Dental implantology: Evolution or the road to ruin?

By Aws Alan, UK

Teeth are highly evolved structures that have developed progressively over millions of years in attempts to protect themselves from caries and periodontal diseases. Over the years, many advances have been made that can treat these various diseases predictably. Various strategies have been developed to prevent or slow down these problems given adequate patient compliance and appropriate personal and professional maintenance.

Despite these very significant improvements, there are still instances when patients are advised that one or other tooth has to be extracted. It is the obvious sadness, heartache or despair that patients are caused by this bad news that has driven, caring clinicians to find ways to replace teeth with various devices, including dentures, bridges and implant-retained prostheses.

P-I. Brånemark, now sadly deceased, famously quipped: “No one should have to die with their teeth in a glass of water beside their bed.” His original inspiration coupled with determination, intuition, passion and an ability to surround himself with a great team of individuals with differing skills made osseointegration much more predictable. Brånemark’s landmark studies changed prosthetic dentistry dramatically, but a careful look at the design of these protocols and the implants themselves reveal that they were hugely different to the patient selection protocols and the types of implants being placed today.

Furthermore, the restorations supported on them were made of the established materials then and obeyed traditional mechanical laws. In terms of biological cleanability, the metal, polished “high water” abutment design allowed for optimal interproximal cleaning, while the implant surface itself was also relatively smooth in comparison with the rougher surfaces we often see today. Market saturation, cost, profit and market share in many technology-driven markets often pursue innovation of some sort of change to help gain greater market share or profit. The over-commercialisation of dentistry generally creates a constant turnover of supposedly new and better products, where the common notion of “if it ain’t broke don’t try to fix it” is lost on many directors of marketing or increasingly profit-driven CEOs.

Why and where?

Where this technological change has taken implantology and what the real reasons are that this was and is happening need to be examined. Increasingly, the shadow of peri-implantitis looms like a spectre over the provision of implants. Unlike caries or periodontal disease, there is very little consensus or re-
search that can provide a predictable cure for what now is a new breed of disease. Peri-implantitis is relentless once established within fine threads of the implant, and the bone resorption and soft tissue problems that follow can result in spectacular problems. Part of the key issue probably lies in the surface exposed to the susceptible patient’s oral environment, as most microbiologists will allege. The bacterial content and make-up of the biofilm is a reflection of the surface on which it resides. Implant surfaces have become progressively rougher in order to hasten the early osseointegration processes and to try to provide patients with their restoration quicker in an ever more competitive financial environment.

However, speed is not always helpful. Experience shows that some things are better achieved gradually.

Once exposed to the environment of a susceptible patient, the macro-topography of the threads provides an ideal ecological niche for bacterial proliferation. Further nano-level features make the implant surface a veritable inflammation super-highway for the pathogenic organisms. Predictably enough, the microorganisms found on the rough surface are usually the common pathogenic ones, but also some species are found that have previously never been discovered in the oral cavity.

Patient selection issues

We need to consider the types of patients whom we are now accepting for implant provision. At King’s College Hospital, the criteria for sponsored implant provision largely involve patients with hypodontia and those who have suffered trauma. Usually both cohorts are likely to present with well maintained, minimally restored dentition with scope for oral health improvement prior to consideration for any restoration, let alone an implant. Unfortunately, we are unable to provide this treatment for smokers. This is in stark contrast to the patients who may be provided with implants in general and specialist practice, such as patients who are likely to have lost teeth as a result of plaque-associated diseases. Indeed, it could be considered a paradox by many interested observers that some clinicians are providing patients with implant provision when they have shown that they are highly prone to plaque-associated disease via tooth loss and have not demonstrated any real capacity for changing that. Patients who smoke, those with a history of periodontitis and those with poor oral hygiene are well known to be at a very significantly higher risk of peri-implantitis.

Biological versus mechanical problems

We are being frank, the pathogenic bacteria-induced diseases are not the only long-term problem that we are now seeing. The reported frequency of mechanical complications has risen over the years, but the reported problems are probably only the tip of the iceberg, as many complications have not and will not be reported for a variety of understandable reasons.

Over time, the components of implants have shown notable weaknesses. Screw loosening, fractured screws, bone absorption and leakage of ceramic can be laborious and expensive to manage. One aspect, which may be lost on some, is that since they lack a periodontal ligament dental implants cannot and will never be able to accommodate to changing occlusal and non-axial forces. These are very likely to create stresses within the masticatory system, thereby resulting in breakages. These forces are compounded greatly if patients exhibit parafunction on a daily basis and that is sometimes an unknown risk factor until it is too late. The more implants that are placed, usually the fewer the teeth left, resulting in an increased risk of physical feedback and thereby creating an increased chance of failure of some type.

Ethical, moral and legal issues

These problems become much more worrying when viewed from ethical, valid consent and medico-legal perspectives. This is particularly so when patients are convinced to undergo elective extractions of teeth that often seem reasonably intact or treatable with conventional proven treatment strategies.

It appears that there is a worrying drift towards aggressive treatment with extractions in order to provide a supposed full-mouth rehabilitation with multiple implants. The increasingly dubious practice of sacrificing teeth for the sake of implants appears to many concerned clinicians to be quite irrational. As ethical oral health practitioners, deliberately removing saveable teeth for prophylactic treatment using implants as support appears to be consciously flying in the face of increasingly apparent evidence of various complications with implants and many would consider that approach to be foolish. How many ‘implantologists’ doing that to others would genuinely have it done to themselves or done to some close family member?

Planned obsolescence

A state-of-the-art implant today is likely to be obsolete tomorrow. Efficaciously removing teeth is irreversible and replacing teeth with implant-retained devices means that patients are trapped in the era of the implantology in which these were placed and restored, that means issues of machining, surface blasting, roughness, platform switching, design and attempts at bone augmentation by cote, coral or Californian substances. The list goes on and on and will probably continue to expand with what many might consider human experimentation without licence.

Now comes the time for implant manufacturers to take stock of their many “market-driven” mistakes, including fast initial integration with the roughest possible surfaces. Instead they need now to produce proven (i.e. not speculative) designs to better prevent these well-known problems of infection and breakage.

A wiser, pragmatic approach appears to be to concentrate everyone’s efforts on saving teeth and thereby eke out their usefulness for the patient’s lifetime. Recently, the very Prof Ian Lindhe, interviewed in the British Dental Journal, summarised the state of play as follows: “There is an average of implants in the world and an under-use of teeth as targets for treatment.”
Managing patients with risk factors

By DTI

GILLINGHAM, UK/GOTHENBURG, Sweden: Requests for shorter treatment times along with an increasing number of patients with risk factors place greater demands on dentists and technology. Correctly assessing osseointegration and implant stability is key in successful implant treatment. Using traditional methods such as torque and percussion tests are not suitable for monitoring osseointegration, it requires a more advanced diagnostic tool.

Gain insight from these esteemed periodontists on what they do to objectively and noninvasively identify which implants are ready to load and which ones need additional healing time.

Drs Pamela K. McClain and Rachel Schallhorn, both Diplomates of the American Board of Periodontology, have been using Osstell and the ISQ scale (Booth 43d) for a number of years now to measure primary implant stability and osseointegration.

“We are currently using Osstell when we place all implants to establish a baseline measurement of implant stability,” they say. “At the time of placement if the ISQ is too low (depending on the location—anything below 45) we will remove the fixture, possibly graft and then wait another 3-6 months before trying to place another fixture. We try to take the measurement on the buccal/lingual, and mesial/dental aspects and record the highest and lowest values.”

McClain and Schallhorn add: “We typically recheck the ISQ value at three months. If the ISQ has improved (or is stable if the number was high to begin with—over 65) we will release the patient for restorative treatment. It gives us and the patient a more objective way to assess the implant stability. If it’s not ready at that time we continue to recheck every six weeks until the ISQ has improved or indicates stability.”

“Since we began using this device in 2009, our decision making process has become more simple and objective. We will continue to use the Osstell value to help guide treatment decisions and as a communication tool with our referring dentists.”

Dr Paul Rosen, Clinical Professor of Periodontology & Oral Implantology Temple University Kornberg School of Dentistry in Philadelphia, USA, also explains below why Osstell is important in his practice.

“Osstell use is critical for my implant practice. Every year, this device more than pays for itself as there are always several patients who heal slowly or who have implants placed with extremely low insertion torque. This confounds my ability to predict when healing has been adequate to proceed to the restorative phase. Osstell provides me with quantitatively and qualitatively important information necessary to make informed decisions. No longer am I the villain who slows up patient care, but it is objective data about the patient’s healing that becomes the determining factor.”

“The launch of THE REVU is a fantastic opportunity to transform the way we communicate online. Our aim is to build an online community that embraces not just our company values, but all dental professionals connected with implant dentistry too,” he commented at the launch.

“The platform will deliver the perfect combination of branded and non-branded editorial and video content. The platform will launch with interactive questions and answers, scientific reviews and an inside look into one clinician’s journey into implants. It will cover key performance indicators (KPIs) every day by bringing new and informative content to the forefront of dental professionals and the public.”

Dental professionals can access the site via their computer, laptop or mobile device at www.therevu.co.uk

FDI 2015 BANGKOK
Annual World Dental Congress
22 - 25 September 2015 - Bangkok Thailand
Dentistry in the 21st Century

By DTI

CRAWLEY, UK: To facilitate online communication within the implant industry Straumann has recently launched a new digital hub for dental professionals in the UK and Ireland. With a look of a stylish digital magazine, the THE REVU platform will feature news and clinical cases, among other content covering everything from the dentistry industry and marketing to business and education.

According to Straumann, THE REVU is taking an original approach to blogging and video blogging (vlogging), delivering the perfect combination of branded and non-branded editorial and video content. The platform will launch with interactive questions and answers, scientific reviews and an inside look into one clinician’s journey into implants. It will cover key performance indicators (KPIs) every day by bringing new and informative content to the forefront of dental professionals and the public.

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“Taking the leap into digital is courageous, but one which we feel continues to keep us at the forefront of both our and our customers’ marketing activities.”

Dental professionals can access the site via their computer, laptop or mobile device at www.therevu.co.uk
Peri-implantitis: Is it a crisis?

By Dr Michael R. Norton, UK

In the UK over 100,000 implants are placed each year, whilst in the UK that figure was around 140,000 for 2010. The prevalence of peri-implantitis has been reported to be up to 29% most notably in patients whose implants are placed within a partial dentition. This yields a potentially vast number of implants, possibly as many as 185,000 in the US and UK alone that might succumb to some form of peri-implant disease on an annual basis.

The bacteria found within peri-implant lesions are similar to those found in deeper periodontal pockets, and cross infection by periodontopathogens is a primary aetiology that has been implicated as a possible pathway. However the wide variety of implant designs, surfaces etc. make the treatment of peri-implantitis much less predictable and subject to much greater variability than periodontal disease, where natural teeth present a known anatomy and well defined surface structure.

In 2008 a systematic review of the literature regarding peri-implantitis using PubMed and the Cochrane library revealed little consensus on the treatment of this troublesome condition. One study reported on the efficacy of sub-mucosal debridement using ultra-sonics or carbon fibre curettes, while two others compared the effect of an Er:YAG laser against that of mechanical debridement and 2% chlorhexidine as a combined therapy.

The first found similar results between laser and combined therapies, while the second concluded that the laser effect was limited to a six month period. A further study compared combinations of oral hygiene instruction, mechanical debridement and topical minocycline with a similar regime which substituted 1% chlorhexidine as the antimicrobial. The former seemed to confer some benefit whereas the latter showed limited or no clinical improvements. Finally, a study comparing two bone regeneration procedures reported clinically significant improvements mediated by both.

Nonetheless a multitude of other studies have also been published reporting on the efficacy of tetracycline, CO2 laser, and photocalytic decontamination amongst others in the treatment of peri-implantitis. Such a plethora of therapies makes it difficult for the clinician to choose a regimen that is both within the reach of the average clinician and has some documented reliability.

Risk factors

There have been a number of risk factors cited for peri-implantitis. Recently, in a study published in the Journal of Clinical Periodontology, a clear association was demonstrated through multi-level statistical analysis between risk of peri-implantitis and infection ensues. This then is the patient who has endured significant facial dehiscences, as well as the use of cement retained prostheses.

Other factors that have been implicated include excess cement, poor oral hygiene, and prosthetic design which are of course inter-related with some prostheses making effective oral hygiene untenable, while others present deep margins that make removal of excess cement almost impossible.

Warning signals

Peri-implantitis rarely presents unannounced unless of course the patient fails to be placed on a regular recall programme or fails to attend for regular review. Early signs are often apparent in the form of peri-implant mucositis. This condition is characterised by mucosal oedema, rubor and bleeding on probing (ROP). By definition it is not associated with purulence or bone loss. However this condition is often asymptomatic to the patient and as such is typically only diagnosed at routine recall. Hence there is a need to recognise that when implant treatment is completed the patient should remain on annual reviews for at least the first five years, and thereafter once every two years.

On presentation with mucositis a combination of mechanical debridement and sub-mucosal de-contamination and antimicrobial therapy are indicated. The treatment should be repeated three times within a two week period, so-called Triple Therapy (Norton M).

The protocol is as follows:
1. Mechanical scaling of implant surface with titanium or carbon fibre curettes.
2. Sub-mucosal irrigation with 3–5 ml chlorhexidine (0.2%) per site, at the deepest level of the pocket on all sides of the implant.
3. Application of Minocycline Gel 2% (Dentomycin, Henry Schein Ltd) at the deepest level of the pocket on all sides of the implant.

On presentation with clinical and/or radiographic signs of peri-implantitis, there may be a varying degree of bone loss it often results in colonisation of the deeper pockets with well known periodontopathogens and infection ensues. This then is peri-implantitis.

Peri-implantitis is characterised by the presence of vertical or crater-like bone defects and spontaneous purulence and bleeding on palpation (Figs. 1 & 2). It is typically associated with deep peri-implant pocketing >5mm.

This condition is undoubtedly of increasing concern due to some principle factors, such as the almost exclusive use of roughened implant surfaces, the treatment of partially denatured patients with a history of periodontal disease, the placement of implants with inadequate bone volume resulting in facial dehiscences, as well as the use of cement retained prostheses.

Implants with a micro-roughened surface texture have presented excellent long-term data and until recently there has been very little published in the literature demonstrating a susceptibility of these surfaces to this condition. However recent work by Albouy et al. has received widespread attention with concern for the evidence that suggests some modern micro-textured surfaces may be completely resistant to decontamination.

Ultimately, if left unchecked and untreated, it may become impossible to arrest the condition, leading to wholesale failure of the case (Figs. 3 & 4). Such failures impose a tremendous strain and burden on the clinician (let alone the patient), destroying the confidence of a patient who has endured significant expense and trauma and occasionally results in a breakdown of communication between both parties that all too often sadly results in a legal claim of negligence such claims can be hard to defend for patients where no warnings and/or suppressive periodontal peri-implant therapy have been undertaken.

Treatment typically requires surgical access to excise any fibrous capsule and for direct access to the implant for surface decontamination. The author’s preference until now has been to use chlorhexidine and tetracycline solution for this purpose while others have reported the use of citric acid and hydrogen peroxide amongst others. The use of lasers has also been extensively reported. However in a recent systematic review a meta-analysis could only be done for Er:YAG laser as the literature on all other laser types was weak or heterogeneous.

The author has recently completed the acquisition and treatment of 20 patients in this efficacy study using Er:YAG water laser (Morita, ADVEnt Evo) and it is hoped that publication of the results will be forthcoming. Indeed promising data has already been published to date using this same machine.

Nonetheless this methodology remains one of the most general practitioners and has yet to be proven predictably effective. As such most attention therefore remains focused on nonsurgical decontamination via surgical intervention and topical antimicrobial therapies.
Open flap debridement, defect decontamination, and repair as well as pocket elimination have all become the mainstay of those treating this condition.

So is there a crisis? The problem is that there is no clear consensus on the prevalence of the disease since this will vary according to the cut off values for the clinical parameters measured and to date there appears to be little consensus as to these cut off values. As such estimates of the incidence of the disease appear to vary from 28 to 56 per cent of subjects and 12 to 43 per cent of implant sites. Furthermore there is an ongoing controversy about the initiating process of peri-implant disease since it is potentially considered a primary infection of periodontopathic origin by some while others hold that it is a secondary opportunistic infection subsequent to bone loss caused by other etiological factors such as a provoked foreign body reaction or iatrogenic dehiscence of the bone, exogenous irritants such as dental cement, bone loss through occlusal overload etc. If the latter is true then controlling the disease is theoretically made more simple by controlling the conditions for the implant, such as ensuring adequate buccal bone thickness, avoiding or controlling more carefully the use of dental cement, and paying closer attention to the occlusion.

In an effort to gauge the rate of mucositis and peri-implantitis requiring surgical intervention, the author audited his patient pool in the year 2014. Out of a total of 191 patient reviews constituting 795 implants only 15 patients (7.9 per cent) required triple therapy at 20 implants (2.5 per cent) for mucositis while 10 patients (5.2 per cent) required surgical decontamination at 10 implants (1.3 per cent).

As can be seen this is well below the figures proposed in the article by Zitzmann & Berglundh (2005). This may of course reflect a more liberal approach to cut off values for parameters such as pocket depth and bleeding on probing as proposed Klings in 2012.

Nonetheless after over 20 years running a practice dedicated to implant dentistry the author’s own audited failure rates indicate that less than 1 per cent of implants present as late failures, owing to peri-implantitis or fixture fracture as a result of bone loss. This would corroborate the findings by Jemt et al in which a cohort of patients already diagnosed with peri-implant bone loss showed a slow rate of additional progressive bone loss over a 9-year follow-up with an implant failure rate of 1 per cent.

In all likelihood it is the author’s view that peri-implantitis is only a crisis if we allow bad implant dentistry to persist where there is a lack of control of the initiating factors as described above, and that it is more rather than less likely that it is the result of a secondary opportunistic infection rather than a direct susceptability to primary infection of periodontopathic origin. However there will clearly be some patients with a high genetic susceptibility with other predisposing factors such as the presence of untreated periodontal disease, smoking and diabetes who may succumb as a result of primary infection. Furthermore there remains a clear need to better define the different types of peri-implant disease and to establish a consensus as to the cut off values for the different parameters used to evaluate the disease so that future figures for incidence and prevalence are comparable.
Making implantology affordable

Controlling costs and increasing access to dental implant treatment

By Dr Tuss Tambra, UK

Implant dentistry is an elective restorative treatment solution with a surgical component and a restorative component. If properly executed, it is one of the most successful and clinically researched treatment modalities in dentistry. Unfortunately, patients who are not disease-free are being treated with dental implants, and as a result, the litigation rate has risen sharply.

A success rate of 98 per cent is almost universally claimed when promoting implant dentistry to patients. So, if implant dentistry is 98 per cent successful, then why are more cases failing and why is litigation increasing? Lack of proper training, poor treatment planning and poor execution (surgical and restorative) are undoubtedly the main culprits. If a clinician has the appropriate surgical and restorative training in dental implantology, does the brand of dental implant used make a clinically significant difference to the success rate? Does paying more for the implant and restorative component guarantee better results? Why is price an issue?

Price should generally not prevent access to high-quality, well-researched and effective dental treatment. However, the current pricing structure in implantology means that a huge proportion of patients do not have the disposable income to cover the cost of such treatment. The McCull study demonstrated the numerous benefits (functional, clinical, psychological and general health) of edentulous patients in whom dental implants were used to stabilise complete dentures. The improvements in chewing efficiency, general health resulting from an improved diet and general well-being (more social interaction owing to a lack of fear of teeth falling out) show the significant impact dental implants make in society as a whole.

How can this situation be changed to allow more potential patients to access dental implant treatment? First, clinicians could significantly reduce fees charged to patients. This can happen if the component and laboratory costs are reduced, with the dentist passing the savings on to the patient. Another option is that dental implant companies reduce the prices of both implants and restorative components. According to the industry, however, prices across the industry are already competitive and companies need to cover their business costs.

Is there an alternative to the above? Clinicians cannot reduce charges without assistance from the dental implant companies and all dental implant companies are private businesses with shareholders who want to produce products (implants) that benefit society and see some return on their investment in terms of profit generation.

Economic drivers

Market forces must come to bear in dentistry. In the current global economic climate, ignoring the financial implications of the decisions we make is no longer an option. Patients expect high-quality, safe and affordable treatment. For this to happen, clinicians need to source products at a reasonable price, passing on these savings directly to the patient, reducing overheads and treatment charges, and, therefore, increasing access to treatment. Some of the prestige implant companies have already felt the impact of the loss of market share and have either bought out competitors, created joint ventures or incorporated competing products into their product lines.

Do smaller implant providers offer potential benefits? One is certainly their ability to respond more quickly to increased patient expectations of treatment. The rapid expansion of digital dentistry, CAD/CAM technology and intra-oral scanning is resulting in smaller companies being able to provide implants with a total, open-source guided surgery and restorative solution. With larger companies, the ability to change direction is much more difficult and time-consuming, turning an oil tanker takes more time than a dinghy.

Key points of consideration when reviewing a new implant system

Globally, all medical and dental products undergo strict vetting procedures to ensure patient safety, including product durability testing, animal studies, human trials and testing at universities. They are then required to obtain a CE mark, FDA approval or some other approval to allow the products to be used in clinical dentistry. In short, once a product has a CE/FDA mark, it means all the necessary testing and patient safety requirements to be used on humans.

All CE/FDA-marked systems meet the same standard whether affordable or prestige brands.

The next step is to assess clinically relevant criteria. Since there are more than 1,300 dental implant systems available, clinicians need to assess all available clinical and scientific data and test the validity of various claims made by dental implant companies. If checking for certification/approval is the first step for a clinician, then the second should be establishing how future proof the new implant is. In the early days of implantology, dozens of companies started trading and most of them closed in a relatively short period. For early adopters of those systems, the risk was not being able to restore or maintain such systems, as parts were no longer available. Therefore, as a general dentist, one should verify the length of time for which the system has been on the market, who the parent company is and what the connection interface is (is it a clon system of a well-known implant that is no longer in patent?). In simple terms, if the company ceases to trade, can I still source components and maintain my patients?

Implant-specific considerations

A significant proportion of connection options (internal hex, external hex, Morse taper and conical connections) are no longer in patent. The clinical research on these has already been done and their success rates have been well documented in a multitude of studies. As a result, most affordable implant systems are adopting these non-patented connections rather than developing their own, meaning that prosthetic components are cross-compatible with other similar systems.

A clone connection implant can thus be restored with a high-end restorative component provided by another implant company using patent-free connections by open-source milling centres that can provide these components for significantly lower costs. One caveat with open-source milling is to check the quality of the milling provided in order to avoid the complications that arise from poorly fitting restorations.

Systems like the iX now provide non-precious metal blanks with pre-milled implant connection interfaces and ceramic blanks bonded to adhesive bases. It is a permade type implant connection that is bonded to the all-ceramic block. It is the milling of the implant connection interface that is the most vital part of the process, so if an open-source centre can produce pre-milled connection blank, then its work is much reduced and the dentist can be rest assured of a high-quality component with an accurate fit. The benefit of adhesive bases in all-ceramic work is the improved strength of the connection and reduced fracture rates compared with all-ceramic abutments.

Is using one of the clone connections listed above an issue? All these connections function with excellent long-term, clinically documented results. The key factor for success is the closeness of fit between the internal/external implant connection and the mating surface of the abutment, also called the micro-gap. This produces a stable, rigid connection with no abutment movement under loading. A stable implant-abutment interface combined with platform switching is the key to bone preservation around the neck of the implant and avoiding screw loosening.

How can one most easily compare multiple connection platforms in a simple and easy to understand way without needing a degree in mechanical engineering? Engineer Holger Zipprich from Goethe University in Germany has produced real-time videos of
A personal recommendation is to focus on the restorative aspects first (restoratively driven treatment). Questions to be asked include whether the system offers a wide range of implants tested (rigid) under loading can be reached, which connections are more stable and this information then applied to your implant portfolio. What impact does the macro-geometry (implant shape) and micro-geometry (surface treatment) have in relation to long-term success? The surface treatments applied to various implant systems are designed to improve the degree of osseointegration and bone-implant contact. This is extremely important for the long-term preservation of the implant. Smooth or machined surfaces clinically show reduced levels of osseointegration, so the current thinking seems to be that micro-roughened surfaces provide the optimum surface for osseointegration.

**An affordable implant solution**

The low-cost system that will be used in the laboratory against the prestige systems? The Fraunhofer Institute conducted durability (ISO 4680/10) in several implant systems, including Straumann Bone Level implants. These tests showed that the ICX implant was more fatigue resistant than all of the implants tested (Figs. 2a & b). Thus, the implant has a durable, fatigue-resistant connection interface.

How is the implant fare when tested in laboratory against the prestige systems? The Fraunhofer Institute conducted durability (ISO 4680/10) in several implant systems, including Straumann Bone Level implants. These tests showed that the ICX implant was more fatigue resistant than all of the implants tested (Figs. 2a & b). Thus, the implant has a durable, fatigue-resistant connection interface.

The implant–abutment interface

How stable is the connection when viewed in terms of closeness of fit? Three micro-gaps between the implant and the abutment(Figs.1a & b). The ICX System has well-developed CAD/CAM workflow for fabricating abutments, bars and frameworks for restoration with both ICX and other dental implants in addition to pre-made components. Titanium, zirconia and non-precious restorative components for ICX and other brands are available and supplied with the final prosthetic screw included. With some systems, the final screw is not available and must be pro-

In summary, use of a cost-effective dental implant system is justified in terms of economic savings to the patient and increasing the reach of dental implant treatment to the wider public.

Conflict of interests: Dr Tsu Tamba has not received any payments or other income from any company mentioned in the article.

**Reference**

EQUIA Forte takes the proven EQUIA approach to the next level. No need for conditioning or bonding with its built-in universal adhesive technology and outstanding wettability. EQUIA Forte is extremely tolerant and bonds equally well to all surfaces even in the deepest of lesions. With EQUIA Forte Coat acting like a lustre coating, you save on polishing time and achieve excellent aesthetics in no time.