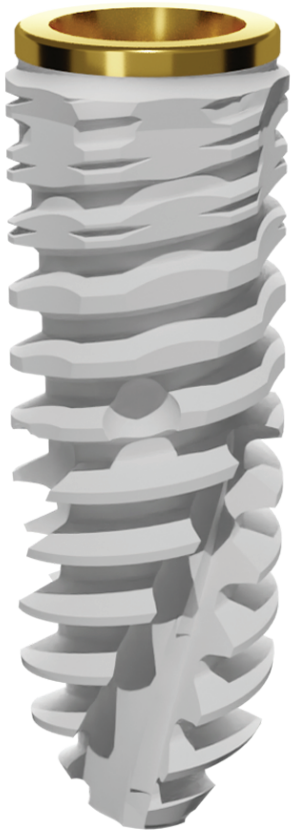
COMPARATIVE STUDY SHOWS THE SGS DENTAL IMPLANT COATING IMPROVES OSSEOINTEGRATION AND PATIENT OUTCOMES

REVOLUTIONIZING DENTAL IMPLANTS WITH ADVANCED SURFACE TECHNOLOGY

Dental implants have revolutionized restorative dentistry, providing durable solutions for tooth loss. This white paper highlights the importance of dental implant surface coatings, the innovative SGS Dental Implant surface treatment (focusing on its calcium phosphate [CaPO4] coating), and its superior performance in enhancing patient outcomes. Drawing from a recent study, we demonstrate how SGS implants achieve better osseointegration, increased stability, and improved overall patient satisfaction compared to traditional implant surfaces.



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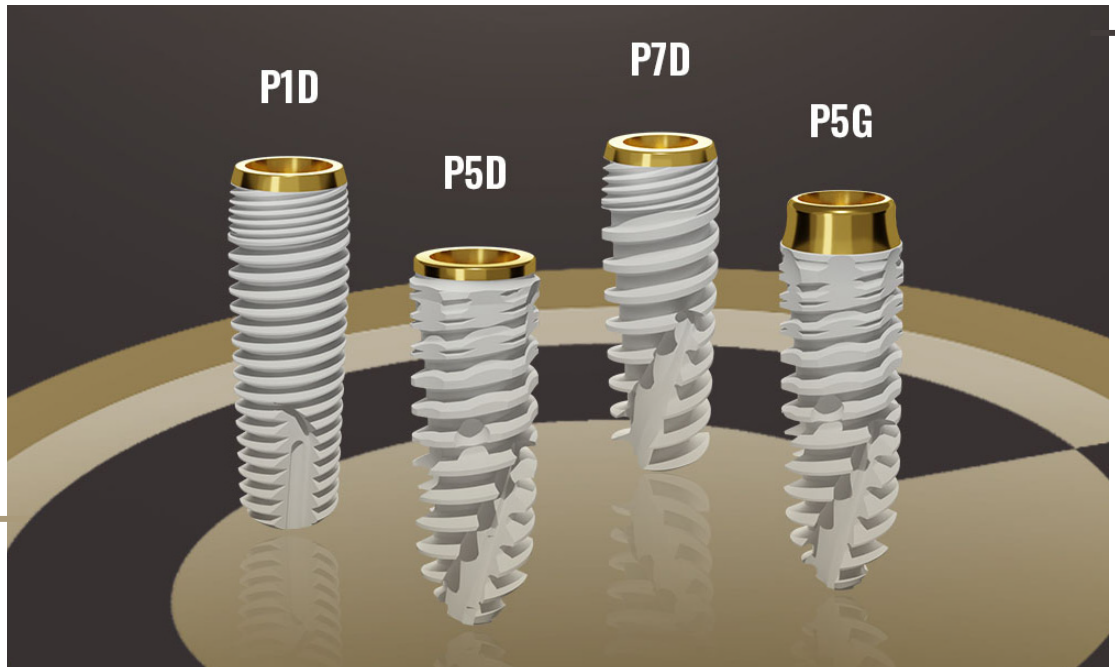
SGS Dental
Swiss Implant System

The advancements in dental implant technology have significantly improved patient care in restorative dentistry. The success of dental implants largely depends on their ability to integrate with the surrounding bone, a process known as osseointegration. Surface treatments play a critical role in this integration, influencing the biological response and stability of the implants. This paper explores the benefits of SGS Dental Implant surface treatment, emphasizing the unique properties and superior performance of its CaPO4 coating.



COMMON ISSUES WITH UNCOATED DENTAL IMPLANTS

Osseointegration Challenges:

Osseointegration is the process where bone tissue grows and integrates with the surface of a dental implant, providing stability and functionality. Uncoated dental implants often face significant osseointegration challenges due to the lack of bioactive surfaces. Without a coating, the implant surface is typically smooth or minimally roughened, which limits the adhesion and proliferation of osteoblasts (bone-forming cells). This can result in slower and less effective bone integration, leading to a higher risk of implant loosening or failure over time. The absence of bioactive materials like calcium phosphate or hydroxyapatite, which promote bone cell activity, makes it more difficult for the implant to achieve a strong bond with the surrounding bone.

Infection Risks:

Uncoated dental implants are more susceptible to bacterial colonization and subsequent infection. The smooth surface of uncoated implants does not possess antimicrobial properties, making it easier for bacteria to adhere and form biofilms. These biofilms protect the bacteria from the immune system and antibiotic treatments, leading to persistent infections. Peri-implantitis, an inflammatory condition affecting the tissues around the implant, is a common complication that can arise from such infections. It can cause bone loss and compromise the stability of the implant. Additionally, infections can result in prolonged pain, swelling, and the need for additional surgical interventions to manage and treat the infected implant site.

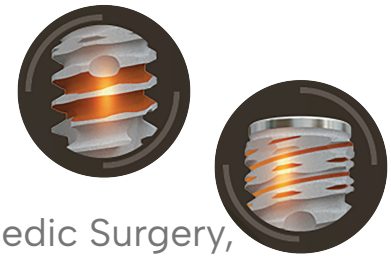
Bone Loss and Implant Failure:

The lack of a coating also means reduced stimulation for bone remodeling and maintenance around the implant. Over time, this can lead to marginal bone loss, which further undermines the stability and longevity of the implant. The combination of poor osseointegration and increased infection risks creates a higher likelihood of implant failure, necessitating removal and replacement, which can be costly and traumatic for the patient.

Uncoated dental implants pose significant challenges in achieving successful osseointegration and are more prone to infections. These issues highlight the importance of surface treatments and coatings that enhance bioactivity, promote bone integration, and reduce infection risks, ultimately leading to better patient outcomes and longer-lasting dental implants.

LEARN MORE ABOUT THE IMPACT OF DENTAL IMPLANT SURFACE MODIFICATIONS IN THIS STUDY.

A COMPARATIVE ANALYSIS OF DIFFERENT DENTAL IMPLANT COATINGS



A study by Daniel A. Grande, PhD (Professor of Orthopaedic Surgery, Molecular Medicine, Urogynecology, and Otolaryngology, Director of Orthopaedic Research Laboratory, and Associate Director of Research at the OrthoBiologics Center), titled "The effect of surface topologies and treatments on short-term osteointegration potential of dental implants," found that overall, titanium dental implants with surface treatments fared much better than those without surface treatments. The surface topologies and treatments tested included:

- Sandblasted and Acid-Etched (Straumann, Basel, Switzerland)
- Sandblasted with Machined Microgrooves (Zimmer Biomet, Warsaw, IN)
- Anodized (Nobel Biocare, Zurich-Flughafen, Switzerland)
- Microgrooved with Resorbable Blast Texturing (Biohorizons, Birmingham, AL)
- Calcium Phosphate Coated (SGS Dental, Gallen, Switzerland)

Surface Topologies and Treatments Matter

This study highlights the importance of surface treatments like hydroxyapatite and calcium phosphate coatings. These coatings significantly promote bone formation by upregulating osteocalcin and alkaline phosphatase, critical markers of bone growth. Additionally, they encourage angiogenesis through the secretion of vascular endothelial growth factor (VEGF), which indirectly supports osteogenesis. By improving cell adhesion and creating an optimal environment for bone and blood vessel formation, these coatings enhance the stability and longevity of dental implants, leading to better patient outcomes.

The SGS Dental Implant Coating Promotes Osseointegration and Improves Patient Outcomes

The SGS dental implant coating facilitates the direct differentiation of bone marrow-derived mesenchymal stem cells (b-mMSCs) into osteoblasts, leading to increased secretion of key bone formation markers such as osteocalcin and alkaline phosphatase. Additionally, the CaPO4 coating encourages the upregulation of vascular endothelial growth factor (VEGF), which supports angiogenesis and further enhances the bone formation environment through crosstalk between angiogenesis and osteogenesis. These combined effects have resulted in improved implant stability and long-term success, providing better integration with

the patient's natural bone and ultimately leading to more reliable and durable dental restorations.

At completion, the study discovered that the SGS Dental calcium phosphate ($CaPO_4$) coating offers several significant benefits that enhance osseointegration and bone formation, including:

1 **Promotion of Osteointegration:** In vivo, $CaPO_4$ coatings have been shown to effectively promote osteointegration and bone formation. This is critical for the long-term stability and success of dental implants.

2 **Induction of Osteoblastic Differentiation:** $CaPO_4$ coatings can induce the differentiation of mesenchymal stem cells (MSCs) into osteoblasts, the cells responsible for bone formation. This differentiation is vital for creating a robust bone-implant interface.

3 **Bioactivity and Solubility:** Amorphous $CaPO_4$ is highly bioactive due to its high solubility and rapid crystallization. These properties make it an effective surface coating that supports bone tissue formation and integration with the implant.

4 **Enhanced Angiogenesis:** The $CaPO_4$ coating not only supports osteogenesis but also promotes angiogenesis—the formation of new blood vessels. This dual action is essential because angiogenesis supports the supply of nutrients and oxygen to the developing bone tissue, further aiding in the integration and stability of the implant.

5 **Direct Bone Formation:** Among various surface treatments, $CaPO_4$-coated implants show a unique ability to directly promote bone formation rather than relying solely on angiogenesis or other indirect methods.

Overall, these benefits of the SGS $CaPO_4$ coating lead to improved patient outcomes by enhancing the stability and longevity of dental implants through better integration with the surrounding bone tissue and supporting structures.

A DIRECT COMPARISON OF SGS DENTAL IMPLANTS TO OTHER IMPLANTS IN THE STUDY

SGS Dental Implants (Calcium Phosphate Coating):

- **Direct Promotion of Osteogenesis:** SGS implants demonstrated a significant upregulation of osteogenic markers, such as alkaline phosphatase (ALPL) and osteocalcin (OCN), indicating a direct promotion of bone formation.

- **Enhanced Bone Formation:** The calcium phosphate coating on SGS implants directly influenced the differentiation of bone marrow-derived mesenchymal stem cells (bmMSCs) into osteoblasts, which are critical for bone formation.

- **Superior Osteointegration:** The unique surface treatment of SGS implants led to a higher degree of osteointegration, ensuring better stability and long-term success of the implants.

Other Implants (Sandblasted, Acid-Etched, Anodized, etc.):

- **Indirect Promotion of Osteogenesis via Angiogenesis:** Other implants, such as sandblasted and acid-etched (SB+AE) and anodized (AN), primarily promoted angiogenesis rather than direct bone formation. They showed upregulation of vascular endothelial growth factor (VEGF), which indirectly supports osteointegration by enhancing blood vessel formation.

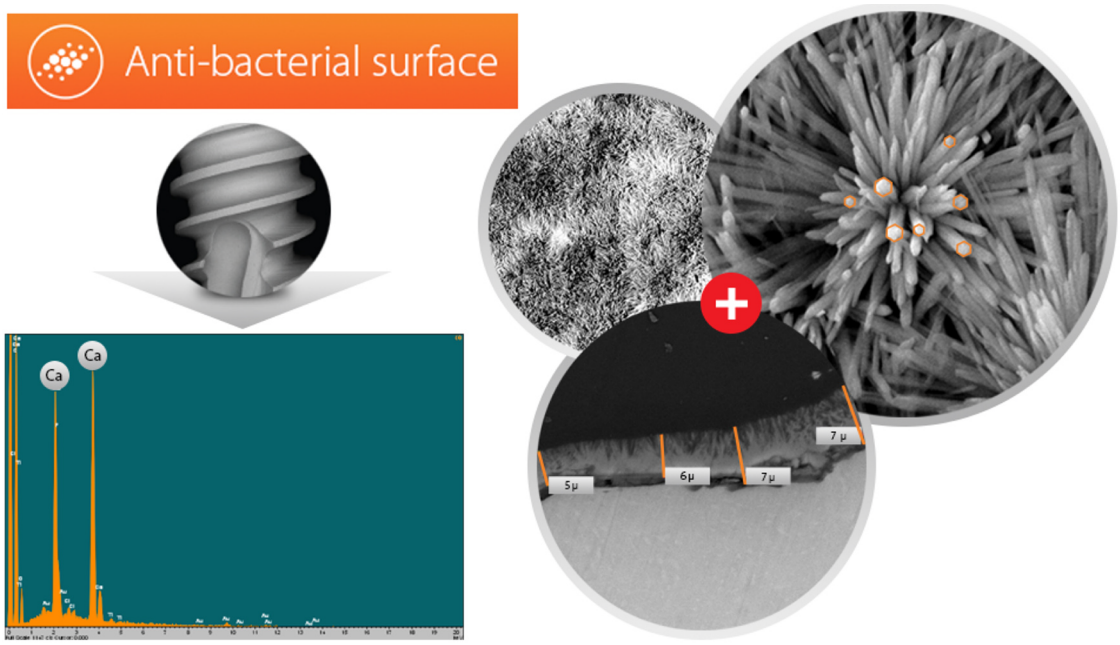
- **Mixed Results in Osteogenic Markers:** These implants showed varied results in the upregulation of osteogenic markers. For instance, while RUNX2 was upregulated initially, other markers like ALPL and OCN were not consistently elevated, indicating a less direct influence on osteogenesis.

- **Moderate Osteointegration:** The osteointegration potential of these implants, although present, relied more on the angiogenic response and subsequent bone formation rather than direct differentiation of bmMSCs into osteoblasts.

SGS dental implants with calcium phosphate coating outperform other surface treatments by directly enhancing osteogenesis and promoting bone formation. This leads to improved implant stability, faster recovery, and better long-term outcomes for patients. Other implants in the study, while beneficial, primarily enhance osteointegration through angiogenesis, resulting in a less direct approach to bone formation.

THE SCIENCE BEHIND THE SGS DENTAL IMPLANT'S SBTC SMART SURFACE

The Smart Bioactive Trabecular Coating is a thin, bioactive calcium phosphate coating that provides numerous benefits because of its thinness, cleanliness, and high surface area. SGS Dental developed the hydrophilic SBTC coating to accelerate the formation of new bone by absorbing the blood. This can shorten the loading time from six months to as little as six weeks.



Testing the Product

To ensure our surface coating is the best of the best, we rigorously tested every element of it, including the:

- Starting materials: brushite and hydroxyapatite
- Phase composition and Ca:P ratio
- Solubility
- Shelf life
- Adhesion strength
- Coating thickness
- Cytotoxicity
- Sensitization
- Irritation
- Acute systemic toxicity

The Clinical Data

Extensive research has demonstrated the efficacy of the SBTC coating in dental implants. One comparative study revealed that the SBTC coating achieved nearly 14% more bone contact than the TPS surface. Another study evaluated the SBTC coating alongside a plasma-sprayed hydroxyapatite (HA) surface and a TPS surface. The findings indicated that the SBTC coating was fully resorbed after seven months and had been replaced by newly formed bone tissue, particularly between the threads of the implant. This study also highlighted the SBTC coating's

clear osteoconductive effect and excellent biocompatibility, with no detected reactions to foreign bodies. The coating was almost entirely resorbed within six weeks, underscoring its effectiveness.
In a multicentric study assessing the immediate loading of CaP-coated dental implants, researchers examined 156 implants with the SBTC coating placed in the maxilla and mandible of 62 patients, including 40 implants in fresh extraction sites. After six months under load, 94.9% of these implants were successfully osseointegrated and functional.
These findings collectively affirm the SBTC coating's ability to enhance bone integration and stability, leading to more reliable and long-lasting dental implants.

Read more about these studies and findings here.

Conclusion

In summary, the SGS Dental Implant with its advanced calcium phosphate ($CaPO_4$) coating demonstrates significant improvements in osseointegration and patient outcomes compared to traditional implant surfaces. The coating not only promotes direct bone formation by inducing osteoblastic differentiation but also enhances angiogenesis, creating a conducive environment for bone growth and stability. Clinical studies have shown that SGS implants achieve higher rates of bone contact and faster recovery times, resulting in a more reliable and durable dental restoration.
The innovative Smart Bioactive Trabecular Coating (SBTC) developed by SGS Dental has been proven to accelerate new bone formation, reducing the loading time dramatically from six months to as little as six weeks. This technological advancement ensures that dental implants integrate more effectively with the patient's natural bone, thereby enhancing the long-term success of the implants.
As the field of dental implantology continues to evolve, ongoing research and development in surface coatings will play a crucial role in further improving implant performance and patient satisfaction. Dental professionals are encouraged to consider SGS-coated implants for their superior integration capabilities and overall benefits to patient outcomes.

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- **SBTC surface.pdf**