various complications on the abutments. *Aim*: Considering these aspects, in this study we wanted to highlight the presence and the types of the microorganisms that can be found under the pontic even in an ideal situation, selecting only young adult patients with a good oral hygiene and only with metal-ceramic bridges. *Materials and Methods*: Determination of microorganisms was achieved by growing on BD Columbia Agar with 5% sheep blood. Incubation was done in anaerobe condition using GENbag system produced by BioMérieux Company. *Results*: The microorganisms that we determined were *Streptococcus mutans*, *S. mitis*, *S. oralis*, Gram-negative bacilli (*Bacteroides ovatus*, *B. thetaiotaomicron*) and Gram-positive bacilli (*Bifidobacterium* spp., *Actinomyces israelii*, *Clostridium butyricum* / *beijerinckii*) with relevance in the carious and periodontal disease. *Conclusions*: In cases of single unit bridges with very narrow pontics, even in patients with a very good oral hygiene and metal-ceramic restorations, we can still find micro-organisms that can potentially generate decay or periodontal disease on the abutments, located in the gingival area underneath these pontics. These bacteria can have negative implications on the long-term prognosis of prosthetic restorations.

Keywords: pontic morphology, single edentulous space, specific bacteria, root decay, periodontal disease.

Introduction

Infections with various microorganisms are the main cause of dental caries and periodontal disease [1].

According to a study conducted by Loma Linda University in California, within over 20 years, the most common complications that may occur on the abutments were root decays (18%), decementation of prosthetic restoration (7%) or periapical processes that may require endodontic retreatment (11%) [2].

A retrospective study analyzing the causes of the abutment teeth's loss in fixed partial dentures showed that periodontal disease is deemed to be a major risk factor [3]. Also, periodontal disease is one of the most frequent and severe dental diseases [4], so its presence is worth taking into account. Some of the problems that occur on the abutments teeth are due to the size and shape of the pontic, which may prevent the sanitizing by classic or special oral hygiene methods, and may cause accumulation of plaque under the bridge in the immediate vicinity of the abutments. In this area, a pathogenic flora develops and the consequences on the long-term can include the late loss of the abutments. It is possible to evaluate a patient as having a high-risk for root decay or periodontal disease because of the presence of the type of bacteria in a culture made from the area between the pontic and the gingival surface. We have tried to determine in what measure the pontic morphology can be a local risk factor in root decay and periodontal disease using analysis of the flora in the anaerobic environment on a lot of 22 metal-ceramic bridges. All of these were made for old single spaces having narrow pontics due to the migration of the abutment teeth in the absence of any previous treatment.

Materials and Methods

We selected healthy young adult patients aged between 30 and 45-year-old with no serious medical condition and no sign of active caries and periodontal disease wearing metal-ceramic bridges with high fused ceramic on the mucosal surface of the pontic.

We selected only patients with porcelain-fused to metal bridges having high fused ceramic on the mucosal surface of the pontic because the surface texture of restorative materials differ in their capacity to retain plaque and we wanted to have the highest polished surface and most accessible to individual care.

They brushed their teeth at least twice a day and used the oral irrigator every evening. We instructed them not to brush their teeth two hours before the appointment and not to use any other antimicrobial agent. Sampling was made in a private dental office in Bucharest, Romania.

In our study we included 15 patients, seven men and eight women, of whom eight had only one single edentulous space, seven had two single edentulous spaces. We obtained 22 samples collected from gingivo-periodontal secretions under the pontics. Pathogenic flora from gingivo-periodontal secretions was identified in the AIS Clinics and Hospital Bucharest laboratory.

The samples were taken using a sterile device, immersed immediately after sampling in a test-tube containing thioglycolate as medium. The sample's parallel sowing and cultivation was performed for anaerobi and aerobi germs, on BD Columbia Agar with 5% sheep blood. All samples were incubated for 48–72 hours for anaerobi germs, using GENbag anaerobic system (BioMérieux). In the plastic bags included in the kit, we introduced the culture medium, generators of anaerobiosys, closure system, technical insert, indicators for verifying and obtaining anaerobic atmosphere and bands.

Smears from pathological products were stained Gram and Giemsa. In mixed cultures were performed more inoculations on Columbia Blood Agar for getting isolated colonies. Of isolated cultures it has been identified germs using API20A (Mediclim), with 21 biochemical tests, fermentation of sugars, indole product and urease, esculin and gelatin decomposition, the test of catalase and oxidase.

Internal quality control has been carried out with the following strains: *Clostridium perfringens* ATCC 13124, *Bacteroides ovatus* ATCC 8483, and *Clostridium sordellii* ATCC 9714.

Results

The distribution of the patients by sex criteria showed that 53% were females, and 47% were males. Graphic representation of this situation can be observed in Figure 1.

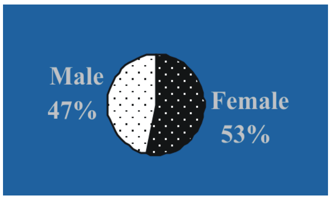

Figure 1 – *Distribution of patients by sex.*

In terms of the distribution of patients by number and type of edentulous spaces, it was observed that 47% of patients have presented two edentulous spaces both on upper arch, both on lower arch or one superior and one inferior on the same patient, and 53% of the patients presented only one edentulous space. This aspect is highlighted in Figure 2.

Figure 2 – *Distribution of the group by number of single edentulous spaces.*

In our study, there were 22 edentulous spaces, 12 from women (five in upper arch and seven in lower arch) and 10 from men (seven in upper arch and three in lower arch). Graphic representation of percentage analysis is evidenced in Figure 3.

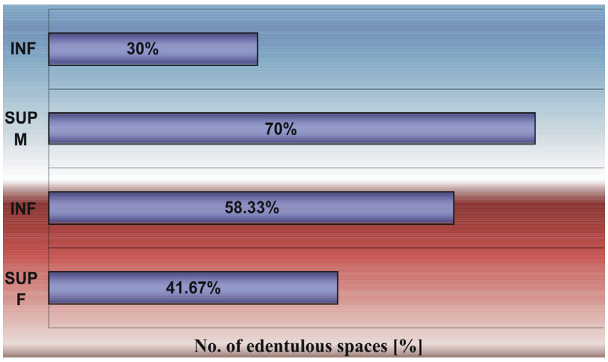

Figure 3 – *Distribution of edentulous spaces by position in the dental arch and by the gender of patients.*

After the identification, the following germs were developed: anaerobics – *Bacteroides ovatus* (in some patients *B. thetaiotaomicron*), *Bifidobacterium* spp. (in some patients *B. dentium*), *Actinomyces israelii*, *Clostridium butyricum / beijerinckii* and Gram-positive microaerophillic cocci – *Streptococcus mutans*, *S. mitis*, and *S. oralis*.

In three of the 22 samples it was identified a single pathogen, in eight samples two pathogens, in one sample three pathogens, in two samples four pathogens, and in one samples five pathogens were determined.

In descending order, the following frequency was observed: *Streptococcus mutans* < *Actinomyces israelii* < *Bifidobacterium* spp. < *Clostridium butyricum* < *Bifidobacterium dentium* < *Bacteroides ovatus* < *Streptococcus mitis* < *S. oralis* < *Bacteroides thetaiotaomicron* (Figure 4).

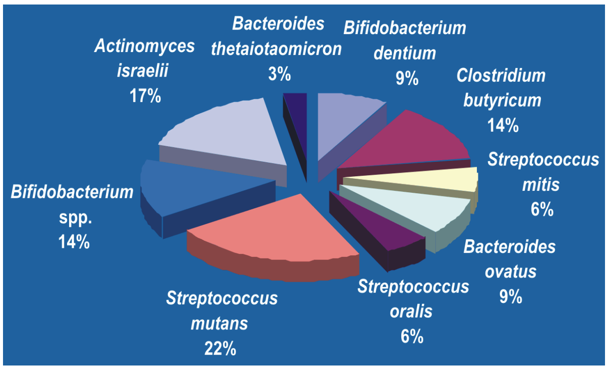

Figure 4 – *Distribution of all pathogens determined in our samples.*

Bacteroides was most frequently found in samples from females, but *Streptococcus mutans* and *S. oralis* were determined in equal quantities in men and women and the *Bifidobacterium* spp. and *Actinomyces israelii* were most frequently found in samples from men (Figure 5).

The value obtained after the statistical analysis of the study was p=0.3238310, which indicates a rate of credibility of 70%.

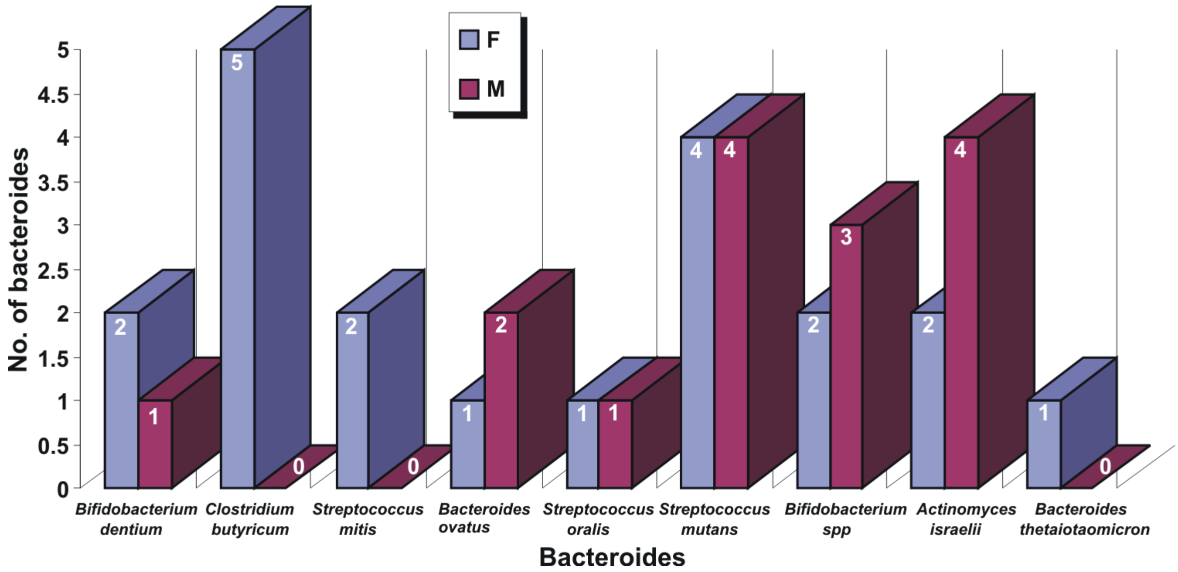

Figure 5 – ***Distribution of Bacteroides by gender of patients (F – Females; M – Males).***

Discussion

The morphology, design and dimensions of the pontic can be a local risk factor for root decay and periodontal disease. Periodontal disease can occur even in cases of healthy individuals [5]. The clinical signs are usually bleeding gums and bad breath. A number of 200 to 300 bacterial species are colonizing the human mouth. Only a limited number of them, most being anaerobes, participate in periodontal disease and dental decay. Mutant streptococci and lactobacilli are known as cariogenic oral bacteria [6, 7]. It has been proven that *Streptococcus mutans* is the primary cause of dental decay [8, 9]. *S. mutans* is able to adapt to the different conditions of the oral cavity and may have a high resistance even in cases of antimicrobial treatments [10]. The mechanisms that offer increased resistance to *S. mutans* are not completely known [11]. Mutant streptococci including *S. mutans* and *S. sobrinus* have a high virulence in the oral cavity [12], causing tooth decay. On the abutment teeth, these decays compromise the longevity of the prosthetic restoration. In our study, the presence of *S. mutans* was the highest one (22%), revealing a high risk for the abutment teeth.

Actinomyces is a microorganism that is involved in the occurrence of periodontal disease [13]. *Actinomyces* common types identified in patients with fast and aggressive periodontal disease are *A. israelii*, *A. naeslundii*, *A. viscosus*, *A. odontolyticus*, *A. pyogenes*, and *A. meyeri* [14]. Our study revealed the presence of *A. israeli* under the pontic, revealing a potential risk of periodontal disease for the abutment teeth.

The various substances elaborated by these bacteria determine a protective inflammatory response [9]. The periodontal disease is related to specific bacteria that are elaborating enzymes, endotoxins, antigens and other substances, which penetrate the gingival sulcus and determine an inflammatory response that can lead to loss of periodontal tissue, pocket formation, loosening and finally tooth loss [9]. The greatest accumulation of plaque occurs especially beneath the pontics of the single edentulous spaces bridges, even in patients with good oral hygiene habits. If the plaque remains undisturbed, in time, the consequences for the abutments can be loss of attachment and inflammation. This way, the morphology of these pontics can cause a shift in the microbial composition from healthy flora to one characteristic of periodontal disease [15]. The bacterial or plaque accumulation beneath the pontics can determine the appearance of decays on the root of abutments and a defense reaction translated as inflammatory response of the gingival and surroundings connective tissues, leading first to gingivitis and later even to periodontitis. The results of our study showed that under the pontic, even in patients with good oral hygiene, microorganisms could be found, which can cause abutment teeth damage by caries or periodontal disease, later resulting in the loss of prosthetic restoration.

Conclusions

In clinical situations of old edentulous spaces with narrow length caused by the migration of the limiting teeth, the treatment solutions should be chosen taking into account the oral hygiene methods, in order to ensure a good long-term result. In such cases, it is recommended to include in the treatment options, beside a fixed restoration, an implant or an orthodontic treatment for closing or opening the space in order to incorporate an implant or to obtain a better space for pontic.

References

[1] Van Dyke TE, Serhan CN, *Resolution of inflammation: a new paradigm for the pathogenesis of periodontal diseases*, J Dent Res, 2003, 82(2):82–90.

[2] Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JYK, *Clinical complications in fixed prosthodontics*, J Prosthet Dent, 2003, 90(1):31–41.

[3] Tan K, Pjetursson BE, Lang NP, Chan ESY, *A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years: III. Conventional FPDs*, Clin Oral Implants Res, 2004, 15(6):654–666.

[4] Caraivan O, Manolea H, Corlan Puşcu D, Fronie A, Bunget A, Mogoantă L, *Microscopic aspects of pulpal changes in*

patients with chronic marginal periodontitis, Rom J Morphol Embryol, 2012, 53(3 Suppl):725–729.
[5] Petruţiu SA, Buiga P, Roman A, Danciu T, Mihu CM, Mihu D, *Degenerative alterations of the cementum–periodontal ligament complex and early tooth loss in a young patient with periodontal disease*, Rom J Morphol Embryol, 2012, 53(4): 1087–1091.
[6] Hamada S, Slade HD, *Biology, immunology, and cariogenicity of Streptococcus mutans*, Microbiol Rev, 1980, 44(2):331–384.
[7] Loesche WJ, *Role of Streptococcus mutans in human dental decay*, Microbiol Rev, 1986, 50(4):353–380.
[8] Ryan KJ, Ray CG, *Sherris medical microbiology*, 4^{th} edition, McGraw–Hill Medical, Washington, DC, 2004.
[9] Loesche WJ, Microbiology of dental decay and periodontal disease. In: Baros S (ed), *Medical microbiology*, 4^{th} edition, University of Texas Medical Branch at Galveston, 1996.
[10] Biswas S, Biswas I, *Role of VltAB, an ABC transporter complex, in viologen tolerance in Streptococcus mutans*, Antimicrob Agents Chemother, 2011, 55(4):1460–1469.
[11] Nicolas GG, Lavoie MC, *Streptococcus mutans et les streptocoques buccaux dans la plaque dentaire*, Canadian Journal of Microbiology, 2011, 57(1):1–20.
[12] Nishikawara F, Nomura Y, Imai S, Senda A, Hanada N, *Evaluation of cariogenic bacteria*, Eur J Dent, 2007, 1(1):31–39.
[13] Slots J, *The predominant cultivable organisms in juvenile periodontitis*, Scand J Dent Res, 1976, 84(1):1–10.
[14] Murray PR, Baron EJ, Pfaller MA, Tenover FC, Yolken RH, *Manual of clinical microbiology*, 6^{th} edition, ASM Press, Washington, DC, 1995.
[15] Matthews DC, Tabesh M, *Detection of localized tooth-related factors that predispose to periodontal infections*, Periodontol 2000, 2004, 34:136–150.

Corresponding author
Ruxandra Mărgărit, Assistant, MD, PhD, Department of Restorative Odontotherapy, Faculty of Dentistry, “Carol Davila” University of Medicine and Pharmacy, 37 Dionisie Lupu Street, 020021 Bucharest, Romania; Phone +40747–440 013, e-mail: ruxandra.margarit@gmail.com

Received: November 14th, 2012

Accepted: April 13th, 2013