Dental implantology: Evolution or the road to ruin?

By Aws Alani, 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 state-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 periodontal disease and those with poor oral hygiene are well known to be at a very significantly higher risk of peri-implantitis. Biological versus mechanical problems

There 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, loose abutments and the wearing 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 acclimatise 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 teeth that remain, resulting in a reduction in 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 consented 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 increasing 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 savable 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. Electively 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 macchining, surface blasting, roughness, platform switching, design and attempts at bone augmentation by core, 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 life. For many, Prof Ian Lindhe, interviewed in the British Dental Journal, summarised the state of play as follows: “There is an aversion of implants in the world and an under-use of teeth as targets for treatment.”

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Managing patients with risk factors

By DTI

GILINGHAM, 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 40) 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, 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 enough) we begin with—the patient for restorative treatment. If it's not ready at that time we continue to recheck every six weeks until the ISQ has improved or indicates stability.”

“We are currently using Osstell 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, 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 accurate 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.

“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 US over 500,000 implants are placed each year, whilst in the UK that figure was around 150,000 for 2010. The prevalence of peri-implantitis has been reported to be up to 29 percent 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 as a primary aetiology 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 ultrasonic or carbon fibre curettes, while two others compared the effect of an Er:YAG laser against the presence of a rough surface texture have previously been 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 photocatalytic 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 location, specifically the maxilla while overt peri-implantitis was shown to be highly correlated to patients with a predisposing maxillary and being male. It is noteworthy in this particular study no correlation was demonstrated with smoking, poor oral hygiene, and prosthesis design which are of course interrelated 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 once peri-implant mucositis has taken hold it is unfortunately that it is often exacerbated by the design of implants today. The presence of a rough surface, taken to the top of an implant, and the application of microthreads or grooves have been proposed as potential confounding factors for the advance of the lesion due to biofilm formation and bacterial contamination of the surface which leads to bone loss and further surface exposure. With advancing bone loss it often results in colonisation of the deepest 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 pockets > 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 Alhouy 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 in 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 supportive periodontal/per-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 undergoing an efficacy study using Er:YAG water laser (Morita, Advei EVO) and it is hoped that the publication of the results will be forthcoming. Indeed promising data has already been published to date using this same machine. Nonetheless this methodology remains outside the treatment armamentarium of most general practitioners and has yet to be proven predictably effective. As such most attention therefore remains focused on non-surgical intervention 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\(^2\) and there appears to have been little consensus on these cut off values. As such estimates of incidence of the disease appear to vary from 28 to 56 per cent of subjects and 12 to 43 per cent of implant sites.\(^2\)

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\(^2\) while others hold that it is a secondary opportunistic infection subsequent to bone loss caused by other etiological factors\(^2\) 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).\(^2\) 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 Klinge 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 0.5 per cent.\(^8\)

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 suscept-
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 patient 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 ensure better results? Why is price an issue?

Price should generally not present 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) for dentate 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 only 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 company 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 point, passing on these savings directly to the patient, reducing overheads and treatment charges and, therefore, increasing access to treatment. Some of the pretigious dental 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, therefore, 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/TDA mark, it meets all the necessary testing and patient safety requirements to be used on humans.

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 ICX now provide non-precious metal blanks with pre-milled implant connection interfaces and ceramic blanks bonded to adhesive bases. It is a pre-milled titanium 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 obtain pre-milled connection blanks, 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 Frankfurt’s dental school in Germany has produced real-time videos of

All CE/TDA-marked systems meet the same standards 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. 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 generalist 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 clone 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 done 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.
several implant–abutment interface responses to loading that are available on the market. Often there have been viewed, a rational decision as to which connections are more stable (right or left). Imaging can be reached and this information then applied to selecting an implant system.

Does the system offer a wide range of prosthetic, CAD/CAM and guided surgery solutions for dental implant treatment? Once a dental implant system has gained some degree of market penetration (or traction) and has documented evidence to support its clinical effectiveness, it is worthwhile taking an unbiased view of the system. Hopefully, most glitches would have been identified and corrected by the early adopters, thus reducing the risks for the more cautious clinicians.

A personal recommendation is to consider the restorative aspects first (restoratively driven treatment). Questions to be asked include whether the system has a broad range of comprehensive treatment needs in implant dentistry, CAD/CAM-based treatment solutions and a guided surgery solution for the surgical placement of dental implants. If you are impressed by what you see, then place a few implants and monitor them closely. If the treatment outcomes are successful and you have a positive impression of the system, then there is no reason that you should not add a cost-effective solution 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.

Primary stability is mainly governed by the implant thread design and this directly affects the insertion torque. The implant–abutment connection stability is equally important. This was not the case, then an implant would fail with a low insertion torque and poor component fit would subject to prosthetic movement under occlusal loading with loss of primary stability and implant failure long before osseointegration would have occurred.

If one is following conventional delayed loading protocols, then the surface treatment, as well as the macro-geometry and connection stability, will affect long-term success. Do the longer dental-implant brands provide dental implants with the most ideal thread designs, best primary stability, and highest tolerances of fit of abutments and frameworks? Do the various surface treatments have a clinically significant improvement in long-term success when compared with a so-called budget brand? Again, no real cross-comparison research studies. The surface roughness of the dental implant is also of vital importance, as research has found increased peri-implantitis associated 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 are supplied with the final prosthetic screw included. With some systems, the final screw is not available and must be purchased separately. ICX also has a bespoke CBT guided surgery solution called Magelanz which is also a multi-implant system based. The software or upload the DICOM file to the parent company server and the company will carry out the design process and fabricate the guide once the design has been approved by the dentist. Magellan can also be used to produce guided surgical drill guides for various dental implant systems, but at a fraction of the cost.

In summary, use of a cost-effective dental implant system (in the author’s opinion) is justified in terms of economic savings to the patient and increasing the reach of dental implant treatment to the wider public. It is reasonable to assume that the system has been classified for use in general dentistry (CE mark, FDA approval) and should be considered a viable clinical option once the dentist has reviewed the available clinical data (conventional and guided surgery solutions) and restorative treatment (commercial and CAD/CAM) based options. However, she will then come to an informed decision, at which point he/she should place and review a small number of implants in varying clinical situations and monitor the results.

Conflict of interests: Dr Tuss Tambra has not received any payments or other inducements from any company mentioned in the article.

Reference


Trends & Applications

Implant Tribune United Kingdom Edition | 3/2015

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The glass hybrid revolution

EQUIA Forte
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