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Original Article

Assessment of surface characteristics of two commercially available zirconia dental implant systems- A comparative study

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ABSTRACT

Background: Dental implants have become a well-established treatment method for oral rehabilitation after tooth loss. In present study two zirconia implant system (Bredent white SKY™, Straumann pure Ceramic) were assessed for surface characteristics. **Materials & Methods:** The present study was conducted on 44 zirconia dental implants. Group I had Bredent white SKY™ and group II had Straumann pure Ceramic implants. The evaluation was performed by means of scanning electron microscopy (SEM). Comparable areas for all implants under investigation are selected by splitting up the cylindrical shape of the implant into sections. **Results:** Group I had Bredent white SKY™ (22) and group II had Straumann pure Ceramic implants (22). Group I and II implants were sand blasted, group II was etched and special coated. Group I had smooth and group II had deep markings. Group I had bigger droplets and group II had finest. **Conclusion:** From SEM analysis it was concluded that Straumann pure zirconia dental implants, which was sandblasted and acidized were proven to have better surface characteristics than Bredentwhite SKY™ zirconia dental implants.

Key words: Ceramic, Dental implant, Straumann.

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INTRODUCTION

Dental implants have become a well-established treatment method for oral rehabilitation after tooth loss. Pure titanium is still the material of choice when it comes to dental intraosseous implants and has been used for decades. However, titanium implants have esthetic limitations, especially in the front aspect of the maxillary jaw. The recession of the gingiva can lead to visible implant necks. Furthermore, titanium may cause immunological reactions with early local infection and possible risk for implant loss.[1] The first generation of successfully used clinical titanium implants, which were machined with a smooth surface texture, now approach 50 years in clinical use. The second generation of clinically used implants underwent chemical and topographical modifications, usually resulting in a moderately increased surface topography. Many of these oral implant systems now approach 15 years of clinical use.[2] The coating of titanium with, for example, different types of calcium phosphates may improve bone integration even further. The surface properties of any material will be different from those of the bulk, for different reasons. One reason is a fundamental characteristic of surfaces. The creation of a surface inevitably involves breaking of the chemical bonds that keep the material together. A freshly created surface represents an energetically unfavourable situation, often referred to as high surface energy.[3] In present study two zirconia implant system (BredentwhiteSKY™, Straumann pure Ceramic were assessed for surface characteristics.

MATERIALS & METHODS

The present study was conducted in the IMMT institute. It comprised of 44 zirconia dental implants. Group I had Bredent white SKY™ and group II had Straumann pure

Ceramic implants. The evaluation was performed by means of scanning electron microscopy (SEM). High-resolution SEM images with magnifications up to 25,000 are possible to demonstrate the micro-structured appearances at different locations. Comparable areas for all implants under investigation are selected by splitting up the cylindrical shape of the implant into sections. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Graph I shows that group I had Bredent white SKY™ (22) and group II had Straumann pure Ceramic implants (22).Table I shows that group I and II implants were sand blasted, group II was etched and special coated.Table II shows that group I had smooth and group II had deep markings. Group I had bigger droplets and group II had finest.

Graph I Distribution of implants

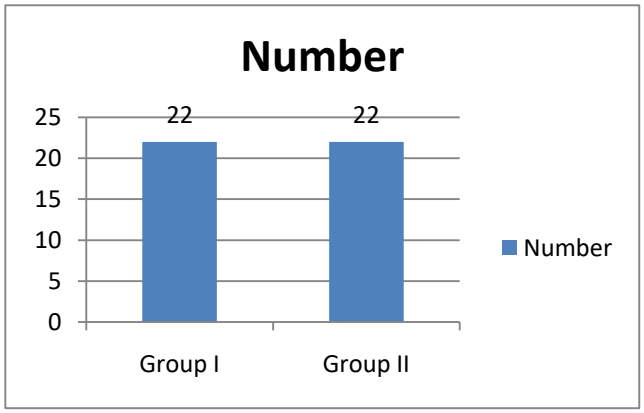

Table I Surface characteristics in both groups

Surface characteristics	Group I	Group II
Sandblasted	Yes	Yes
Etched	No	Yes
Special coating	NA	Yes

Table II SEM characteristics in both groups

Surface characteristics	Group I	Group II
Surface	Smooth	Deep markings
Droplets	Bigger	Finest

DISCUSSION

Currently, titanium and titanium alloys are the materials most often used in implant manufacturing and have become a gold standard for tooth replacement in dental implantology. These materials have attained mainstream use because of their excellent biocompatibility, favorable mechanical properties, and well documented beneficial results. When exposed to air, titanium immediately develops a stable oxide layer, which forms the basis of its biocompatibility. The properties of the oxide layer are of great importance for the biological outcome of the osseointegration of titanium implants.[4]

Implant surface characteristics are of ongoing scientific interest. Implants made from titanium are still the most common to be used. Titanium implants are made from alpha-beta alloy which consists of 6% aluminum and 4% vanadium (Ti-6Al-4V). These materials have low density, high strength, and resistance to fatigue and corrosion, and their modulus of elasticity is closer to the bone than any other implant material.[5]

In present study, group I had Bredent white SKY™ and group II had Straumann pure Ceramic implants. Group I and II implants were sand blasted, group II was etched and special coated. This is in agreement with AlbrektssonTet al.[6] group I had smooth and group II had deep markings. Group I had bigger droplets and group II had finest.

The surface shape (droplet-like surface), which was observed in the SEM samples can be caused due to the sintering process in which ceramic powder was melted and then formed. Different particle, immersion, and droplet sizes can also change due to possible reasons like usage of various types and dosages of acid for the etching process and change of exposure time to acid effect. A longer exposure time to etching process could also be responsible for lowering aluminum corundum from sandblasting processes.[7]

In a study by Nawas B et al,[8] the evaluation was performed by means of scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and confocal laser scanning microscopy (CLSM). The semi-quantitative element composition showed no significant impurity of any implant tested. Both the machined and the rough areas of the investigated implants were predominated by zirconium, oxygen, and carbon. Roughness values (Sa) showed highest values for I2 and I5. The investigated zirconia implants showed surface characteristics and roughness values close to those of conventionally produced titanium implants, making them a promising.

In recent years, high strength zirconia ceramics have becomeattractive as new materials for dental implants.They are considered to be inert in the body and exhibit minimal ion release compared with metallic implants. Yttrium-stabilized tetragonal zirconia polycrystals appear to offer advantages over aluminum oxide for dental implants because of their higher fracture resilience and higher flexural strength.[9] They have also been used successfully in orthopedic surgery to manufacture ball heads for total hip replacements; this is still the current main application of this biomaterial. Zirconia seems to be a suitable dental implant material because of its toothlike color, mechanical properties, and therefore biocompatibility. Apical bone loss

and gingival recession associated with implants often uncover portions of the metal implant, revealing a bluish discoloration of the overlying gingiva. The use of zirconia implants avoids this complication and accedes to the request of many patients for metal-free implants. The material also provides high strength, fracture toughness, and biocompatibility.[10]

CONCLUSION

From SEM analysis it was concluded that Straumann pure zirconia implants, which was sandblasted and acidized were proven to have better surface characteristics, thereby enhancing the chances of faster osseointegration than Bredent white SKY™ zirconia dental implants. The surface characteristics of zirconia dental implants makes it popular amongst dental surgeons.

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