CERAMIC IMPLANTS – THE AESTHETIC IMPLANTS

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Abstract
Due to an expanding interest and enthusiasm in aesthetics there have been increased concerns and worries about toxic and hypersensitive reactions to certain alloys. In the latter half of the twentieth century zirconia was proposed as another new ceramic material. It has turned into a well known option to alumina as biomaterial.[1] Implant treatment is as of now overruling other prosthetic solutions particularly if there occurs missing teeth in aesthetic region. It is a major concern to notice and be careful about the complications that may occur after such treatment as the only sole reason for the patients to seek this treatment is to make an improvement in the aesthetics. In order to overcome the complications that occurred with titanium implants, the introduction of zirconia dental ceramics gave multiple options in utilization as tooth coloured abutments, soft tissue-zirconia collae in titanium implants and lastly as zirconia dental implants.[2] This article shows a review about the properties of zirconia, and new techniques for fabrication enhancing the mechanical properties of the material.
Keywords: Aesthetics, Biocompatibility, Ceramics, Dental Implants, Zirconia.

Introduction

An expanded number of individuals who endure some type of tooth loss are adapting to dental implants for replacing their teeth. Commercially pure titanium (CPTi) or titanium alloys are used to fabricate dental implants these days. Notwithstanding its biocompatibility, titanium was additionally at first accepted to be inert, nontoxic and non allergenic. Due to wear and corrosion of the titanium implant surfaces high concentrations of titanium has been detected in the tissues that surrounds the dental implants.[1] Both in dentistry and medicine, expanding reports have been seen where the people have reported allergies and hypersensitivities to titanium and additionally titanium alloys.[2] Also titanium promotes plaque retention around the implant (Figure 1). Another part of concern was seen that, some of these implants corrode when they get exposed to the body liquids, for example, saliva and clevicular fluid create electrical movement when they are combined with prosthetic components which are further made of other metal alloys [3]. Zirconia has turned into a prominent other option to alumina as biomaterial and is utilized as a part of dental applications for creating endodontic posts, crown and bridge restorations (Figure 2) and implant projections (Figure3). It has likewise been utilized for the manufacture of aesthetic orthodontic brackets.[1]

Figure 1: Plaque Retention: Titanium versus Zirconium

Evolution

Zirconium Silicate (ZrSO4) is mined and is dealt with and changed into zirconium dioxide which is additionally known as zirconia. The name zirconium originates from the Arabic "Zargun" (which signifies golden in colour) which thusly originates from the two Persian words "Zar" (Gold) and "Weapon" (Color).[1] Zirconium oxide was first utilized for medicinal purposes in 1969 for orthopedic application. It was proposed as another material for hip head substitution rather than titanium or alumina prostheses.[1,2] The more up to date high quality and less weak dental ceramics, less constrained in their rigidity or tensile strength, and with less time dependent stress failure have dominated recently.

Figure 2: Zirconia- based frameworks

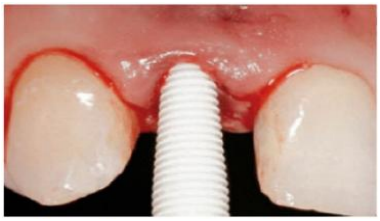

Figure 3: Zirconia- based implant

One-piece vs. two-piece implants

Zirconia implants are delivered as one-piece implants. In any case, such frameworks have a few restrictions. Secondary corrections or remedies of the shape by grinding must be maintained a strategic distance from as this extremely influences the fracture strength of zirconia. Additionally, single-piece implants are exposed to mastication and tongue forces.[2]

White Implant is a novel implant system which consist of root - form, soft tissue level zirconia fixture on which

the glass fibre-reinforced composite abutment is cemented and is prepared by standard techniques used for allceramic crowns preparation. This system can be used for early or delayed loading procedures.[2] (Figure 4)

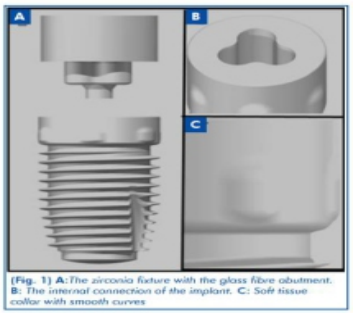

Figure 4A: The Zirconia fixture with the glass fibre abutment. B: The internal connection of the implant. C: Soft tissue collar with smooth curve

Osseointegration

Osseointegration plays an important role in achievement of success in present day dental implants. For achieving the functional ankylosis, Titanium has always been the material of choice. Subsequent to setting up the mechanical properties and incredible biocompatibility of zirconia implants, in various animal studies, the osseointegration of zirconia implants was analyzed.[2] Notwithstanding the material, the underlying collaboration among cells and implant surface is major in accomplishing osseointegration.

Diverse chemical and physical methods were produced to adjust the roughness in surface. The assessment of two different zirconia surface (sandblasted with alumina particles or both sandblasted and acid-etched in a blend of hydrofluoric acid and sulfuric acid) and one standard titanium surface (sandblasted and acid-etched) was done to assess the impact on its osteoblastic activity. Thus it has improved biocompatibility, osseoconductivity and better survival. Cellular adhesion is thus promoted in zirconia implants (Figure 5).

Soft-tissu integration

The soft tissue-to-implant interface is a complex and mind boggling structure that plays a noteworthy part in the maintenance of health in the peri-implant tissue. The nature of this mucosal obstruction appears to depend upon implant surface characteristics. Irrespective of the material, smooth surfaces additionally demonstrated better cell alignment. The outflow of integrin alpha 2 at 3 hour, and of integrin alpha 5 and type I collagen at 48 hour, was up-controlled on zirconia as compared to that of titanium.[2,3] Consequently, it was inferred that the wettability of zirconia could uphold the adsorption of protein and the connection and spreading of fibroblasts.

Microbiology

Studies have affirmed causality between plaque collection on implants and irritation of the peri-implant mucosa. It has been proposed that bacterial biofilm collects less effortlessly on zirconia than on titanium and thus it can be assumed that peri-implant soft tissues

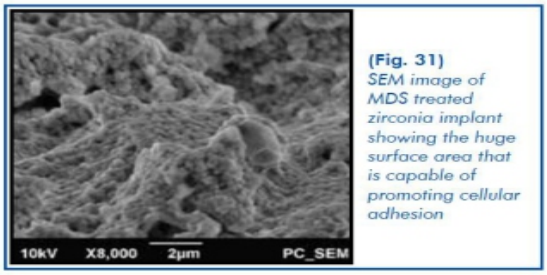

Figure 5: SEM image of MDS treated Zirconia implant showing the huge surface area that is capable of promoting cellular adhesion.

Figure 6: Soft Tissue Health and Aesthetics around Zirconia [3]

around zirconia implants might be at a low risk for inflammation and contamination.[2]

Inflammatory reactions

Since its presentation in dentistry, especially in prosthodontics, zirconia has shown great biocompatibility. In one examination [5] gingival biopsies were harvested around titanium and zirconia healing caps put on titanium implants in five patients. The inflammatory infiltrate around the titanium examples was more noticeable and there were indications of ulceration of the mucosa in one case.[2]

Clinical studies

Various studies assessing the clinical utilization of zirconia implants have been distributed amid the previous decade. Payer et al.[6] demonstrated a 6.3% failure rate with just a single implant failing after loading. Andriotelli et al [7] performed study on 9 animals and their conclusion was that better osteointegration was seen with zirconia implants. Lambrich and Iglhaut [8] watched 127 zirconia and 234 titanium implants for a mean perception time of 21.4 months. In this examination, zirconia implants executed and additionally titanium partners when embedded in mandible (98.4% versus 97.2%) while titanium implants preformed fundamentally better in the maxilla (98.4% versus 84.4%).[2] Once more, all failures were in the mending stage because of expanded implant mobility.

Depprich et al.[9] who discovered just 17 clinical studies on zirconia implants led in the vicinity of 2006 and 2011 in which, survival rate was between 74– 98% following 12– 56 months. The creators commented that the majority of the studies had noteworthy weaknesses and hence, very much planned controlled trials are earnestly required. The creators assert great execution of these implants following 30 months.[9]

Discussion

As of now, zirconia is the ceramic of choice for dental implants is tetragonal zirconia polycrystal, especially 3 mol% yttrium oxide (yttria). In vitro studies have shown no proof to either the mutagenic or the carcinogenic impacts. Zirconia has low thermal conductivity, high flexural quality (900– 1,200 MPa), positive fracture resistance, and is resistant to wear and corrosion.[2,10, 11,12]

On the other hand, one of zirconia's negative properties is its low-temperature degradation or consumption. In the existence of water or water vapor, moderate transformation from the tetragonal stage into the monoclinic stage prompts moderate improvement of roughness, subsequently creating progressive deterioration of the material. Furthermore ageing happens because of compressive anxieties and microcracking, and the level of ageing is subject to the balance between these two factors'. Different developments, for example, the utilization of zirconia toughened alumina and Ceria-doped zirconia to limit the incidence and halt the movement of zirconia aging are likewise considered as key strides in the developing prevalence of zirconia as bioceramic.[2, 11,12, 13]

Conclusion

Titanium dental implants are as yet the key best quality level and for the most times suggested for patient to utilize. Furthermore, a few issues have prompted looking for adjuncts to this material with a specific end goal to rearrange and improve aesthetic result[9] of instant placement of implants in the aesthetic region. Due to its excellent mechanical, biological and aesthetic qualities, zirconia dental ceramics was observed as a decent material to satisfy the purpose.[12,13]

Both (in-vitro and in-vivo) research discovering support for the utilization of zirconia dental implants, also this should be substantiated by its long term and well organised RCTs (Randomized Controlled Trials). Zirconia in view of its biocompatible properties and enhanced Osseo integration, lesser bacterial adhesion takes significance in new generation of dental implants. From the variety in vivo and in vitro studies zirconia is by all accounts a bio inert material which supports the usage of this material in dental implantology.[1,2,5]

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