Single molar restoration—Wide implant versus two conventional

Authors Prof. Amr Abdel Azim, Dr Amanu M. Zakki & Dr Mohamed I. El-Awany, Egypt

The single-tooth restoration has become one of the most widely used procedures in implant dentistry.1 In the posterior region of the oral cavity, bone volume and density are often compromised. Occlusal forces are greater in this region, and with or without parafunctional habits, can easily compromise the stability of the restorations (Fig. 1).2

The single-molar implant-supported restoration has historically presented a challenge in terms of form and function. The mesiodistal dimensions of a molar exceed that of most standard implants (3.75 to 4.0 mm), creating the possibility of functional overload resulting in the failure of the retaining components or the failure of the implant (Figs. 2 & 3).3 Wider-diameter implants have a genuine use in smaller molar and premolar area. 23

Finite element analysis (FEA) is an engineering method that allows investigators to assess stresses and strains within a solid body.4–6 FEA provides calculation ofstresses and deformations of each element and the net of all elements. A finite element model is constructed by breaking a solid object into a number of discrete elements that are connected at common nodal points. Each element is assigned appropriate material properties that correspond to the properties of the structure to be modeled. Boundary conditions are applied to the model to simulate interactions with the environment.3 This model allows simulated force application to specific points in the system, and it provides the resultant forces in the surrounding structures. FEA is particularly useful in the evaluation of dental prostheses supported by implants.7,8 Two models were subjected to FEA study to compare between a wide implant restoration versus the two implant restoration of lower first molar.

Table 1: Material Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Porcelain coating</th>
<th>Gold crown</th>
<th>Implants</th>
<th>Spongy bone</th>
<th>Cortical bone</th>
</tr>
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<tbody>
<tr>
<td>Poisson’s ratio</td>
<td>0.25</td>
<td>0.25</td>
<td>0.3</td>
<td>0.25</td>
<td>0.3</td>
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<tr>
<td>Young’s modulus</td>
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<td>67,200</td>
<td>150</td>
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<td>4.00</td>
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<tr>
<td>Young’s modulus MPa</td>
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<td>-196.86</td>
<td>-1.26</td>
<td>-11.10</td>
<td>-11.10</td>
</tr>
<tr>
<td>Coating (Porcelain)</td>
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<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Coating (Titanium)</td>
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<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Spong bone</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Cortical bone</td>
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<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
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</tbody>
</table>

Table 2: Results

<table>
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<tr>
<th>Differences %</th>
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<th>Implants</th>
<th>Spongy bone</th>
<th>Cortical bone</th>
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<tr>
<td>Ump</td>
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<td>Smp</td>
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<td>-10.22</td>
<td>-196.86</td>
<td>4.00</td>
<td>-39.17</td>
</tr>
</tbody>
</table>

Figure 2: Occlusal view showing a missing first molar. The mesio-distal width is very wide and restoration couldn’t compensate if leaving a space distally.

Figure 3: Proximal view showing radiographic view of mandibular right first molar on standard Brånemark implant with standard abutment (Nobel Biocare).
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The most important years in implantology

A personal retrospective

Author: Dr. Georg Bach, Germany

Introduction

It all started with an inquiry from a well-known professional journal of implantology asking for a contribution to acknowledge their having been in business for 15 years. This was the incident telephone call by an academic teacher who had accompanied and supported me in my first steps in implantology. When I asked him about the upcoming publication project, I received a both spontaneous and surprising reply. “The last 15 years—those were the most important years in implantology!” This from a renowned university professor who was instrumental in establishing implantology—was impressed. Later on I had to ask myself, “Is this really true?” The result of my tracing this development is this article—a personal retrospective.

Phases of implantology

If one considers oral implantology with regards to its major developments, three phases are evident: (i) the empirical and experimental phase; (ii) the arrival of implantology in universities and science; (iii) the mass phenomenon of implantology. I would like to add that this is a rough and probably superficial division to some extent. Phase, however, also allow me to apply it within the scope of this personal—and not exhaustive—review.

Looking back at these past fifteen years, I will barely touch on phase II, but will discuss phase III fully. This entails different directions and priority areas that colleagues working in implantology experienced. When I browsed through implantology textbooks and journals from this period, I realised even more that implantology had undergone considerable change in this relatively short period of 15 years. I would like to recount my highlights of implantology from this period in the following paragraphs.

Farewell to the titraste of papers

A seemingly minor issue to start with: the variety and quality of dentistry-specific print media and digital media, particularly print layout, has developed substantially during the past 15 years. This holds true not only for implantology, but also for dentistry as a whole. The appearance of some professional journals up until the mid-1990s was reminiscent of an official legal amendment, but amazing things have happened since. The quality of colour printing (which is the norm now, but used to be expensive for authors who wanted to include colour images), the accuracy of images, the paper—all of these make for a high quality appearance and leave a lasting impression on the reader. This has clearly been an advantage also for implantology because now highly complex correlations can be more easily conveyed and “sometimes a picture is worth a thousand words”. Ideally, e-learning and electronic professional journals supplement the current training needs of the younger generation of dentists especially.

The end of dogmas

While implantology was marked by many dogmas from its beginning and the mid-1990s, this had changed at the time when our 15-year observation period begins. However, implantology was later called into question in its entirety. Whether it was healing times, waiting times after augmentation or prosthetic concepts—everything underwent scru ity. On the one hand, some of these dogmas did in fact prove to be no longer sustainable because of remarkable developments, especially improvements in implant surfaces. On the other hand, the mark was at times overshoot in the elimination of other dogmas, creating the need to back-track. This was a painful experience for both patients and implantologists.

One dogma that we encountered in the observation period was that of a strict refusal of immediate implant placement. There is general consensus today, however, that under suitable conditions an immediate implant placement can be a high quality and sustainable alternative to established procedures. One clinical case shows an immediate implant placement in the maxillary anterior teeth: the extraction and the immediate implant placement of a maxillary anterior tooth that was not worth preserving under the guidance of a drilling template and implant position (Fig. 1), transfer into the oral cavity (Fig. 2), and the condition immediately after insertion of the implant crown (Fig. 3).

The prospering of the implant market

A welcome variety of new implants, implant forms and prosthesis options has become a reality in the past 15 years. Special implants were developed for special indications so that now even a mandibular molar can be replaced by a corresponding sized implant, followed by insertion of a corresponding sized implant crown. Figures 4 to 7 show the clinical and dental appearance of these in a patient. Implantologists who placed several hundred implants annually were considered the big players on the implant market in the 1990s. Achieving the mark of 100,000 implants placed per year in Germany signifies that the peak had been reached. This was not the case, since the one-million mark was also reached within the scope of a rapid, almost unprecedented development. While the increase has been slower in recent years and global economic developments even caused a brief decline, today we can assume that the implant market will continue to grow.

The maximum growth phase falls into our observed period.

Development in the eyes of implant manufacturers

From manufacturer to global player—this would be an accurate description of the development of some implant manufacturers. The development of some of these companies over the past 15 years, the size of their companies and the number of their employees today are indeed impressive. And these prosperous companies share other characteristics as well: the acquisition of products and entire firms in order to expand or supplement their product portfolio and their pressing on to the field of digital dentistry (CAD/CAM, planning, etc.) into which these global players invest large sums of money. Revenues must be generated so that these investments can be made—and they are still made, albeit declining owing to the economic crisis. Still, the implant market is booming. Although the consistently two-digit annual growth rates some implant manufacturers had started to become used to have become more moderate today, a great deal of money can be made with implants. As a result, an ever-increasing number of implant suppliers and systems make it impossible for the individual user to keep track. Aside from new systems, an increasing number of generics are being launched on the market.

Focus on red-white aesthetics

The President of the German Society for Dental Implantology (Deutsche Gesellschaft für Zahn-ärztliche Implantologie), Prof. Frank Palm, aptly remarked, “What was celebrated as a triumph for some colleagues 20 years ago is today taken for granted.” Dentists are no longer prepared to find themselves confronted with a debate that had spread from North America to Europe: that of red-white aesthetics. This new focus on achieving the highest possible aesthetics for implant-prosthetic treatment was linked to implantology and distanced itself from surgery, which had been dominant up until that time.

In the early phase of implantology, the main focus was on safe placement and the best possible placement in the bone, sometimes even at the expense of subsequent prostheses treatment owing to unfavourable placement of the artificial abutment teeth. Now, however, prosthetic standards and issues have become the centre of the debate in implantology. Different techniques were modified and new techniques were established in order to satisfy these requirements. Patients no longer, or less, allow themselves to sacrifice implant aesthetics for complex cases like the following case.

Both implants in the anterior maxillary region were placed too far buccally, and there was a gap of 5.5 mm between the implant shoulder and the cemento-enamel junction of the adjacent teeth (Figs. 8–10). Treatment with a long-term temporary restoration would only have yielded an acceptable aesthetic result. However, under certain surgical and dental conditions—as shown in our second example—superior results and stability for a period of ten years can be achieved even with challenging initial situations. In 1999, an immediate implant was placed in region 12. The following images show the steps of treatment (Figs. 11–13). The last image shows the condition after ten years (Fig. 14).

This development was made possible mainly by massive improvements in the area of augmentations, which can now be performed with significantly higher predictability. This development was further enhanced by a considerable improvement in the training of implantologists. These improvements are significant for both undergraduate study and postgraduate training. Thus, the training of dentists and professional associations who have contributed immensely in this area deserve much credit in this respect.

The battle of healing times

It was but an episode, yet one that caused an incredible favor at the time: the debate about shortened healing times. Stimulated by a media hype in which the specialised press only played second fiddle and the lay press

Implantology

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appeared to be in the lead, the healing times and the implant manufacturing were inflated. Values were corrected downwards almost on a daily basis. Some manufacturers went along with it, while others remained firm. Some participants felt they needed to be at the forefront, others stayed out of it. A short but remarkable asent was followed by a rapid crash.

A personal highlight for me was an article in a tabloid newspaper that said: a procedure in the morning, directly followed by augmentation and implantation; a firmly seated supra-construction implanted at lunchtime, and two more days later, often with a mix of spare ribs? As can be seen from this eulogistic statement, some got carried away, while others had to painfully back-track. What remains is the realisation, that owing to improved surfaces and other conditions, the long healing times recommended in the early phase of implantology can in fact be reduced considerably, but not at any cost.

__New options for improving the implant site__

The afore-mentioned dominance of prosthetic implantology was only possible because many new and safer augmentation procedures were established during the observation period, enabling dentists to design the osseous bed for the implant as desired. Revolutionary augmentation procedures in the area of the maxillary posterior teeth, which had been the focus of discussions, were now also possible. The treatment of simple cases usually does not require the use of these techniques. In fact, they should not be used in such cases owing to the radiation exposure when obtaining 3-D data.

__Thermals and realities__

Themes of the congresses during the first decade of the observation period contained general positive statements and depicted new opportunities in implantology, which exceeded the then current options by far and expressed a belief in boundless growth. This coincided with many positive statements and evaluations by implant manufacturers and distributors. However, all this changed considerably during the past five years.

Suddenly, new topics were given priority, which shaped specialists’ conventions—topics that had previously been partially suppressed if not neglected. I remember too well the implant congress held by a very important American implant manufacturer in Frankfurt/Main in 1998, where I reported on a concept for the treatment of peri-implantitis developed at the University of Freiburg and was then rebuked by the main speaker, who was from the USA, during the ensuing panel discussion. He asserted that he had “not seen one case of peri-implantitis in twenty years of implantology—this phenomenon does not exist and, if it occurs, it can only be attributed to a lack in skill on the part of the implantologists.” How times have changed. However, this has been a painful process for implantology and even the word “failure” have been mentioned in the themes of many congresses held by leading professional associations of implantology in the past years.

__Patients’ expectations__

Where a consistently positive and at times even euphoric tone prevailed regarding the topic of implants for many years, a few critical voices and later increasing criticism emerged at the beginning of the observation period. This was—concurrent with a noticeable increase in the number of implants—based on the considerable increase in implantology failures and complications. The following images depict total implantological failure— the loss of a partly implant-supported complete maxillary restoration caused by an infant peri-implantitis (Figs. 15–17), leaving profound osseous defects.

However, in line with the consistently positive evaluation of implants and the persisting promise that the use of implants would yield optimum results always—and often publicised by the lay press—our patients’ expectations have increased considerably in the past 15 years. Patients assumed that, regardless of the individual situation, he or she would always receive the optimum results. In this regard, it seems reasonable to maintain a self-critical attitude and to concede that we do not always contradict this general assumption vehemently enough.

And then what was bound to happen, happened at times, the result was not what the patient had expected. An awkward situation arises when the dentist, based on the initial diagnosis, considers the result to be successful and the patient considers it a failure. A long-time legal expert sums up this situation accurately by stating that, “Two-thirds of all pending court proceedings were filed by patients whose expectations were disappointed.” Rather unfortunately, the increasing number of court proceedings are mostly related to implantology. It cannot be by chance that the premiums for mandatory professional liability insurance have increased considerably.

__Emergency criticism__

German periodontist Dr Thomas Kocher referred to implantology as “the red light district of dentistry”. Whether this evaluation is justified is a matter to be decided individually. Personally, I do not agree with this evaluation, but a grain of truth might be found in its reference to overtreatment. In this regard, the extraction of teeth in favour of implants, even when not indicated, is a concern voiced increasingly by periodontists and those in favour of conservative treatment. We have to address this issue by individual evaluation of each patient, as well as through academic discussion. Implant versus tooth preservation has been a frequent debate at conventions and implant symposia in recent years. In my opinion, this would not have been possible ten years ago.

__Trouble-shooting concepts__

Unexpected complications, such as implant fracture and failure of implant supra-structure connections (Figs. 18–21), necessitated the development of surgical and prosthetic trouble-shooting concepts and modification of constructions in implant and abutment design. However, these concepts are not readily available and have not yet been finally agreed upon. In other words, they cannot be said to be common knowledge in implantology, at least not in the treatment of peri-implantitis. Similar statements can be made with regard to pre-implantology arguments, where a pleasing variety of surgical techniques and materials is listed, but no generally valid scheme has been agreed upon.

The fact that the need to develop and convey these trouble-shooting concepts is generally recognised today and that these concepts are yet widely supported by the protagonists on the implant market is gratifying. The specialist press has made a valuable contribution to this development, by no—numerous articles that received a great deal of attention during the past 15 years are those that dealt with implantology and implant-prosthetic trouble-shooting.

__Digital implantology__

I consider the establishment of 3-D diagnostic imaging, with all associated possibilities, to be the significant development during the 15-year observation period. It is true that only implantologists used the new 3-D technology during the initial phase of dental volume tomography (because they made up the group of dentists who could actually afford this expensive equipment); nevertheless, 3-D technology constituted a quantum leap for dental diagnostic imaging as a whole.

Today, we have almost unbelievable possibilities at our disposal that even the greatest optimists would not have considered possible 15 years ago: highly complex patient cases can now receive minimally invasive treatment and implants placed even without the need for augmentation.

Our first case shows a highly anticipated mandible where four implants could be placed without any prior augmentation owing to 3-D data and planning (Figs. 22–24). Three-dimensional diagnostics are sometimes also employed to clarify facts when complications have arisen, for example neural lesions after implantation (Figs. 25 & 26) and bone necrosis after administration of bisphosphonates, and erroneously diagnosed as peri-implantitis (Fig. 27).

__My personal conclusions__

It is difficult to draw a conclusion regarding the development of implantology over the past 15 years because it has been so multifaceted and rapid. To conclude, I would therefore like to quote my academic teacher and former supervisor, Prof. Wilfried Schulli, who, as a founding member of the International Team for Implantology, was undoubtedly among the pioneers of implantology and has contributed to improving implantology through his university work: “Who would have thought that implantology could develop like it did in less than twenty years.”

This very true statement encompasses many aspects: the admiration and appreciation of what has been achieved, the satisfaction with having being considered to be the safest in the entire field of medicine, and some criticism regarding any development in oral and maxillofacial surgery that did not turn so well or went off course.

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___Contact Info___

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Fabrication of a customised implant abutment using CAD/CAM: A solution specific to each clinical case

The multiplicity and sophistication of the offering in the field of prosthetic elements in implantology allow the practitioner to make a choice appropriate to the clinical particularities of each case. If the practitioner chooses a standard implant abutment, the dental technician will have to make adjustments, which implies considerable losses in precision and time. Moreover, with such abutments it is difficult to create an anatomical emergence profile because it cannot be modified and the base of the abutment cannot be changed. This observation is equally applicable to the angulation, which might even be selected by default.

A customised abutment created with CAD/CAM is the most accurate and simplest solution for an optimal result. The abutment is individually designed in order to ensure the homogeneity of the thickness of the materials and therefore the overall strength of the prosthesis. The dental technician has in this case maximum freedom in terms of design in order to create an abutment with the optimum emergence profile and angulation. In this manner, the abutment is specifically designed and fabricated for each patient.

Titanium has been established in dental implantology as the reference material owing to its biomechanical properties and its biocompatibility. Today, we are able to benefit from over 40 years of clinical and experimental experience in implantology. Customised abutments can be fabricated from titanium, zirconia or hybrid materials, such as a combination of titanium and zirconia, which in certain clinical circumstances improves the aesthetics of the visible areas while respecting the requirements of biocompatibility and bio-mechanics.

Seating a four-unit bridge on three anatomical implant abutments

Clinical case
A 40-year-old male patient presented for treatment. He had no particular medical conditions or any contraindications concerning the placement of implants. In 2009, the patient had undergone a sinus lift (an increase of the maxillary bone volume and the displacement of the sinus membrane to ensure implant success by increasing the height of the available bone) at a hospital prior to the placement of implants to replace teeth 14–15–17. The postoperative sequelae (pain, oedema, etc.) resulted in the patient being routinely opposed to another intervention of this kind on the opposite side of the mouth.

During an appointment in October 2013, I was able to persuade the patient to accept implant treatment. I suggested first removing the three-unit bridge on teeth 23–25 and then extracting the roots of teeth 23 and 25, as well as seating of a denture on the day of the extraction, followed by placement of three implants in regions 23–25, the extraction of tooth 26, and seating of a four-unit bridge as the final prosthetic solution.

As the height of the available bone around tooth 26 was insufficient, I would not place an implant in that area but a tooth extension (a sinus lift would otherwise have been essential). The treatment plan was accepted by the patient two weeks later, and teeth 23 and 25 were extracted at the end of January 2012 for implant placement: two implants (NobelReplace RP, Nobel Biocare) with a diameter of 4.3 mm and a length of 13 mm for regions 23 and 24, and one implant (NobelReplace WP) with a diameter of 5 mm and a length of 10 mm for region 25. Tooth 26 was extracted on the same day without placement of an abutment as already mentioned.

In May 2012, implant-level impressions were taken (open-tray impression technique), and the impression was recorded using silicone and a bite tray. Owing to the constraints related to the angulation of the implants in regions 24 and 25, I opted for titanium abutments. The angle of the implant in region 23 allowed for the insertion of a titanium–zirconia abutment for good gingival grip and a better aesthetic result.

Ten days later, two titanium abutments (ANA. T, Laboratoire Dentaire Crown Ceram) and one titanium–zirconia abutment (ANA. TZ, Laboratoire Dentaire Crown Ceram) were screwed onto the implants at a torque of 35 N, and sealed with composite. An adjustment check of the contact points and of the occlusion was performed, followed by cementation of a ceramic bridge with a zirconia framework. A follow-up visit took place three days later.

Technique
For this case, it was possible to use abutments made from different materials according to the angulation of the implant: titanium for the greater accuracy can be achieved. In addition, only two appointments are necessary: one for impression taking and another for seating of the bridge.

The simplicity of the process saves a considerable amount of time: no adjustments are necessary, the bridge is seated immediately, the occlusion is usually ideal, and pronounced angulations, and a combination of titanium and zirconia for the angulation with no particular constraints. It would have been equally possible to use a titanium abutment for the implant in region 23 but I opted for the titanium–zirconia abutment to obtain a better aesthetic result in the anterior region: brightness, translucency and no visible metal margin.

Customised CAD/CAM prosthetic elements and abutments respect the dental anatomy and allow extremely precise seating of a bridge on the implant. Periodontal maintenance is therefore easier owing to easy access with a toothbrush because of the predetermined interdental spaces.
Guided implant surgical placement with CAD/CAM CEREC crown

Author, Dr Nilesh Parmar, UK

_Guided surgery has been around for a long time. However, very few dentists in the United Kingdom place implants using surgical guides. The reasons for this are multiple, ranging from dentists not wanting to follow the procedure, or not having confidence in the procedure, the increased costs of guide fabrication, and the time delay and extra appointments needed to obtain a fully functional and reliable surgical guide._

In this case report, I shall demonstrate a surgical guide manufactured in-house using the CEREC Bluecam (Sirona). These guides do not require any impressions to be sent to a third party and can be made rather cheaply in the surgery within 30 minutes. The guide can then be used in conjunction with specific drill keys, which are compatible with the guided surgery drill sets from all leading implant manufacturers.

In this particular case, Facilitate (Astra Tech/DENTSPLY Implants) was used to place the implant. Once the implant was osseointegrated, the final restoration was fabricated chairside using the CEREC MC XL milling machine (Sirona) and an IPS e.max CAD block (Vivadent). The patient healed with no pain, no swelling and no discomfort. The patient healed with no pain, no swelling and no discomfort. The patient healed with no pain, no swelling and no discomfort.

Case report

A young female patient had lost tooth 36 a few years ago and wanted an implant solution. Her medical history was clear and she had a mildly restored dentition with no current dental pathology. Her BPE scores were low, with excellent oral hygiene.

Once the implant position had been decided, the information was ported to the CEREC software and a CEREC Guide Block a drill body was milled by the CEREC MC XL milling machine. Once this has been milled, it will lock tightly into the thermoplastic drilling template. At this point, the surgical guide is complete and can be used on the patient.

In this particular case, an Osseo-Speed TX implant (DENTSPLY Implants) (4.0 × 11 mm) was placed using the surgical guide. The patient was prepared in accordance with a standard sterile protocol and the area anaesthetised as one would for a regular implant placement. The surgical guide snaps firmly over the existing teeth, expanding over-and-undercuts, becoming a very stable platform through which to drill. The Facilitate soft-tissue punch was used to remove the overlying soft tissue, and a standard drilling protocol using the Sirona drill keys was followed.

A high primary stability of 40 Ncm was obtained and a 4 mm healing abutment was placed immediately. A high primary stability of 40 Ncm was obtained and a 4 mm healing abutment was placed immediately. A high primary stability of 40 Ncm was obtained and a 4 mm healing abutment was placed immediately.

The patient healed with no pain, no swelling and no discomfort. The patient healed with no pain, no swelling and no discomfort. The patient healed with no pain, no swelling and no discomfort.

Contact Info


He has a master’s degree in Prosthetic Dentistry from the Eastman Dental Institute and a master’s degree in Clinical Implantology from King’s College London. He is one of the few dentists in the UK to hold a degree from all three London dental schools and recently obtained his Certificate in Orthodontics from the University of Warwick. His main area of interest is dental implants and CEREC CAD/CAM technology.

Nilesh runs a successful five-surgery practice close to London and is a visiting implant dentist at two Central London practices. Nilesh has a never-ending passion for his work and is well known for his attention to detail and his belief that every patient he sees should become a patient for life. He offers training and mentoring to dentists starting out in implant dentistry. More information can be found on his website, www.drnileshparmar.com; Twitter: @NileshRParmar; or Facebook: Dr Nilesh R. Parmar.
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in cortical bone are less by 20% while the stresses are less by about 40%. The stresses and displacements were significantly higher in the two implant model due to having two close holes, which results in weak area in-between.

Conclusions
This study showed various results between cortical and spongy bone. It was expected that the maximum stresses in the cortical bone was placed in the weak area between the two implants. In addition to be higher than the case of using one wide implant. Although the middle part of spongy bone was stressed to the same level in the two cases, using two implants resulted in more volume of the spongy bone absorbed the load energy** which led to reduction of stress concentration and rate of stress deterioration by moving away from implants. That is considered better distribution of stresses from the mechanics point of view, which may result in longer lifetime. Porcelain coating showed less stress in case of two implants, longer life for the brittle coating material is expected. Contrarily more stresses were found on the gold crown placed on two implants due to its volume reduction (less material under the same load). This is clearly seen in increasing stresses on the two implants, that more load effect was transferred through the weak crown to the two implants. That showed maximum stresses in the area under the crown, while the wide implant showed maximum stresses at its tip. Looking to energy** absorption and stress concentration on whole system starting from coating to cortical and spongy bone, although the stress levels found was too low and far from cracking danger, the following conclusions can be pointed out; the total results favourise the use one wide diameter implant and in the softer bone (D2) quality two averaged sized implants. Therefore more detailed study to compromise between the two implants occlusion and intermediate space can put this stress values in safe, acceptable, and controllable region under higher levels of loading.

** The area under the --- curve up to a given value of strain is the total mechanical energy per unit volume consumed by the material in straining it to that value (Fig. 9). This is easily shown as follows in equation 2:

\[ \text{Stress energy} = \text{area under stress-strain curve} \]

Dental technician's perspective
When the laboratory (Laboratoire Dentaire Crown Ceram) received this case, we were asked to create three customised anatomical abutments with a titanium interface for an individual and more precise fit, respecting the requirements of biocompatibility and biomechanics, and a coronary part in zirconia for a better aesthetic result.

Once the moulds had been cast, we determined that the considerable angulation of the implants in regions 24 and 25 and their shallow position in the tissue posed difficulties regarding the design of titanium–zirconia abutments. However, Dr Lachkar explained to us that in this case (i.e. the patient's reluctance to undergo pre-implant surgery) he was forced to place the implants in the bone available and not necessarily in the ideal situation according to a prosthetic plan.

In this case, the titanium interface would have considerably exceeded the buccal surface and it would therefore have been necessary to reduce it. The bonding surface would therefore have been limited, which would have resulted in a great loss of mechanical resistance. We thus decided to use a titanium abutment manufactured from a single block and especially made to allow for such substantial angulations for teeth 24 and 25. For tooth 23, the implant angle allowed for a titanium–zirconia abutment, which was preferred to a titanium abutment for a better aesthetic result.

Contact Info
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