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INTERNATIONAL DENTISTRY - AFRICAN EDITION

VOL. **10** NO. **5**

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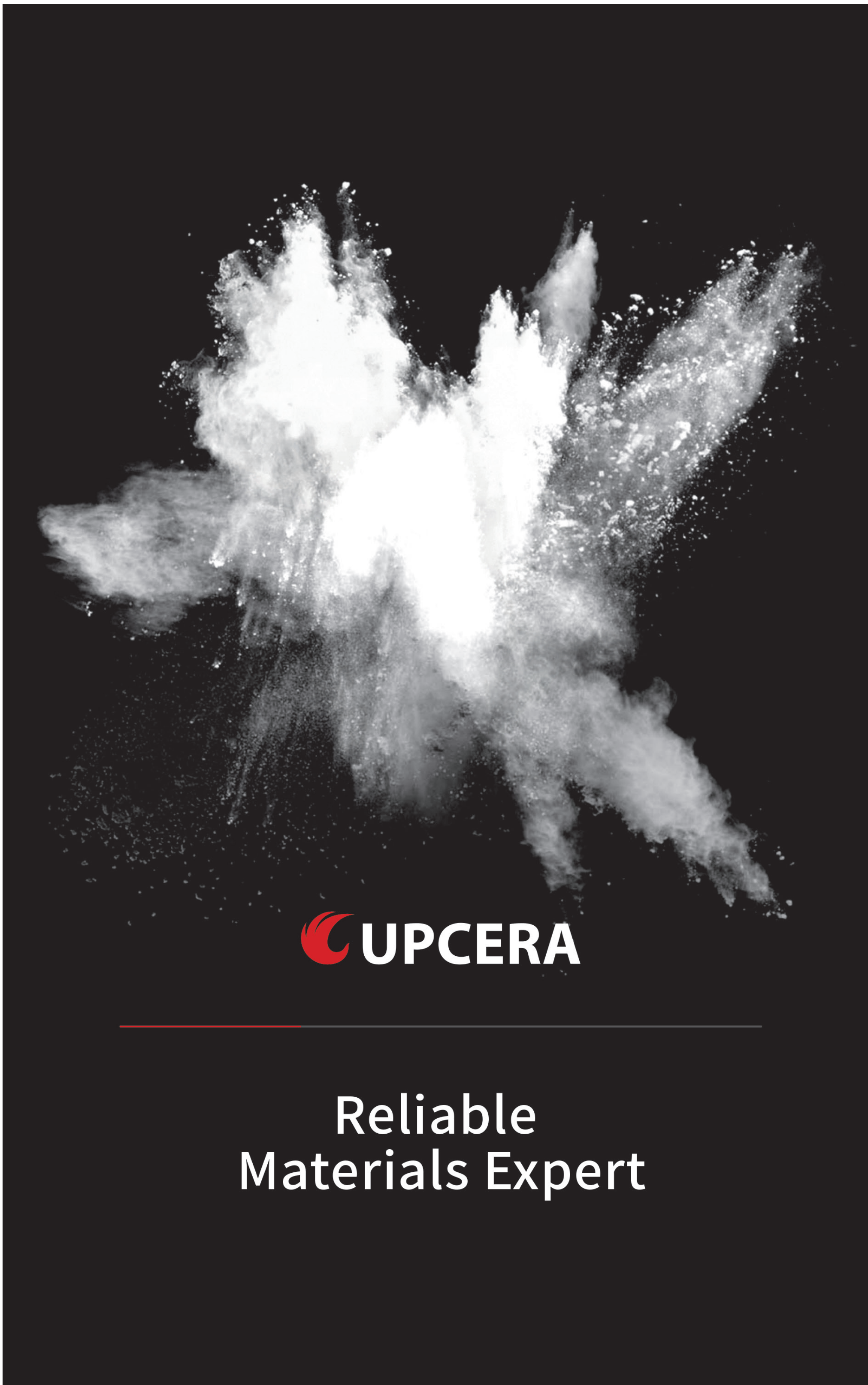

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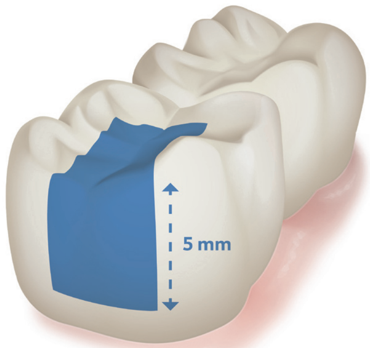

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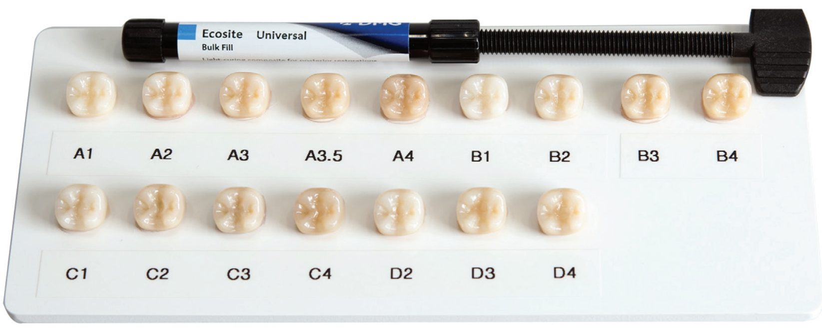

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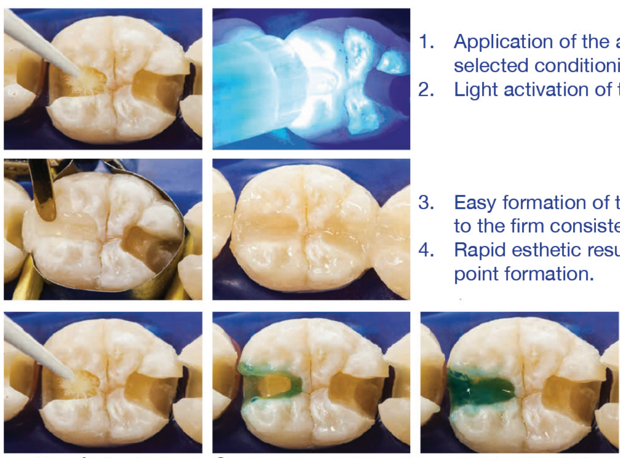

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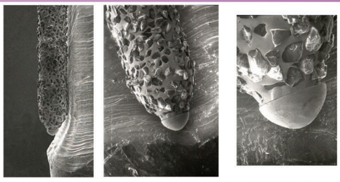
Use of adhesive in self-etch mode | Simple usage with enamel etching technique... | ... or total-etch technique



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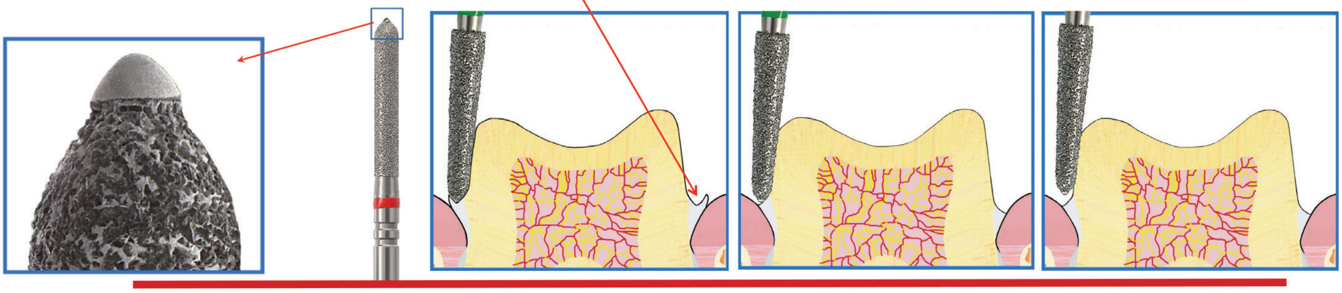

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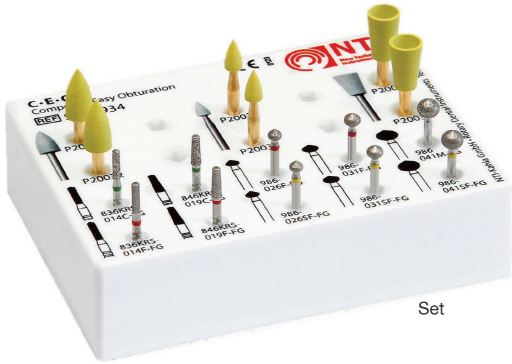

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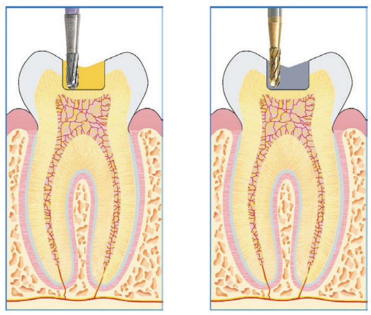

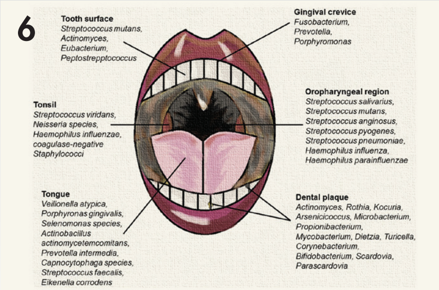

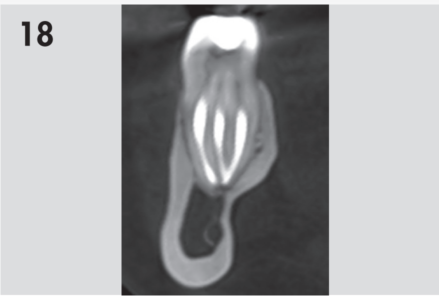

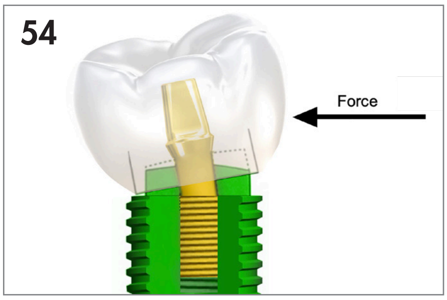

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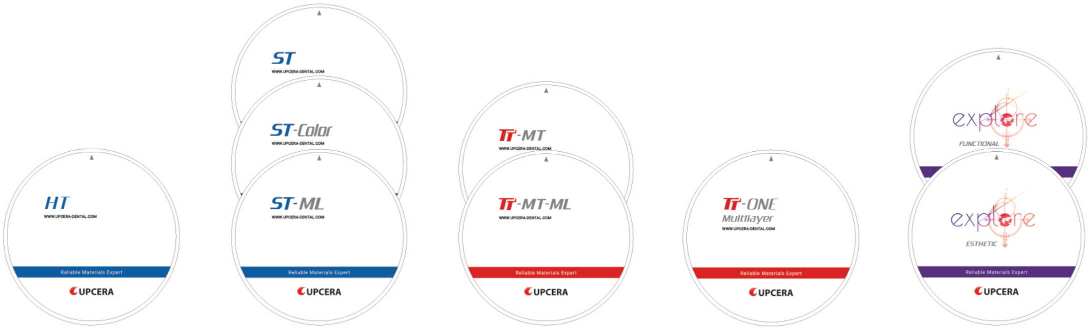

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Strength	1400 MPa	1300 MPa	600 MPa	1000 MPa	1027-1300 MPa 727-1000 MPa
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The link between periodontal health, periodontitis and systemic diseases – emerging insights and new advances for clinicians

Part 1: The oral microbiome – host relationship in health and disease

Andre van Zyl[1] and Johan Hartshorne[2]

Key points

Scientific rationale

- Early diagnosis and prevention of periodontal disease (gingivitis and periodontitis) and maintaining periodontal health is one of the fundamental objectives of clinical dental practice. Understanding oral health and periodontal disease pathogenesis requires a thorough knowledge of the oral environment and the host response. Key elements in this regard are the oral microbiome, the periodontal ecological niche, environmental factors and the hosts' ability to maintain homeostasis through an effective immune response.
- The purpose of Part 1 of this review is to summarize emerging insights and advances reported in the current literature regarding the role of the oral microbiome and ecosystem in oral health and periodontal disease.

Key findings

- The oral microbiome consists of approximately 700 commensal or pathogenic species that maintain a synergistic or antagonistic relationship with each other.
- The composition of the oral microbiome is also uniquely site specific at different oral ecological habitats.
- The gingival sulcus or periodontal pocket forms a unique ecological habitat characterized by predominantly Gram-negative anaerobic bacteria.
- The oral microbiome has recently emerged as an important factor in maintaining oral homeostasis, protecting the oral cavity and preventing periodontal disease development.
- The oral microbiome influences nearly every aspect of human biology, health and disease, and is therefore vital in maintaining oral and systemic health.
- The host and microbiome are a functional entity. Studies unequivocally show that it is not a single bacterial species that causes periodontal disease initiation or progression, but rather a polymicrobial aetiology.
- *Porphyromonas gingivalis* is considered as one of the most important periodontal pathogens.
- The symbiotic relationship between host and microbiome is fundamental to protecting our health and preventing disease.
- Disruption of the equilibrium of bacteria in the subgingival microbiome leads to domination by pathobionts (harmful bacteria) over symbionts (commensal bacteria)

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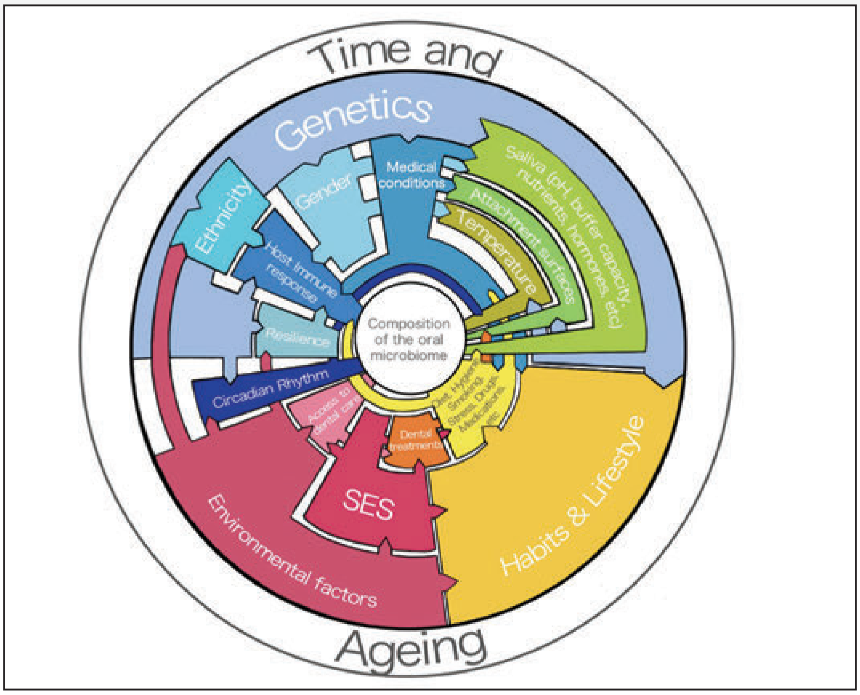

Figure 1: Bio-geography of the oral microbiome. (Ulloa PC, van der veen MH, Krom BP. Review Modulation of the oral microbiome by the host to promote ecological balance. Odontology 2019; 107: 437-448)

with resulting increase in virulence and increased risk of periodontitis.

- This bacterial imbalance is referred to as 'dysbiosis'. Dysbiosis of the oral microbiome and/or the ecosystem can have significant consequences for periodontal, oral and systemic health.

Practical implications

- Good oral hygiene (plaque control) has always been considered a mainstay of periodontal health.
- The oral microbiome influences nearly every aspect of human biology, health, and disease, and is therefore vital in maintaining oral and systemic health.
- A balanced microbiome can be maintained in symbiosis through good oral hygiene, adequate salivary flow and a well-functioning immune system.

Introduction

Periodontal health is a state where there is a homeostasis (equilibrium) between the oral microbiome, the host's oral ecosystem (teeth, implants, crowns, periodontium, tongue, mucosa, palate, saliva), and environment (oral hygiene, nutrition, smoking, stress, medications, diet), to the extent that there is no clinically detectable inflammation. Oral homeostasis is of critical importance for maintaining periodontal health, preventing dental and periodontal disease and supporting overall health and well-being.

Periodontal diseases on the other hand comprise a major global and diverse range of complex, chronic multi-factorial conditions[1,2,3] involving an intricate and disrupted interplay between the subgingival microbiota (biofilm or microbiome), the host immune and inflammatory response, and environmental modifying factors. [4,5] Microorganisms in (endogenous) and on (exogenous) our bodies, also referred to as the human microbiome, are not distinct entities, but have co-evolved over time into a functional "organ" through mutual adaptation, functional integration and biological interaction between microbial species, also called symbiosis. [6,7] The symbiotic relationship between host and microbiome is fundamental to protecting our health and preventing disease. This relationship is also dynamic and influenced by many aspects of modern lifestyle such as diet, smoking, stress, pollution, medications, and hygiene (Figure 1). These and other factors can disrupt our microbiome (also referred to as dysbiosis) and induce a state in which this finely tuned ecosystem is no longer in balance. Changes or disruption to the function and composition of the microbiome can have significant consequences for human health.[8] To maintain a

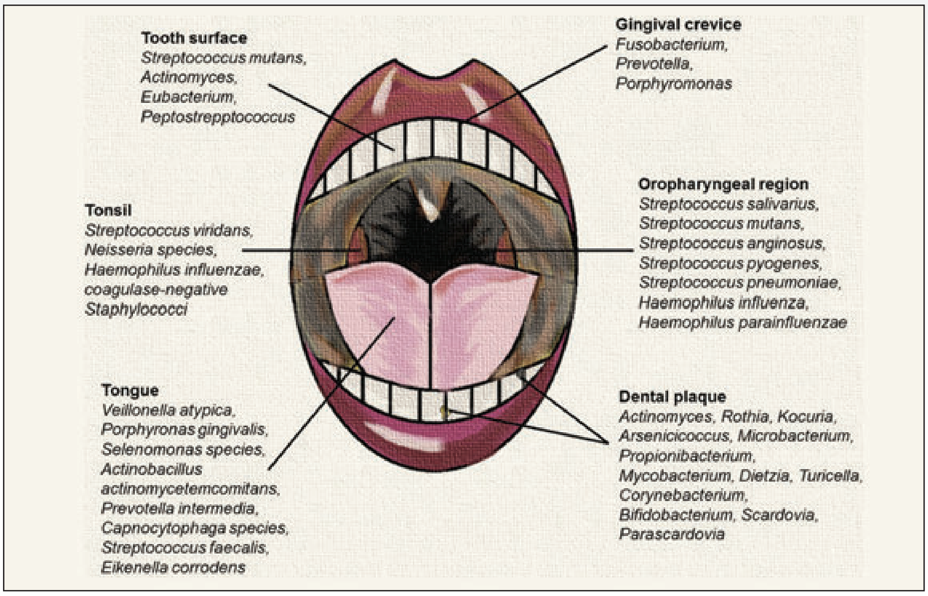

Figure 2: Oral microbiome sites and communities. (Lim Y, Totsika M, Morrison M, et al. Oral microbiome: A new biomarker reservoir for oral and oropharyngeal cancer. Theranostics 2017; 7(17): 4313-4321).

state of harmonious homeostasis that will protect health and prevent disease, it is essential that clinicians focus on the host and the microbiome as one functional entity. [6]

What is the difference between microbiome, biofilm and plaque?

The microbiome is a genetic construct, also referred to as the collective genomes of microorganisms, composed of bacteria, bacteriophages, fungi, protozoa and viruses that live inside and on the human body. There may be 10 times as many microbial cells as tissue cells in the human body. The human microbiome has 200 times the number of genes compared to that of the human genome. Unlike the host genome, which is relatively constant, the microbiome is dynamic and changes all the time in response to host and environmental factors. [9]

A biofilm is a functional and physical construct consisting of a community of microorganisms that attach to each other and to a surface by means of a self-produced extracellular polymeric matrix.[10] The extracellular matrix produced by microorganisms in the biofilm consist of polysaccharides, proteins, nucleic acids and lipids.[11] It provides mechanical stability to the biofilm and mediates bacterial adhesion for a cohesive, three-dimensional network that interconnects and transiently immobilizes microbial cells in the biofilm.[11] In addition, the biofilm matrix also acts as an external digestive system by keeping extracellular enzymes close to microbial cells, enabling the metabolism of biopolymers. The extracellular matrix also protects microorganisms from biocides, antibiotics and the host immune defenses.[11]

Plaque on the other hand, is a microbial ecosystem construct. Plaque is a type of biofilm on teeth and prostheses and its composition differs distinctively between subjects and sites.[12] Dental plaque is also defined as a structurally and functionally organized biofilm (community of microorganisms) embedded in an extracellular polymer matrix of host and bacterial origin.[13]

Defining the oral microbiome

The diverse collection or community of microorganisms that live in the human oral cavity (tongue, teeth, mucosa, periodontium and tonsils), are collectively known as the oral microbiome.[6] (Figure 2) The oral microbiome generally exists in the form of a biofilm, characterized by densely packed, diverse, highly organised structurally and functionally, communities of microbial cells that grow on living (tooth surface, soft tissue) or inert surfaces (implants, prostheses and restorative surfaces), and surround themselves with secreted polymers.[6]

The human oral microbiome is one of the most diverse and heavily colonized populations of commensal, symbiotic or pathogenic microorganisms[14], second only to the gastrointestinal tract,[15,16] comprising more than 700 hundred different bacterial, fungal, virus, archaea and

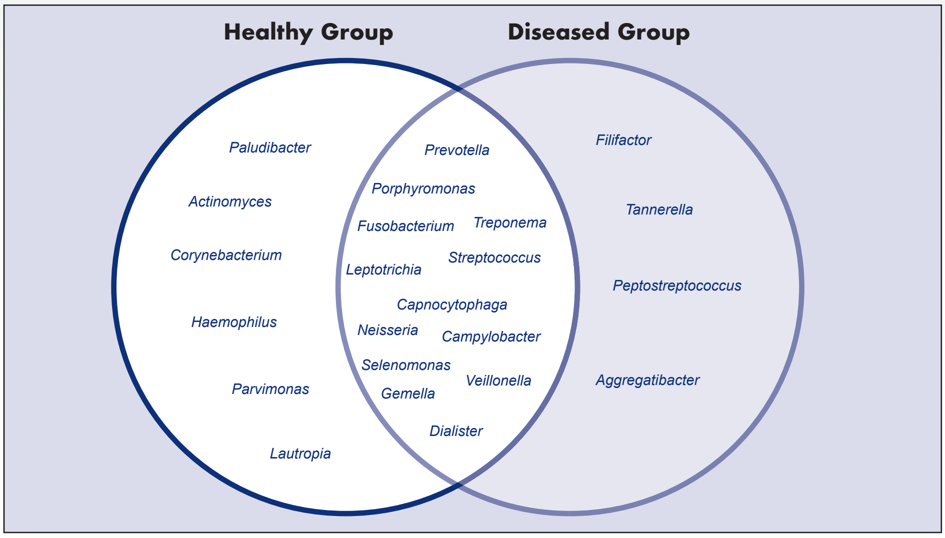

Figure 3: Sub-gingival microbiota among health and disease groups. (Tsai C-Y, Tang CY, Tan T-S, et al. Subgingival microbiota in individuals with severe chronic periodontitis. J Microbiol Immunol Infect 2018; 51(2): 226-234.

protozoa species.[17,18] The oral microbiome is also one of the most complex microbial communities in the human body[17], representing millions of different genes that are being exchanged and expressed on an ongoing basis. Studies show that microbiome diversity is lower at diseased compared to healthy sites, but species abundance was higher in diseased sites.[19] The oral microbiome is an interactive microbial community, representing a consortium of approximately 700 commensal and pathogenic species, where there is constant microbial interaction that may be synergistic or antagonistic.[7] A synergistic effect is where the combined effect of interactions within the microbial community and with the host is greater than the sum of the individual effect of the microorganisms in the microbial community. An antagonistic effect is where there is an active opposition or hostility against members of the community of microorganisms and/or host.

The oral ecosystem, biofilm and their microbial communities

The oral cavity offers several unique ecological habitats or niches for microbial colonization, including the teeth, gingival sulcus, attached gingiva, labial gingiva, tongue, cheek, lip, buccal mucosa, hard and soft palate, implants and other restorative surfaces.[18,20] The oral microbiome essentially exists within biofilms throughout the various niches or habitats in the oral eco system. (Figure 2) The composition of the oral microbiome is also uniquely site specific at different oral ecological habitats.[20,21,22] These oral habitats form a highly heterogeneous ecological system and support the growth of significantly different microbial communities.[23]

The main ecological factors affecting the survival of bacterial species include the availability of nutrients, oxygen level, pH and temperature.[7] (Figure 1) The warm and moist environment in the mouth suits the growth of many microorganisms and offers host-derived nutrients, such as saliva proteins, glycoproteins and gingival crevicular fluid (GCF).[24] The teeth are the only natural non-shedding surfaces in the human body that provide unique opportunities for extensive biofilm formation, and a secure haven for microbial persistence.[25] Dental restorations, removable prostheses and implants constitute additional non-shedding surfaces in the mouth that can influence biofilm formation and composition.[26,27,28]

Saliva has no indigenous microbiota.[20] Bacteria in saliva are those shed from biofilms and oral tissues. Oral niches and biofilms are constantly immersed in saliva. Proteins and glycoproteins in saliva provide lubrication for mastication and gustatory sensation, and both support and antagonize biofilm formation.

The supragingival dental biofilm that forms on the enamel salivary glycoprotein differs from the subgingival community, which forms on the serum protein film (from GCF) that coats the cementum layer of the root.[20] Salivary glycoproteins interact with microbial adhesins facilitating the initiation and adhesion of biofilm (plaque) formation on the enamel tooth

Table 1: A comparison of oral microbiome and host immune response status during periodontal health and disease

Periodontal health	Periodontal disease
Symbiotic microbial community	Dysbiotic microbial community
Low diversity and richness	High diversity and richness
Predominant aerobic organisms (symbionts) *(Actinomyces, Streptococci)*	Predominant anaerobic organisms (Pathobionts) *(P. gingivalis, F. denticola, T. forsythia)*
Host-microbe synergism (commensal)	Host-microbe antagonism (pathogenicity)
Controlled immune-inflammatory state	Dysregulated host-immune response

surface. As the salivary film transitions from the supragingival into the subgingival, the composition changes and the proportion of serum protein in the salivary film on the root surface increases due to the proximity of the GCF.[20] The gingival sulcus or periodontal pocket form unique ecological niches for microbial colonization.[20] With the adsorption of serum proteins, the composition of the supragingival dental biofilm changes from predominantly pioneer *Streptococci* and *Actinomyces spp.* towards an increased proportion of periodontal pathogens subgingival.[20] During this process the subgingival ecosystem becomes more anaerobic and increasingly shielded from foodstuffs and extremes in pH and temperature.

The oral ecosystem is well positioned as the initial meeting place between oral mucosa, periodontal tissues, teeth, micro-organisms, outside environment, lifestyle habits, toxins, pollution, food nutrients, medications, salivary flow and host immune system. In the oral cavity, the immune system is constantly exposed to unique tissue specific signals, including a rich diverse community of commensal microbes (oral microbiome)[29] and their metabolites, tissue damage from mastication, antigens from food and airborne particles (i.e. Smoking).[30,31]

Microbial composition and shifts within the gingival sulcus

Studies show that it is not a single bacterial species that cause periodontal disease initiation and progression, but rather, a consortium of microbial pathogens.[7,18,20] (Figure 3)

The most prevalent microbiota of the healthy gingival sulcus or crevice (≤3mm deep) are the phylum *Proteobacteria*, in particular *gammaproteobacteria* of the genus *Acinetobacter, Haemophilus* and *Moraxella*.[20] Within the phylum *Firmicutes*, the class *Bacilli* comprising genus *Streptococcus, Granulicatella* and *Gemella* are also associated with periodontal health.[20] A review of molecular studies revealed that a range of species, including *Actinomyces, Propionibacterium, Peptostreptococcus, Eubacterium, Fusobacterium, Prevotella, Campylobacter, Treponema*, and *Porphyromonas*, are the most important pathogens associated with periodontal disease.[32] Microbiota highly associated with periodontitis (true pockets ≥4 mm) include the phyla *Spirochaetes* genus *Treponema*, *Synergistetes* genus *Sinergistes* and *Bacteroidetes* such as genera *Porhyromonas, Prevotella* and *Tannerella*.[33] The class of *Fusobacteria* genera *Fusobacterium* and *Leptotrichia* are also highly associated with periodontitis. As the level of disease increased as measured by deeper pockets, the class *Negativicutes* genera *Selemonas* and *Megasphera* appeared most prevalent[34,35,36,37] and *Clostridia* (genera *Filifactor, Lachnospiraceae*, and *Peptostreptococcus)* also becoming more prominent. *Erysisepotrichia* genera *Erysipelothrix, Solobacterium* and *Bulledia* were also associated with deeper diseased sites[34,36]

Microorganisms most associated with periodontitis (deep periodontal pockets)[38], historically defined as the "red complex" microorganisms, are *P. gingivalis, Tannarella forsythia* and *Treponema denticola*. Although present in low numbers in healthy subjects[39, 40] these species are considered to be responsible for initiation and progression of disease.

Newly recognized microorganisms including Gram-positive *Filifactor alocis, Peptostreptococcus stomatitis* and species from the genera *Prevotella, Synergistes,*

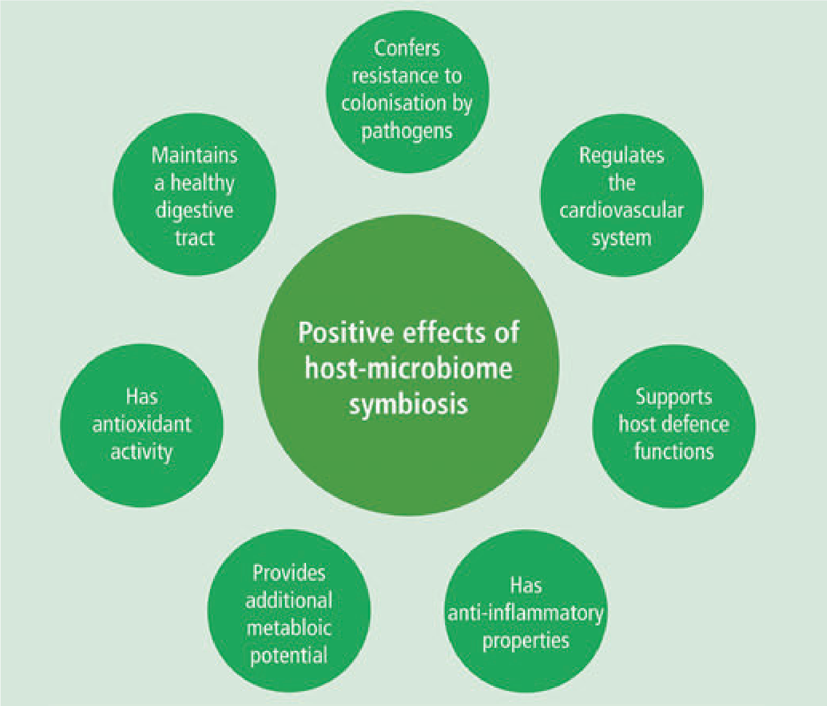

Figure 4: Positive effects of host-microbiome symbiosis. (Kilian M, Chapple ILC, Hannig M, et al. The oral microbiome - an update for oral health care professionals. Br dent J 2016; 221: 657-666)

Megasphaera, *Selenomonas*, and *Desulfobulbus* correlate with periodontitis as strongly as the classical red complex bacteria. [20] Species with less stringent association with periodontitis was previously defined as the "orange complex" and includes *Prevotella spp*, *Fusobacterium spp*, and *Parvimonas* micra.

Pathogens associated with aggressive early onset forms of periodontitis in genetically susceptible individuals include *Aggregatibacter actinomycetemcomitans (A.a)* and *Treponema spp*. Infection of the periodontal ecosystem by *A.a* follows a specific chronologic and site-specific pattern with the incisor and molar teeth selectively affected. [41]

Oral microbiome and homeostasis

The complex equilibrium between resident species in the oral microbiome has recently emerged as an important factor in maintaining oral homeostasis. It protects the oral cavity, prevents disease development and maintains health.[42,43] A mutually beneficial, balanced or synergistic relationship among members of the microbial community or between the microbial community and the host, is called symbiosis.[4] Oral health is associated with an oral microbiome that is in a state of homeostasis or symbiosis. (Table 1) Synergistic interactions (partnerships) between microorganisms are dependent on enzyme complementation, food chain feeding (feeding from other micro-organisms), co-adhesion, cell-cell signalling, gene transfer or exchange, and environmental modification for mutual benefit (i.e. pH and temperature).[44]

The oral microbiome influences nearly every aspect of human biology, health and disease, and is therefore vital in maintaining oral and systemic health. It also contributes towards the modulation of critical metabolic, physiological and immunological functions (Figure 4), including:[45,46,47]

- Differentiation and maturation of the host mucosa and its immune system
- Food digestion and nutrition
- Energy generation
- Metabolic regulation and control of fat storage
- Processing and detoxification of environmental chemicals
- Maintenance of skin and mucosa barrier function
- Development and regulation of the immune system and fine-tuning of its reaction pattern, that is, the balance between pro-inflammatory and anti-inflammatory processes
- Prevention of invasion and growth of disease-promoting microorganisms (colonization resistance).

The oral microbiome is in a symbiotic and synergistic

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relationship with the host and this relationship plays a fundamental role in maintaining oral homeostasis and periodontal health.[48] It does this through its symbiotic and dynamic interactive relationship with other microorganisms within the microbial community and the hosts' immune system.

Maintaining symbiosis through bacterial and bacteria-host interactions

The oral microbiome is maintained by host- and microbe-derived factors, involving multiple complex processes that are still not fully understood.[31] Resident bacteria in the microbiome release both pro-and anti-inflammatory factors that are crucial for maintaining oral homeostasis.[49] Both saliva and GCF provide nutrients for microbial growth and are required for a balanced symbiotic oral microbiome.[6] Other salivary proteins (i.e. immunoglobulin A, lactoferin, lactoperoxidase, lysozyme, statherin and histatins), directly and indirectly regulate the microbiome, keeping it in balance.[24]

Bacteria within the biofilm can communicate with each other by producing, detecting, and responding to small diffusible signal molecules (a process called quorum sensing). Quorum sensing allows microorganisms in the microbiome to colonize and proliferate more effectively within the human host.[7] Quorum sensing activities in the biofilm are involved in activities such as colonization, defense against competitors, adaptation to changes in the environment, virulence and pathogenic potential of bacteria and are therefore important to control bacterial infections and to maintain homeostasis. [6]

In a synergistic oral microbiome environment, the primary nutrients for oral micro-organisms are obtained from host proteins and glycoproteins derived from saliva, supragingival plaque, GCF, biofilm matrix (glycoprotein) and feeding off bacterial metabolic products such as CH_4 and H_2S (cross feeding).[44]

The gingival crevice is colonized by a diverse microbiota, and compatible organisms converge into heterotypic communities that are in equilibrium with the host. Although they are pro-inflammatory and can produces toxic products such as proteases, the host controls overgrowth and overt pathogenicity. The microbial constituents of the communities can vary over time, and from person to person and site to site.[50]

It has become apparent that both microbiome-dependent and microbiome independent factors participate in the regulation of local immunity.[31] Several oral innate responses are triggered by the oral microbiome. Recruitment of neutrophils to the oral mucosa is amplified in the presence of the microbiome [51], and specific innate epithelial defenses are triggered in response to local commensals [52] The oral mucosa has resident dendritic cells (antigen presenting cells) that release pro-inflammatory cytokines to activate adaptive immunity and secretes anti-inflammatory immune modulators (Interleukin, TGF, and PGE2) which suppress the activity of the immune system, thereby propagating a tolerant state of oral equilibrium (homeostasis).[53] Additionally, salivary antibodies also neutralize microbes.

Other host-derived mechanisms to control the microbial burden include the release of serum proteins such as IgG into the gingival crevicular fluid, production of antimicrobial proteins and peptides of whole saliva such as cystatins, histatins, lysozyme, beta defensins, enzymes (e.g. lactperoxidase), and iron scavenging molecules (e.g. lactoferrin).[7,20]

A balanced microbiome can be maintained in symbiosis through good plaque control, adequate salivary flow and a well-functioning immune system. Despite variations of the microbiomes between individuals, it is important to note that its overall function remains relatively consistent.[54]

The relationship between the bacteria in the biofilm and the host immune-inflammatory response is dynamic, and the ecologic interactions between them determine local homeostasis or transition to a state of disease (i.e. periodontitis).[18,48]

The transition of the oral microbiome from symbiosis to dysbiosis

Most microorganisms in the oral microbiome are beneficial to oral health, but some microbes will transition from a commensal relationship (symbiosis) to a pathogenic state (dysbiosis) due to changes in the microbiome, host ecosystem or environmental factors. When the finely-tuned ecosystem in the mouth is disturbed, there is loss of community balance or diversity in the microbiome, [55] resulting in a single or few species predominating with an increase in their virulence and an associated increased risk of gingivitis and periodontitis.[8] Dysbiosis is a disruption of the equilibrium between symbionts and pathobionts within the gingival sulcus, or the development of an antagonistic relationship between members of the microbial community with a breakdown of the beneficial relationship with the host and the microorganisms within the microbiome. [19,50,56,57,58,59]

Modifiable factors driving oral dysbiosis include poor plaque control (increased bacterial biomass), smoking, changing dietary or nutritional habits, stress and certain medications. [6,60,61,62] It follows that any factor contributing to poor plaque control will add to this burden, i.e. overhanging restorative margins. (Figure 1)

Other non-modifiable factors that could affect or disrupt the balance within the oral microbiome include age, pH, reduced salivary flow (xerostomia), salivary gland dysfunction (changes in saliva flow and/or composition), hormonal (puberty and pregnancy), changes in the hosts immune system (infection or systemic conditions e.g. diabetes), and genetic predispositions or disorders.[6,61,62]

These factors may cause pressure on the oral ecosystem, altering the composition, competitiveness, and adaptation of microorganisms to the new environment resulting in microbial species with greater pathogenicity (virulence) and inability of the host to contain their proliferation.[6,44]

Microbial communities present in periodontal health are characterized by lower diversity and richness, harbour keystone pathogens, symbionts and pathobionts at very low frequency and in proportions adequate to ensure periodontal health.[20] (Table 1)

However, when host and/or environmental deviations occur in the periodontal tissues (e.g. poor oral hygiene, smoking), or where the host is genetically susceptible, pathobionts elicit an inflammatory response that changes the nutrient foundation of the ecological niche (i.e. periodontal pocket). [20] The altered nutrient foundation promotes proportional expansion of pathobionts or putative pathogens relative to symbionts, promoting inflammation that ultimately leads to connective tissue and bone destruction (periodontitis).[20] *P. gingivalis* is a minor member of the plaque biofilm but nonetheless a keystone pathogen. The virulence factors of *P. gingivalis* appear to manipulate and depress the host immune response. *P. gingivalis* also impairs host defense systems and modifies the nutritional foundation in ways that facilitate the growth and development of the entire microbial community and promotes significant shifts in the composition of the microbial community.[20] The resulting disruption of the proportional relationship between symbionts and pathobionts triggers the destructive cascade leading to activation of inflammation and subsequent bone destruction.[50] This forms the basis of why the focus on effective home plaque control to stabilise a periodontitis patient is so important. It will keep this shift from happening.

The key periodontal pathogenic bacteria in the dysbiotic communities are the triadic group of oral anaerobic pathogens (pathobionts), comprising *Porphyromonas gingivalis, Treponema denticola*, and *Tannerella forsythia*.[63] However, there is also strong evidence showing that other pathogens like *Prevotella intermedia, Fretibacterium fastidiosum, Selenomonas sputigena*, and *Filifactor alocis* play an important role in the pathogenesis of periodontal disease. [64]

The pathogenic potential or virulence of the community of microorganisms in the gingival sulcus / periodontal pocket can be increased by both host-induced species–specific suppressions and interspecies microbial competition.[65] The shift in composition of the microbial community leads to alterations in the host-microbe crosstalk via cytokines, sufficient to mediate a destructive inflammatory response. Microbial antagonistic interactions leading to dysbiosis are caused by production of enzymes, bacteriocin, H_2O_2, organic acids, bacteriophage release, nutritional competition and predation.[4,65] These are the weapons or ecological drivers that can give an organism a competitive advantage in the oral microbiome leading to dysbiosis and disease[44] Microbial interaction and increased metabolic activity can induce a microbial shift characterized by increased virulence to create a more pathogenic microbiome or dysbiosis.

The dysbiosis hypothesis maintains that the transition from periodontal health to disease reflects that an increase has taken place of low-abundances species (i.e. *P. gingivalis)* in the bacterial community of the periodontal pocket. (Table 1)

Changes in the microbial community in the gingival sulcus are also caused by the growth of microorganisms such as *P. gingivalis*, which alter the nutrient foundation of the subgingival ecosystem and disrupt the equilibrium between symbionts and pathobionts.[20] Colonization by keystone pathogens such as *P. gingivalis* elevates the virulence of the entire community following interactive communication with accessory pathogens.[50] The keystone effects of *P. gingivalis* are likely exerted via both host inflammatory modulation and bacterial synergy, thereby facilitating initial colonization and promoting other pathogenic organisms. [51] Microorganisms activate the innate and adaptive immune responses. Pathogens can control the gene expression of a healthy oral microbial ecology, leading to a different portfolio of bacterial products that could interact with host cells.[66]

Changes, shifts or disruption of the composition of the oral microbiome and/or the ecosystem can have significant consequences for periodontal, oral and systemic health. Dysbiosis or disturbances in the complex equilibrium between resident species in the oral cavity, result in a state associated with an increased inflammatory response and increased risk disease.[42] Local inflammation causes an increased flow of nutrient rich GCF and gingival bleeding, whereby the site becomes deprived of oxygen, favouring the growth of anaerobic microorganisms.[67] The inflammatory changes in the periodontal environment provide an ideal environment for the growth of obligatory anaerobic and protein-dependent bacteria that reside in the gingival crevice, driving a shift from a symbiotic microbiome to dysbiosis. [67]

The pathogenesis of periodontal diseases is initiated, propagated or influenced by a disruption of the oral microbiome (dysbiosis). The dysbiotic pathogenic bacteria influences or modulates the host immune response, resulting in an increase local and/or systemic inflammatory response, resulting in periodontal tissue destruction (periodontitis).

Conclusion

The oral ecosystem is well positioned as the initial meeting place between host, microorganisms, and environmental factors. The complex equilibrium between resident species in the oral microbiome has recently emerged as an important factor in maintaining oral homeostasis and health, protecting the oral cavity and preventing disease development. The oral microbiome influences nearly every aspect of human biology, health and disease and is therefore vital in maintaining oral and systemic health. Knowledge of the composition, homeostasis, inter-microbial interactions as well as host-microbe interactions is fundamental for developing effective preventive and therapeutic measures. Contrary to what we have been taught, the objective of preventing and treating periodontal disease, is not simply aimed at maintaining good oral hygiene and killing the “bad” bacteria, but more reflective of maintaining an equilibrium between the microbiome, host ecosystem and environmental factors. Studies unequivocally show that it is not a single bacterial species that cause periodontal disease progression, but rather a polymicrobial aetiology. Preventing a build-up of microbes (plaque) that may overwhelm the host immune response, resulting in a dysbiosis remains the mainstay in preventing periodontitis. It is essential to understand this interplay in order to treat our patients with a holistic approach to maintain oral and systemic health.

References

1. Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Periodontal Disease Surveillance workgroup: Prevalence of periodontitis in adults in the United States: 2009 and 2010. J Dent Res 2012: 91: 914–920.
2. Eke PI, Dye BA, Wei L, Slade GD, et al. Self-reported measures for surveillance of periodontitis. J Dent Res 2013: 92: 1041–1047.
3. Eke PI, Dye BA, Wei L, Slade GD, Thornton-Evans GO et al. Update on prevalence of periodontitis in adults in the United States: NHANES 2009–2012. J Periodontol 2015: 86: 611–622.
4. Bartold PM, Van Dyke TE. Periodontitis: a host-mediated disruption of microbial homeostasis. Unlearning learned concepts. Periodontol 2000 2013; 62: 203–217.
5. Bartold PM, Van Dyke TE. An appraisal of the role of specific bacteria in the initial pathogenesis of periodontitis. J Clin Periodontol 2018.. doi: 10.1111/jcpe.13046.
6. Kilian M, Chapple ILC, Hannig M, et al. The oral Microbiome – an update for oral health care professionals . Br Dent Jnl 2016; 221(10) 657-666.
7. Ebersole JL, Dawson D, Emecen-Huja P, et al. The periodontal war: microbes and immunity. Periodontology 2000, 2017; 75: 52-115.
8. Cho I, Blaser MJ. The human microbiome: an interface of health and disease. Nat Rev Genet 2012; 13: 260-270.
9. Hair M, Sharpe J. Fast facts about human microbiome. Center for Ecogenetics and Environmental Health, University of Washington, 1/2014. https://depts.washington.edu/ceeh/downloads/FF_Microbiome.pdf
10. Edwards AM. Silence is golden for Staphylococcus. Nat Biol 2019; 4: 1073-1074.
11. Flemming HK, Wingender J. The biofilm matrix. Nat Rev 2010; 8: 623-633.
12. Schoilew K, Ueffing H, Dalpke A, et al. Bacterial composition in health subjects with and without caries experience. J Oral Microbiol 2019; 11(1): Art 1633194 https://doi:10.1080/20002297.2019.1633194.
13. Marsh PD. Dental plaque as a biofilm and a microbial community – implications for health and disease. BMC Oral Health 2006; 6(suppl 1): S1-S14. https://doi:10.1186/1472-6831-6-S1-S14
14. Lederberg, J., and A. T. McCray. ’Ome sweet ’omics—a genealogical treasury of words. Scientist 2001; 15: 8–10.
15. Human Microbiome Project Consortium. A framework for human microbiome research. Nature 2012; 486: 215–221.
16. Vasquez A.A., Ram J.L., Qazazi M.S., et al. Oral Microbiome: Potential Link to Systemic Diseases and Oral Cancer. In: Sun J., Dudeja P. (eds) Mechanisms Underlying Host-Microbiome Interactions in Pathophysiology of Human Diseases. Physiology in Health and Disease. 2018; Springer, Boston, MA
17. Wade, W. G. The oral microbiome in health and disease. Pharmacological Research 2013; 69, 137–143.
18. Dewhirst FE, Chen T, Izard J, et al. The human oral microbiome. J Bacteriol. 2010; 192(19): 5002– 5017.
19. Belibasakis GN, Curtis MA, Hajishengallis G, Zaura E. Meeting report: 12th European oral microbiology workshop (EOMW) in Stockholm, Sweden. Virulence 2018; 9(1): 64-69. DOI: 10.1080/21505594.2017.1376147 https://doi.org/10.1080/21505594.2017.1376147
20. Costalonga M, Herzberg MC. The oral microbiome and the immunobiology of periodontal disease and caries. Immunol Letters. 2014; 162 (200); 22-38. https://www.ncbi.nim.nih.gov/pmc/articles/PMC4346134/
21. Zaura E, Keijser BJF, Huse SM, Crielaard W. Defining the

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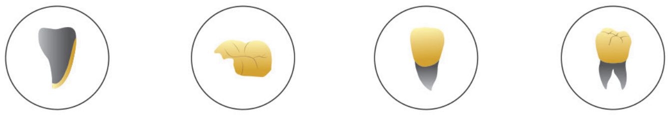

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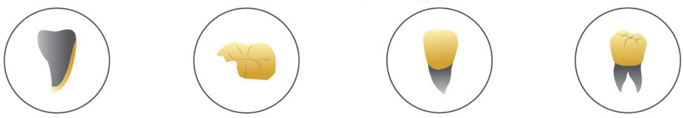

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health "core microbiome" of oral microbial communities. BMC Microbiol 2009; 9: 259.
22. Krishan K, Chen T, Paster BJ. A practical guide to the oral microbiome and its relation to health and disease. Oral Dis 2017; 23(3): 276-286.
23. Xu X, He J, Xue J et al. Oral cavity contains distinct niches with dynamic microbial communities. Environ Microbiol 2015; 17: 699–710.
24. Van't Hof W, Veerman E C, Nieuw Amerongen A V, Ligtenberg A J. Antimicrobial defense systems in saliva. Monogr Oral Sci 2014; 24: 40–51.
25. Marsh P D, Devine D A. How is the development of dental biofilms influenced by the host? J Clin Periodontol 2011; 38 (Suppl 11): 28–35.
26. Busscher H J, Rinastiti M, Siswomihardjo W, van der Mei H C. Biofilm formation on dental restorative and implant materials. J Dent Res 2010; 89: 657 665.
27. Hannig C, Hannig M. The oral cavity - a key system to understand substratum-dependent bioadhesion on solid surfaces in man. Clin Oral Investig 2009; 13: 123–139.
28. Øilo M & Bakken V. Biofilm and dental biomaterials. Materials 2015; 8: 2887–2900.
29. Abusleme, L., Dupuy, A. K., Dutzan, N., et al. The subgingival microbiome in health and periodontitis and its relationship with community biomass and inflammation. The ISME Journal, 2013; 7, 1016–1025.
30. Belkaid, Y., & Harrison, O. J. Homeostatic immunity and the micro- biota. Immunity, 2017; 46, 562–576.
31. Moutsopoulos NM, Moutsopoulos HM. The oral musosa: A barrier site participating in tissue specific and systemic immunity. Oral Diseases 2018; 24: 22-25.
32. Park I, Gu H, Park K-K. Molecular pathogenesis of bacteria-induced periodontitis. Int J Clin Exp Med 2018; 11(6): 5513-5522.
33. Vartoukian SR, Palmer RM, Wade WG. Diversity and morphology of members of the phylum "synergistetes" in periodontal health and disease. Applied and Environmental Microbiology. 2009; 75: 3777–3786.
34. Griffen AL, Beall CJ, Campbell JH, et al. Distinct and complex bacterial profiles in human periodontitis and health revealed by 16S pyro sequencing. ISME J. 2012; 6(6):1176–1185.
35. Kumar PS, Griffen AL, Moeschberger ML, Leys EJ. Identification of Candidate Periodontal Pathogens and Beneficial Species by Quantitative 16S Clonal Analysis. J Clin Microbiol. 2005; 43: 3944–3955.
36. Hutter G, Schlagenhauf U, Valenza G, et al. Molecular analysis of bacteria in periodontitis: evaluation of clone libraries, novel phylotypes and putative pathogens. Microbiology. 2003; 149: 67–75.
37. Paster BJ, Boches SK, Galvin JL, et al. Bacterial diversity in human subgingival plaque. J Bacteriol. 2001;183: 3770–3783.
38. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL. Microbial complexes in subgingival plaque. J Clin Periodontol. 1998; 25:134–144.
39. Hinrichs JE, Wolff LF, Pihlstrom BL, et al. Effects of scaling and root planing on subgingival microbial proportions standardized in terms of their naturally occurring distribution. J Periodontol. 1985; 56:187–194
40. Kumar PS, Griffen AL, Barton JA, et al. New Bacterial Species Associated with Chronic Periodontitis. J Dent Res. 2003; 82: 338–344.
41. Fine DH, Markowitz K, Furgang D, et al. Aggregatibacter actinomycetemcomitans and Its Relationship to Initiation of Localized Aggressive Periodontitis: Longitudinal Cohort Study of Initially Healthy Adolescents. J Clin Microbiol. 2007; 45: 3859–3869.
42. Avila M, Ojcius DM, Yilmaz O. The oral microbiota: Living with a permanent guest. DNA Cell Biol 2009; 28: 405-411.
43. Jia G, Zhi A, Lai PFH, et al. The oral microbiota – a mechanistic role for systemic diseases. Br Dent J 2018; 224: 447-455.
44. Marsh PD, Zaura E. Dental biofilm: ecological interactions in health and disease. J Clin Periodontol 2017; 44 (Suppl. 18): S12–S22.
45. Krajmalnik-Brown R, Ilhan Z E, Kang D W, DiBaise J K. Effects of gut microbes on nutrient absorption and energy regulation. Nutr Clin Pract 2012; 27: 201 214.
46. Relman D A. The human microbiome: ecosystem resilience and health. Nutr Rev 2012; 70 (Suppl 1): S2–S9.
47. Relman D A. The human microbiome and the future practice of medicine. JAMA 2015; 314: 1127–1128.
48. Graves DT, Corrêa JD, Silva TA. The oral microbiota is modified by systemic diseases. J Dent Res 2018; 1-9. https://www.researchgate.net/profile/Joice_Correa/publication/328521222_The_Oral_Microbiota_Is_Modified_by_Systemic_Diseases/links/5bd87ba14585150b2b91e11c/The-Oral-Microbiota-Is-Modified-by-Systemic-Diseases.pdf
49. Devine D A, Marsh P D, Meade J. Modulation of host responses by oral commensal bacteria. J Oral Microbiol 2015; 7: 26941.
50. Hajishengallis G, Lamont RJ. Beyond the red complex and into more complexity: the polymicrobial synergy and dysbiosis (PSD) model of periodontal disease etiology. Mol Oral Microbiol. 2012;27:409–419.
51. Zenobia C, Luo XL, Hashim A, et al. Commensal bacteria-dependent select expression of CXCL2 contributes to periodontal tissue homeostasis. Cellular Microbiology, 2013; 15, 1419–1426.
52. Nassar M, Tabib Y, Capucha T, et al. GAS6 is a key homeostatic immunological regulator of host-commensal interactions in the oral mucosa. Proceedings of the National Academy of Sciences of the United States of America, 2017; 114: E337–E346.
53. Autoimmune Research Foundation, The Marshall Protocol

Knowledge Base Accessed on the internet 22 July 2018 at: https//:mpkb.org/home/pathogenesis/successive_infection. 2015

54. Gillings M R, Paulsen I T, Tetu S G. Ecology and evolution of the human microbiota: Fire, farming and antibiotics. Genes (Basel) 2015; 6: 841–857.

55 . Gross E L, Leys E J, Gasparovich S R et al. Bacterial 16S sequence analysis of severe caries in young permanent teeth. J Clin Microbiol 2010; 48: 4121–4128.

56. Darveau RP. Periodontitis: a polymicrobial disruption of host homeostasis. Nature Rev. Microbiol. 2010; 8:481–490.

57. Rosier BT, de Jager M, Zaura E, Krom BP. Historical and contemporary hypotheses on the development of oral diseases: are we there yet? Front Cell Infect. Microbiol. 2014; 4

58. Coretti L, Cuomo M, Florio E, et al. Subgingival dysbiosis in smoker and non smoker patients with chronic periodontitis. Molecular Medicine Reports, 2017; 15: 2007-2014. https://doi.org/10.3892/mmr.2017.6269

59. Sanz M, Beighton D, Curtis MA et al. Role of microbial biofilms in the maintenance of oral health and in the development of dental caries and periodontal diseases. Consensus report of group 1 of the Joint EFP/ORCA workshop on the boundaries between caries and periodontal disease. J Clin Periodontol 2017; 44 (Suppl.18): S5–S11

60. Albandar JM, Susin C, Hughes FJ. Manifestations of systemic diseases and conditions that affect the periodontal attachment apparatus: case definitions and diagnostic considerations. J Periodontol. 2018; 89(Suppl 1):S183–S203.

61. Marsh P D, Head D A, Devine D A. Prospects of oral disease control in the future – an opinion. J Oral Microbiol 2014; 6: 26176.

62. Wu J, Peters B A, Dominianni C et al. Cigarette smoking and the oral microbiome in a large study of American adults. ISME J 2016; 10: 2435-2446.

63. Socransky SS, Haffajee AD. Periodontal microbial ecology. Periodontology 2000 2005; 38: 135-187.

64. Deng, Z-L, Szafranski SP, Jarek M, et al. Dysbiosis in chronic periodontitis: Key microbial players and interactions with the human host. Scientific Reports 2017; 7:, Article number: 3703

65. Wang J, Qi J, Zhao H, et al. Metagenomic sequencing reveals microbiota and its functional potential associated with periodontal disease. Scientific Reports. 2013: 3.

66. Madianos PN, Bobetsis YA, Kinane DF. Generation of inflammatory stimuli: how bacteria set up inflammatory responses in the gingiva. J Clin Periodontol 2005: 32(Suppl. 6): 57–71.

67. Marsh, PD, Head DA, Devine DA. Ecological approaches to oral biofilms: control without killing. Caries Res 2015; 49(Suppl 1): 46-54.

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Peter Buchan

Figure 1: Initial situation right view.

Figure 2: Initial situation left view

Figure 3: Initial situation labial view

Figure 4: Initial situation close-up

Figure 5: After edges bevelled

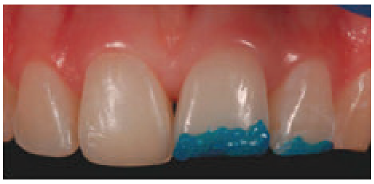

Figure 6: Acid etching the incisal edges

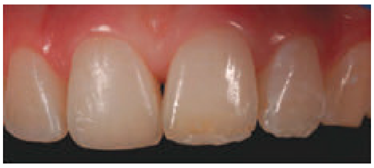

Figure 7: Building up the palatal surface with Omnichroma Blocker

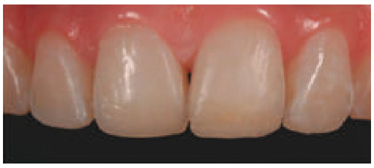

Figure 8: Building up the labial surface with Omnichroma

Figure 9: Pre polish right view

Figure 10: Final restoration labial view

Case Report

This was a 24-year-old female patient requiring small incisal build-ups on teeth UL 1 and UL2. There was nothing of note in the medical history and the periapical radiograph showed good bone, some existing intact restorations and no evidence of caries.

Before photographs were taken, using polarised photography in order to remove the surface reflection and aid proper shade evaluation. Estelite shade OA2, Estelite A2 and Omnichroma were compared to evaluate which shade would match best. The Omnichroma was selected.

Because it was a minimal restoration, in enamel only, no local anaesthetic was required. The margins were bevelled with a red flame diamond high speed bur. The enamel was then acid-etched and Tokuyama Bond Force II applied.

Tokuyama Bond Force II is a one bottle adhesive that only requires one single application. It can be used on both cut and uncut enamel and dentine. You can choose to use it using either a self-etch or selective enamel-etch technique. I prefer to use the selective enamel-etch technique. It gives an extended five minutes working time and only requires 10 seconds to light-cure.

The Omnichroma restoration was then built up freehand, no palatal stent was required on this occasion, and then the Omnichroma was light-cured for 20 seconds. Immediately upon light-curing the previously opaque material transformed into a translucent restoration, which seamlessly merged with the surrounding teeth.

The occlusion was checked, smoothed and then a final high lustre polish created using a Dentsply Enhance polishing disc then Cosmedent flexi mini disc kit.

The patient was shown the final restoration and departed extremely happy with the final result.

Peter Buchan, BDS FDS RCSEd DIP IMP, Dent RCSEd, Private Practice, West Lothian, Scotland, UK

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- Diastema closure
- Repair of porcelain/composite

Treatment of mandibular first molars with atypical anatomy: a case report

Yurii Riznyk[1] and Svitlana Riznyk[2]

Abstract
A 30 year old female patient presented with symptomatic irreversible pulpitis of both LR6 and LL6 teeth. Cone beam computed tomography (CBCT) of the region revealed, a middle mesial canal in tooth LR6, and a middle distal canal in tooth LL6. The case was managed with K files (Dentsply Maillefer), K file Nitiflex (Dentsply Maillefer), Protaper Next (Dentsply Maillefer), XP-endo Shaper (FKG) and BT-Race (FKG) under copious irrigation with sodium hypochlorite, ethylenediaminetetraacetic acid and saline. Premixed bioceramic sealer TotalFill (FKG) and gutta percha were used for root canal obturation. The access cavities were restored using glass ionomer cement and resin composite. A 12-month review showed that the teeth were functional within normal periodontal parameters. The favourable clinical and radiographic outcome in this case demonstrated that the treatment approach followed is effective in solving complex clinical challenges.

Keywords: Atypical anatomy, endodontic treatment, mandibular molars, middle distal canal, middle mesial canal.

Introduction
The main objective of endodontic therapy is a thorough debridement of the root canal space followed by complete obturation (Vertucci, 2005). The latest advances in the instrumentation techniques and equipment have enabled us to solve difficult clinical cases in endodontics (Berutti et al, 2009). At the same time, regardless of the continuous improvement in technology, the thorough knowledge of the internal anatomy of the pulp chamber and the root canal system is critical to increasing the rate of clinical success of endodontic treatment (Fava, 2001; Vertucci, 2005). The failure of the treatment could be the result of failure to recognise any unusual canal configuration, as well as prepare and perform the proper obturation of the missed root canals (Leonardo, 1998; Almeida et al, 2015). This assertion may be confirmed by the research of Song et al (2011), who reported that 30% of possible causes of failure in the previous root canal treatment of first lower molars were missed root canals.

In most of the cases, the first mandibular molar has two roots with two root canals in the mesial root and one canal in the distal root (Vertucci et al, 2006; de Pablo et al, 2010). In the endodontic treatment of the first mandibular molar, the main difficulty is the mesial root, which may have an additional middle root canal middle mesial canal (MMC), located in the developmental groove between the mesiolingual (ML) and the mesiobuccal (MB) canals. According to studies, the third canal in the mesial root can be found up to 18% of cases (Pomerantz et al, 1981; Navarro et al, 2007; de Pablo et al, 2010; Versiani et al, 2016). The MMC is categorised into three types fin, independent and confluent (Pomerantz et al, 1981):

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[2] Dr Svitlana Riznyk, DMD, PhD. Therapeutic Dentistry Department, Lviv Medical Institute, Lviv, Ukraine.

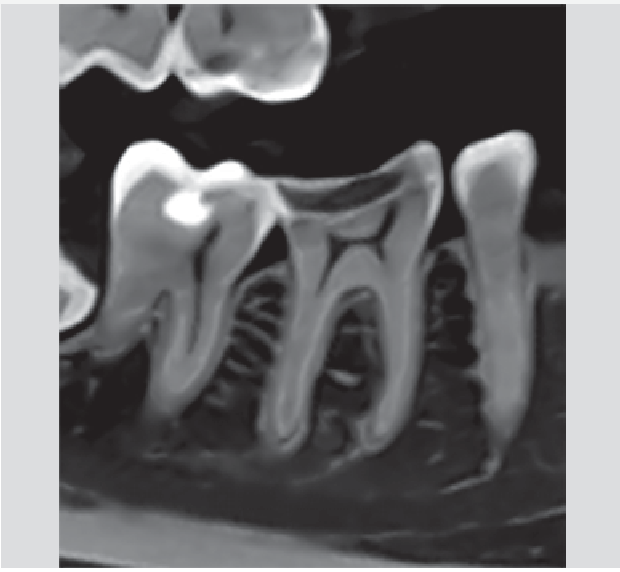

Figure 1.

1. Fin type lacks a separate orifice. It is usually a small linear extension of MB or ML canal
2. A separate orifice and separate apex are specific to this independent type
3. The confluent type is characterised by a separate orifice but it merges with either the MB or the ML canal. It was found in the research that confluent configuration is the most prevalent anatomic configuration (Versiani et al, 2016). Most of the MMC orifices are at the cementoenamel junction (CEJ) level, however it may also be detected at 1mm and 2mm depths from the CEJ and even deeper (Kele & Keskin, 2017), and may need an additional groove preparation.

There are also reports of the presence of three root canals in the distal root, with the incidence of 0.2-3% (Kottoor et al, 2010).

Analysing the morphology of the mesial root, type IV, according to Vertucci classification, was most often identified (52.3%), and type II in 35% of cases (de Pablo et al, 2010). In the distal root, the most often identified was type I (62.7%), and type II (14.5%) (de Pablo et al, 2010).

The usage of the intraoral radiographs, a dental operating microscope, a sharp explorer, and staining with methylene blue dye are commonly accepted principles for primary endodontic treatment (de Carvalho & Zuolo, 2000; Chavda & Garg, 2016). However, radiographs provide a very simple two-dimensional image, hiding the complex structure of root canals, making the evaluation of the morphological structure of the molars complex and challenging. At the same time, the use of 3D analysis has undeniable advantages in the identification of morphological variations of teeth (Durack & Patel, 2012; de Paula et al, 2013). Nevertheless, the use of this method is limited for the primary endodontic treatment due to the ALARA principle, which states that every effort should be made by professionals to keep the patient's exposure to ionising radiation as low as practically possible (Farman, 2005). In this case report, the preoperative 3D examination, and CBCT one year after the treatment were not performed for the endodontic treatment of teeth LL6 and LR6, but for the examination, diagnosis, planning and evaluation of results of surgical treatment on the mandible. The technique enabled to evaluate the complexity of the morphology of lower molars before the endodontic treatment.

Case report

A 30-year-old female patient was referred to the clinic with the chief complaint of spontaneous pain in the lower right region of the jaw for the previous three days. The patient's medical and family history was non-contributory. On clinical examination, a deep carious lesion was seen in tooth LR6. Thermal testing of the right mandibular first molar caused intense, lingering pain. Percussion and palpation in the region of this tooth were painless and investigations for sinus tract and periodontal involvement were negative.

The preoperative sagittal section of CBCT (Figure 1) revealed radiolucency on the occlusal surface of the crown, approaching the pulp space in the LR6. The coronal sections of CBCT of the mesial (Figure 2) and distal root (Figure 3), revealed two root canals in each of them. The axial section (Figure 4) confirmed MMC in the tooth LR6.

A diagnosis of symptomatic irreversible pulpitis was made, based on the clinical and radiographic examination, and we recommended conservative endodontic treatment. The patient declined alternative treatment methods.

After administration of conductive anaesthesia (Ubistesin 4% 1:100000 (3M Oral Care) and rubber dam isolation of the operative area, we performed access to the pulp chamber using long neck drills and ultrasonic tips. The pulp chamber was rinsed with 6% sodium hypochlorite (NaOCl). We used staining with methylene blue dye and Micro-Opener 15.04 (Dentsply Maillefer) under the optical magnification to examine the pulp chamber floor.

After access preparation and a careful analysis of the floor, we found two root canals in the mesial roots and two root canals in the distal ones. The orifice of the MMC was found

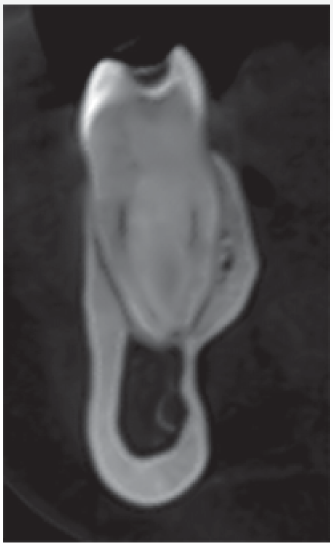
Figure 2.


Figure 3.


Figure 4.

after developmental groove preparation by the ultrasonic tip in the mesial root between the previously identified ML and MB canals. It is necessary to remember that the diameter of the MMC canal is smaller in comparison with the ML and MB canals, and due to the anatomical danger zones, it requires more careful preparation (De-Deus et al, 2019; Keles et al, 2020).

We negotiated the canals, and established patency at working length with 10 K-file (Dentsply Maillefer) using an I-pex apex locator (NSK, Japan) and confirmed with radiographs. A size 15 K-file Nitiflex (Dentsply Maillefer) was used to perform the glide path.

We then conducted the shaping of the root canals using the Protaper Next X1 (Dentsply Maillefer) instrument, followed by the XP-endo Shaper (FKG), and 35/.04 BT-Race (FKG). At each change of the endodontic instrument, we irrigated the canals with 6% NaOCl. For better purification of the isthmus, Micro-Debriders (Dentsply Maillefer) were used.

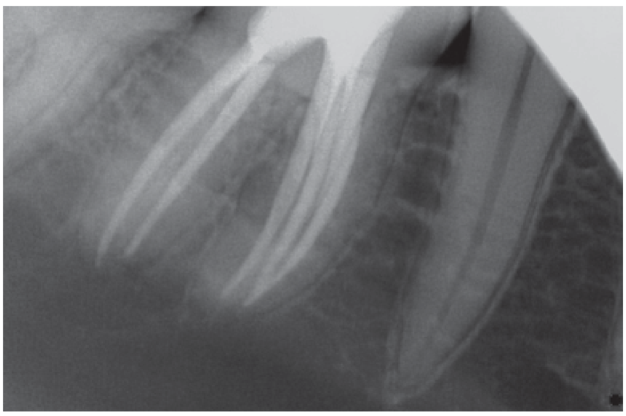
Figure 5.

At the end of the preparation, we applied 17% ethylenediaminetetraacetic acid (EDTA) for one minute to remove the smear layer and performed the irrigation with a copious volume of 6% NaOCl. XP-endo finisher (FKG) was used within 15 seconds to activate all of the solutions, applying slow, gentle longitudinal movements of 7-8 mm to cover the entire length of the canal. Before the obturation, we rinsed all canals with saline. All master cones were processed antiseptically, fitted and set on a working length. The canals were partially dried with paper points and obturated by the cold hydrodynamic obturation technique of gutta-percha and premixed bioceramic sealer Totalfill (FKG). We cleaned the pulp chamber in order to remove the excess of gutta-percha and bioceramic sealer, temporarily restored the tooth with resin composite and made the post-treatment radiograph of tooth LR6 (Figure 5). Then we referred the patient for the permanent restoration of tooth LR6.

We were able to evaluate the complexity of the morphology of tooth LR6 and its obturation, with the CBCT (Planmeca ProMax, Finland) of the mandible one year after the treatment (Figures 6-9).

In the medial system, the pulp space separates into three canals and two of them join into one during its course to exit as two root canals (Figure 7), which are the 3-2 type according to the classification of the root canal morphology (Gulabivala et al, 2001; Sert & Bayirli, 2004; Bansal et al, 2018).

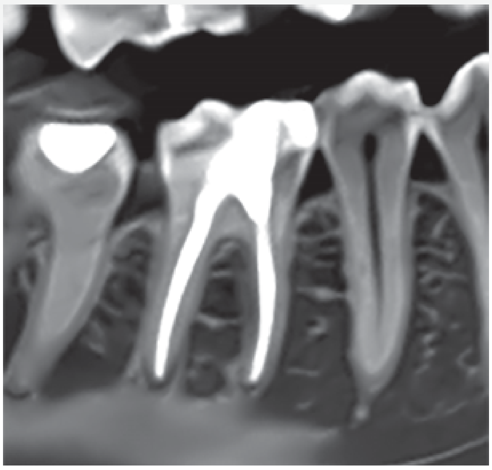

Figure 6.

Figure 7.

In the distal system (Figure 8), two canals run separately from orifice to apex, which corresponds to the type 2-2 classification of root canals morphology (Vertucci, 1984; Weine at al, 1988; Bansal et al, 2018). Axial CBCT slice of tooth LR6 confirmed three root canals in the medial and two root canals in distal roots (Figure 9).

After a short while, the same patient was referred to the clinic with the chief complaint of intermittent moderate pain in the lower-left region of the jaw. On clinical examination, we could see a deep carious lesion in tooth LL6. Pulp thermal testing caused intense, extended pain. The percussion test of the tooth LL6 was negative. The tooth was apically painless to palpation. The periodontal probing near LL6 was within the physiological norm.

A preoperative sagittal section of CBCT (Figure 10) revealed radiolucency on the occlusal surface of the crown, approaching the pulp space in the LL6. The coronal sections of CBCT showed two root canals of the medial root (Figure 11) and two main canals in the distal root (Figure 12). The axial sections (Figure 13) confirmed MDC in the tooth LL6.

Figure 8.

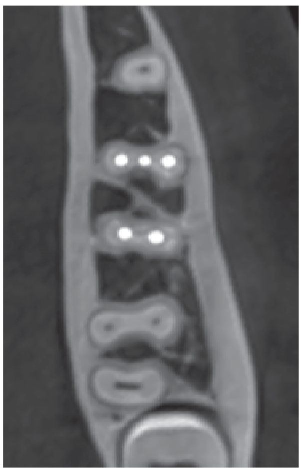

Figure 9.

All clinical signs indicated symptomatic irreversible pulpitis and conservative endodontic treatment was recommended. As the patient declined alternative treatment methods, we carried out the treatment of tooth LL6 according to the same main principle as mentioned above.

After anesthesia (Ubistesin 4% 1:100000 (3M Oral Care) and rubber dam isolation of the operative area, we gained access to the pulp chamber. We then investigated the bottom of the pulp chamber with Micro-Opener 15.04 (Dentsply Maillefer) under optical magnification. The pulp chamber was antiseptically processed.

As in the previous case, during the examination of the bottom of the pulp chamber, we found two root canals in the mesial roots and two root canals in distal ones. Based on the CBCT data, we made the preparation of the developmental groove in the distal root between the identified DL and DB canals and the orifice of the MDC was found approximately 3 mm below the CEJ.

Afterwards, we negotiated canals, and established patency at working length with 10 K file (Dentsply Maillefer) using an I-pex apex locator (NSK, Japan) and confirmed with radiographs. A size 15 K file Nitiflex (Dentsply Maillefer) was used to perform the glide path. The mechanical instrumentation of the root canals was performed using the 10/.06 BT-Race (FKG) instrument followed the XP-endo Shaper (FKG), and 35/.04 BT-Race (FKG), with isthmus cleaning with the Micro-Debriders (Dentsply Maillefer). At

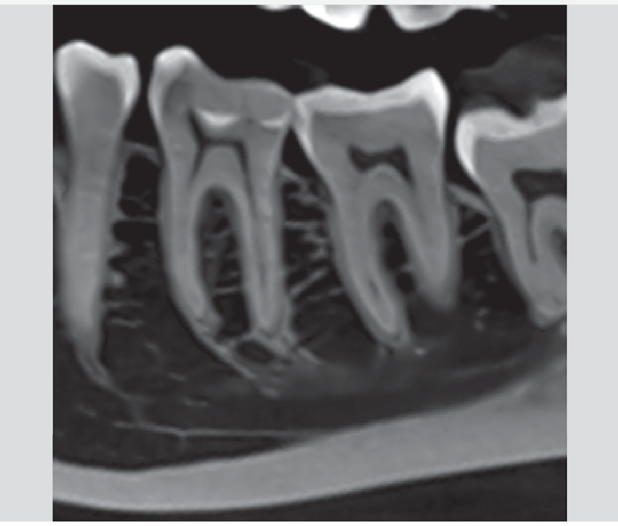
Figure 10.

each change of instrument, we irrigated the canals with a 6% NaOCl. At the final stage of biomechanical preparation, 17% EDTA was applied for one minute succeeded by the copious amount of 6% NaOCl. To activate the solutions we used the XP-endo Finisher (FKG). Before the obturation, all canals were rinsed with saline. We processed all master cones antiseptically, then fitted and set them on a working length.

The canals were partially dried with paper points and we carried out the cold hydrodynamic obturation technique of gutta-percha and bioceramic sealer TotalFill (FKG) to obturate them. The cleaning of the pulp chamber was performed and glass-ionomer cement and resin composite were applied to temporarily restore the tooth. We took the post treatment radiograph of tooth LL6 (Figure 14). The patient was then referred for the permanent restoration of tooth LL6.

The patient was recalled at six and twelve months postoperatively. At follow-up appointments, the LL6 and LR6 teeth were asymptomatic and functional.

We used the same CBCT (Planmeca Promax, Finland) of the mandible to evaluate the complexity of the morphology of tooth LL6 and its obturation, one year after the treatment (Figures 15-18).

In the mesial system, two separate root canals with separate orifices and two separate apexes (Figure 16) that correspond to type 2-2 morphology of root canals system (Vertucci, 1984; Weine at al, 1988; Bansal et al, 2018).

Distal root canals correspond to type 2-3-1: two canals divide into three and then during its course unite into one (Sert & Bayirli, 2004; Al-Qudah & Awawdeh, 2009; Bansal et al, 2018). Root canals overlap one another on the postoperative radiograph (Figure 14). Axial slice of CBCT tooth LL6 confirmed two root canals in mesial and three root canals in the distal roots (Figure 18).

Discussion

Endodontic treatment of mandibular molars requires a high level of knowledge and clinical skills due to their anatomical variations. In one of the studies it was claimed that the middle mesial canal can be rather the sequelae of instrumenting the isthmus between the mesiobuccal and mesiolingual canals than an extra canal (Mortman & Ahn, 2003). However, according to more recent studies, the true third canal in the mesial root of the mandibular first molar was found up to 18%

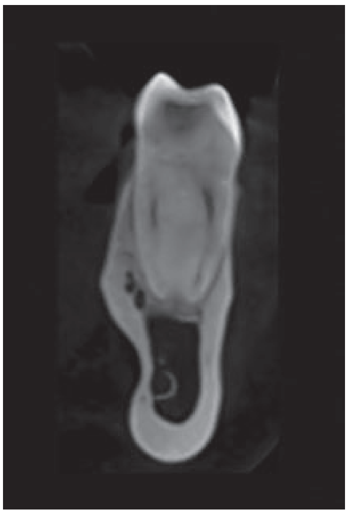
Figure 11.

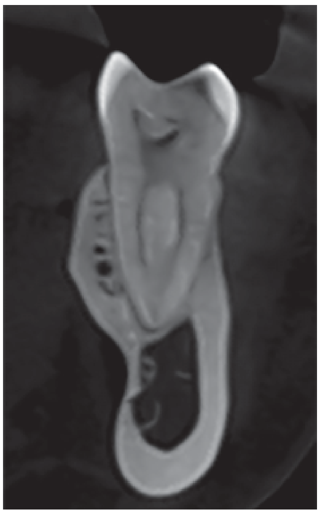
Figure 12.


Figure 13.

Figure 14.

(Navarro et al, 2007; de Pablo et al, 2010; Versiani et al, 2016), and 0.2-3% in the distal root (Kottoor et al, 2010).

Teeth with atypical canal configuration complicate the process of identifying and accessing root canals in the endodontic treatment. CBCT has the ability to overcome the limitations of conventional radiography such as three-dimensional evaluation of the complex canal anatomy during endodontic treatment (Durack & Patel, 2012; de Paula et al, 2013), but it is necessary to remember that, in usual practice, a post treatment CBCT must be confirmed by appropriate indications and meet with current guidelines regarding ALARA.

The dental operating microscope is necessary for the detection of accessory canals in mandibular molars (de Carvalho & Zuolo, 2000; Karapinar-Kazandag et al, 2010).

At the present stage of the development of endodontics, it is impossible to carry out a complete cleaning of the root canal system. When flat, or curved root canals with oval cross-sections are considered, the most current rotary nickel-titanium file systems will not adequately clean and shape the canal with favorable results (Metzger et al, 2010).

Therefore, an endodontic file should be used, which adapts to the natural morphology of the root canals and efficiently cleans it. Appropriate shaping and cleaning of the root canal system with the XP-endo Shaper and XP-endo Finisher instruments used for this clinical case have the potential to improve root canal system cleaning (Azim et al, 2016; Azim et al, 2017).

Conclusion

Professionals should always consider morphological variations of the root canal system before the beginning of treatment.

This case report reinforces the importance of using cone-beam computed tomography, to evaluate the complexity of the morphology of teeth before the endodontic treatment.

The favourable clinical and radiographic outcome in this case demonstrated that the treatment approach followed in the present case is effective in solving complex clinical challenges.

References

Almeida G, Machado R, Sanches Cunha R, Vansan LP, Neelakantan P (2015) Maxillary first molar with 8 root canals detected by CBCT scanning. Gen Dent 63(2): 68-70

Al-Qudah AA, Awawdeh LA (2009) Root and canal morphology of mandibular first and second molar teeth in a Jordanian population. Int Endod J 42(9): 775–84

Azim AA, Aksel H, Zhuang T, Mashtare T, Babu JP, Huang GT (2016) Efficacy of 4 irrigation protocols in killing bacteria

Figure 15.

Figure 16.

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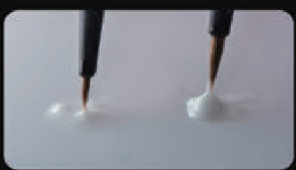

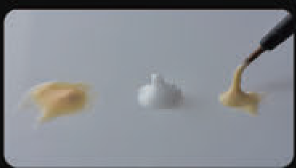

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Figure 17.

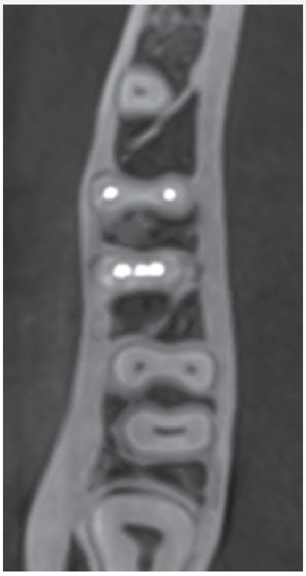

Figure 18.

colonized in dentinal tubules examined by novel confocal laser scanning microscope analysis. J Endod 42(6): 928-34

Azim AA, Plasecki L, da Silva Neto UX, Cruz ATG, Azim KA (2017) XP-Shaper, a novel adaptive core rotary instrument: Micro-computed tomographic analysis of its shaping abilities. J Endod 43(9): 1532-8

Bansal R, Hegde S, Astekar MS (2018) Classification of root canal configurations: A review and a new proposal of nomenclature system for root canal configuration. Journal of Clinical and Diagnostic Research [Internet]. May 12(5):1-5

Berutti E, Cantatore G, Castellucci A et al (2009) Use of nickel-titanium rotary PathFile to create the glide path: comparison with manual preflaring in simulated root canals. J Endod 35(3): 408–12

Chavda SM, Garg SA (2016) Advanced methods for identification of middle mesial canal in mandibular molars; An in vitro study. Endodontology 28(2): 92-6

de Carvalho MC, Zuolo ML (2000) Orifice locating with a microscope. J Endod 26(9): 532-4

De-Deus G, Rodrigues EA, Belladonna FG et al (2019) Anatomical danger zone reconsidered: a micro-CTstudy on dentine thickness in mandibular molars. Int Endod J 52(10): 1501-7

de Pablo OV, Estevez R, Péix Sánchez M, Heilborn C, Cohenca N (2010) Root anatomy and canal configuration of the permanent mandibular first molar: a systematic review. J Endod 36(12): 1919-31

de Paula AF, Brito-Júnior M, Quintino AC, Camilo CC, Cruz-Filho AM, Sousa-Neto MD (2013) Three independent mesial canals in a mandibular molar: Four-year followup of a case using cone beam computed tomography. Case Rep Dent

Durack C, Patel S (2012) Cone beam computed tomography in endodontics. Br Dent J 23(3): 179-91

Farman AG (2005) ALARA still applies. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 100(4): 395-7

Fava LRG (2001) Root canal treatment in an unusual maxillary first molar: A case report. Int Endod J 34: 649–53

Gulabivala K, Aung TH, Alavi A, Ng YL (2001) Root and canal morphology of Burmese mandibular molars. Int Endod J 34(5): 359–70

Karapinar-Kazandag M, Basrani BR, Friedman S (2010) The operating microscope enhances detection and negotiation of accessory mesial canals in mandibular molars. J Endod 36(8): 1289-94

Keleş A, Keskin C (2017) Detectability of middle mesial root canal orifices by troughing technique in mandibular molars: a micro–computed tomographic study. J Endod 43(8): 1329-31

Keleş A, Keskin C, Alqawasmi R, Versiani M (2020) Evaluation of dentine thickness of middle mesial canals of mandibular molars prepared with rotary instruments: a micro-CT study. Int Endod J 53(4): 519-28

Kottoor J, Sudha R, Velmurugan N (2010) Middle distal canal of the mandibular first molar: a case report and literature review. Int Endod J 43(8): 714–22

Leonardo MR (1998) Aspectos anatomicos da cavidade pulpar: relacoes com o tratamento de canais radiculares. In: Leonardo MR, Leal JM editors. Endodontia: tratamento de canais radiculares. 3rd edn. pp.191 Sao Paulo: Panamericana

Metzger Z, Zary R, Cohen R, Teperovich E, Paque F (2010) The quality of root canal preparation and root canal obturation in canals treated with rotary versus Self-adjusting files: a three-dimensional micro-computed tomographic study. J Endod 36(9): 1569-1573

Mortman RE, Ahn S (2003) Mandibular first molars with three mesial canals. Gen Dent 51(6): 549-51

Navarro LF, Luzi A, Garcia AA, Garcia AH (2007) Third canal in the mesial root of permanent mandibular first molars: review of the literature and presentation of three clinical reports and two in vitro studies. Med Oral Patol Oral Cir Bucal. 12(8): 605–9

Pomerantz HH, Eidelman DL, Goldberg MG (1981) Treatment considerations of the middle mesial canal of mandibular first and second molar. J Endod 7(12): 565-8

Sert S, Bayirli GS (2004) Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod 30(6): 391-8

Song M, Kim HC, Lee W, Kim E (2011) Analysis of the cause of failure in nonsurgical endodontic treatment by microscopic inspection during endodontic microsurgery. J Endod 37(11): 1516-19

Versiani MA, Ordinola-Zapata R, Keleş A, Alcin H, Bramante CM, Pécora JD, Sousa-Neto MD (2016) Middle mesial canals in mandibular first molars: a micro-CT study in different populations. Arch Oral Biol 61: 130-7

Vertucci F (1984) Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol, 58(5): 589-99

Vertucci FJ (2005) Root canal morphology and its relationship to endodontic procedures. Endod Topics 10: 3-29

Vertucci FJ, Haddix JE, Britto LR (2006) Tooth morphology and access cavity preparation. In: Cohen S, Hargreaves KM, editors. Pathways of the pulp, 9th edn; Louis MO USA: Mosby. pp 148–232

Weine FS, Pasiewicz RA, Rice RT (1988) Canal configuration of the mandibular second molar using a clinically oriented in vitro method. J Endod 14(5): 207-13

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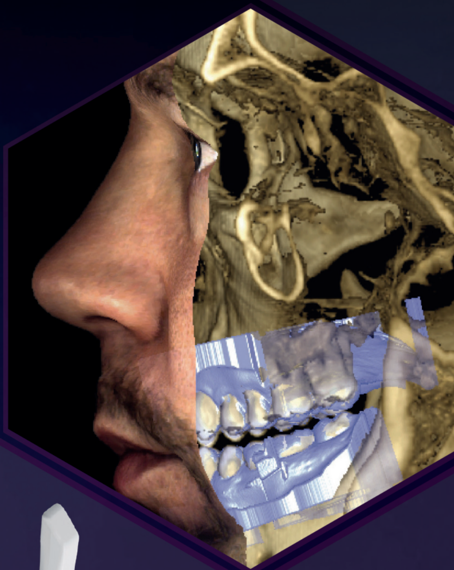

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Peter Anderson looks back on 16 years with Straumann

International Dentistry - African Edition chats to Peter Anderson on his years with Straumann in South Africa

Peter Anderson

International Dentistry - African Edition (ID-AE): Peter Anderson, you have been involved with Straumann in South Africa since 2004, during which time you have overseen two main achievements - putting Straumann on the map in South Africa/sub-Saharan Africa and then launching the ITI Southern African section.

Peter Anderson (PA): Starting with the ITI, I think to some extent Diego Cunatti certainly laid the foundation by getting Gerrit Wyma and Paul van Zyl appointed as Fellows. That was actually one of the trickier parts of getting the ITI Section going – South Africa didn't have any local Fellows and you need Fellows to start a Section. That's where Daniel Buser, together with Urs Belser, came in and supported us by initially Proposing and Seconding Gerrit and Paul. Others later came on board, including Blackie Swart and Pieter Wolfaardt. In those days it was far more "restrictive" to become a Fellow than it is today, as you had to have some kind of Academic record as well. Back then there were probably only about 200 Fellows worldwide, so that was quite an achievement for us.

ID-AE: I also believe that your constant sponsorship and support of the ITI Congresses also contributed to the Section's growth. Without that commitment, do you believe it would have been a lot more difficult for the Section to become what it is now?

PA: Yes, I think so, but that's why they always refer to Straumann and ITI as a "symbiotic" relationship. However, we didn't really push the commercial side particularly hard. That's why, today - fortunately or unfortunately - not all the Members are Straumann users per se.

ID-AE: Apart from the ITI Southern Africa Section, you also supported other Congresses, Courses and Universities. Straumann played an instrumental part, in particular, with the University of Pretoria Post Graduate Courses started by Prof Andre van Zyl back in 2011. While other Systems were involved initially, was Straumann not at the forefront?

PA: Yes. I had a very good relationship with Prof Andre Van Zyl and always supported the Post Grad courses. We attended an ITI Education Week in Bern together in the early 2000's. He had been running Diploma Courses at the University of Stellenbosch initially and subsequently the University of the Western Cape. When Andre came to the University of Pretoria, he was motivated by Danny Buser's Education Week in Bern to apply for Africa's first ITI Centre of Excellence, which, under his leadership, was awarded to UP in 2014.

We also managed to put a substantial number of Specialists and Post Grad Students through the Bern courses over the years. That could be partially self-interest, but there's no direct link between taking somebody on a course and actually getting their business subsequently. In fact, a number of those people didn't give us much business afterwards!

ID-AE: You were involved with Straumann for over 16 years – firstly as a distributor with ASM Consulting and then as Country Manager of Straumann Group South Africa.

PA: When I took over the distributorship in 2004 there were just three surgical customers - Gerrit Wyma, Peter Wolfaardt and Blackie Swart. Their referral group was obviously almost entirely Cape Town-based. It was somewhat parochial back in 2004. And on top of that we were still called ITI implants in those days, but we successfully managed to keep ourselves as the most "expensive" brand on the market for a number of years. In fact I think we still are, but not like quite the same margin as we were back in 2004.

I think what has always been in my favour, particularly, is that I was lucky in that I ended up with Straumann as a brand. Even today it's clearly recognised as probably the most or the "best" researched implant brand in the world. That has a lot to do with the symbiotic relationship between the ITI and Straumann. All the Research that goes into implants from the ITI side supports a lot of the work that Straumann does..

But, bringing in a product priced in Swiss Francs is a challenge. When I first started in 2004, the exchange rate was just under R5.00 to the Swiss Franc. And then it ended up going up to R16.00/R17.00 by the time I finished. Managing that exchange risk as a distributor is particularly difficult, because at any one time, you might be owing a million or two Swiss Francs. What I've learnt subsequent to the last three years with big corporate, is that they have ways of managing that exposure. To give you an example, the other countries in the regional group that South Africa falls under - Turkey, Russia, Iran – all have huge problems with the exchange rate, with South Africa having probably the most stable currency. In Iran they're sometimes dealing with inflation rates of 1000%, with Turkey well over 25%. It obviously has huge effects on the currency. So in some ways South Africa is lucky. It's certainly easier dealing with the corporate rate than as a distributor.

ID-AE: Your journey with Straumann has seen the company develop from an implant manufacturer to one offering a broad range of dental products. Do you believe that is a good development?

PA: Yes, absolutely. In 2004, Straumann was essentially a Tissue Level implant Company. And while not everyone agrees with Tissue Level, the Straumann mindset in those days was to convert the rest of the world to Tissue Level. It was really only when Marco Gadola took over as CEO in 2013, that the company expanded its product profile. On the implant side they are now number one globally, by quite a long way, if you include all the other Brands that were introduced. With the acquisition of the other implant brands, Straumann is now available in every single space in the implant market, whether it's Premium or whether it's Value. That means that basically one in every five or six Implants sold globally is a Straumann brand. Plus, Straumann is the last of the independent implant companies left. The rest are all owned by major companies, for example, Dentsply Sirona, Danaher. That has given them more flexibility.

ID-AE: CAD/CAM, has been probably one of the biggest game changers in dentistry since the development of Implants. How do you see CAD/CAM growing?

PA: The first group of Specialists that I took to a course in Bern was in 2004/2005, and there was a CBCT unit . I remember them saying, "These Swiss people have got this machine that probably costs a million Swiss Francs. We will never be able to afford this back in South Africa. We are still going to go along with X-Rays." It hasn't taken very long and today, you're almost being reckless if you start placing implants and you haven't at least taken a CBCT.

While Straumann is not in imaging equipment, they are in just about everything else. There was also a time when when Danny Buser himself was particularly dismissive of Computer-Guided surgery and said he far preferred "Brain-Guided surgery!". That was only six or seven years ago and today, Computer-Guided surgery and Digital Planning has improved to such an extent that now the guides are exceptionally accurate. I think that's a huge advancement. In my opinion, one of the biggest problems in the implant Industry is not the implant system used per se. To be brutally honest about it, as long as the material is pure and the design acceptable, the implant itself is going to work. The biggest problem is actually a malpositioned Implant. And there are thousands of those. So hopefully, in another five years time we won't see too many of them because of the trend towards Digital Planning. In fact, I hope in the next five years all the surgery taking place will be Guided Surgery.

So yes, CAD/CAM is a tremendous advancement and Straumann is particularly well placed with that because of their partnerships with 3Shape and our own Dental Wings Virtuo Vivo™ Scanner is great. But the TRIOS® Scanners are acknowledged as probably the best in the world. The Co-Diagnostics Planning Software is probably generally regarded as the best as well. So they are particularly excited about that at Straumann, because their new product concepts, such as a "Smile in a Box", makes them particularly well placed to take advantage of the move to CAD/CAM.

ID-AE: To expand a little more on the aesthetic side, Straumann has now gone into the clear aligner market. What are your thoughts on ClearCorrect coming in as a product as an adjunct to the implant market?

PA:: It's huge. Invisalign is clearly the market leader in that particular market, but ClearCorrect is, I think, number two. With their tie up with Doctor Smile and their rapid growth, I have no doubt that ClearCorrect could one day be the market leader in that space. That is very exciting because it's pretty much the same trend as we saw in implant dentistry. As I said earlier, when I took on Straumann in 2004, there were only three surgeons

Roelyn Lombard and Peter Anderson.

Back L-R: Peter Anderson, Christiaan Vorster, Paul van Zyl. Front: Andre van Zyl, Gerrit Wyma, Pieter Wolfaardt, ITI Congress 2013 using the system. Implantology back then was pretty much still in the realm of specialists - you went to a specialist Surgeon to have the Implant placed and a Prosthodontist to have the crowns placed. That has changed dramatically. Many General Dentists are successfully doing implant surgery today. The same thing with Orthodontics, which was probably made to look slightly more complicated than it actually is. Clear aligners are clearly eating into that market in a big way. The big market in Europe, North America and South America, and Asia is Adult Orthodontics. In South Africa it's probably still mainly youth-orientated, with adults, a hugely untapped market. As aligners become more simpler and more attractive, I think they will become more popular as a treatment option. I also believe that in Africa, because it's a particularly small implant market, the potential for Orthodontics is actually bigger. So one day our Orthodontic business could probably be larger than implants.

ID-AE: On a personal note, how does one go from being an Accountant to somebody with as much knowledge of dentistry as you have? Is it something that you just got into and really enjoyed.
PA: I think you should follow your interests – and I was interested in it. I was a lot more interested in the surgical side than the prostho side, to be honest. I'm clearly not a clinician, but I have acquired quite a wide, deep knowledge of a very narrow field of Dentistry. I can hold my own on certain topics but I think sometimes it's better just to have a broad interest when you're looking at something like this, rather than to be too narrowly focused. One of the most satisfying aspects was actually being able to help people through our University Programmes where we gave implants for free and where we helped in Pro Bono Cases. Today we still have that. If any Clinician comes to us and says, "I have this Patient I really want to help" and they agree to forego their fees, and the Laboratory agrees to forego their fees, we will supply them with free "hardware". I always got a kick out of that, to be honest, being able to help people who weren't otherwise able to afford the treatment - because it is still a terribly expensive procedure.

ID-AE: Are you going to completely retire or will we still see you sometimes at certain events?
PA: No! I'll give my advice to my former colleagues if needed, but I'm not going to take up any kind of Consulting role. I think it's important that when you have a change of guard, that the old guard disappears. Straumann has a young team in place and I think they're very well-equipped to deal with the very significant challenges that are there. We haven't felt the full effects of Covid yet, but we were pleasantly surprised at how we managed to bounce back. However, our economy is going to suffer for years to come, so it's a very difficult environment to operate in. I think they're going to do a good job but they don't need me hanging around and offering too much advice!

ID-AE: Is there anything you'd like to add, something that stands out as being your best moments?
PA:: I've been incredibly privileged to do something that I've really enjoyed for the last 16 odd years. Plus some of the people I've dealt with - the people in my team, both with ASM and then Straumann, as well as on the client side. I've met some fantastic people who are friends and will continue to be friends. To me that's one of the more satisfying things, having really enjoyed myself for the last 16 years. To wake up in the morning and not dread going to work is a privilege.

ID-AE: Peter Anderson, it was also a privilege to have a working relationship with you all these years and we wish you everything of the best in your retirement.

Stephen Chen and Peter Anderson, ITI Congress 2016.

L-R,Peter Anderson, Corlene Schnetler and Adell Naidoo , ITI Congress 2019.

L-R, Paul van Zyl, Dr Ophir Fromovich, Blackie Swart, Peter Anderson, BLX launch 2019.

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Restoring discoloured composite

Joe Bansal[1]

Introduction

The patient, a 25-year-old aspiring actress teaching dance at a local studio, was referred to our clinic for composite bonding by a local cosmetic dentist.

She presented with discoloured composite bonding on her upper left central incisor. She became more aware of it when one of her young dance students mentioned it and has become progressively conscious of it since.

At the initial consultation, her main concerns were the colour match of her composite bonding, as well as her overall tooth colour.

History

The tooth was initially traumatised during a swimming incident in her childhood. The composite bonding was placed around a year ago following whitening. It discoloured soon after its placement and she was too nervous to return to the treating dentist to have it redone. She overcame this by guarding her teeth during smiling.

She is originally from Birmingham and on her move to London, she researched cosmetic dentists on Harley Street. After having been to see a few of them, the options she was given ranged from having one to 10 porcelain veneers. She wanted to have her bonding replaced, leading to one of the dentists she saw referring her to our clinic.

The patient was very open and honest about her dental anxiety. She was otherwise a confident young lady but the thought of actual dental treatment (as opposed to an examination and hygiene session) terrified her. In the past she had managed to have treatments such as Invisalign, tooth whitening and bonding done but it had taken a lot for her to undergo these procedures. She, to this point, had not had any pharmacological measures (such as sedation) to help her with her dental treatments.

Despite her previous anxiety, she gave enough encouraging signs that we could attempt to help her in a non-pharmacological manner. Medically, she was fit and well with no known allergies nor medications.

It would take time and patience from both her and myself to rebuild her confidence in the dentist but I felt she was motivated and ready to improve her smile.

Diagnosis and treatment plan

The main features from her assessment were:

- Discoloured composite bonding present on the upper left central incisor
- Due to previous trauma history, it was difficult to assess whether the discolouration came from the composite or underlying tooth
- The UL1 was asymptomatic, not tender to percussion, with no buccal tenderness, no mobility, a ‘normal’ response to cold ethyl chloride testing and the periapical was unremarkable
- She was wearing upper and lower retainers from previous Invisalign treatment
- Her teeth were well aligned bar a small degree of relapse in the upper arch
- There was a composite MOB inlay present on the upper left first molar, which had an open mesial margin and caries leading to gingival inflammation
- The posterior teeth (in general) showed signs of early carious lesions on radiographs

[1] Dr Amerjote (Joe) Bansal BDS
Private practice, London, UK

Figure 1a: Frontal smile

Figure 1b: Frontal lateral smile (left)

Figure 1c: Frontal lateral smile (right)

Figure 2a: Retracted (left)

Figure 2b: Retracted (right)

Figure 2c: Retracted frontal

Figure 3a: Upper arch

Figure 3b: Lower arch

and clinically

- BPE scores were 112/121
- The UR1 and UL1 were both 12mm in length
- The upper incisors and upper canines were Vita B1shade
- The UR1 has Intensive 2 and Opalescent 3 effects (Vanini Colour Chart)
- Thin soft tissue biotype
- Soft tissues clear of signs of oral pathology/cancer
- No soft tissue signs of parafunctional habits
- Load test negative using a leaf gauge
- TMJ joints and muscles were clear
- Tentative Piper class I
- Maximum opening 47mm.

The provisional diagnosis of the upper left central incisor was that of a discoloured composite restoration causing an aesthetic concern. There was a possibility that the discolouration may have also been caused by calcific metamorphosis due to the previous trauma.

The other concerns were of the early lesions present in her posterior teeth.

Her overall treatment plan was as follows:

1. Replace the composite bonding on the UL1 to improve confidence in herself and our clinical skillset. This would in turn provide a positive pathway to restoring the carious lesions present in her posterior teeth
2 Replace the UL6 inlay
3. Restore the early carious lesions present in her posterior teeth.

To help us diagnose the cause of her lesions, a diet analysis was carried out and there were no obvious issues with her diet. It did transpire that there was a period where her consumption of a high acid and sugar diet was present.

The patient was happy with this treatment plan and the approach that we had proposed.


Figure 4a: Bonding removal


Figure 4b: Temporary bonding


Figure 5: Post whitening frontal smile


Figure 6a: Post whitening retracted close-up polarised


Figure 6b: Post whitening retracted close-up twin flash


Figure 6c: Post whitening retracted close-up

Treatment Stage One: Tooth colour

Prior to replacing the bonding, we advised the patient to top up her tooth whitening if she wished as we would be shade matching her bonding to the tooth colour at the time of treatment.

She was happy overall with her colour but wanted to see if she could make her teeth any whiter. She came in with her tooth whitening trays, which fit well, and was given a three-syringe pack of Zoom! Daywhite 6% hydrogen peroxide gels to wear for a week or so. Day gels were given in preference over night time gels as she was wearing retainers overnight and there were possible issues with patient compliance.

As the patient was very concerned about the discoloured bonding, we took this opportunity to place a temporary restoration on the tooth during the whitening process. This would also give us the chance to see beneath the restoration.

The patient consented to treatment but was extremely nervous. She declined local anaesthetic.

Some of the strategies that we used to overcome the anxiety were based upon deep breathing and relaxation exercises prior to and during treatment, aromatherapy devices in the surgery and giving her the element of control during her procedures. We also used a pair of video goggles and a film to help to distract her during her treatment.

Using a slow handpiece and 3M Softflex discs, we were able to gently remove most of the bonding. The underlying tooth colour was coincidental with the exposed tooth colour so the possibility of calcific metamorphosis was ruled out. The tooth was then restored using Venus Pearl shade B1.

We had to work extremely slowly with regular breaks and patient reassurance. It was difficult and at times frustrating but we were able to manage the patient well.

The patient was advised to use and finish the whitening gels and to return after a 10- to 14-day period (to allow the tooth colour to settle and the surface to recover to maximise bond strength) for her bonding.

Treatment Stage Two: Composite Bonding

My protocol for shade matching composite restorations is to assess the colour at the very start of the session to minimise the effects of dehydration on the tooth colour. Using a Vita 3D shade guide, her approximate shade was between 1M1 and OM3.

This is done prior to any local anaesthetic, retraction or photographs. Anterior teeth are known to dehydrate within a few minutes of being dry.

Taking into account the colours I would need, I felt that the best suited system I had at my disposal would be Empress Direct. The composite shades were tested against the teeth by using a small amounts of the material in a ball shape and placed on the buccal surface of the two central incisors. The material was placed with no etch nor adhesive and fully light-cured for 20-30 seconds to assess their colour.

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BEFORE AFTER

Before and after photos by Dr Hannes Scheepers (Dainfern Dental Studio)

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Figure 7: Initial shape

Figure 8: Bonding removed

Figure 9a: Shade tabs cross polarised

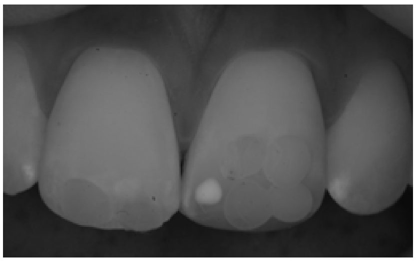

Figure 9b: Shade tabs cross polarised monochrome

Figure 9c: Shade tabs cross polarised high contrast

Figure 10a: Colour check cross polarised

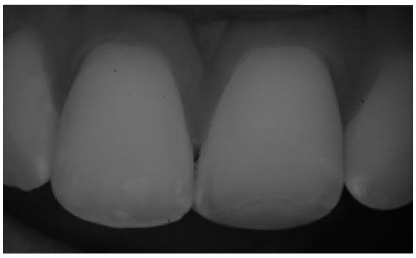

Figure 10b: Colour check cross polarised monochrome

Figure 10c: Colour check cross polarised high contrast

Figure 11: Cut back

Figure 12a: Final result – initial polish

Figure 12b: Final result – initial polish cross polarised

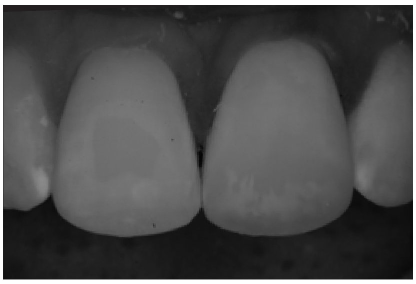

Figure 12c: Final result – initial polish cross polarised monochrome

Figure 12d: Final result – initial polish cross polarised high contrast

The dentine shades were placed in the mid body of the tooth to assess the chroma and the enamel shades were placed towards the incisal third to assess translucency. I also tested the white coloured effect shade at the same time. No retraction was used and the patient was actively encouraged to keep her lips together and teeth moist during this phase to minimise dehydration.

The shades tested were a selection of the enamel and dentine shades for Empress BL and B1.

A series of photographs were taken using a cross polarising filter (Polar eyes) to assess the colour match. My own protocol is to take photos of the central incisors at a 1:1 ratio with different (in-camera) colour profiles

Figure 13a: Postoperative frontal smile

Figure 13b: Postoperative frontal smile left

Figure 13c: Postoperative frontal smile right

Figure 14a: Postoperative retracted frontal

Figure 14b: Postoperative retracted close-up frontal

Figure 14c: Postoperative retracted close-up left

Figure 14d: Postoperative retracted close-up right

and with/without the polarising filter. The camera used was a Canon 30D with a 100mm macro lens. A crop body sensor is especially useful in this scenario due to the additional magnification the crop factor gives when at 1:1 ratio.

The photos taken were:

1. With polarising filter at 'normal' intraoral setting with standard colour profile
2. With polarising filter at 'normal' intraoral setting with monochrome colour profile
3. With polarising filter at 'normal' intraoral setting with high contrast colour profile.

The standard profile allows a baseline photograph to be taken of the composite in relation to the tooth colour.

The monochrome profile allows the verification of the value of the composite in relation to the tooth colour.

The high contrast profile allows the verification of the chroma of the composite in relation to the tooth colour.

My own understanding of composite colouring leads me to believe that the most important parameter when shade matching a single tooth restoration is the value of the composite, rather than the chroma. The relative brightness of the restoration (when incorrect) is far more visible than when the chroma is not so correct.

The other important factors are the tooth form and shape and relative surface finish, which can also make a restoration appear more obvious when not well integrated.

We chose Empress Direct Dentine (B1 and BL), Empress Direct Enamel (BL), Venus Color White for the characterisation effects, and Empress Direct Trans 30 for the translucent effects.

Final Result

As I was unable to fabricate a stent prior to the appointment, my plan was to use the first layer to help create the tooth form and outline. I would then cut this back to allow space for the internal colours and effects.

A selection of preoperative photographs of the UR1 were left on the surgery computer screen to refer back to when layering. The cross-polarised images are especially useful for this.

My own bonding protocol is to treat these cases over two visits. The first visit (as explained to the patient) will take them to around 80% of the final result.

A refinement visit a week or two later allows me to reassess the colour integration following rehydration, the patient's thoughts, any functional issues with the occlusion and finalise the surface finish and polish.

I will also take impressions for replacement whitening trays and retainers at this visit to help maintain the colour and alignment long term.

Treatment steps – visit one

- Local anaesthetic (lignocaine) and optragate retraction
- Bonding carefully removed using 3M Softflex discs and tungsten carbide composite finishing burs
- The tooth was prepared using a coarse disc to smooth the surface and create a bevel
- Air abrasion of the surface using 27micron alumina oxide powder
- Total etch, prime and bond using Optibond FL
- The instruments used are a selection of my favourites from American Eagle, LM Arte Style Italiano, Firm Rubber clay brushes and Sable hair art brushes
- Empress Direct Trans 30 was used to create the initial tooth form and outline with the help of a Garrison Blueview Varistrip
- The translucency of this shade will allow good optical effects in the incisal third
- Softflex discs were used to reshape the composite
- A diamond bur was used to cut back the composite for the internal colours
- Once happy, the composite dust was carefully removed with dry air and the surface was cleaned using Optibond adhesive
- Empress Direct B1 dentine was used in the deepest parts of the internal space and bevel to help mask the join
- Empress Direct BL dentine was used over this and over the bevel to help with colour integration
- The dentine shades were shaped in the lower incisal third to mimic the flat comb effect in the UR1
- Empress Trans 30 was used to fill in the incisal third to allow a translucent effect
- Venus Color white was used via a brush and diluted with Optibond FL Adhesive to copy the white characterisation
- This characterisation layer helped in masking the join of the restoration
- It was also used to recreate the halo effect on the incisal edge
- The final layer of Empress Direct BL enamel was used to cover the final surface
- This layer often takes time to shape well and right, which helps in simplifying the finishing stages
- This was cured under a layer of glycerine to minimise the oxygen inhibition layer
- The outline form and primary anatomy was created using Softflex discs
- The bonding was polished with 3M Softflex discs, Contours points (Optident) and a Groovy Diamond (Optident) to give a good level of initial finish.

Treatment steps – visit two

- The patient was seen a week later for refinement of the shape and polish
- The secondary anatomy (line angles) was defined to match the UR1
- We finalised the finish with 3M Softflex discs, 3M rubber soft flex high polish wheels
- She was happy with the overall result and look.

Case Discussion

I was very happy with the outcome of the result overall.

It is often very easy to over-use the stain effect shades and to place more than is necessary. The effect in this case has helped in not only the shade matching but also in helping mask the join to create a seamless blend between natural tooth and restoration.

This is all the more rewarding taking into account the additional difficulty in trying to manage the patient's anxiety towards the treatment.

I would not have done anything vastly different to how the case planned out. My only regret is that I wish I was able to take more photographs of the various stages but due to patient anxiety this was not possible.

At present, the patient has had three quadrants of her posterior restorations completed and is waiting to finish off the last quadrant at some point in the near future.

References

Fahl N (2006) A polychromatic composite layering approach for solving a complex class IV/direct veneer-diastema combination part 1. Practical Procedures in Aesthetic Dentistry 18(10): 641-45

Fahl N (2007) A polychromatic composite layering approach for solving a complex class IV/direct veneer-diastema combination part 2. Practical Procedures in Aesthetic Dentistry 19(1): 17-22

Fahl N, Dietschi D (2016) Shading concepts and layering techniques to mater direct anterior restorations: an update. British Dental Journal 221: 765-771

Ferracane J (2011) Resin composite: state of the art. Dental Materials 27: 29-38

Peyton JH (2004) Finishing and polishing techniques: direct composite resin restorations. Practical Procedures in Aesthetic Dentistry 16(4): 293-298

Vanini L (2010) Conservative composite restorations that mimic nature. Journal Cosmetic Dentistry 26(3): 80-98 Van Putten C (2015). Controlling composite surface texture. Journal Cosmetic Dentistry 31(3): 16-24

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The cardinal role of chemical composition in abutment screw loosening - A literature review and analysis

Jose' Alexandre da Silva Nunes[1]

Introduction

The replacement of missing teeth in modern dentistry by using dental implants is satisfying for patients and clinicians. Everybody desires the best possible outcome at all times.

Implant restorations comprise of an implant and the abutment-prosthesis complex. This is joined together utilizing an abutment screw, which creates and maintains a joint compression. In the natural dentition, the maximal vertical (axial) biting forces approximate 800 N and lateral forces circa 20 N (Brunski, 1999), consequently implant systems are required to withstand similar forces.

The performance of the abutment screw in maintaining joint compression is dependent on the implant system connection (internal hex, external hex, Morse taper)

In external hexed connections, the abutment screw is the weakest link in the implant-abutment-prosthesis complex. A common problem is loosening and fracturing of abutment screws.

Regardless of the implant attachment system the common complication of abutment screw loosening and fracture, reported extensively in the literature, plagues both clinicians and patients. Despite decades of engineering improvements to abutment screws this author continues to encounter patients with this complication in daily implant practice.

Abutment screws differ in their shape; size, physiognomy, roughness, and chemical composition yet are primarily manufactured from titanium and gold alloys. Chemical composition determines a material's Brinell hardness (indentation hardness) and tensile strength.

Gold alloy (GA) abutment screws dominated early years, however, titanium alloy screws have become the standard in recent years.

This review scrutinizes:

1 - frequency of abutment screw loosening and fracture

2 - root causes of this complication.

3 - clinical suggestions to reduce screw loosening and

4 - the superior alloy in the Implant-abutment-screw prosthesis complex (IAPC)

Background

One of the most significant challenges in the literature is to determine how common is abutment screw loosening (Taylor, 1998)

Some authors state this is not a complication but rather an annoyance. Common sense dictates it results in a disruption to workflow, has financial consequences and more importantly may be a sign of imminent fracture of the IAPC.

Goodacre et al., 2003 reported that the average loosening with single implant crowns using original screw designs was 25% but contrasted that when the data

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from 6 recent studies were combined, the mean incidence was 8%, indicating substantial improvement with new screw designs.

Varying frequency in abutment screw loosening has been reported: (Jung et al., 2012) 8.8%; (Naert, Quirynen, Van Steenberghe, et al., 1992) 5% and (Becker & Becker, 1995) 38%.

Early abutment screws were made of gold (the 'premium standard') to secure abutments to the implant fixture as they offered a superior engineering outcome with more favourable preload, Young's modulus, and coefficient of friction.

Coefficient of friction is a value used to quantify frictional force between the abutment screw and implant body whereas Young's modulus is the value of a substance's resistance to being deformed elastically when stressed. Preload is defined as an internal application of stress to an implant system.

Recently it has become common to fasten implant crowns with titanium alloy (TA) abutment screws. The principal reason for this being cost. Tsuge & Hagiwara, 2009 found that TA abutment screws were less likely to loosen than GA.

An extensive PubMed review could not identify any prospective or retrospective in vivo studies comparing the performance of GA versus TA screws regarding loosening and fracture.

To understand intricacies of abutment screw loosening/tightness, an audit of screw mechanics requires reviewing. An understanding of the underlying technical anatomy of the implant abutment screw is also needed. The descriptive terms used are at times confusing for clinicians, and therefore reviewed articles were scoured for information and compiled into one diagram for ease of reference and understanding [Figure 1]

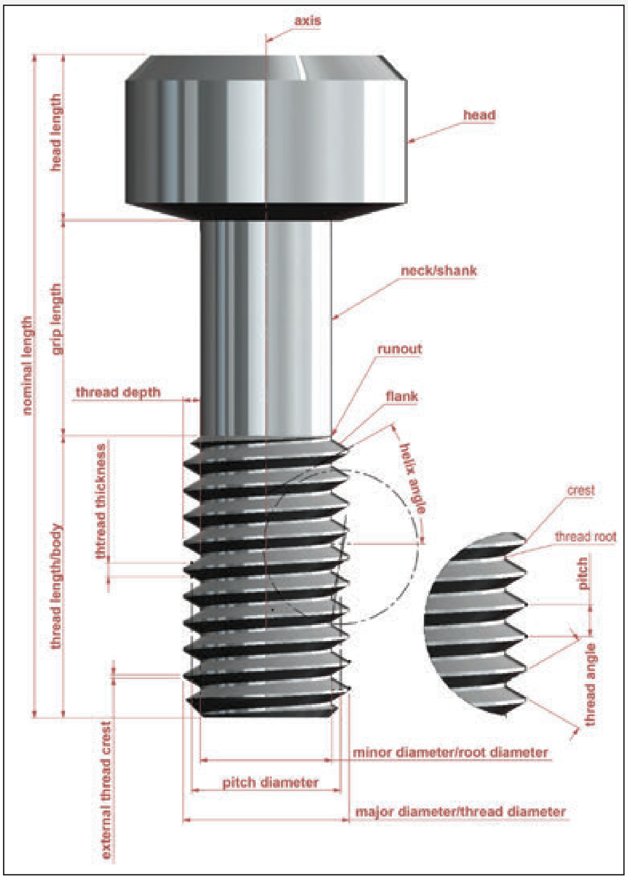

Figure 1: Technical anatomy of a classic implant abutment screw.

Abutment screw engineering

Dziedzic et al., 2012 reported the success of a screw joint is related to the preservation of the preload, properties in the material such as elasticity modulus, composition, clamping of the parts, screw head design, strain, finishing of the interfaces, and presence of a lubricant.

An interface is defined as the point where two systems meet such as implant/abutment (IA). A lubricant is a substance used to reduce friction between abutment screw and implant body.

IA interface is what determines the lateral and rotational stability of the IA joint, and that is decisive in prosthetic stability of an implant-supported restoration (Prithviraj et al., 2012).

Burguete et al., 1994 found lubrification of the screws lowered friction resulting in higher preload for the same torque value compared with non-lubricated screws.

This literature review identified 20 factors affecting the loosening of screws (this article elaborates on some of these factors):

- Clamping force
- Torque
- Preload
- Excessive bending
- Settling effect/embedment relaxation
- Wet lubricants
- Abutment screw coating/dry lubricants
- Metal fatigue
- Clockwise and counterclockwise moments
- Consecutive loosening and retightening
- External & internal hexagon (butt connection) types and micro-gap formation
- Conical connection types and micro-gap formation

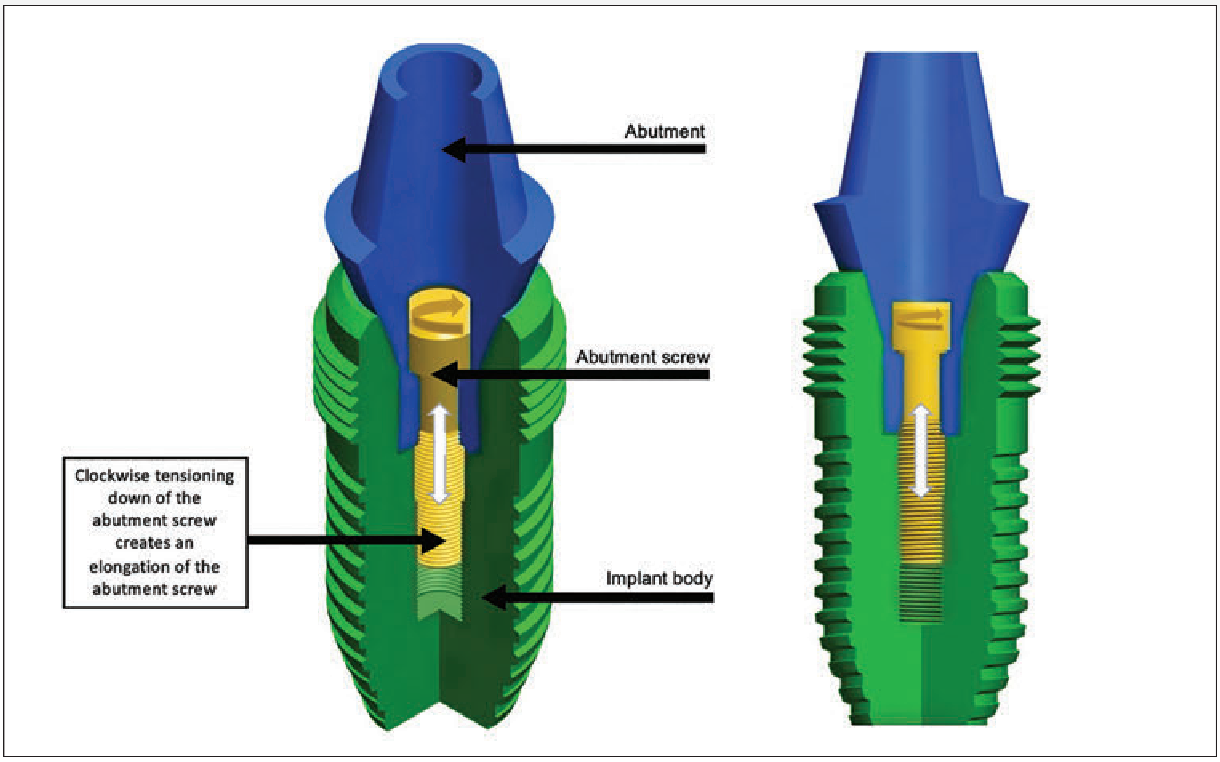

Figure 2: Graphical (conical connection) representation of how the abutment screw in the centre joins the upper abutment to the lower implant. Torqueing the abutment screw develops a tensile (elastic) force called the preload which is illustrated by the white arrow with opposite pointing arrowheads. This preload produces a compressive force clamping the abutment and the implant together.

- Abutment screw alloy composition and tensile strength
- Galling (cold welding due to excessive friction)
- Number of screw threads
- Number of implants and diameter
- Prosthetic design and occlusal table
- Abutment and screw head interface
- Screw head and body design
- Abutment screw flanks connection with the implant internal thread flanks

A review by Siamos et al., 2002, highlighted the following influences:

When two parts are tightened together by a screw, the unit is called a screw joint.

The screw loosens only if outside forces trying to separate the parts are higher than the forces keeping them together. Forces attempting to disengage the parts are called joint separating forces while the clamping force keeps the parts together, such as the abutment to the dental implant.

To prevent screw loosening these separating forces must remain below the threshold of the clamping force.

If the joint does not separate when a force is applied, the screw does not loosen. The two primary factors involved in keeping screws tight are:

1- maximising the clamping force and

2 - minimising joint separating forces.

To achieve secure an IA connection, screws should be tensioned to produce a clamping force more significant than the external separation forces. In the design of a rigid screw joint, the most important consideration from a functional standpoint is the initial clamping force developed by tightening the screw, more than the tensile strength of the screws. Clamp load is usually proportional to tightening torque. Tensile strength is the resistance of a material to break under tension.

Torque is a convenient, measurable means of developing desired tension. Too small a torque may allow separation of the joint and result in screw fatigue, failure, or loosening. Too large a torque (above the tensile strength of the material) may cause the failure of the screw or stripping of the screw threads.

A specific torque is recommended for each screw for different implant systems from different manufacturers. Administered torque develops a force within the screw

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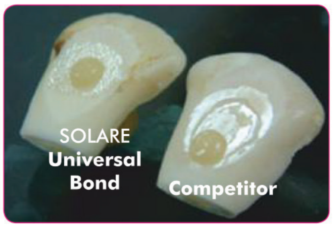
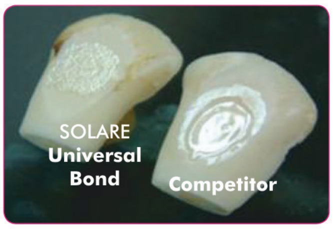


SOLARE **Universal Bond** creates a sticky, frosty, matte-like surface to aid in composite adhesion and manipulation.



Traditional adhesives leave a wet, glossy surface after light activation. Composites do not adhere well to the adhesive, making it hard to manipulate.

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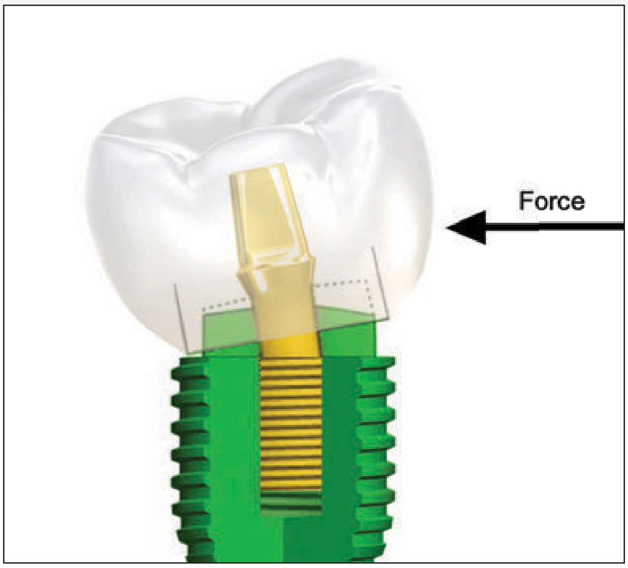

Figure 3: Graphical representation of excessive bending of an abutment screw.

called preload, and that preload is the initial load on the screw.

Tan & Nicholls, 2001 described the efficiency of a material in converting torque to preload and Haack et al., 1995 reported higher preload values with gold alloy screws. Preload is induced in a screw when torque is applied during tightening and this preload keeps the screw thread tightly secured to the screw's mating counterpart and holds the parts together by generating a clamping force between the screw head and its seat. The screw elongates, positioning tension in the shank and threads.

The elastic recovery of the screw generates the clamping force that pulls the prosthesis and the implant together. [Figure 2]

Preload must be maintained and fluctuate as little as possible to prevent joints from separating.

Several factors play critical roles in screw joint stability, including settling effects, preload, and screw geometry.

IA interface geometric design and precision fit of mating components serve to resist mastication forces.

Two main mechanisms of screw loosening for implant-supported restorations are excessive bending on the screw joint and settling effects.

Excessive bending is defined as a force that can cause material failure of the abutment screw.

Tan & Nicholls, 2001 reported screw joint preload as the "clamping" force necessary to maintain screw joint integrity. Torque dispatched to the fastening screw is transformed into tensile stress in the screw shank and into an equal and counter compressive force holding the two implant components together. Opening of the screw joint, or its loosening, has been incriminated as the primary cause of gold screw breakage.

For certain prosthetic implant connections, two screw joints are of concern: the prosthetic gold cylinder/abutment screw joint and the abutment/implant screw joint.

The overall stress in the screw joint in clinical function can be viewed as the summation of screw joint preload, stress from distortion of the prosthesis, and stress from functional loading.

Metallurgical properties of titanium screws permit for the generation of a more consistent albeit lower preload than gold abutment screws (Doolabh, 2014).

Martin et al., 2001 concluded that, as friction decreased the preload of the screw joint increases.

Zipprich, Rathe, et al., 2018 stated that the preload force of an abutment screw depends on the amount of friction, the thread pitch, and the tightening torque.

Krishnan et al., 2014 found the optimum preload of a screw is when it is elongated to capacity but does not surpass its yield strength. In a perfect scenario, the preload should be 75% of the yield strength or 65% of the screws fracture strength. Preload is primarily dependent on the enforced torque and secondarily on the component material, screw head and thread design and surface roughness.

Screw strength is related to the modulus of elasticity of the material from which the screw is manufactured. The torque values of 32-35 Ncm were established based upon gold screws made from materials with low moduli and yield strengths. With more progressive technologies available today, perhaps it is time to reconsider these torque values (Piermatti et al., 2006)

Occlusal forces seem to play an essential role in screw loosening of implants with hex connections, with screw preload the only force that resists it to prevent abutment separation. If the occlusal force exceeds preload, the screw will loosen (Schwarz, 2000)

If a bending force on a single-tooth restoration causes a load larger than the yield strength of the screw, permanent plastic deformation of the screw results, with a loss of tensile force in the screw stem. Plastic deformation is defined as the ability of metal to undergo permanent deformation. Excessive bending (Figure 3) results in reduced contact forces between the abutment and the implant, and consequently, the screw joint loosens easier.

Another mechanism resulting in screw loosening is due to

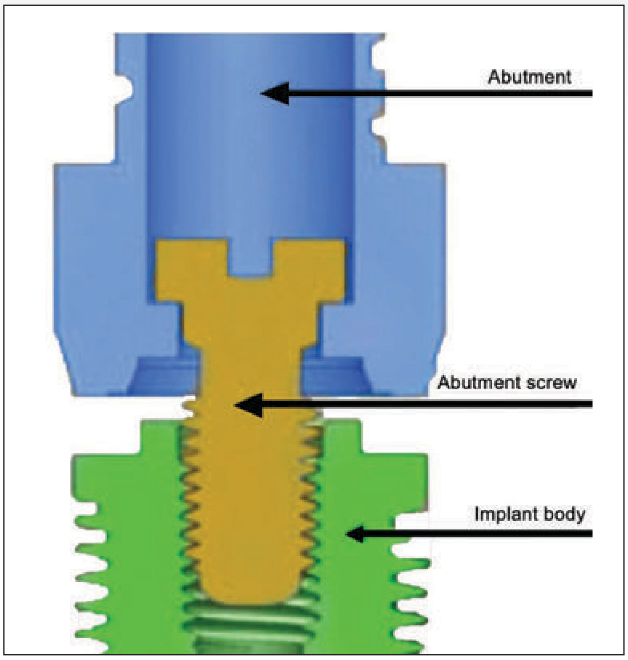

Figure 4: Graphical representation of an external implant abutment connection.

no surface being completely smooth.

Even a machined implant surface is slightly rough when viewed microscopically. As a result of this micro-roughness, no two surfaces are entirely in contact with one another. When the screw interface is subjected to external loads, micromovements occur between the surfaces.

Wear of the contact areas might be a result of these motions, thereby bringing the two surfaces closer to each other. This is referred to as the settling effect or embedment relaxation. The magnitude of settling depends on the initial surface roughness and surface hardness as well as the extent of the loading forces.

Rough surfaces and large external loads increase the settling effect. When the total settling impact is more than the elastic elongation of the screw, the screw works loose as there are no longer any contact forces holding the screw.

It has been hypothesised that up to 10% of initial preload is lost due to the settling effect.

Thread friction is highest for the first tightening and loosening of a screw, after repeated tightening and loosening cycles, friction decreases. Settling effect results in less torque necessary to remove a screw than that used to place the screw initially.

It has therefore been suggested that the implant-abutment joint be tightened periodically after the initial placement.

Seddigh & Mostafavi, 2019 highlighted the following influences:

There is no consensus whether saliva and chlorhexidine, that act as wet lubricants in the implant cavity affects torque and preload. However, blood contamination of the abutment screw implant interface could result in greater loosening. This is due to the high protein content in blood and the presence of platelets or fibrinogen, leading to the formation of a thin film on screws.

A higher preload can be achieved by altering the chemical composition of an alloy in an abutment screw and utilising dry lubricant coated screws

A metal with low strength, like pure gold, may play the same role as a dry lubricant.

Byrne et al., 2006 demonstrated that gold-coated abutment screws showed increased preload compared to non- coated screws. All abutment screws demonstrate less preload with repeated tightening cycles, yet gold-coated abutment screws still present higher preload in comparison to non-coated screws.

Stüker et al., 2008 found preload in gold-coated screws to be three times higher than titanium-coated screws.

Martin et al., 2001 established that screws with a 0.76 μm pure gold coating had a greater tightening rotation angle and significantly higher value of preload than titanium alloy screws. They also concluded that coated titanium alloy screws with solid lubricants act better than non-coated titanium screws in preserving the stability of the IA joints.

External and internal hexagons are referred to as flat connections.

Distinctive characteristics among screws with the same design and geometry can be attributed to manufacturing processes and contrasting intrinsic material properties. Screws made by the same manufacturer but from different lots, show disparate tensile stability.

The ideal connection system should act as a one-piece implant without micro-gap formation at IA interface. Micro-gap formation in IA connections is paramount to their biomechanical deterioration such as screw loosening. External and internal hexagon systems have shown larger micro-gaps allowing passage of bacteria (Zipprich, Weigl, et al., 2018).

Seddigh & Mostafavi, 2019 reported external hexagon (Figure 4) systems to be more prone to screw loosening, especially when exposed to tension forces different from the axial. This causes a micro-gap at the IA connection and mechanical instability in the IA complex with screw loosening. Micro-gap production is linked to the force applied to an abutment. External hexagon connection systems may therefore be a risk in bruxism or clenching.

Pardal-Peláez & Montero, 2017 described micromovements in the IA interface causing both mechanical problems (increased loosening, breakages of screw, abutment and implant body) as well as biological complications.

Micro-gaps permit the colonisation of bacteria resulting in mucositis, peri-implantitis, and finally implant loss due to cyclic loads worsening the effect.

Internal connection systems (Figure 5) were seen as an improvement of the external hexagon system, to decrease or eliminate the micro-movement at the abutment connection level and increasing load absorption, especially under a lateral force. Theoretically, internal hexagons have reduced biomechanical complications such as screw loosening.

Pardal-Peláez & Montero, 2017 found no qualitative data comparing loosening between external and internal connections.

Tsuge & Hagiwara, 2009 reported internal hex did not necessarily offer advantages over external hex concerning abutment screw loosening.

Most of the fixation of conical IA connection systems is not performed by the screw, but rather by the frictional resistance derived from the contact between the tapered mating sections (Schwarz, 2000)

Zipprich, Weigl, et al., 2018 highlighted the following influences: Dynamic loading (non-static load) of 100 N or more on IA connections led to a cyclical opening and closing of gaps between the implant and the abutment. Such gaps, albeit exceedingly small, may allow a direct connection between the internal cavities of the implant and the peri-implant tissues, leading to damage of these tissues.

Zipprich, Weigl, et al., 2018 demonstrated that conical connections displayed no or reduced formation of micro-gaps during dynamic loading of 200 N compared with flat connections.

Additionally, conical IA connections act not only as an anti-rotational device but also to ensure positional stability and reduce screw loosening.

Abutment screws comprise of a flat head seat, a long stem length, and six screw threads and originally the stem stretched elastically, evoking a preload.

A lesser number of screw threads lowers friction and additional threads are superfluous, considering the first three threads carry most of the load (Piermatti et al., 2006). Zipprich et al., 2018 found the preload force of the IA screws were independent of the number of screw threads and only tightening torque and screw head angle affected the resulting preload force of the IA connection.

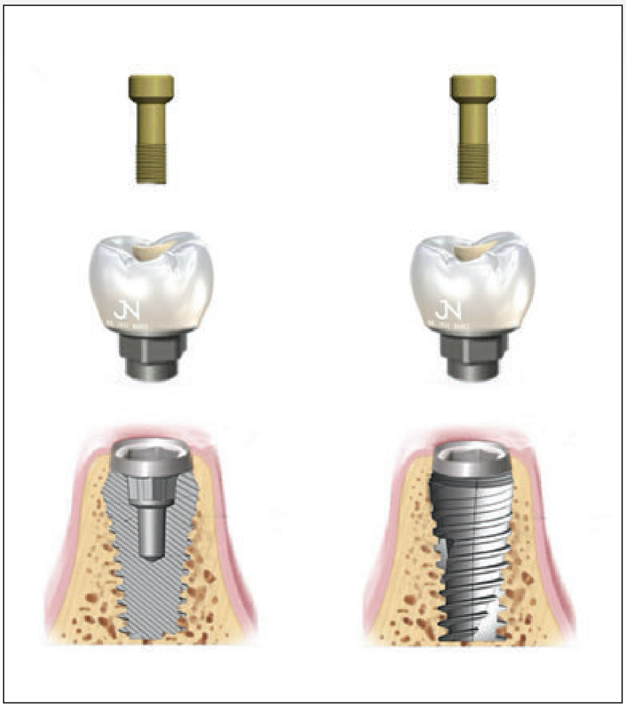

Figure 5: Graphical representation of an internal implant abutment connection.

Zipprich, Rathe, et al., 2018 found that only the screw head angle affected the preload force when comparing different screw head angles with varying numbers of thread.

Abutment screw loosening is reduced when two conventional diameter implants are used instead of one wide implant to replace a missing molar. (Bakaeen et al., 2001)

Maximum biting forces are three times greater in molar areas as compared to anterior regions. Posterior implants carry the heaviest loads (Schwarz, 2000)

Wide diameter (WD) implants have wider IA platforms resulting in increased abutment stability by reducing the occlusal-table to loading-platform-cantilever (OT/LPC) and the collateral stress to the abutment screw.

When a WD implant is subjected to a masticatory/off-axis bending force, that force is dispersed over a wider IA area with a reduction in the plastic deformation at the IA interface (Krishnan et al., 2014)

Narrowing the occlusal table of restorations can reduce the degree of screw loosening when using one implant to support a missing molar.

Moving the occlusal contact area further in line with the


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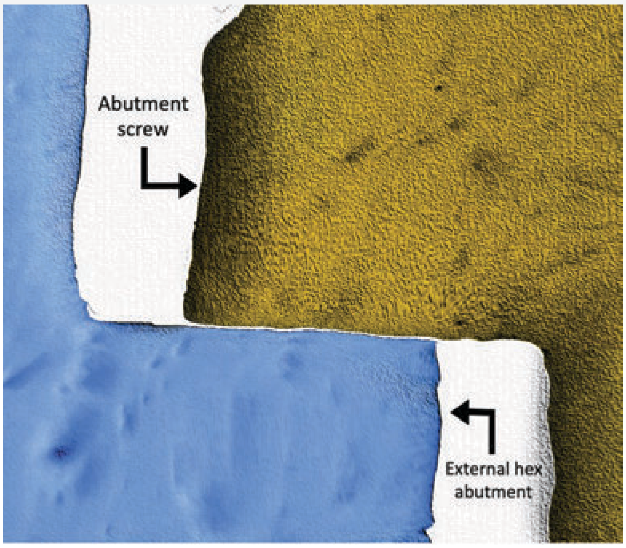

Figure 6: Graphical representation of the interface between an abutment screw and an external hex abutment.

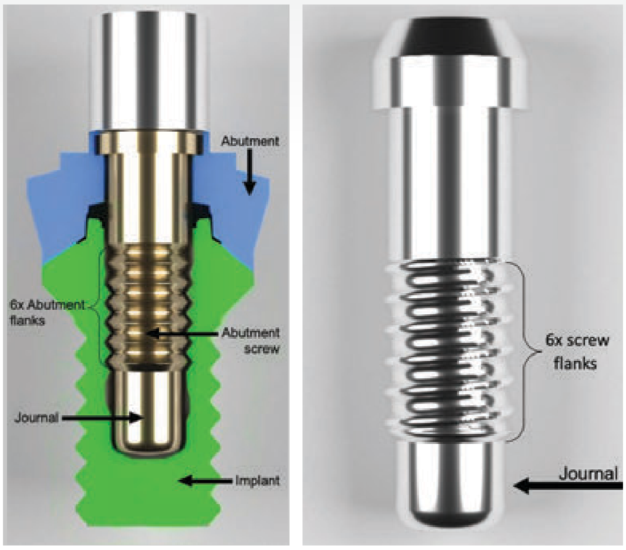

Figure 7: Graphical representation of a journal on the inferior end of an abutment screw. Classical abutment screws have six screw flanks.

implant location reduces the shearing stress on the abutment screws. Flattening the cusp inclination of the crown furthermore reduces the stress on the abutment screw.

Reducing the buccolingual prosthetic design width may require selecting a different occlusal scheme such as a cross-bite relationship or lingualized occlusion to lessen the bending moments on the implant and associated structures. (Krishnan et al., 2014).

As a result of preload achieved in the components which are dependent on the finish of the interfaces (Martin et al., 2001) clinicians should always use original components to ensure the best possible clinical outcome. Figure 6 shows a graphical representation of the interface between an abutment screw and an external hex abutment

Flat-head screws, by virtue of a reduced surface contact, cause less frictional resistance when tightened, than screws with bevels or tapers. When torque is lost to heat and friction, further torque is transferred into usable preload. Subsequently, flat-head screws always offer a higher preload at any given torque range than tapered or bevelled screws (Figure 8) and are, therefore, more stable (Piermatti et al., 2006).

Zipprich, Rathe, et al., 2018 showed persistently greater preload force of flat-head screws which they concluded could arise from lower friction between the screw head and its counterbore, because of the passive fit.

Piermatti et al., 2006 further reported that long and conventional flat-head screws with a machined journal were better and highlighted the importance of screw design in preload maintenance.

The journal is a smooth diameter machined on the end of the screw fitting in an intimate aspect within the walls of the implant, resisting lateral movement and bending of the joint.

The combined use of a screw with a thick stem and a journal (Figure 7) contributed to the least loss of torque and, thus, highest joint stability.

Clinically, if a patient bruxes or has less than favourable implant placement, the use of a thick stem abutment screw with a journal is useful. Furthermore, with some current screw designs, torque values of 40 and perhaps 50 Ncm may be possible without plastic deformation. Therefore, the use of higher torque values would increase the preload and provide increased resistance to joint separation and better abutment screw stability.

As torque is applied, the preload keeps the screw flanks tightly secured to the internal aspect of the implant threads and the screw elongates. Screw flanks are the side of threaded part of screw which connects the crest with the root.

The elongated screw places the screw shank and screw flanks in tension. (Siamos et al., 2002) The elastic recovery of the screw enables the clamping force that brings the prosthesis and implant together. (Piermatti et al., 2006). Thus, screw flanks are important for this action.

The relationship between torque and screw preload is affected by many variables, such as shank thread hardness

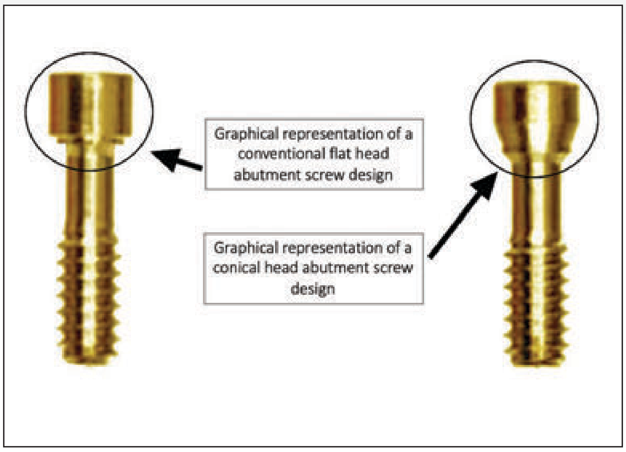

Figure 8: Graphical representation of conical head abutment screw design and conventional flat head abutment screw design.

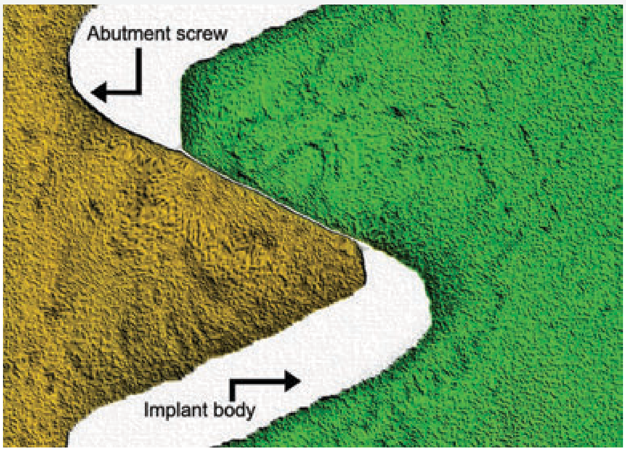

Figure 9: Graphical representation of abutment screw flanks connecting with the implant body internal thread flanks.

and shank surface finish which affects the coefficient of friction of the screw shanks (Tan & Nicholls, 2001)

No machined surface is entirely smooth, always having some high spots.

After the initial torque and unscrew process there is a "flattening out" phenomena of the high spots on the machined surfaces to a more even contact at the flanks to implant thread-contacting surfaces (Tan & Nicholls, 2001)

Martin et al., 2001 investigated the performance of GA versus TA screws. He identified that in both the screw flanks connecting to the implant threads were localized between the superior edge of the screw flanks contacting the middle portion of the implant mating threads [Figure 9]. This phenomenon was also identified by Dziedzic et al.,2012.

Martin et al., 2001 also compared GA abutment screws which had a 0.76 μm pure gold coating lubricant over the screw flanks to other abutment screws (regular GA, regular TA and TA with carbon surface treatment) and showed a greater number of mating thread contacts in the gold screws that had gold coating lubricant. This finding was explained by either an increase in gold screw elongation and or the higher preload value of gold abutment screws.

Discussion

A basic implant system comprises of an implant crown, abutment screw, abutment, and implant. [Figure 10]

An abutment screw (AS) does not function as a stand-alone entity but rather as an integral part of an implant system. It follows that performance of an AS is affected in a greater or lesser extent by other components of an implant system.

In implant abutment connections (IAC) that are flat (external hexagon and internal hexagon), the abutment screw plays a more important role in securing the IAC. A review by Zipprich, Weigl, et al., 2018 showed that during dynamic loading, conical connections produce fewer micro-gaps at the IAC and the abutment screw plays a less important role compared to flat connections.

Flat connection type implant systems continue to be used for a variety of historical and technical reason by clinicians. Conical implant systems are less reliant on the abutment screw in terms of their maintenance of preload at the IA interface. Using the best possible abutment screw design made from the best possible materials will ultimately improve both patient and clinician satisfaction.

Manufacturing an abutment screw from the best possible alloy combination that produces the most favourable preload is one of the factors affecting the long-term prognosis of the IAC, as favourable preload prevents abutment screw loosening. (Schwarz, 2000) (Pardal-Peláez & Montero, 2017)

This may seem like a quite simple and attainable objective, yet one of the most challenging problems to discern from the literature is the frequency of screw loosening. (Taylor, 1998)

The chemical composition of an abutment screw alloy stands paramount to its performance. Surprisingly, small changes in the chemical composition on an alloy can change its modulus of elasticity and tensile strength. (Piermatti et al., 2006)

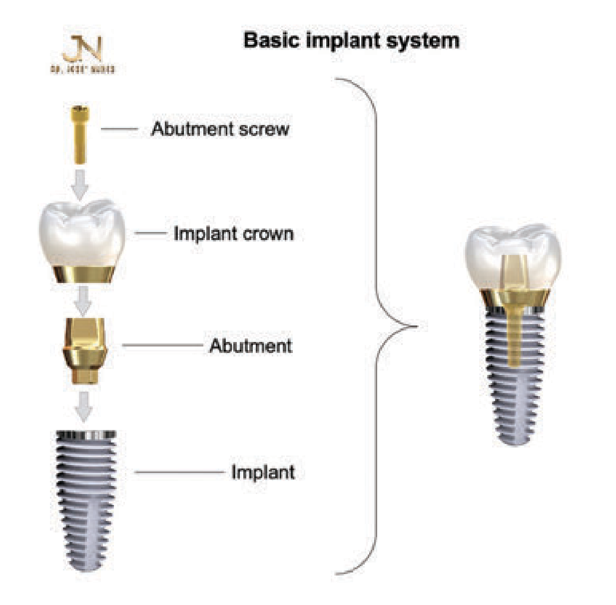

Figure 10: Graphical representation of a Basic Implant System comprising of implant crown, abutment screw, abutment, and implant.

The majority of studies demonstrate that gold abutment screws provide superior performance in comparison to titanium abutment screws.

Conclusion and clinical hints

Screw loosening and screw fracture continues to be a common complication and is not improving. Over a lifespan abutment screw loosening and fracture increase by 0.61% per year.

To reduce the complication of screw loosening and fracture, manufacturers should use the best alloys and the clinician should select an abutment screw manufactured from a strategically chosen alloy that warrants a more favourable preload.

Gold alloy abutment screws are the material of choice to secure the implant-abutment connection in that they have a higher modulus of elasticity, greater preload values, lower coefficient of friction and result in more stable implant-abutment connections. The highest possible preload is paramount but too high a preload will result in fracture of the abutment screw

Clinicians looking for cheaper options should use a titanium abutment screw with surface dry lubricant to achieve optimal preload values but manufacturers should make these available.

To neutralize the certain initial loss of preload, clinicians should retighten (a second time) freshly placed abutment screws either after a few seconds, a few minutes, or the following day- whichever is practical.

Clinicians must be vigilant of pirate components which may result in less than desirable preload and screw loosening due to poorly finished interfaces.

External hexagon connection systems should be used guardedly in cases of functional overloads, such as bruxism or clenching.

Narrowing the occlusal table, flattening cuspal inclination and moving the occlusal contact in line with implant location will reduce lateral forces and decrease abutment screw loosening.

Conical IA connection mechanisms act not only as an anti-rotational device during functional loading but also to ensure positional stability and reduce abutment screw loosening.

The benefit of gold abutment screws is their capacity in securing a preload of more than twice that of a titanium alloy screw, thus minimizing risk of abutment screw loosening and fracture.

Clinicians require their implant manufacturer to provide essential information such as the chemical composition, tensile strength, coefficient of friction and more importantly the preload that can be achieved at a particular torque (e.g. 500N at 30 Ncm torque) from the abutment screw they are inserting into their patients as this has vital biological and performance effects.

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References

Bakaeen, L. G., Winkler, S., & Neff, P. A. (2001). The effect of implant diameter, restoration design, and occlusal table variations on screw loosening on posterior single-tooth implant restorations. Journal Oral Implantology, 27, 63–72.

Becker, W., & Becker, B. E. (1995). Replacement of maxillary and mandibular molars with single endosseous implant restorations: A retrospective study. The Journal of Prosthetic Dentistry, 74(1), 51–55. https://doi.org/10.1016/S0022-3913(05)80229-X

Brunski, J. B. (1999). In vivo bone response to biomechanical loading at the bone/dental-implant interface. Advances in Dental Research, 13(June), 99–119. https://doi.org/10.1177/08959374990130012301

Burguete, R. L., Johns, R. B., King, T., & Patterson, E. A. (1994).

Tightening characteristics for screwed joints in osseointegrated dental implants. The Journal of Prosthetic Dentistry, 71(6), 592–599. https://doi.org/10.1016/0022-3913(94)90443-X

Byrne, D., Jacobs, S., O'Connell, B., Houston, F., & Claffey, N. (2006). Preloads generated with repeated tightening in three types of screws used in dental implant assemblies. Journal of Prosthodontics, 15(3), 164–171. https://doi.org/10.1111/j.1532-849X.2006.00096.x

Doolabh, R. (2014). Dental Implant Retaining Screws:The effect of using gold or titanium on preload. South African Dental Journal (SADJ), 69(7), 316–320. https://doi.org/10.1558/jsrnc.v4il.24

Dziedzic, D., Nhata, J., Jamcoski, V., & Dziedzic, M. (2012). Assessment of preload in carbon coated prosthetic screws. Rsbo- South Brazilian Dental Journal, 9(2), 137–142.

Goodacre, C. J., Bernal, G., Rungcharassaeng, K., & Kan, J. Y. K. (2003). Clinical complications with implants and implant prostheses. Journal of Prosthetic Dentistry, 90(2), 121–132. https://doi.org/10.1016/S0022-3913(03)00212-9

Haack, J. E., Sakaguchi, R. L., Sun, T., & Coffey, J. (1995). Elongation and Preload Stress in Dental Implant Abutment Screws. International J Oral Maxillofac Implants , 10 (5), 529-36, 10(5), 529–536.

Jung, R. E., Zembic, A., Pjetursson, B. E., Zwahlen, M., & Thoma, D. S. (2012). Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. Clinical Oral Implants Research, 23(SUPPL.6), 2–21. https://doi.org/10.1111/j.1600-0501.2012.02547.x

Krishnan, V., Thomas, C. T., & Sabu, I. (2014). Management of abutment screw loosening: Review of literature and report of a case. Journal of Indian Prosthodontist Society, 14(3), 208–214. https://doi.org/10.1007/s13191-013-0330-2

Martin, W. C., Woody, R. D., Miller, B. H., & Miller, A. W. (2001). Implant abutment screw rotations and preloads for four different screw materials and surfaces. Journal of Prosthetic Dentistry, 86(1), 24–32. https://doi.org/10.1067/mpr.2001.116230

Naert, I., Quirynen, M., Van Steenberghe, D., & Darius, P. (1992). A six-year prosthodontic study of 509 consecutively inserted implants for the treatment of partial edentulism. The Journal of Prosthetic Dentistry, 67(2), 236–245. https://doi.org/10.1016/0022-3913(92)90461-I

Pardal-Peláez, B., & Montero, J. (2017). Preload loss of abutment screws after dynamic fatigue in single implant-supported restorations. A systematic review. Journal of Clinical and Experimental Dentistry, 9(11), e1355–e1361. https://doi.org/10.4317/jced.54374

Piermatti, J., Yousef, H., Luke, A., Mahevich, R., & Weiner, S. (2006). An in vitro analysis of implant screw torque loss with external hex and internal connection implant systems. Implant Dentistry, 15(4), 427–435. https://doi.org/10.1097/01.id.0000245440.09464.48

Prithviraj, D. R., Muley, N., & Gupta, V. (2012). The Evolution of External and Internal Implant–Abutment Connections: A Review. International Dental Research, 2(2), 37. https://doi.org/10.5577/intdentres.2012.vol2.no2.3

Schwarz, M. S. (2000). Mechanical complications of dental implants. Clinical Oral Implants Research, 11 Suppl 1, 156–158. https://doi.org/10.1034/j.1600-0501.2000.011S1156.x

Seddigh, M. A., & Mostafavi, A. S. (2019). Implant Abutment Screw Loosening: A Review of Effective Factors. Journal of Clinical and Diagnostic Research, 13(8), 6–9. https://doi.org/10.7860/jcdr/2019/41751.13088

Siamos, G., Winkler, S., & Boberick, K. (2002). The relationship between implant preload and screw loosening on implant-supported prostheses. Journal Oral Implantology, 28(2), 67–73.

Stüker, R. A., Teixeira, E. R., Beck, J. C. P., & Da Costa, N. P. (2008). Preload and torque removal evaluation of three different abutment screws for single standing implant restorations. Journal of Applied Oral Science, 16(1), 55–58. https://doi.org/10.1590/S1678-77572008000100011

Tan, K. B., & Nicholls, J. I. (2001). Implant-abutment screw joint preload of 7 hex-top abutment systems. The International Journal of Oral & Maxillofacial Implants, 16(3), 367–377.

Taylor, T. D. (1998). Prosthodontic problems and limitations associated with osseointegration. Journal of Prosthetic Dentistry, 79(1), 74–78. https://doi.org/10.1016/S0022-3913(98)70197-0

Tsuge, T., & Hagiwara, Y. (2009). Influence of lateral-oblique cyclic loading on abutment screw loosening of internal and external hexagon implants. Dental Materials Journal, 28(4), 373–381. https://doi.org/10.4012/dmj.28.373

Zipprich, H., Rathe, F., Pinz, S., Schlotmann, L., Lauer, H.-C., & Ratka, C. (2018). Effects of Screw Configuration on the Preload Force of Implant-Abutment Screws. The International Journal of Oral & Maxillofacial Implants, 33(2), e25–e32. https://doi.org/10.11607/jomi.5837

Zipprich, H., Weigl, P., Ratka, C., Lange, B., & Lauer, H. C. (2018). The micromechanical behavior of implant-abutment connections under a dynamic load protocol. Clinical Implant Dentistry and Related Research, 20(5), 814–823. https://doi.org/10.1111/cid.12651

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CBCT identifies uncommon root canal variation

Prashant P. Jaju and Sushma P. Jaju

Introduction

CBCT has brought a paradigm shift to dental imaging, unraveling the unsolved mysteries of dentistry from a two-dimensional perspective to a threedimensional perspective. Hybrid CBCT machines such as the Orthophos SL (Dentsply Sirona, Germany) offer better resolution which helps to evaluate changes in cortical and cancellous bone at the sub millimeter level. The following case demonstrates how CBCT enabled the identification and subsequent navigation of complex root canal anatomy.

Case Report

A 27-year-old female patient was referred to our dental diagnostic center for evaluation of the maxil-lary right first molar because the general dentist suspected variation in root canal anatomy. A 5 x 5.5 cm CBCT scan was performed. On evaluation of the scan, three major orifices were present, mesiobuccal, distobuccal and palatal. The mesio- buccal canal below the furcation region showed two canals – mesio-buccal 1 and 2.

Approximately 2.5 mm below the pulpal floor, a third canal emerged (MB3) from the main mesiobuccal canal (MB1) (Fig. 1–3). At approxi-mately 4 mm distance below the pulpal floor, 2 and 3 merged again with each other to exit through a single foramen and the main me- siobuccal canal exited through another foramen. Oval shaped periapical radiolucency was pres-ent with all three roots. Thinning and perforation of the palatal and buccal cortical plates on the sinus floor were observed.

Opening and modifying the shape of the access cavity to approach all orifices is a key to success in identifying and negotiating unu-sual anatomy of root canals. CBCT is a valuable tool for the initial identification and effective evalua-tion of the internal morphology of teeth. Mesiobuccal 2 canal is one of the most common root canal anatomy variations with respect to maxillary molars. Mesio-buccal 3 canal is quite rare with an incidence of 1.1 percent. Minute assessment of this complex root canal anatomy was possible due to the high resolution offered by Ortho phos SL. The diagnosis and information were then passed on to the patient's dentist.

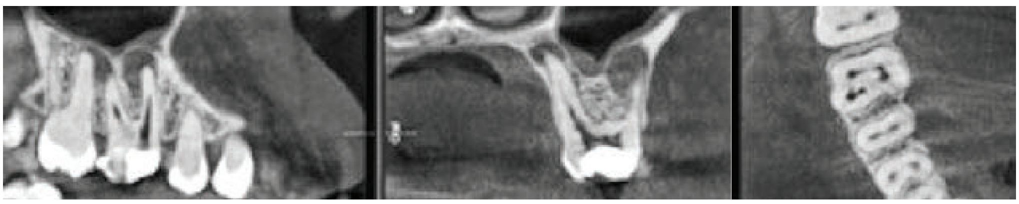

Figure 1: Images taken at coronal third level of roots. Orthophos SL axial image shows four major orifices, with two mesiobuccal canals. Periapical lesion is pres-ent with both buccal roots.

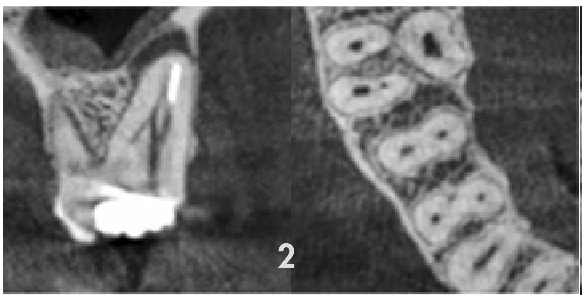

Figure 2: Orthophos SL cross-sectional and axial image view show separation of mesiobuccal 1 canal into mesiobuccal 3 canal in middle third level of root.

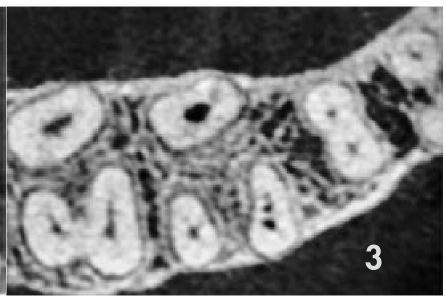

Figure 3: Orthophos SL axial images show all three canals in the mesiobuccal root at apical third level.

CASE REPORT

Diagnosing dens invaginatus with CBCT

Prashant P. Jaju and Sushma P. Jaju

Introduction

As a practice specialized in dental radiology, many dentists use our services. We were the first practice in India to use 3D imaging. With the introduction of the Orthophos SL CBCT (Dentsply Sirona), complicated cases are diagnosed and treated efficiently and more successfully with the help of a smaller volume specific for endodontic purposes. Indeed, cone beam computed tomography is a boon for endodontists across the globe. In this article we are presenting a difficult endodontic case where an Orthophos SL CBCT 5x5,5 volume aided in identifying dens invaginatus and its subsequent treatment planning.

Case Report

A 24-year-old male patient had swelling in the upper right canine region. An intraoral, periapical radi-ograph showed variation in pulpal floor anatomy but the lack of a third dimension limited its utility. For fur-ther evaluation of tooth root canal anatomy, limiting volume CBCT was advised. Orthophos SL CBCT 5x5.5 High Definition (HD) volume, at 80 microns showed variation in pulpal floor anatomy. CBCT images revealed invagination extending through the root and communicat-ing laterally with the periodontal ligament space through a pseudo- foramen without communicating with the main root canal space. A single major orifice was present sur-rounded by two radiolucent areas on mesial and distal sides extending approximately 4 mm within the root not associated with the main canal (Fig.). A single, large, periapical radi-olucency was present with the tooth resulting in thinning of labial cortical plates.

This was radiographically diagnosed as a case of dens invaginatus type IIIA resulting in chronic periapical abscess.[1] With three-dimensional visualization of the root canal space anatomy variation, the endodontist was able to proceed with a new, im-proved treatment protocol resulting in successful root canal filling and restoration.

Dens invaginatus is a developmental anomaly resulting in a deepening or invagination of the enamel organ into the dental papilla prior to calci-fication of the dental tissues. Al-though dens invaginatus is common it may be easily overlooked because of the absence of any significant clinical signs of the anomaly.

Periapical radiographs are limited in revealing the type, extension, and complex morphology of dens invaginatus as well as the actual bone loss when compared to tomographic techniques. More advanced imaging techniques, such as CBCT, may aid the diagnosis as well as the management plan and follow-up of teeth with this developmental defect.[2]

References

1.Alani A, Bishop K. Dens invaginatus. Part 1: Classification, prevalence and aetiology. Inter-national Endodontic Journal, 41(12): 1123-1136.

2. Pradeep K, Charlie M, Kuttappa MA, Rao PK. Conservative Management of Type III Dens in dente using cone beam computed tomography. Journal of Clinical Imaging Science 2(1): 51.

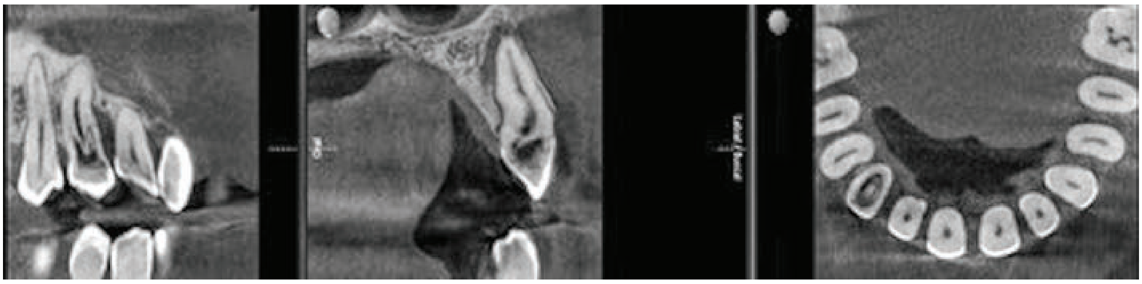

Figure 1: Sagittal, cross-sectional, axial images of upper right canine on Orthophos SL with a resolution of 80 µm.

Dr. Prashant P. Jaju, BDS, MDS, and Dr. Sushma P. Jaju, BDS, MDS, Bhopal, India

Article: The link between periodontal health, periodontitis and systemic diseases – emerging insights and new advances for clinicians. Part 1. Van Zyl and Hartshorne, page 6

1. *Which of the following statements regarding the oral microbiome is correct?*
   a A community of microorganisms consisting of bacteria only
   b The microbiome occurs only on teeth
   c The microbiome diversity is lower at diseased compared to healthy sites
   d The oral microbiome consists of 7 different bacterial species

2. *Which of the following statements regarding biofilm is true?*
   a Is a genetic construct
   b Is a functional construct
   c Is a physical construct
   d Is a functional and physical construct

3. *Which of the following statements regarding the oral ecosystem is true?*
   a Teeth are the only ecological niches for microbial colonization
   b. The oral microbiome is uniquely site specific at different niches
   c Saliva has several indigenous micro-organisms
   d Supragingival and subgingival microbial communities do not differ from each other

4. *Porphyromonas gingivalis is considered as one of the most important pathogens associated with the initiation and progression of periodontal disease. (True or False)*
   a True
   b. False

5. *Which of the following statements about periodontal health is true?*
   a Dysbiotic microbial community
   b Controlled immune-inflammatory state
   c. High diversity and richness
   d Predominant anaerobic

Article: The link between periodontal health, periodontitis and systemic diseases – emerging insights and new advances for clinicians. Part 1. Van Zyl and Hartshorne, page 6

6. *Modifiable factors driving dysbiosis include:*
   a Reduced salivary flow b Diabetes.
   c Genetic predispositions d Poor oral hygiene

7. *Which one of the following statements is incorrect?*
   a The only requirement to treat periodontitis is to kill the bad bacteria
   b Periodontitis is not caused by a single bacterial species
   c The oral microbiome influences nearly every aspect of human biology
   d Periodontal health shows low diversity and richness of oral microbiome

8. *Which one of the following statements is the most accurate?*
   a The only requirement to treat periodontitis is to kill the bad bacteria
   b Periodontitis is caused by a single aerobic spirochete bacterial species
   c Periodontal disease shows predominant anaerobic organisms
   d Periodontal disease reflects a controlled immune-inflammatory state with host response destroying the alveolar bone

9. *Which one of the following statements is the most correct?*
   a Periodontal disease shows 80% aerobic and 20% anaerobic bacteria in the periodontal pocket
   b *P. Gingivalis* dominates in periodontal health
   c *A.a* is the dominant species in adult periodontitis
   d Periodontal health indicates host-microbe synergism

10. *Which one of the following statements is the most accurate?*
   a Studies show that periodontal disease has a polymicrobial aetiology
   b *P. Gingivalis* used to be regarded as an important periodontal pathogen but not anymore
   c Periodontitis is mostly caused by viruses and anaerobic bacteria
   d Dysbiosis between host and microbiome is fundamental to protecting our health and preventing disease

Article: Treatment of mandibular first molars with atypical anatomy: a case report. Riznyk and Riznyk, page 20

11. The failure of endodontic treatment could be a result of:
a Failure to recognize unusual canal configurations
b Thorough debridement of the root canal space
c Complete obturation
d All of the above

12. Song et al reported the following percentage of endodontic failure in first lower molars due to missed root canal systems:.
a 50%
b 30%
c 15%

13. Studies indicate that a third canal in the mesial root of lower first molars can in:
a *3% of cases*
b *9% of cases*
c *18% of cases*

14. Katoor et al reported that the incidence of a third canal in the distal root of lower first molars is:
a *0.2 - 3%*
b *0.5 - 0.7%*
c *0.9 - 1.1%*

15. The following can be used to identify additional root canal systems in teeth endodontic treatment:
a Intra-oral radiographs
b Dental Operating Microscope
c Methylene blue dye
d CBCT
e All of the above

Article: The cardinal role of chemical composition in abutment screw loosening - A literature review and analysis. Nunes, page 48

16. Which factor causes abutment screw loosening?
a Excessive bending
b Prosthetic design and occlusal table
c Abutment screw alloy composition and tensile strength
d All of the above

17. To prevent abutment screw loosening what should clinicians avoid?
a Retightening freshly placed abutment screws
b Pirate components that have better finished surfaces can result in more desirable preload and less screw loosening.
c Conical I/A connection mechanisms that act as an anti-rotational device during functional loading
d Narrowing the occlusal table, flattening cuspal inclination and moving the occlusal contact in line with implant location

18. Which factor make gold alloy abutment screws the material of choice to secure the implant-abutment connection?
a they have a higher modulus of elasticity
b they have greater preload values
c they have a lower coefficient of friction and result in more stable implant-abutment connections.
d All of the above

19. Which statement has been shown to be incorrect?
a A basic implant system comprises of an implant crown, abutment screw, abutment, and implant
b Screw loosening and screw fracture continues to be a common complication and is not improving.
c Studies have shown that significant changes in the chemical composition on an alloy will not change its modulus of elasticity and tensile strength
d The chemical composition of an abutment screw alloy stands paramount to its performance.

20. According to (Becker & Becker, 1995) what is the frequency in abutment screw loosening?
a 25% b 38%
c 8% d 5% and decreasing

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