Ceramic dental implants: What benefits do they offer?

By Brendan Day, DTI

Although the search for metal-free implant materials began in the late 1960s, recent improvements in ceramic materials have made their development process considerably easier. As an alternative to titanium-based implants, ceramic implants offer greater aesthetic appeal and possess antiallergenic and tissue-friendly properties. This article highlights some of the companies that currently offer ceramic implants and explores why they are still much less commonly used than their titanium counterparts.

For the better part of four decades, titanium and titanium-alloy dental implants have been successfully used as tooth replacements. However, recent research findings have raised fears regarding these implants’ tendency to corrode and decay. During the corrosion process, titanium implants release particles or ions into their surrounding tissue, which could lead to implant failure and bone disintegration. A 2014 paper published in the *Open Journal of Stomatology*, titled “Corrosion aspect of dental implants—An overview and literature review”, detailed this process by explaining that the compatibility of titanium implants is largely the result of a thin layer of oxide that forms on their surface. This layer can erode due to movements between bone tissue and the implant during loading conditions, which could lead to corrosion, leaking and an overall weakening of the implant. Given their non-metallic nature, ceramic implants are not susceptible to this form of decay.

However, the lack of concrete evidence concerning the mechanical properties and osseointegration of ceramic implants has impeded their uptake, although this is partially due to their relative newness. The FDA only approved ceramic implants in 2007. Additionally, there have also been relatively few clinical studies conducted on their long-term use.

However, in the *Clinical Implant Dentistry and Related Research* journal, a 2015 study of zirconia implant abutments that supported entirely ceramic crowns found that after 11 years of use, these abutments had a cumulative success rate of 96.3 percent. In addition, a 2010 study in the journal for *Clinical Oral Implants Research* found that the osseointegration of zirconia implants is similar to that of titanium implants. Despite these positive findings, the sheer lack of depth in research has deterred the majority of dental professionals from using ceramic implants.

The one-piece design of ceramic implants is another element that has both positive attributes and drawbacks. A one-piece implant eliminates the connective point between the abutment and the fixture, ideally reducing bacterial growth and improving overall oral health. However, a high level of attention to detail with regards to the implant’s placement is required, as it does not possess the same capability as titanium implants to correct errors in placement with an angled abutment. This inability to correct errors in placement created the demand for two-piece ceramic implants that allow for more flexible placement options and better healing.

The American Academy of Implant Dentistry estimates that, while three million Americans currently have at least one dental implant, this number is rising by half a million each year. Given the growing global demand for dental implants, it is more important than ever to provide patients with options that best suit their individual needs. Although they are an expensive option, ceramic implants are increasingly meeting the standards for stability, compatibility and osseointegration that titanium-based implants have set. Combining this with their aesthetic appeal and anti-allergenic nature, ceramic implants should continue to grow in popularity.

“Ceramic implants today, in my experience and for many fellow ceramic implantologists, have the same success rate as titanium implants. They are now as versatile as metal implants thanks to the evolution in design, surface enhancement protocols and biomaterial improvements,” says Dr Sammy Noumbissi, President of the International Academy of Ceramic Implantology (IAOCI), an association entirely dedicated to ceramic alternatives of metal-based implants.

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Only a few implant manufacturers focus on ceramics

Interestingly, most of the major implant manufacturers do not have a ceramic implant on the market, let alone in development. The most notable exception is Straumann. Headquartered in Basel, Switzerland, Straumann is an international leader in implant and restorative dentistry, with its products and services available in more than 100 countries. Straumann currently offers Pure, a completely zirconia-based implant that is ivory-colored, similar to a natural tooth. The company recently announced that it has entered into a partnership with maxon motor, which will allow it to develop dental implant components through ceramic injection moulding rather than conventional cutting techniques. The move demonstrates the company’s recognition of the growing market for aesthetically pleasing, metal-free implants. Given that one of the main barriers to zirconia implants is their comparatively high price, Straumann aims to make it a more widely available and affordable option.

In addition, TAV Dental is one of the few companies that offer both one-piece and two-piece ceramic implants. Their primary focus is to create state-of-the-art zirconia dental products through an innovative approach to technology, fostered by their parent company, TAV Medical. TAV Dental offers a variety of one-piece and two-piece zirconia implants that are entirely white, a distinct aesthetic improvement from the metallic colour of a titanium implant that is often visible. Furthermore, the inert nature of TAV Dental’s zirconia implants make them less likely to fracture and highly resistant to foreign compounds as well as the application of heat, further benefiting patients. Another company manufacturing ceramic implants, Ceralogic, introduced its zirconia implant system to the European market in 2005 and the US market in 2011. Located in Barcelona, Spain, the company utilised improvements in ceramic materials to design a one-piece ceramic implant. Whereas titanium-based implants have two separate parts—the fixture and the abutment—Ceralogic’s product incorporates both elements into one implant. This ensures that there is no prosthetic connection where bacteria can grow, theoretically leading to better periodontal health.

One of the primary players in ceramic implantology is Dental point with their metal-free Zeramex system. Established in 2005, the company spent four years researching and developing a two-part implant made of zirconia, presenting it to the world in 2009. Zeramex offers a revolutionary approach to ceramic implantology through their metal-free, screw-in implant, allowing for a flexible restoration with a high level of biocompatibility. Combining this with a higher resistance to corrosion results in a product that rivals titanium implants in performance.

Zysems is a Switzerland-based company that, through their Zerkolthin range of products, offers extensive ceramic implant options. Similar to TAV Dental, they offer both one-piece and two-piece implants and their osseointegration rate is similar to leading titanium implants. Another company, VITA, has entered the ceramic implant market with its own one-piece zirconia-conical ceramic implant in operation since 2014, and with a focus on innovation, VITA claims their ceramic implant offers faster, safer healing than titanium-based implants. With a compatibility rate of 95 per cent for more recent models, zirconia-based ceramic implants are increasingly matching the standards set by titanium implants and could thereby become a more viable option.

As Noumbskis concludes, “The future of ceramic implants is really bright for many reasons. Patients increasingly ask for safer, less invasive solutions, as well as metal-free alternatives for teeth repair or replacement. Dental attitudes and understanding of zirconia and bioceramics are slowly but steadily evolving, with a definite shift toward biological and inert materials. There has been a shift in the health care industry towards wellness and wellbeing, and providing therapies that have little to no side effects.”

Since some of the larger players in the implant industry are incorporating, or have already adopted ceramic implants in their product lines, either by development or by corporate acquisitions, implantologists could eventually look at ceramic implants as a viable alternative to titanium.
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Shifting consumer preferences and positive uptake of CAD/CAM technology

Current developments in the European dental implant market

By Artur Kim & Dr Kamran Zamanian, Canada

Europe has some of the most highly penetrated markets for dental implants in the world, including Italy, Germany and Spain, but it also contains regions with considerably under-developed markets, such as France and the UK. A shift in consumer preferences will be a key characteristic of the European market in the future, in both the dental implant fixture market and final abutment market. Although the shifts will contrast one another, they will both have a significant impact on the market in terms of overall pricing, the competitive landscape and technological innovation.

Historically, premium dental implant companies have dominated in Europe, but have recently faced increased competition from the value and discount brands. A growing prevalence of local manufacturers and an increasingly cost-sensitive consumer demographic will contribute to overall price depreciation and the declining presence of premium implants in the future.

Region-specific growth of the premium segment is highly reliant on the prevalence of domestic, lower cost dental implant brands. In countries such as Italy, Germany and Spain, there is a plethora of local value and discount dental implant companies that have emerged to cater to the growing cost sensitivity expressed by dentists. Within these regions, the premium segment of the market has also been particularly successful at capitalising on the shift in consumer preferences and now represent the top leading implant brands in those regions, both in terms of volume and revenue.

Premium implant companies have acknowledged the impact of value and discount brands on the market, not only through discount pricing, but also through acquisitions and strategic investments. In April 2015, Straumann increased its ownership of Neodent, a leading value implant manufacturer from Latin America, to 100 per cent in order to strengthen its product portfolio and maintain a competitive position in both the premium and value segments. Straumann has also invested in a number of value and discount brands that cater to the European market, including Biodenta, Medentitka, MegaGen and Anthogyr. These investments are supplemented by Instradent, Straumann’s business platform established in 2014, which currently provides distribution for Neodent and Medentitka through an online store and worldwide network. In June 2016, Dentsply Sirona continued its expansion by announcing a definitive agreement to acquire MIS Implants Technologies, an Israeli-based company that has a leading position in the value implant segment. Large conglomerates too have taken note of the changing structure of the market, with Henry Schein making strategic investments in BioHorizons and CAMLOG, while Danaher Corporation has invested in Nobel Biocare and Implant Direct.

Rapidly growing CAD/CAM segment in the final abutment market

Similar to the historical dominance of the premium segment in the implant market, the market for final abutments has traditionally been controlled by the stock abutment or prefabricated abutment segment. Although the majority of stock abutments lack many benefits associated with patient individualised solutions found within the custom-cast abutment and CAD/CAM abutment segments, they still provide a relatively simple and cost-efficient solution in most implant procedures. The segment is expected to continue experiencing price erosion owing to increasing pricing pressure from local, low-cost and generic manufacturers. Another recent development within the stock abutment segment also contributing to price depreciation is the introduction of Ti-base abutments.

Ti-base abutments, also known as titanium bases or titanium interfaces, are a recent innovation within the stock abutment market that are a cost-effective alternative to traditional CAD/CAM abutments, since they are intended for in-house or independent milling machine use. Examples include Straumann’s VarioBase and Nobel Biocare’s Universal Base, which give dentists the option of placing a cement-retained or screw-retained restoration. Ti-bases also allow dentists to choose between a hybrid abutment and a hybrid abutment crown (a combination of an abutment and a monolithic crown). The presence of Ti-base abutments has grown rapidly across most regions in Europe and it is expected that these will be the predominant stock abutment type in the near future. The cost-effective nature and flexibility of options offered with Ti-base abutments will help maintain the position of the total stock abutment segment in the overall market. Stock abutments currently represent over 50 per cent of the total final abutment volume in the majority of markets across Europe, but this share is expected to steadily decrease.

Recent improvements in production capability and technological innovation have made CAD/CAM abutments significantly more affordable than in the past. CAD/CAM abutments are now relatively comparable in price to custom-cast abutments and are more easily accessible, especially in regions where milling laboratories with CAD/CAM production are in greater abundance. Furthermore, CAD/CAM abutments are primarily required in cases in which aesthetic outcomes are of higher priority, such as the anterior region of the mouth. CAD/CAM abutments are expected to continue to experience double-digit growth, and the expanding market share of the segment will limit ASP of the overall abutment market, since it carries a substantially premium relative to stock abutments and custom-cast abutments.

Consolidation and emerging players in the competitive landscape

In addition to investments in value and discount companies, the market for dental implants has been distinguished by consolidation among the top competitors. Most recently, Dentsply Sirona was established after the merger of DENTSPLY International and Sirona Dental Systems in February 2016, combining the strengths of each company in dental consumables and innovative technology, respectively. The premium implant company acquired ASTRA TECH in 2011 and announced the acquisition of MIS in June 2016. In June 2013, Zimmer Biomet was formed through the merger of Zimmer and Biomet, combining the dental divisions of each company. Zimmer Dental and Biomet’s joint venture would still represent over 60 per cent of the market in Europe since it carries a price premium relative to stock abutments and custom-cast abutments.

Although the premium implant companies still collectively maintain over 60 per cent of the European market, they are expected to face competition and challenges from emerging players in the value and discount segments. Competitors have been able to secure a notable market share from the premium companies including BioHorizons, CAMLOG, Global D, medentis medical, Sweden & Martin and regional manufacturers.

Other notable developments in the European market for dental implants include the increased take-of ceramic materials, growing presence of implant companies in the biomaterials space and rising demand for modern surgical protocols, such as immediate loading and full arch restorations. Overall, growth within each segment will be highly dependent on the aforementioned factors and region-specific characteristics.

By Artur Kim & Dr Kamran Zamanian

Editorial note: A list of references is available from the publisher.
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One week diary with our X-Mind Trium 3D CBCT in practice

By Dr Diyari Abdah, UK

There is mounting evidence in the literature in regards to the diagnostic superiority of 3-D imaging versus 2-D. As a result, many clinicians today are using 3-D imaging either by referring their patients to a CBCT-scanning centre or having mobile units visiting them, and the only benefit of this method is that there is no initial capital outlay to buy the machine. In contrast, the benefits of having your own in-house CBCT machine are many, including the total convenience of an on-demand service at any time (pre-op or during and after if needed), learning one software and fully utilising it rather than having to learn different software for different machines (manufacturers), thus not utilising it to its fully intended use.

Additionally, patient acquaintance that they do not have to travel to another location and that fact that you care enough to have a machine installed in your clinic for their convenience and yours.

Our X-Mind Trium CBCT unit from ACTEON is rather young in a family practice, it would be beneficial to share a week’s diary utilising the machine should allow for different scan settings and solutions in 3-D versus an old fashioned 2-D image that did not make sense to the untrained eye in most cases.

One week diary with our X-Mind Trium 3D CBCT in practice

For clinicians who use more than one implant system, to change the implant model that was inserted from the library, we simply click in the middle of the implant and the implant library opens again and it is possible to choose another implant model, the software will keep the same insertion point and direction of the previous one. In addition, the software will easily evaluate the bone density around the implant. The aim is to show, both through colour maps and numerically (Figs. 3 & 4) the values before commencing surgery (green if the values are acceptable and high and red if the values are low—Fig. 5), allowing the clinician to make the right decision. This can also be a very good educational tool to show patients how their bone density potentially is around the implants.

In our experience, patients like this feature once shown what they mean.
The most posterior bridge abutment tooth was beyond saving (visual inspection and probing).

3-D imaging helped with planning the case. It helped tracking the position of the mandibular canal in relation to the proposed implants (Figs. 11 & 12).

In addition, the density of the bone was also checked (Fig. 13), indicating that a wider implant is possibly a better choice to improve integration rather than the current one used from the implant library. This will also allow us for deciding to perhaps perform an under preparation of the osteotomy site in order for the implant to engage in the bone better, this obviously depends on the type of implant used and other factors that the expert clinician will be familiar with.

References


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