DIGITAL DENTAL FORUM

DIGITAL DENTAL TIMES

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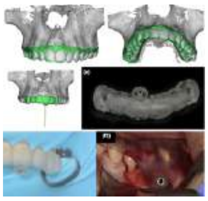

Digital Dentistry in Endodontic: An update

Guided Endodontics is a very promising concept which would aid in higher accuracy in cases with calcified canals aiding in unnecessary removal of tooth structure, as well as planning apical surgeries for minimally invasive osteotomies and precision

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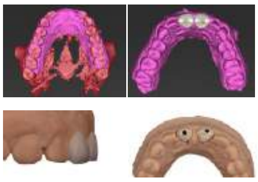

A Full Digital workflow for a minimally invasive aesthetic rehabilitation:

Latest insight on new age Bio-material and predictable protocol to achieve unsurprising treatment outcome.

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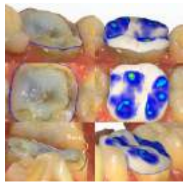

The Non - Retentive Overlay: And why is everyone doing it?

New guidelines for the preparation form of bonded all-ceramic restorations were formulated by Ahlers et al and Arnetzl and Arnetzl. These guidelines describe eight points of interest which were kept in mind while preparing the overlay

DIGITAL DENTAL FORUM

I' m a Digital Dentist

LATEST TRENDS IN DIGITAL DENTISTRY

Being early pioneers in the field of Digital Dentistry there was a need to collaborate with all aspects of the digital revolution in dentistry. This led to the founding of Digital Dental Forum in 2018 by Dr. Burzin Khan & Mr. Danesh Vazifdar. DDF's vision is to improve overall patient care for the clinician, by integrating advancing technologies such as CBCT imaging for accurate diagnosis,intraoral scanning, softwares for planning, designing and machining using additive and subtractive technologies such as milling and 3D printing. It's mission is to bring all facets of digital dentistry under a global education forum easily accessible to the dental practitioner and technicians. Be a part of the **DIGITAL DENTAL FORUM** and join us in revolutionising digital dentistry in India at par with the global standards

FOUNDERS MESSAGES

Dr Burzin Khan

It gives me immense pleasure to welcome you all to the release of our first of the biannual Newsletter, 'DIGITAL DENTAL TIMES'. I congratulate the energetic Editorial Team for having been able to put together an excellent issue with good quality articles, product announcements and latest developments in the field of Digital Dentistry. I am grateful to all our Support Companies and Authors who have willingly contributed to this issue & hope that they continue to do so to engage our readers in keeping abreast with the ever evolving field of Digital Dentistry. As we know that learning should never end, there is an ever growing need to provide the right content and bring together the clinical & laboratory aspects to be able to understand the technologies and their applications for use in our daily practice. DDF's vision therefore is to be able to primarily improve patient care, by elevating the standards of our practices by staying tuned with the latest developments and integrating all the different aspect of digital for diagnostic, restorative, prosthetic, implants, endodontic, periodontics and orthodontic applications. We urge you to join us in this exciting journey of discovering and sharing our digital experiences to support and kindle an exponential growth of the digital dental world.

Burzin Khan

Danesh Vajifdar

A very warm welcome to the Digital Dental Forum - DDF. Digital Dentistry is revolutionizing our profession and without a doubt it is changing at a rapid pace. There is a huge learning curve ahead of us in various aspects of Digital Dentistry. Our vision is to try and create an online as well as a in person platform to help Dentists understand and adapt to this change thru education online as well as offline. With this focus in mind, we are associating and working with leaders in this field . We are working with Clinicians, Technicians Researchers and Dental Companies, Dental associations and other Digital Societies of Digital Dentistry worldwide to share their knowledge and expertise to the end benefit of our members and eventually treatment concepts for ultimate patient wellbeing and dental care. We look forward to keeping this Forum as interactive and proactive with the support of all our members and members of our Dental Fraternity. Welcome to DDF.

Adaro Dental Laboratory
DIGITAL DENTISTRY

EDITORIAL MESSAGE

With more than 25 years in clinical practice it is obvious to most individuals that a sense of redundancy does tend to set in even with constant upgrades in knowledge, equipment, and skillsets. An approach to work that is repetitive and requires less involvement on many levels becomes everyday routine. At such a time to have something suddenly enthuse your attitude towards your work with a new sense of purpose is very welcome. For a lot of clinicians, the advent of digital dentistry has done just that. A comprehensive approach to dental treatment was always advocated, but was difficult to apply since the merging of diagnostic scans, photographs, other evaluations and planning tools was a long winded and cumbersome process. Now it's the question of a well-placed click. Using all the tools available to us digitally, and the possibility of integrating them with years of experience and knowledge in planning, is at our fingertips; again a function of the digital cloud that surrounds us with its largesse. The added advantage of the digital technology is that now the patient and the lab technician are the part of the planning process and not just a mute receivers of the dentists' plan. The initiation happened with aesthetics, as much in our field of dentistry tends to. Smile designs and the integration of the overall facial aspects of a patient into the plan to rejuvenate their smile was how digital dentistry first pulled us in. Eventually, though the myriad other benefits of being a part of thisrevolution have become obvious to us. The demands for precision and accuracy along with the need for speed, fuelled the digital dentistry revolution and the benefits rapidly percolated in diagnostics, radiology, endodontics, periodontology, full mouth rehabilitation with virtual articulation, material science and in implant dentistry with guided surgeries and customized options. The era in which we practice dentistry today is truly a modern one. We can now take digital face scans, merge that with intraoral scans and CBCT data and virtually extract teeth, make guides to reduce unwanted crestal bone and place implants truly prosthetically driven and the plan to provide an immediate premilled provisional restoration to the patient is a beautiful possibility. All this is possible due to the millions of dollars and hours spent globally in developing and integrating various software's, making new hardware and creating materials and components that can work seamlessly together. The behind-the-scenes movie of these modern dental processes is definitely worth being on OTT platforms for the larger public to realize how far we have come and identify the infinite possibilities that we can bring to our patients. All these advances in dental technology workflows need training and that is where the ***Digital Dental Forum*** plays a crucial role where the first adopters, established users and selfless leaders from within the fraternity share their knowledge and experience in a comfortable atmosphere and help hundreds of clinicians and lab techs to shorten their learning curve and master the nuances of the newer steps that need to be undertaken to harness the full potential of this digital dental era. The ***"Digital Dental Times"*** newsletter is an initiative in that direction too. A number of clinicians and lab technicians have contributed interesting articles with step by steps techniques so that the readers can plan and execute various cases in aesthetics, endodontics, implant surgery, implant prosthodontics and equipment management with renewed confidence and without hesitation. We enjoyed getting this newsletter together and hope you will find it an interesting read that inspires you to rush back to your workspace and dive deep in the digital world. We urge you to spread this information far and wide and would love to receive your work to be published in the subsequent issues of this newsletter.

INDEX

Digital Approach to Minimally Invasive Tooth Wear Management

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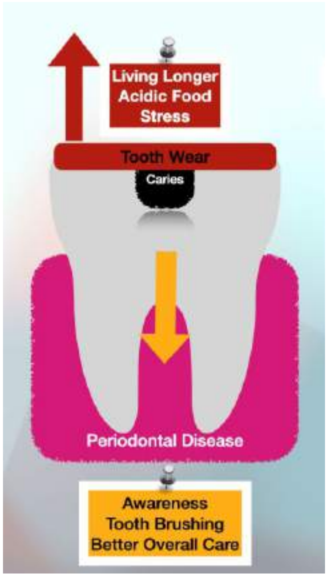
Introduction

Tooth Wear is a cumulative loss of mineralised tooth structure, occurring over time. It is a complex process that may be slow and steady or episodic, affecting both deciduous and permanent teeth due to chemical and/or mechanical factors. [1,2]



Prevalence

Rise in incidence of Tooth Wear is becoming more and more of a concern and presents a challenge in its management due to its multifactorial causes, difficulty in predicting the time of a treatment and unpredictable outcomes. 30% of children and adolescent have been found to be affected by it, as per some epidemiological studies.[3, 4] Adult Dental Health Survey of UK between 1978 - 2009, when compared, revealed, prevalence of decay and periodontal disease have fallen from 46% to 28% and 55% to 45% respectively, whereas Tooth Wear has increased by 10% (more significant in the 16-44 age group).[5]

Dilemma

Dental Practitioners are often in dilemma and at times even in denial in recognising Tooth Wear. In the absence of robust index and omnipresent complexities, at times, it has become an area of neglect. Due to its multi-factorial etiology, age of the patient and phases of active and inactive periods, it is difficult for the practitioners to decide on when to act and what approach to take in its management.

Physiological vs Pathological

European Consensus does provide us with some guidelines in its management.[1] Firstly, it tries to clarify on differentiating Tooth Wear into Physiological or Pathological depending on the loss of tooth structure.

Table 1 and Fig 2 may act as our reference point in

Tooth	Normal Physiological Tooth Wear per Year
Incisors	0.018mm
Premolars	0.036mm
Molars	0.054mm

Table 1

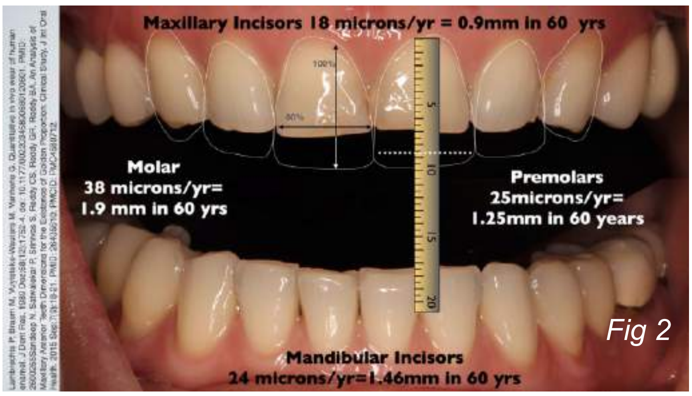


Fig 2

recognising that.[6,7] Based on that the following table could be a guide for us to understand if 'Tooth Wear' is more than certain parameters for it to be considered pathological and into which category the particular patient falls into. Table 2 is the physiological guide as per age beyond which the pathological progression can be considered. Fig 3 demonstrates the normal thickness of enamel on various teeth.

Clinicians should look for even a simple demineralisation in early ages as a concern and make the patient aware along with trying to find the causes and rooting them out.

Age	Inciser	Premolar	Molar
20	>0.18mm	>0.25mm	>0.38mm
30	>0.36mm	>0.50mm	>0.76mm
40	>0.54mm	>0.75mm	>1.14mm
50	>0.72mm	>1mm	>1.52mm
60	>0.90mm	>1.25mm	>1.90mm
70	>1.08mm	>1.50mm	>2.28mm

Table 2

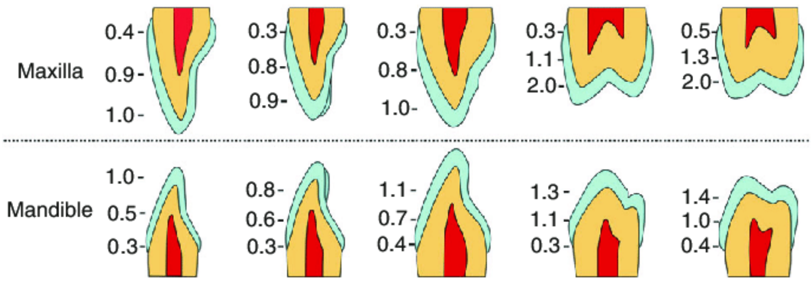


Fig 3

Chemical vs Mechanical

Current effort at classification of Tooth Wear has been to find the cause of the problem and classify them accordingly rather than just note the condition as Erosion, Abrasion and Attrition. They are broadly classified under causative factors as Chemical and Mechanical and sub

Chemical

- **Intrinsic**: Salivary Deficiencies; Gastric Causes
- **Extrinsic**: Acidic Food; Acidic Drinks

EROSION

Mechanical

- **Intrinsic**: Normal Function; Parafunction — **ATTRITION**
- **Extrinsic**: Abrasives; Habits — **ABRASION**

divided into Intrinsic and Extrinsic causes.

Key Principles of Management

- According to Loomans et al [9], following key points need to be considered whenever Tooth Wear is recognised.
- Early recognition and patient education
- Preventive strategies and Monitoring in place
- Minimally invasive care

They further advise that, "For each patient with moderate or severe tooth wear, without functional or aesthetic concerns, counselling and monitoring is the treatment of first choice." The following statements that they advise for Tooth Wear could be very crucial in planning any strategies and Treatment. "Definitive Dental Restoration for Tooth Wear Management should not be prescribed until full patient commitment can be secured. The temptation to undertake complex rehabilitation of a minimally worn dentition, or to rush into such forms of treatments must be avoided. Restorative Treatment should ideally be conservative and of an **'additive '**nature rather than **'subtractive'**, thereby reducing the need for further loss of healthy tooth tissue and higher risks of unwanted pulp pathology. The use of **additive techniques** using dental materials such as composite resin may also permit the ease of modification, whereby further restorative material may be added or removed intra orally to meet the patients aesthetic expectation and functional needs.

Role of Digital Dentistry in Tooth Wear Management

As stated in the Key Principles of Management, Digital Dentistry could be used as an important tool in recognition, monitoring and

Fig 4 2018

Fig 5 2022

Fig 6 2022

Recognition and Monitoring

Fig 4 and 5 are the intra-oral scans of a patient with tooth wear being monitored with an intra-oral scan (Cerec Omnicam - Dentsply Sirona). Various softwares are already in existence and in development to quantify the exact amount of tooth wear along with their state of activity further helping dentists to recognise and predict its physiological or pathological nature. One does not need an intra-oral scanner in the practice to monitor Tooth Wear digitally, as a cast made up of a good alginate impression can also be scanned in the lab and used for the same. Along with the scans, simple intra-oral photographs can be equally useful in patient awareness and monitoring. (Fig.6) Besides the scans and photographs, index such as BEWE (Basic Erosion and Wear Examination) may also help us in monitoring Tooth Wear.

Management

As stated in the key principles, our first line of management is to find the cause and root it out, along with the use of remineralising agents and Fluoride Varnish. It may be worthwhile to give support to the unsupported enamel and facets with the help of restorative materials without any invasive procedure and periodic monitoring. Splints may have a role if the cause is Mechanical and Intrinsic in nature. Use of splints in Chemical Intrinsic variety may cause further demineralisation due to pooling of the acid in the splint. During regular check up, apart from checking for TMJ, muscles, soft and hard tissues and looking for caries, periodontium and soft tissue changes, we should observe for any changes in the surface of the tooth. If a restorative procedure is to be executed, minimally invasive, additive care should be our first choice of managing Tooth Wear.

Role of Digital Tools in Additive Dentistry

Dahl's Treatment

Besides many other treatment modalities, Dahl's treatment has been showing promising results in the Tooth Wear Management due to its simplicity, non invasiveness and reduction in both

Fig 7 [9]

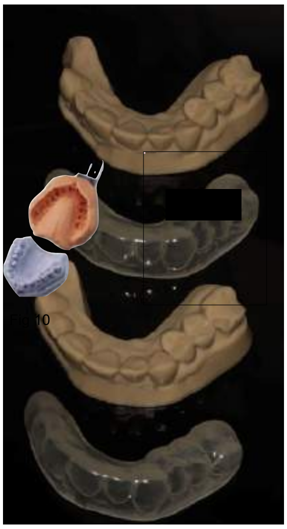
biological and economic costs.

Dahl's Concept proposed by Dahl et al in 1975 and modified currently due to predictability of adhesive dentistry has been proposed as a treatment of choice in some of the cases which employs additive adhesive dentistry on the palatal aspect of the anteriors. [10] It

Fig 8 3D Printed Digital Wax up with elastomeric template

raises the Vertical Dimension by adding composites to the surface of worn anteriors creating an anterior and lateral guidance by anteriors disclosing the posteriors. If the posteriors do not show signs of Tooth Wear, they are left with posterior open bite which eventually will close by ex trusion and intrusion of the posteriors and anteriors respectively. In case, posteriors also show Tooth Wear, direct composite onlays can be bonded on the occlusal surfaces. It helps in creation of anterior and lateral guidances by the anterior teeth creating a mutually protected dentition.

Digital dentistry helps us in this procedure by creating a digital wax up with smile design principles in place. Such digital wax up can be printed and templates made for direct composites or injection moulding technique. Besides, close monitoring is also possible.



Clinicians wishing to carry out these procedures but do not currently possess intra-oral scanner can send a good cast taken in alginate or rubber base impressions along with patient's photograph. This will help the technician to do the digital wax-up along with smile designing protocols in an appropriate software.

Fig 9 Injection Moulding with Alternate Tooth Digital Wax-up Technique

Possible advancements

Once we have the possibility of easy and economical way of Face Bow Transfer and Centric Relation recordings digitally, additive adhesive dentistry with the help of a templates created in digital wax ups will further enhance our care in the management of Tooth Wear. Early recognition and monitoring through photographs in the form of mobile apps may further enhance in the early management diminishing the need for extensive subtractive procedures in the long run.

Conclusion

Tooth Wear is an ever rising problem in dentistry and one of the most complex one to treat. Early recognition, preventive strategies, monitoring and additive adhesive treatments have been recommended in its management by the European Consensus.[1] Digital Dentistry provides predictable tool for monitoring Tooth Wear as well as help us in planning and fabricating a guide for direct composite restorations or milling an indirect restorations with composites or other materials. Additive Dentistry could be the first step to prevent tooth from needing subtractive treatments where high level of skill and precision is required, besides high biological and economical costs to patients. It could be a Transitional Dentistry, preventing complex FMR. It can be known as pFMR procedure in Dentistry.

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The Non-Retentive Overlay: And why is everyone doing it?

A case report by Dr. Urvashi Tanwar

Introduction

Partial Indirect Adhesive Restorations play a pivotal role in the modern therapeutics, either to overcome the limitations of direct restorations or, on the contrary, to offer the patient an alternative to coronal-peripheral restorations, which are considered to be more damaging to the bio-rim which we are essentially trying to conserve. It will be a question of privileging the most conservative therapies possible while responding to an ever-increasing demand from patients and practitioners in terms of aesthetics but also in terms of durability and longevity. In recent times, the understanding of the biomimetics of the tooth with improvement of biomaterials and adhesion protocols, have made it possible to develop treatment options that meet the biological, biomechanical and esthetic objectives of restoring a tooth to its functional capacity. Restoring posterior teeth exhibiting large defects (replacing two cuspids or more) with directly bonded restorative composite is possible, but can be very challenging for the dentist, in particular in busy clinical practices where treatment time should be as short as possible. This is where CAD CAM dentistry plays a crucial role and following is a case report demonstrating its role in today's fast paced world.

Case Report :

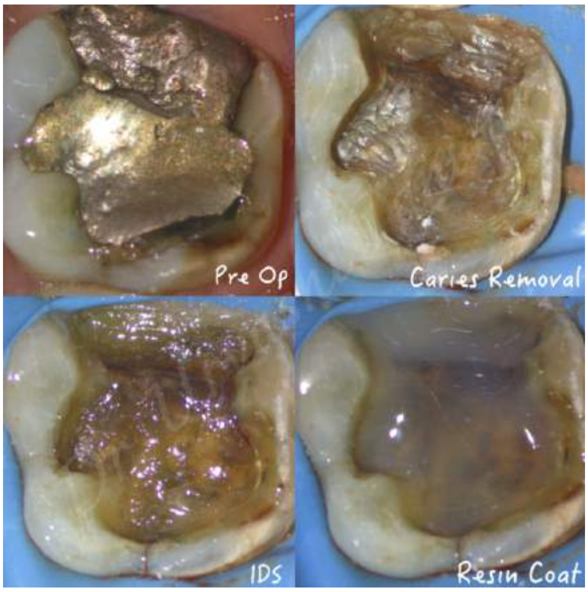
The patient complained of pain in the first mandibular molar during biting. This tooth showed an unacceptable amalgam restoration with caries underneath and a crack at the mesial side.

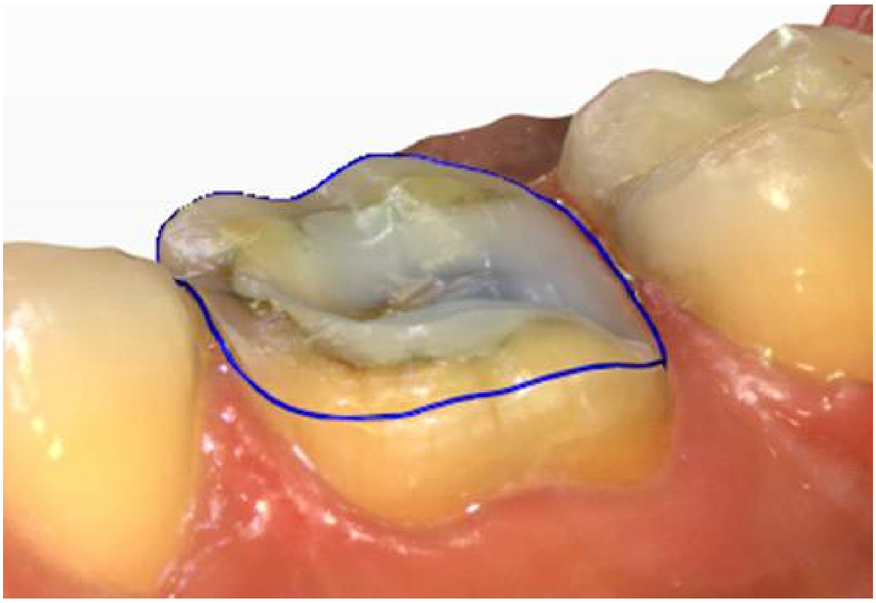
Biomechanical Tooth Preparation Analysis

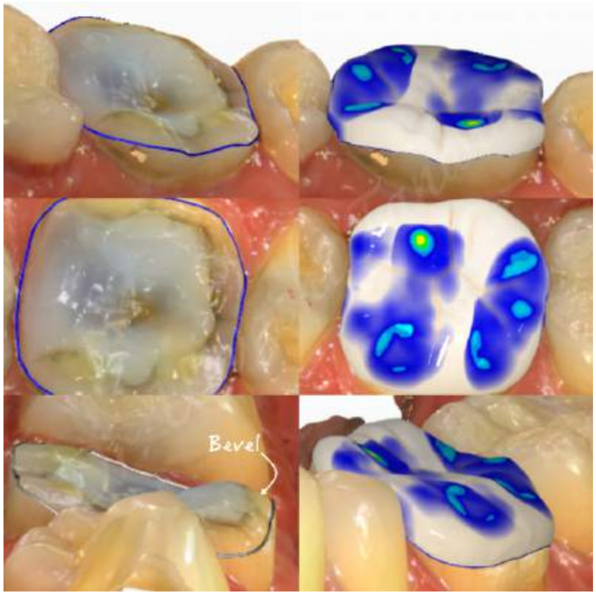
- After removal of the amalgam filling, infectious dentin underneath became visible. The crack at the mesial side involved only the proximal half. The cusps were undermined by caries
- The tooth was prepared for a lithium-disilicate glass-ceramic partial crown.
- All infectious dentin was removed. The dentin surface was protected by immediate dentin sealing (IDS) followed by resin coat. Decoupling with time was done for 5 minutes to give the hybrid layer time to mature and protect it from the shrinking stresses of the overlying composite. A stress dissipation area is created such that the forces, absorbed by the restoration, are transferred in the most favorable way to the adhesive interface and the tooth, by converting the tensile stress in the ceramic and at the interface as much as possible into compressive stress.
- The preparation area is antifragile. The enamel prisms were sectioned obliquely to give good mechanical support to the restoration.
- Due to the heavy loading on the buccal and lingual cusps and caries undermining the cusps, the cusps were reduced (minimum 1.5 mm) to a level at which enamel was supported by dentin. Bevel preparation was done on both the buccal and lingual cusps.

After biomechanical analysis, the preparation phase starts with removal of the existing defective restoration and selective removal of decayed and infected tissues.

- Next, a smooth dentin surface is created with gradual and soft transitions between concavities and convexities
- No resistance and retention form are required
- The crack was reduced to be included in the preparation
- The preparation outline follows a smooth and fluid curve, with open angles to increase and ensure the mechanical stability of the restoration







The restoration was made from lithium disilicate ceramic bloc IPS e.max CAD (Ivoclar Vivadent AG, Schaan, Liechtenstein). The preparation was scanned and designed with CEREC System and then sent to the milling unit. After glazing, the overlay restoration was cemented with a RelyX U200 dual cure adhesive resin cement (3M ESPE) One may face difficult while seating such non retentive restorations, and it has been suggested if possible to incorporate a dowel in the preparation which will help stabilize the restoration acting as a retention point and to help seat it correctly repeatedly.

The bonded lithium-disilicate glass-ceramic restoration shows a perfect integration with the surrounding tooth

Follow Up Care: Finally, regular maintenance of the bonded ceramic restorations will lengthen their life span. The occlusion and articulation must be checked during recalls and corrected if needed. Rough areas must be re-polished to a high surface gloss, as they result more easily in the formation of cracks with a possible catastrophic failure as a long-term consequence. In addition, the ceramic-tooth interface must be carefully monitored, corrected and re-polished if needed.

Discussion

Large hard tissue losses are frequent in molar teeth depending on caries or aging of the restoration. Due to these reasons, the remaining coronal tooth structure and the functional requirements are important factors to be considered in deciding the treatment planning. [1] Adhesively luted partial ceramic crowns have been documented to be clinically more durable than direct composite restorations when minimally invasively restoring large defects (replacing two cusps or more) in posterior teeth.

Preparations of the teeth to receive such restorations must be defined accurately. In accordance to that, ***New guidelines for the preparation form of bonded all-ceramic restorations were formulated by Ahlers et al and Arnetzl and Arnetzl. These guidelines describe eight points of interest which were kept in mind while preparing the overlay:***

1. Cavities designed for ceramics must have the simplest possible basic geometry
2. An appropriate and uniform layer thickness of the restoration is recommended (minimum 1.5 to 2 mm)

3. Corners and sharp edges must be avoided
4. High tensile stresses should be avoided and must be transformed whenever possible into compressive stresses by changing the prep design
5. Stress peaks and sudden changes in cross-section should be avoided by soft and smooth transitions
6. Notch stresses must be minimized
7. The contact surface with the ceramic restoration must be made as large as possible
8. Enamel bordered restoration margins facilitate a stable and adhesive bond of the ceramic restoration via the luting composite to the remaining tooth structure and will thus permanently guarantee better marginal quality

CAD CAM CEREC SYSTEM

Improvements in computer technology, equipments, and restorative materials have made it possible to manufacture an indirect aesthetic restoration in a single visit while the patient is waiting[4]. The CAD/CAM systems offer many advantages in clinical practice. Customized shaping, definite milling of blocks, adaptation of the inner surface of the restoration which provides precision-fit, replication of the occlusal morphology, producing the restorations chairside and cementing in one appointment are the most important properties of this system. Also, by CAD-CAM system, the errors are minimized, the cross-contamination due to impression and laboratory processes is reduced which is finilized with patient satisfaction.

EMAX: THE NEED OF THE HOUR

IPS e.max CAD (Ivoclar Vivadent AG, Schaan, Liechtenstein) is a lithium disilicate glass-ceramic for CAD/CAM applications, the blocks are produced by massive casting of transparent glass ingots, a continuous manufacturing process based on glass technology is utilized to prevent the formation of defects (pores, accumulation of pigments and so forth) in the bulk of the ingot. Partial crystallization process leads to a formation of lithium metasilicate (Li2SiO3) crystal, which are responsible for the material's optimal processing properties, edge stability, and relatively high strength. After the milling procedure, the restorations are tempered and lithium disilicate crystals are formed, which impart the ceramic object with desired high strength
Onlays, but ***mostly overlay*** restorations allow to delay the execution of a full crown, preserving the healthy dental tissue[5]. Besides, adhesive overlays preserve coronal structure, avoid contamination of the root canal treatment, reinforce residual dental tissues, guarantee optimal form, function and aesthetics. ***Magne and Besler***[6] were also reported that onlay and overlay restorations were the most effective choices in the treatment of the excessively damaged posterior teeth.

The clinical longevity of such restorations is largely determined by the tooth-preparation design, material selection and adhesive luting procedure[7]. The most frequently recorded failure in medium to long-term clinical trials is fracture of the restoration but they do seem to have fairly good success rates.

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CASE STUDIES

Single visit re-treatment of porcelain laminate veneers using chairside CAD-CAM.

Abstract :

The last decade has seen a major leap in the field of digital dentistry. The transformative change has brought with it, newer techniques, workflows and systems. Right from changing clinician-patient interactions, these innovations have spurred new opportunities in all major areas of dentistry. Digital workflows facilitate the clinician to deliver highly predictable precise and aesthetic restorations in a short span of time. This case report aims to describe the use of digital workflows along with the use of chairside CAD/CAM (CEREC) in the re-treatment of 2 indirect veneers in a single visit.

Introduction :

In less than a century, CAD (Computer-aided design) & CAM (Computer-aided manufacturing) has revolutionised almost all major industries. Dentistry adopted CAD/CAM to create precise restorations with the least possible error. Conventional manufacturing techniques are highly technique sensitive and are prone to various errors.In a broad sense, CAD/CAM systems can be classified as either chairside or laboratory. chairside CAD/CAM systems incorporate the use of Intra-oral scanners for digital data acquisition, a cad design software for the independent design of the restoration, a milling system for reductive manufacturing and/or a furnace for processing various ceramics. The chairside cad cam system allows clinicians to independently fabricate inlays, onlays, porcelain veneers, crowns and bridges in a short period during a single visit. The CEREC CAD/CAM system is the oldest chairside cad cam system in the market and has introduced the first version of their system (CEREC 1) in 1985. The latest iteration of this system incorporates an I/O scanner (Primescan), a four-axis milling machine (Primemill) and a speed sintering furnace (Speedfire).Over the past 30 years, porcelain veneers have proven to be one of the most successful treatment modalities in cosmetic dentistry. These are often 0.3 – 0.7 mm in thickness and for the better part of the past 20 years have been fabricated using analogue techniques. Amongst various fabrication techniques (refractory die, platinum foil), hot pressing ceramics seems to be the preferred choice of the majority of dental technicians. The use of CAD/CAM was limited to the milling of the designed veneers in wax & then pressing them in the preferred ceramic ingot. Due to the recent advances in both CAD & CAM monolithic, veneers can now be directly milled, significantly reducing processing time.


Fig 1: Pre-op


Fig 2: Pre-op

Case Report :

A 59-year-old female patient visited our practice with a chief complaint of sensitivity & stained maxillary anterior (Fig 1 & 2). Diagnosis & treatment planning: The patient was treated with 2 PLVs on her central incisors 2 years ago. She reported frequent debonding of the upper left central veneer after which was restored with an indirect composite veneer. She had a history of stage 4 liver cancer & was undergoing treatment for the same in a different country & was scheduled to travel back in 3 days. The patient was taking oral Iron supplementation for the past 6 months which was discontinued 1 month back. A comprehensive case history was taken following which a diagnostic intra-oral scan and radiographs were taken including an OPG. Intra-oral examination revealed moderate sensitivity & food entrapment with the upper left central incisor. Treatment objectives: managing discolouration of the upper anterior teeth, modification of the shape and contour of the previous veneers within the financial constraints of the patient, addressing hypersensitivity and Completing the full treatment in one visit.


Fig 3 : Pre-op scan


Fig 4: After Removal of veneers


Fig 5 : Tooth preparation Facial View

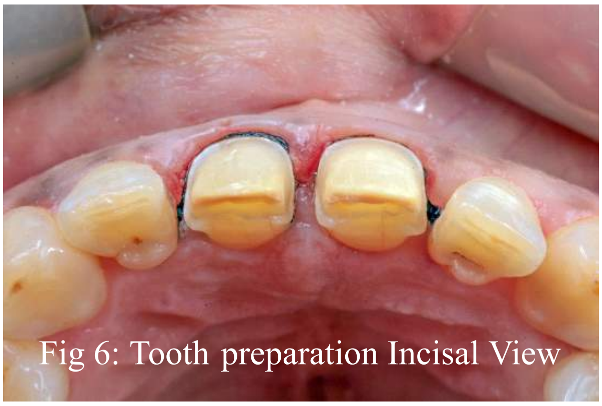
Fig 6: Tooth preparation Incisal View


Fig 7

Treatment Plan: Considering the constraints (time, money) of the patient the treatment had to be carried out during the first consultation visit itself. Porcelain laminate veneers were planned on the upper 2 central incisors after dismantling the old veneers. The patient was informed of possible treatment options and consent was taken for the procedure before starting. Pre-Operative Scan: Before dismantling the previous veneers, a pre-operative scan was taken using the biocopy design mode on the Cerec CAD 5.2 software (Fig 3) This was used as a reference during the designing of the final veneers. Possible design modifications were shown to the patient in the software before starting the preparation. Direct Putty indices were fabricated intra-orally for guidance during the preparation. The existing composite & ceramic veneer was dismantled using high-speed coarse diamond burs (Diatech, Coltene Whaledent) & magnification of 4x (Carl Zeiss). Since the existing veneers had a substantial marginal gap it was decided to section and debond the veneers as opposed to cutting the veneers off to avoid over-preparation. A buccal & incisal grove was made and the veneers were debonded using a Christensen Crown Remover (Hu Friedy). After removal of the veneers, a significant amount of marginal leakage & food impaction was observed below leading to gingival inflammation Fig (4).Considering the nature of the previous preparation and the residual bonding tooth substrate the palatal & proximal aspects of the margin were modified, defined and extended. The overlap design of the previous preparations was converted to a cingulum preserving preparation and enamel margins were defined around the whole preparation. Preservation of the cingulum maintains structural integrity and rigidity of the anterior teeth. (Fig 5, 6) The buccal surface was prepared using fine diamonds only to avoid over-reduction. All sharp edges and corners were smoothened using coarse & fine polishing disks (Sof-Lex,3M). Double cord retraction (Ultra Pak Ultradent 000; 00) was used for gingival retraction. A 3D digital impression (Fig 7, Fig 8) was obtained using an optical intra-oral scanner (CEREC Primescan) of both the jaws and the closed bite. The restoration was designed using the CEREC 5.2 software. The final design was merged with the pre-operative scan to compare the incisal edge position and final design changes (Fig 9 & 10)

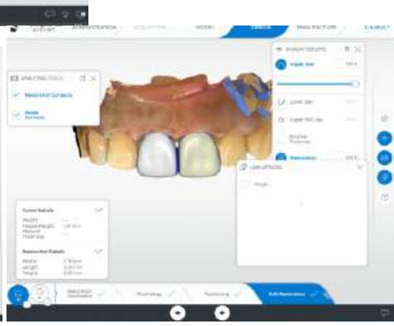


Fig 10

Final veneers were milled in the MCXL milling machine in Emax Cad. The IPS Emax shade navigation app (Ivoclar Vivadent) was used to select the final block translucency and shade after intra-oral shade selection was carried out. The final block used was LT A2. The Emax cad blocks are milled in the partially crystallized "blue state". This metasilicate phase is softer to mill, results in lower bur wear and has high edge stability. The final milling time was a total of 17 minutes combined for the two veneers. Before crystallisation, the veneers were tried intra-orally and the primary anatomy was finalised. Crystallisation along with simultaneous staining and glazing was carried out in the Speedfire furnace (26 minutes). A second round of surface staining was then carried out to further blend the restoration to the remaining dentition. The second staining is carried out with the restoration kept intra-orally and then fired to get an accurate final result (Fig 11). After which the restorations were prepared for final cementation Cementation Procedure: The intaglio surface of the veneers was etched with 5 % HF for 20 seconds (Ceramic Etching Gel Ivoclar) and rinsed off for 30 seconds with an air-water spray. Silane coupling agent was applied in a thin layer (Monobond Plus Ivoclar Vivadent) for 1 minute. After rubber dam isolation. All surfaces of the prepared tooth were etched using 37% phosphoric acid etching gel and rinsed off using water. A thin layer of adhesive(Adhese Universal) was applied and light cured for 20 seconds. The veneers were then coated with Variolink esthetic LC and positioned in place and excess resin cement was removed after tac curing for 3s. Final curing was carried out for the 20s on each surface.

Fig 11: Final Veneers Stained & Glazed


Cementation Procedure: The intaglio surface of the veneers was etched with 5 % HF for 20 seconds (Ceramic Etching Gel Ivoclar) and rinsed off for 30 seconds with an air-water spray. Silane coupling agent was applied in a thin layer (Monobond Plus Ivoclar Vivadent) for 1 minute. After rubber dam isolation. All surfaces of the prepared tooth were etched using 37% phosphoric acid etching gel and rinsed off using water. A thin layer of adhesive(Adhese Universal) was applied and light cured for 20 seconds. The veneers were then coated with Variolink esthetic LC and positioned in place and excess resin cement was removed after tac curing for 3s. Final curing was carried out for the 20s on each surface.


Fig 12


Fig 13

Discussion: The present case report shows the management of a veneer retreatment case using CAD/CAM technology. Given the lack of time in a traditional setting it would not be possible for the clinician to restore this case in a single session. Since the planned final morphological changes were minor, we could use the existing design to make the necessary changes & skip the mockup phase. The bio copy mode in the software allows the clinicians to accurately match the planned shape changes and the final design. The Lithium di silicate veneers made through CAD are monolithic, hence they lack the three-dimensional incisal effects. Instead of using a layering technique, the surface is stained and characterised using stains to give a pseudo incisal translucency. The advantage of using IPS e.max CAD is a combination of high strength and esthetics. The cad blocks are available in varying translucencies (HT, LT, MT: high medium & low) and MO (Medium Opaque) with 20 different shades for HT & LT. There is a wide range of glass ceramics available for chairside use: VITA Suprinity, Vita Triluxe, CEREC CPC, CEREC TESSERA (Dentsply Sirona), and Lisi (GC). Given the diverse options available an appropriate shade & translucency can be selected. Furthermore, the dentist can stain the restoration intra-orally, check the final result and then fire it in the furnace. This gives a great degree of control over the final result.

Conclusion: Chairside Cad Cam technology has empowered dentists to deliver predictable esthetic & durable results in a single visit. The decreased visits allow dentists to serve patients who are highly pressed for time. Minimally invasive anterior restorations can be produced with chairside CAD/Cam with high precision.

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He is currently a tutor for the MclinDent Prosthodontics program at King's College London.

A 2nd Generation dentist he set up the first in house CEREC CAD CAM practice in pune city in 2017.

He is one of the youngest Key Opinion Leaders globally for Dentsply Sirona in Chairside CAD-CAM with CEREC.

He is a Speaker for Ivoclar Vivadent for clinical & restorative dentistry, Lecturing nationally & internationally on digital dentistry & Indirect fixed prosthodontics.

He is currently involved in joint teaching programs aimed at systematic training of dental surgeons for Fixed Implant Prosthodontics. Trained in BlueskyBio for design & production of full arch guided surgery. Undergone international training on Conometric concept with intra-oral welding and CAD CAM technology by Dr.Marco Degidi

Completed training courses & modules mentored by Dr.Ashok Sethi , Dr. Maxim Belograd & Dr Viktor Sherbakov. He has completed the Phantom Master's Course for Implant Surgery Training at IFZI under Dr, Manfred Lang.

Digital Dentistry in Endodontics : An Update

by Dr. Shaurya Srivastava

Aim:

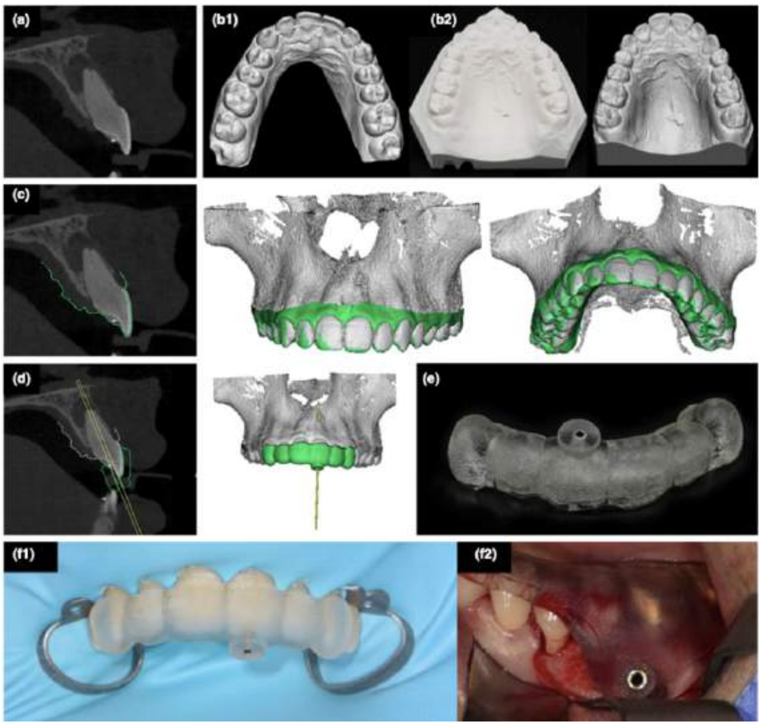
The aim of this review is to provide an update with regards to the introduction of digital modalities in Endodontics which would aid in conservative, preservative and predictable management of complex cases.

Introduction:

Dentistry is making a major transition into the digital world. Following the growing digitalization in many fields of restorative dentistry, digital technologies are gradually being introduced into Endodontics for enhanced diagnosis, minimal and preservative treatments, management of teeth that present with significant complexities for predictable outcomes and reducing iatrogenic errors in technique sensitive cases. Successful management of Endodontic treatments is reliant on diagnostic imaging to provide significant information regarding the teeth under investigation, pathology associated, challenges they pose and the relevant surrounding anatomy. Several digital imaging techniques have been researched as potential diagnostic and treatment planning tools in Endodontics, such as; Digital subtraction radiology (DSR); Tuned Aperture Computed Tomography (TACT); Cone Beam Computed Tomography (CBCT); Ultrasound (US)[1-3]; Magnetic Resonance Imaging (MRI) and Computed Tomography (CT)[4]. The acceptance for several of these imaging techniques have been relatively low, and conventional periapical radiography remains the default imaging system in Endodontics despite its inherent limitations. The diagnostic yield of two dimensional images generated[5, 6] is impaired significantly by anatomical noise superimposed over the area of interest [7, 8] and geometric distortion [9]. The introduction of cone beam computed tomography (CBCT) has highlighted the inadequacies of conventional radiography[10-14] and overcomes these limitations[15]. The three-dimensional radiographic assessment of teeth and their surrounding structures with cone beam computed tomography (CBCT) is desirable for aiding diagnosis and/or management of complex endodontic problems[16, 17]. The use of CBCTs in Endodontics is well established and is reflected in the position statements published by leading endodontic specialist societies in the world[18, 19]. We are now transitioning into a phase of incorporating CBCTs with intraoral scanners, 3D printers and microscopes for guided endodontic treatments particularly associated with calcific metamorphosis/pulp canal obliteration (PCO)[20], anatomical complexities[21] and access cavity designs for preservation of natural tooth structure, although where sensible, as well as volumetric measurement of residual tooth structure impacting the outcome of endodontically treated teeth[22].

Guided Endodontics :

Pulp canal Obliteration is the deposition of hard mineralised tissue in the root canal space[23], commonly associated with injuries to the pulp[24], history of dental trauma[23, 25, 26], dental caries[27], following orthodontic treatment [25, 28], restorative procedures or abfractions[29] and in teeth of elderly patients[27, 30, 31]. If root canal treatment is indicated in such cases, they can pose a significant challenge as compared to teeth with wide and patent canals [32]. There are significant risks associated while trying to locate calcified canals which can lead to iatrogenic errors and damage to the tooth structure, inevitably having a negative impact on the outcome of endodontic treatment [33, 34]. Cone Beam Computed Tomography should be used in cases where conventional radiography doesn't provide sufficient information [18, 19] . The three dimensional volume acquired through a CBCT can be supplemented with an intra oral scanner design and 3D print a guide for treatment[35, 36]. Guided Endodontics is a concept where computer designed guides are created for access cavity preparation [37-39] and endodontic surgery[40] for safe and predictable management[35]. This concept could help clinicians in avoiding iatrogenic errors, preserving tooth structure and therefore improving the prognosis in challenging cases. This modality of treatment would also reduce chair time, increase accuracy without being influenced by operator experience. Following diagnosis, the planning phase consists of: High resolution CBCT scan of the patient; Digital intraoral impression of the patient's teeth with the use of an intraoral scanner; Both scans (CBCT and intraoral) are to be registered by surface registration, using a specialized image processing software; With the help of a 3D design software, a template or guide is designed according to the desired pathway for treatment; Finally, the guide is 3D printed or milled for use during treatment.



Workflow for guided endodontics. A CBCT from the patient is acquired (a) as well as a digital intraoral impression directly (b.1) or indirectly by scanning the impression tray or plaster cast with an optical scanner (b.2). The information from both sources is combined and registered in a digital planning software (c). Then, a treatment guide is designed (d) and fabricated (e). Finally, the guide is either used during guided access cavity preparation (f.1) or apical surgery (f.2: image adapted from[41]).

The images and workflow above have been adapted from [20], and the following workflow is from a case report[42].t

Figure1. (a) patient's intraoral scan of upper arch (b) Cone-beam computed tomography (CBCT) image presenting patient's maxilla; patient's intraoral scan of upper arch. The images and workflow above have been adapted from [20], and the following workflow is from a case report [42].t

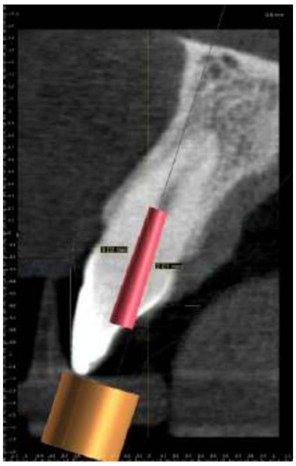


Figure 1. (a) patient's intraoral scan of upper arch (b) Cone-beam computed tomography (CBCT) image presenting patient's maxilla; patient's intraoral scan of upper arch.

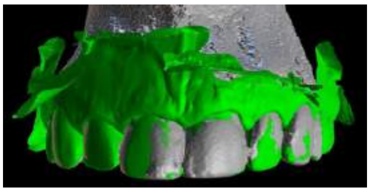


Figure3. Image presenting aligned files
of patient's CBCT data and intraoral scan

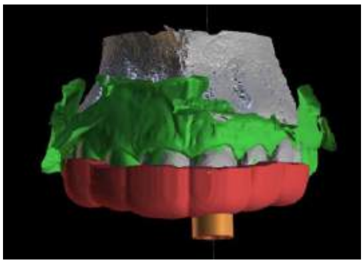


Figure 4. Figure showing extent of the guide

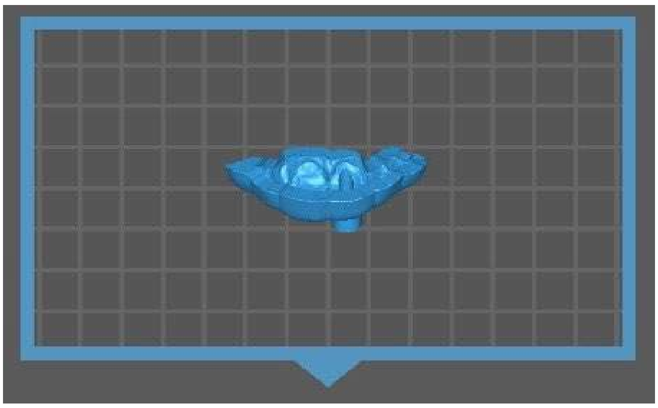


Figure 5. (a) STL file of the guide imported to the slicer software (Chitubox)

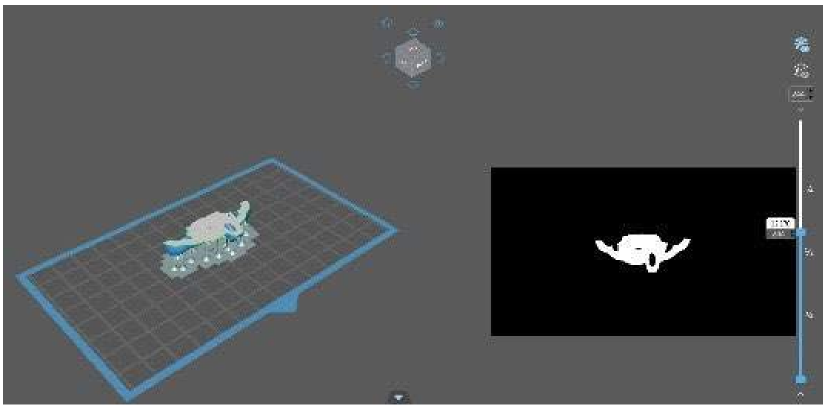


Figure 5. (b) Image after adding connectors for printing

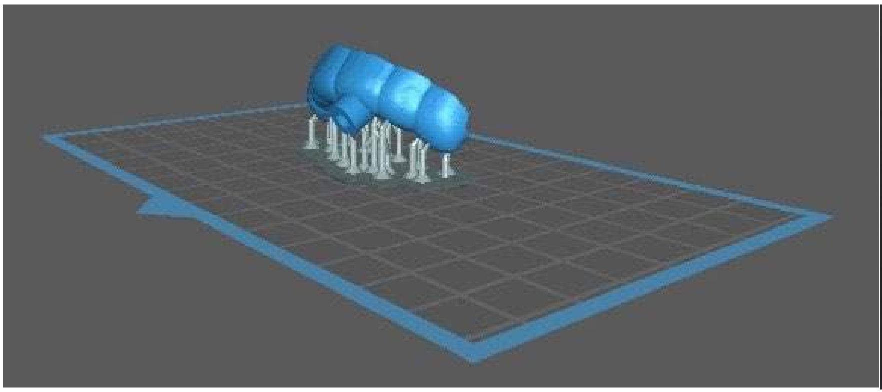


Figure 5. (c) Software showing object sliced into 50 micron layers. Each layer can be displayed and checked.

Figure 6. Endodontic guide and patient's upper arch 3D-printed model.

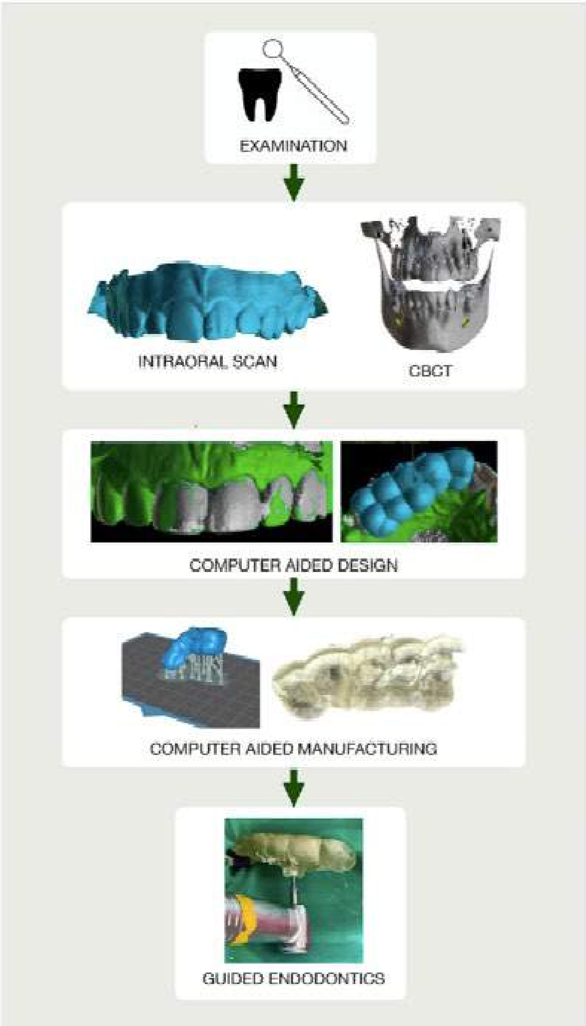


Figure 7.Flowchart illustrating the digital workflow.

Figure 8. CBCT sagittal view image revealed a 7.58mm long visible part of the root canal on the UL1.

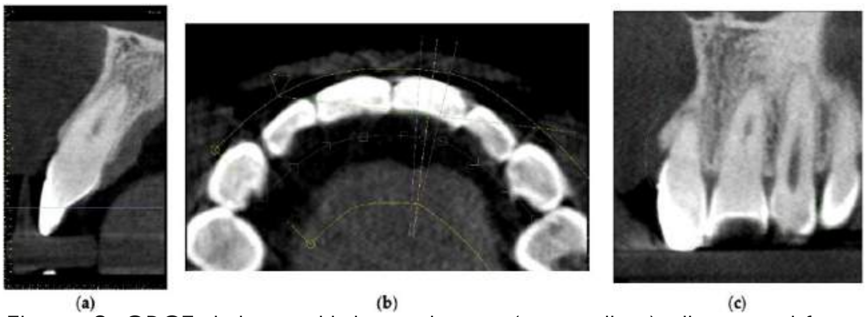


Figure 9. CBCT data and intraoral scan (green line) alignment from different views: (a) Sagittal; (b) Axial; (c) Coronal

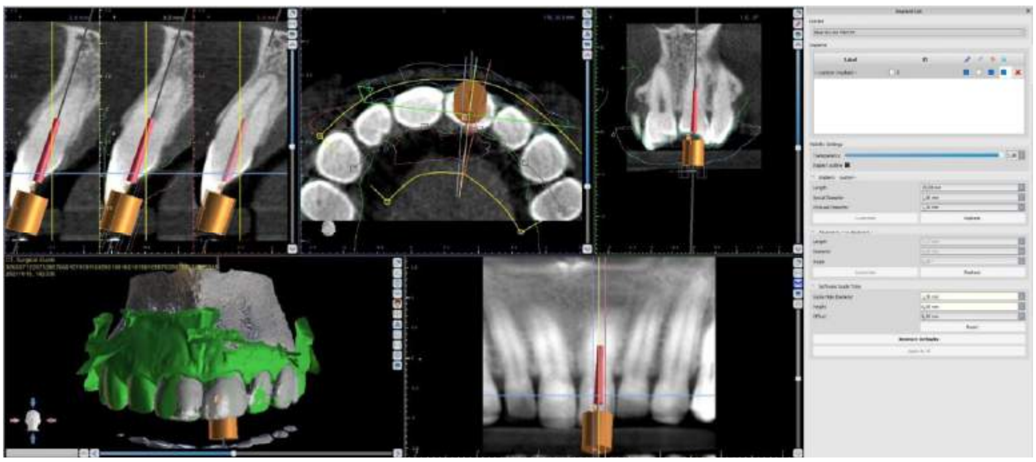


Figure 10. Settings of custom implant in Blue Sky Plan software. Implant length guide tube height, and offset must be equal to access tool's working length.

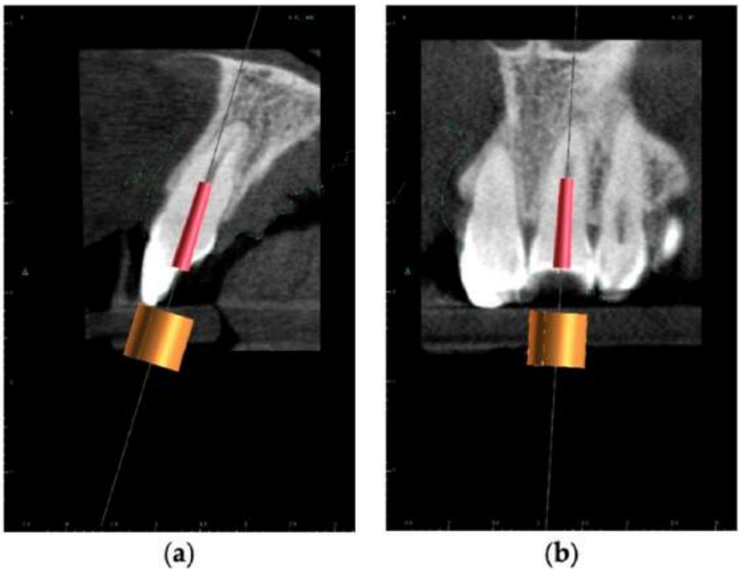


Figure 11. CBCT image presenting a scheduled virtual implant: endodontic access path in (a) sagittal view and (b) coronal view. The volume of the preserved dentin around the access path is shown.

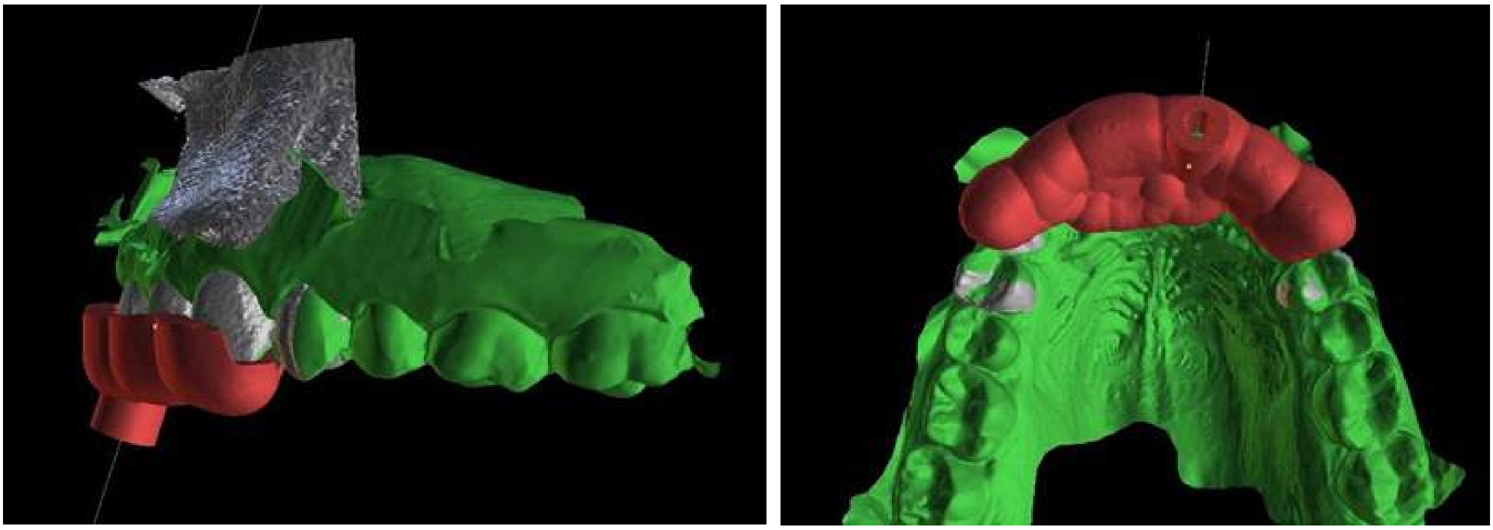


Figure 12. The range of the guide is drawn on the combined CBCT and STL image. This figure shows the extent of the template (a) Labially and (b) Palatally

Figure 13. Three-dimensional printed endodontic guide

Figure 14. The three-dimensional printed guide and the patient's model enabled us to check the accuracy of the guide and to practise proper drill insertion.

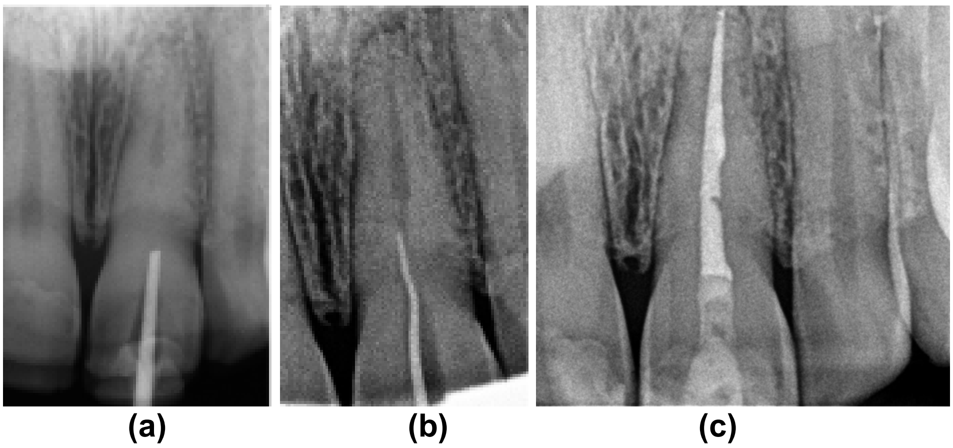


Figure 15. Radiographic examination was used to confirm (a) correct path of access pathway during procedure and (b) correct root canal access; (c) post-obturation radiograph.

Print and Try Technique[21]

Endodontic treatment entails three steps; Shaping, Cleaning and Obturation. The canals are mechanically debrided to facilitate irrigants for the desired disinfection, following which the root canal system is obturated with a suitable filling material. Prior to initiation of any endodontic treatment, the morphology of the root canal system must be assessed for any potential anatomical variations which may pose as a challenge for treatments. Management of root canals with complex anatomy are frequently associated with; Separation of instruments, Ledges, Perforations, Apical Transportation and Zipping of canals. These iatrogenic errors can affect the ability of the clinician to debride, disinfect and fill the canals, which inevitably leads to failure of endodontic treatments. The use of operative microscopy, cone beam computed tomography (CBCT) and microcomputed tomography have increased the number of reports on complex root canal anatomies previously ignored [43-47]. CBCT imaging is often utilized clinically by manually exploring the three axial planes (axial/frontal/sagittal), although the use of a 3D reconstruction has been demonstrated to improve the diagnosis, understanding of the clinical case and to reduce the stress of the operator before the clinical procedure[48]. The introduction of 3D printing of teeth using data from a CBCT volume for both, soft and hard tissues show relatively comparable results and accuracy to real teeth [49]. Additionally, tooth analogues specific to patients, with their root canal system could be replicated and reproduced with a high degree of similarity between the 3D printed teeth and real teeth[50]. The print and try technique can be a very useful approach to treat teeth with complex anatomies, which is a simulation method on customised 3D printed models of real teeth with similar anatomical variations, making the procedure more predictable and aiding in the clinician's confidence prior to treating the patient. Print and Try technique and treatment planning workflow: From the CBCT dicom file, an STL file is converted to generate a whole image of the teeth and supporting bone in three planes, thus allowing a better three-dimensional understanding of the structure involved (**Figure 7a-l**); subsequently a 3D plastic model is obtained with a Stratasys printer using a clear filling material (**Figure 7m).**

The following case presented has been adapted from[21]

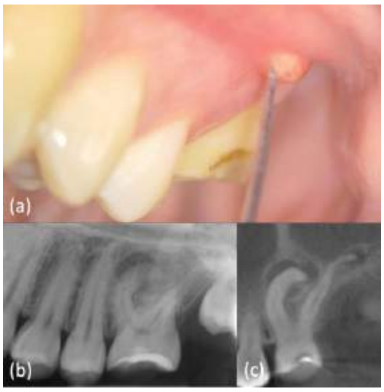


Figure 16. (a) Intraoral examination showed a lump on buccal side of the 26, which appeared not to be completely erupted and with a carious lesion. (b) Periapical X-ray showed dilacerated roots of 26, with a periapical lesion on the mesial-buccal one. 27 was not erupted, but present. (c) CBCT confirmed these findings and highlighted a periapical lesion also on the other roots

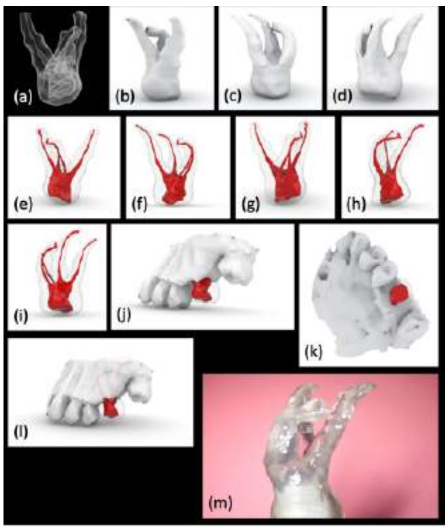


Figure 17. (a-l) CBCT data were uploaded to an STL software and (m) a transparent plastic model was three-dimensionally printed

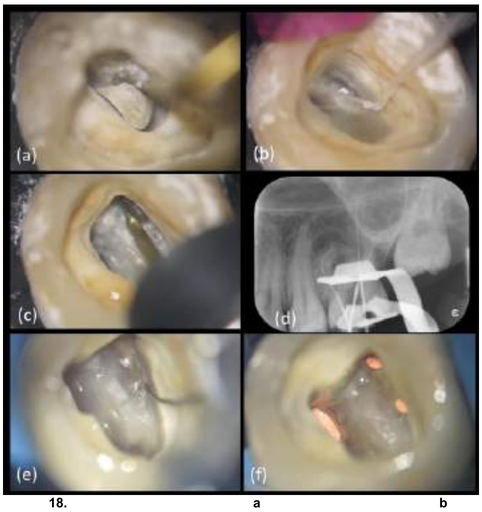


Figure 18. Main clinical steps of case 2. (a) Access cavity with US tips, (b) chamber irrigation with IrriFlex®, (c) orifices enlargement with TruNatomyTM Orifice Modifier followed by the TruNatomyTM series, (d) working lengths X-ray control, (e) MB2 location and (f) filling with bioceramic sealer and single cone gutta-percha technique

Figure 19. (a) Post-operative X-ray was taken. (b) At 6 months review the periapical X-ray showed a smaller radiolucent area around the mesial buccal root.

Discussion:

The introduction of digital modalities in Endodontics certainly is in its teething phase with several novel techniques being researched across the world which would make treatments more predictable with reduced chair time, and a reduced margin for error in cases with complexities. Guided Endodontics is a very promising concept which would aid in higher accuracy in cases with calcified canals aiding in unnecessary removal of tooth structure, as well as planning apical surgeries for minimally invasive osteotomies and precision in areas where certain anatomical structures lie in close proximity. However, this should be interpretated with care due to the level of evidence available, lack of a standardised protocol associated with the workflow and the variation in the reproducibility in accuracy of the guides or 3D models printed due to the difference in quality of various CBCTs and intraoral scanners. Similar advantages and reservations can be implied for the print and try technique. Higher hierarchy of evidence in larger populations is required for a more standardised approach with regards to the materials, methods and software aiding in the accuracy of the models which are replicating the corresponding real teeth.Dynamic Navigation (www.dentistrytoday.com; Bobby Nadeau-Dynamic Navigation and HUD for Endodontic Access) is in its inception phase, which is aimed at preservation of dentin during access cavity preparation. It uses data from a CBCT scan to guide the clinician during dental procedures. Overhead stereoscopic cameras track the position of markers attached to the dental handpiece and the patient's jaw. The position of the instrument tip is shown overlaid over the patient's virtual dentition on the system's screen interface. As the clinician moves the instrument clinically, the virtual representation of the instrument moves on the screen, which provides real-time guidance.

Freehand Navigation (FN) is used in implantology to transfer a fixture position from surgical planning to the surgical site. In endodontics, the magnification and illumination properties of surgical operating microscopes (SOM), have enhanced the accuracy of FN access cavity preparations and micro-surgical osteotomies. This has resulted in a paradigm shift towards conservative, more restricted access cavities that facilitate the preservation of coronal and radicular tooth structure by optimizing the long axis entry point, the drill angulation and the glide path to the terminus of the root canal space.The feasibility of these concepts in routine treatments will largely depend on the availability of these materials, softwares and technologies to a clinician, as well as comprehensive training for practitioners to optimise the use of the same. Digital dentistry in Endodontics is certainly very promising, however further research is required for assessment of its consistency and predictability of complex treatments.

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Triple Scan Technique,to copy the peri-implant soft tissue architecture from well-designed custom healing abutments and provisional restorations.

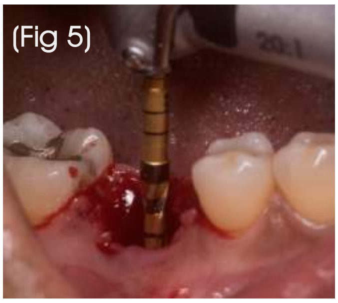
Dr Ali Tunkiwala & Danesh Vazifdar


(Fig 1)


(Fig 2)


(Fig 3)


(Fig 4)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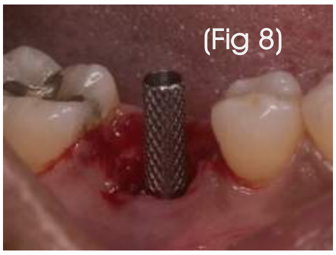
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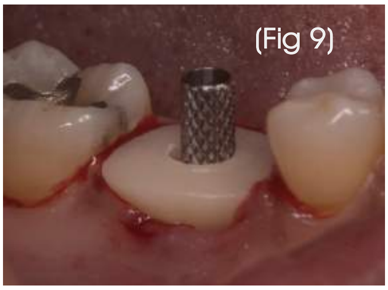
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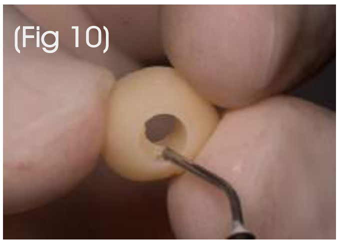
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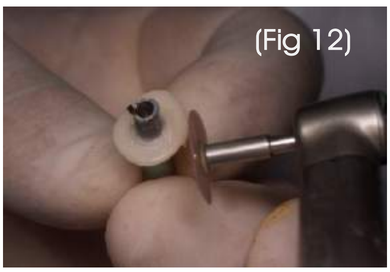
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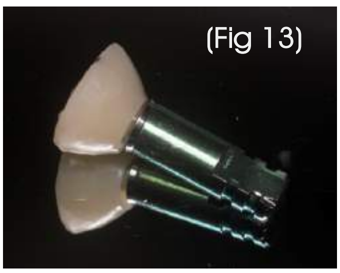
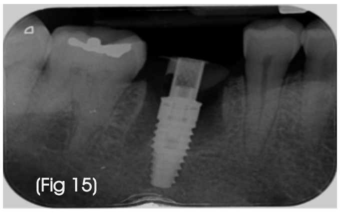

(Fig 13)


(Fig 14)

The healthy, well contoured peri-implant soft tissue architecture is the sum total of ideal 3D implant placement and accurate handling of the peri implant tissues at the time of surgery. While submerged healing protocol has been long established as a safe approach towards implant dentistry, current evidence clearly suggests that equivalent, high success can be achieved with immediate placements too. The shape of the peri implant tissues will play a crucial role in establishing the emergence profile of the final restoration that will eventually be crucial for good esthetics as well as hygiene. Traditionally, a circular healing abutment that is available as a stock component is used to govern the shape of the peri-implant soft tissues (Fig 1). However, the tooth shapes to be replaced in the anterior have a parabolic architecture at the CEJ while several posterior teeth have square or trapezoidal outlines. A custom healing abutment or a provisional restoration that is designed keeping in mind this architecture is the key to achieving proper peri implant contours (Fig 2). A custom healing abutment can be placed at the time of implant placement or can be designed and installed at second stage surgery. These can be done for anterior as well as posterior implant sites. A well-designed provisional restoration is generally fabricated only for anterior implant sites where esthetics is crucial and the provisional restoration can be easily kept out of occlusion while the implant is integrating.The following case demonstrates the step by step technique for surgically creating and digitally registering the peri-implant soft tissue architecture, so that the final abutment or restoration can copy the shape of custom healing abutment or provisional restoration and establish a good emergence profile. Clinical Case: Posterior Zone with Custom Healing Abutment. (Fig 3 to Fig 29).

Lower right first molar was extracted as atraumtically as possible and the implant was placed in correct 3 D position. The depth of placement of the implant platform should be about 3mm from the CEJ of adjacent teeth and thus be deep enough to create an ideal emergence. Needless to mention, the mesiodistal and buccolingual placement of the implant must allow the screw access of the final restoration to be from the central fossa of the final restoration. After the implant is placed, a custom healing abutment is fabricated chairside using a temporary cylinder. These can be made by adding flowable composite on the cylinder after the socket area around the implant is protected by packing teflon tape in it. Alternatively, as in this case a prefabricated, acrylic healing abutment shell was fabricated specifically for #46 preoperatively. After implant placement, this was luted to the temporary titanium cylinder with flowable composite. After integration of the implant, at three months, the peri-implant soft tissue displays correct contours and these are replicated in the final abutment following the Triple Scan technique as demonstrated in the figures below with legends that explain the technique. Essentially, the first scan records the tissues with the custom healing abutment in situ. The second scan is of the implant itself with the surrounding tissues using a scan body. The third scan is of the custom healing abutment extra-orally while it has been attached to an implant replica. At the lab, on dedicated designing software such as Exocad, the data from the three scans is merged together to design a custom final abutment that can be milled from titanium or any other suitable material and a final restoration is designed and milled to fit the custom abutment.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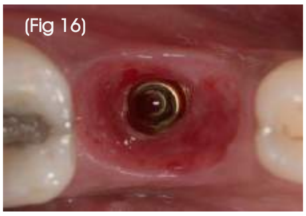
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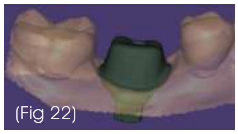
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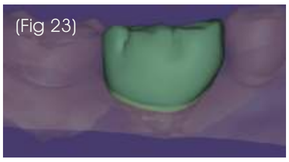
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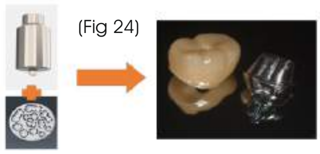
(Fig 24)


(Fig 25)


(Fig 26)


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Conclusion:

The subgingival shape of the final restoration in implant dentistry must match the shape of the custom healing abutment or the provisional restoration. With digital workflow as described in this article, the copying of these contours and fabrication of final restorations with accurate subgingival contours has become very easy and predictable. This helps the clinician-lab team to achieve consistently good emergence that is so crucial for esthetics and hygiene and thereby the overall health of the implant-soft tissue complex.

Legends for Figures:

Fig 1: Inappropriate emergence for a lower molar created by stock healing abutment

Fig 2: Appropriate soft tissue profile for correct emergence profile of lower molar created by custom healing abutment

Fig 3: Preoperative status of structurally poor tooth (#46) requiring extraction

Fig 4: Extraction done of the offending tooth after sectioning the roots

Fig 5: Osteotomy prepared with site optimization with Densah drills for immediate implant placement

Fig 6: Implant being installed

Fig 7: Final position of Implant in the Socket with high ISQ value of 75

Fig 8: Temporary Titanium Cylinder attached

Fig 9: Prefabricated Acrylic shell being tried on the temporary cylinder

Fig 10: Prefabricated Acrylic shell being attached with flowable composite

Fig 11: Prefabricated Acrylic shell attached with flowable composite

Fig 12: Custom healing abutment being finished and polished extraorally

Fig 13: Finalized shape of custom healing abutment

Fig 14: Custom Healing Abutment secured on the implant with a torque of 30 Ncm

Fig 15: Post-Surgical Radiograph

Fig 16: Healed site at 3 months after surgery demonstrates good tissue volume and anatomically accurate tissue contour

Fig 17: First scan of Implant site with custom healing abutment in place

Fig 18: Scan body on the implant for second scan

Fig 19: Data from Second Scan. The hex of the implant captured

Fig 20: Third scan is of the custom healing abutment placed on an implant replica

Fig 21: Data from the scans merged in software. The green hue is of the custom healing abutment; the contour of which will decide the final shape of custom abutment

Fig 22: Final design of Custom abutment that has been copied using the custom healing abutment as a template

Fig 23: Final Zirconia restoration being designed on custom healing abutment

Fig 24: Premill Titanium abutment used to manufacture custom abutment followed by cement retained zirconia full contour monolithic crown with screw access open for retrievability

Fig 25: Custom Titanium milled abutment in situ

Fig 26: Final zirconia restoration cemented with definitive cement

Fig 27: The entire abutment-restoration assembly removed to clean off the excess cement

Fig 28: Final Restoration in Situ

Fig 29: Immediate Post-operative radiograph


Dr Ali Tunkiwala


Danesh Vazifdar

DIGITAL SYNERGY IN SURGERY & PROSTHETICS:

FMR on implants

Introduction :

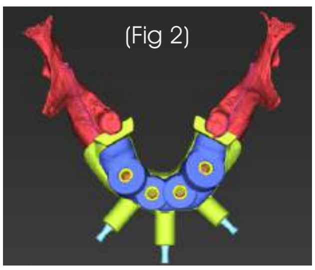
Over the years, innovations relating to equipment, techniques and technology in the field of dentistry have pioneered the so-called 'Digital Dentistry Era'. The application of artificial intelligence and software in planning and execution has broadened the spectrum of treatment modalities and enhanced the possibilities, taking us out of ordinariness and into a realm of virtual empowerment. When it comes to implant dentistry, we cannot deny the fact that pre-surgical planning and simulation have undeniable advantages, be it communicating the plan with the patient or a near flawless transfer from the operating table to the mouth. Operator benefits include a noticeable reduction in operating time, and surgical invasiveness, while the patient benefits mostly from reduced visits and lesser post-operative discomfort. Computeraided design – Computer aided manufacture (CAD-CAM) technologies have two-pronged applicability by way of additive and subtractive workflows. Furthermore, 3D printing has changed the way we look at hard and soft tissues from the perspective of implant dentistry. We can now easily scan and print accurate models, simulate and overlay soft tissues or even use the DICOM capture from the CT scan to print a model with an overlayed surgical stent. Techno-polymers, hybrid composites and gen-next polycrystalline materials offer excellent properties of mechanical and thermal resistance, implying that we can carry the sterile models/templates onto our surgical trolleys and into the patient's mouth without contaminating the surgical field.

Case workflow

Here-in we showcase how the digital synergy between surgical and prosthetic planning has eased the process of full mouth rehabilitation. The existing dentition was mutilated and deemed fit for total extraction (Fig.1) The gentleman approached us with a need to restore the form, function and speech (Fig.7) 3D printed models made from the patient's DICOM CT data provided us with an accurate representation of the available bone in the maxilla/mandible. A well-fitting removable prosthesis was made in line with form, function and aesthetics. The same was scanned and files merged with the DICOM data using the Codiagnostix software to provide us with a virtual position of the future teeth. This helped plan the virtual position of 4 implants per arch positioned in a 3D envelope of bone (Fig.2) Keeping in line with the prosthetic transition zone from natural to artificial pink, the plan necessitated a reduction in the bone platform. The first guide printed was a master guide (Nextdent SG, 3D systems). This was used for osteotomy to the planned level of bone. The master guide placement was ascertained using a seating jig (duplicated using the patient's existing prosthesis) (Fig.5). This ensured an accurate transfer from the plan to the surgical table. Bone pins were used to secure the master guide to the existing bone platform (Fig.3) The second stack-on guide was for fixture placement (Fig.4) An immediate interim PMMA milled prosthesis for both arches was engineered to be stacked onto the master guide for accurate positioning during pick-up with the titanium cylinders (Fig.6). Soft tissue height was calculated on the software and appropriate multiunit abutments were chosen for each fixture position.


(Fig 1)


(Fig 7)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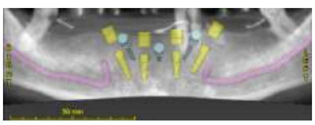
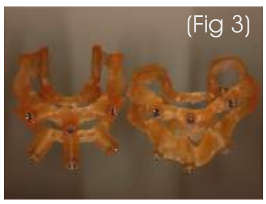
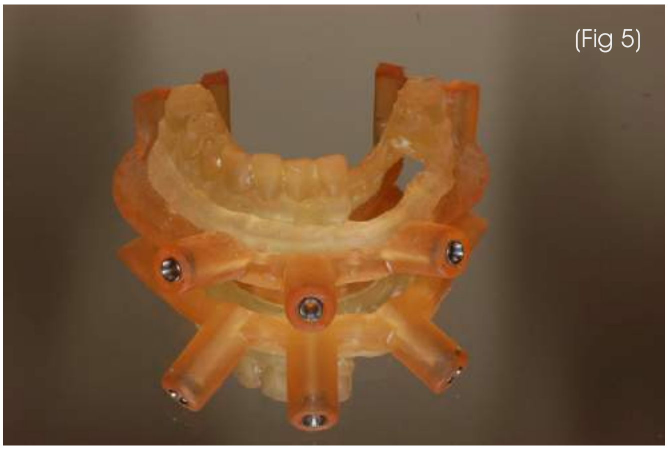



(Fig 3)


(Fig 4)

The procedure was carried out on an OPD basis under local anaesthesia. Full-thickness mucoperiosteal flaps were elevated and the master guide was secured using bone pins. Ostectomy was carried out using a rotary bone trimmer to the pre-designated level. Thereafter the stack-on guide was placed and fixtures were placed as per the plan using the manufacturer's guided placement kit (Biohorizons Inc.). Once all fixtures were at the desired depth, the stack-on guide was removed and multiunit abutments were inserted as per the manufacturer's recommended torque. Titanium cylinders were secured onto the multiunit abutments, the surgical site isolated using a rubber dam and the prosthesis snapped onto the master guide. The cylinders were picked up in the prosthesis using self-curing resin (Protemp, 3M). Wound closure was done using 4,0 vicryl sutures (J&J, USA) Finishing and polishing of the prosthesis were carried out in the laboratory and the same was delivered within an hour of surgery. This restored the form, function, and aesthetics of the patient on the day of surgery via a predictable approach (Fig.8)


(Fig 5)


(Fig 6)

Take home message:
Given the fact that a traditional protocol would have involved multiple visits before the prosthesis was inserted this digitally enhanced rehabilitation is fast, effective, and convenient from the patient's perspective, not to mention the accuracy of surgical deliverance via multiple 3D printed stents.

Keeping in line with the dynamics of digital dentistry and the fluidity of advancing technology, it may be good practice to speculate that protocols available to us today be subject to rapid obsolescence, being replaced by more cutting edge applications including robotics.


(Fig 8)

Dr. Yazad Gandhi

Dr. Gandhi is a Oral & Maxillofacial Surgeon practicing in Mumbai, having trained under Prof. Wilfried Schilli, Director of Maxillofacial Surgery at the Freiberg university, Germany & under Prof. Karl Kahnberg, Director of the Maxillofacial department at the University of Goteborg, Sweden for Hard & Soft tissue surgery. He has trained for Endoscopic Sinus surgery at the Ninewells Hospital, Dundee & Blackpool Victoria teaching hospital, Manchester, UK. Dr. Gandhi is the Fellow and registered speaker of the ITI (International Team for Implantology), a Fellow of the International College of Dentists and a Fellow of the International Congress of Oral Implantologists. He remains on board as a reviewer for the Journal of Maxillofacial & Oral Surgery, the National Journal of Maxillofacial Surgery and is the section editor for the Journal of Oral Biology and Craniofacial Research. He holds a membership to the European Association for Osseointegration. He is the recipient of the Ginwala oration award for implant related hard tissue regeneration. He is an opinion leader for Biohorizons, Medesy and Geistlich. He has conducted numerous CDE programs and workshops related to implant surgery and prosthetics nationally and internationally. He has mentored implant training programs for nurturing young clinicians. He is the Director of Fusion Education, an organization that conducts CDE courses for dental surgeons across India. He has several national and international publications to his credit . Dr. Gandhi maintains a speciality practice at a private facility in Mumbai, with an attachment to a multi-specialty hospital.

Simplifying Anterior Implant Restoration- A Full Digital Workflow for a minimally invasive Aesthetic Rehabilitation-: (Case report)

Authors : Burzin Khan, Amir Khan, Danesh Vazifdar

Abstract:

Tooth replacement with a dental implant has become an increasingly favored treatment option. However, bone remodeling and resorption following tooth extraction compromises the gingival tissue contours for an aesthetic emergence profile of the implant restoration. Achieving predictable peri-implant esthetics requires a proper understanding and diligent handling of the tissues. Therefore, the key to maintaining the peri-implant esthetics is to preserve the osseous support with minimally invasive treatment protocol.

Objective:

The present case report describes a digital approach for minimally invasive guided implant surgery and immediate restoration with customized one-time Bio-HPP abutment and Final Emax crown in a single visit. The success of the treatment outcome was assessed by measuring the 3-dimensional accuracy of guided implant placement and soft tissue assessment using pink esthetic score (PES) over period of 12 months.

Conclusion:

Accuracy for static Guided implant surgery evaluated by surface registration protocol showed mean linear deviation of 1.7° at the apex of the implant and mean angular deviation of 2.2° which is within clinically acceptable range. Difference in the PES for 12 months from the baseline (0 days) is 1.1 suggesting very good peri-implant tissue tolerance to Bio-HPP abutment. Within the limitations of this case report, we can conclude that the described workflow validates satisfactory treatment outcome allowing implant placement in reliably right position with good accuracy and preservation of peri-implant soft tissue esthetics with reduced overall total treatment time.

Introduction:

The outcomes of dental implant treatment are amongst the most studied and most predictable of therapeutic options in modern dentistry[1]. Although the validity of titanium to bone osseointegration has been established beyond any doubt, the long-term stability of peri- implant hard and soft tissues remains one of the main challenges in implant treatment, especially when dealing with esthetic zone. Different micro and macro implant designs, surgical and prosthodontic protocols, prosthetic superstructures, implant-abutment connections and platform- switching concepts have been developed to minimize marginal bone loss and maintain peri-implant soft tissue levels[2]. However lack of evidence of the superiority of one design over the other has caused confusion among the practitioner to adopt any single treatment workflow to achieve optimal results. One of the limitations of the standard protocol is multiple visits for the prosthetic rehabilitation which warrants frequent disconnect and reconnect of various prosthetic component. Literature exhibits unfavorable changes in peri-implant tissue due to frequent mounting and demounting of the these prosthetic components, thus many researcher have advocated the use of one-time abutment concept to minimize these the changes and preserve the integrity of the peri-implant biological-cuff around the abutment[3]. Moreover, it has been established that abutment material play a great role in preserving biological architecture[4] Ceramic reinforced PEEK (Bio-HPP) has drawn a great attention in recent times for their excellent biocompatible property and are indicated as choice for final abutment for softer loading protocol in immediate implant restoration situation[5,6]. Thus, author here advocates a completely digital and minimally invasive guided treatment protocol following similar principles.

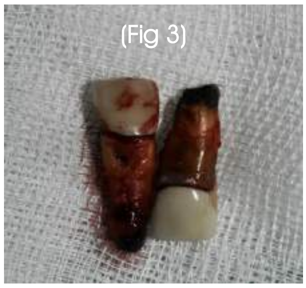
(Fig 1)

(Fig 2)

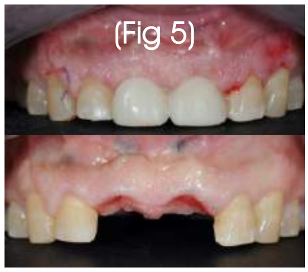
Case presentation:

38 years old male presented with pain in the upper anterior maxilla, intra-oral examination revealed root canal treated central incisors restored with PFM crowns. Gingival recession and large interdental spacing was observed in-between 11, 21(Fig 1). Radiographic examination revealed peri-apical radiolucency suggesting endodontically failing 11, 21 indicated for extraction. CBCT revealed absence labial cortical bone and inadequate bone availability for immediate implant placement (Fig 2). His medical history revealed no known drug allergies nor any medical condition. Social history suggested that he was a non-smoker and his exception were reasonable. Esthetic Risk analysis suggested high risk profile (SAC assessment tool, ITI). After detail analysis of all the factors, a treatment plan of extraction and guided bone regeneration was planned in phase1. Post 8 weeks of healing fully guided implant placement (CopaSky, Bredent medical, Gmbh) following flapless approach and immediate restoration with customised one-time Bio-hpp abutment (Copa Sky Bredent medical, Gmbh) and Emax Zir-CAD prime crown (Ivoclar Vivadent AG). The treatment plan was explained and was agreed by the patient.

Phase 1: Minimally invasive extraction is the first and one of the most critical steps. A sulcular incision with transeptal fiberotomy was performed, using the Periotome (Thinflex, GDC, India) to separate the tooth from the periodontal tissue. Caution must be exercised not to luxate the tooth bucco-palatally. Tooth was extracted with minimal trauma preserving the osseous structure as much as possible (Fig 3). A periodontal probe was used following tooth extraction to verify the integrity of the bony plate which showed absence of labial cortical plate. The socket was thoroughly debrided to eliminate the infectious material and photodynamic laser disinfection (Helbo, Bredent Gmbh) was performed. Guided bone regeneration (GBR) procedure was carried out using Bio-Oss collagen and Bio-Gide membrane (Geistlich) (Fig 4) . Surgical site closure was done using 4-0 vicryl suture . Post one-week of healing bonded provisional crown with ovate Pontic design was given (Fig 5).

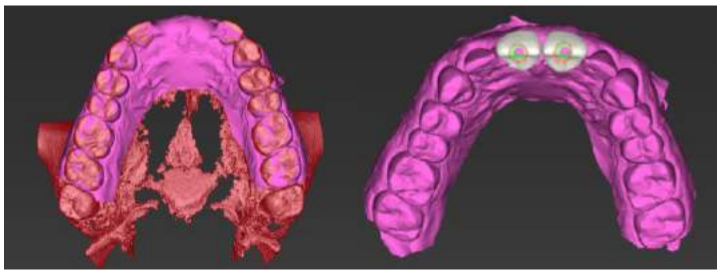

(Fig 3)


(Fig 4)


(Fig 5)

Phase 2, Implant placement and immediate restoration: Post 8 weeks of healing CBCT scan was made which demonstrated adequate native bone availability. Digital implant planning was carried out using CBCT data and Intra-oral scan on Co-diagnostix implant planning software (Dental Wings, Gmbh) and surgical guide was 3D printed (Asiga Max UV) with rotational markers to establish the exact implant position in relation to the internal connection to the abutment (Fig 6).Reverse prosthetic case planning was performed using Exoplan (Exocad, Gmbh) (Fig 7). Custom abutments were designed and milled using pre-fab Bio-HPP abutment (Copa Sky, Bredent, Gmbh) Abutment transfer jig was made to aid the correct insertion of the abutment after implant placement(Fig 8). Final restorative crown was fabricated using Emax ZirCAD Prime (Ivoclar), subsequently implant model with analogue was printed for verification of the abutment and prosthesis (Fig 9)


(Fig 6)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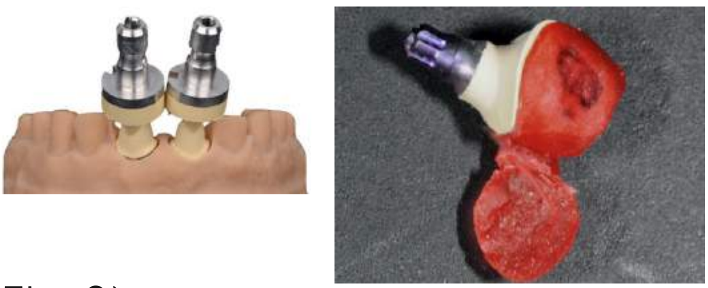
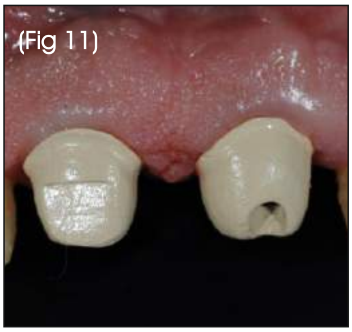

(Fig 8)


(Fig 9)

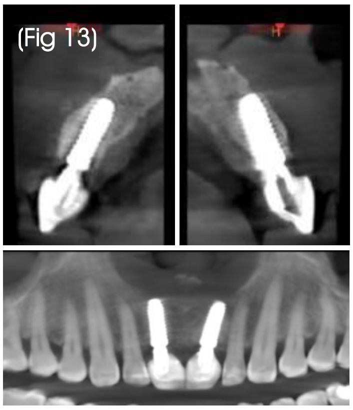
Guided implant placement:

The surgical procedure was carried out under local anaesthesia (lignocaine with Adrenaline1:80,000) and antibiotic cover (amoxicillin plus clavulanic acid 625 mg) starting 1 hour before surgery. Osteotomy was performed with Bredent Pro-guide system and fully guided implant placement was performed for 11, 21 region care taking care to match the hex of the implant mount with rotational marker of the surgical guide (Fig 10). Implant stability was measured using penguin RFA device which showed ISQ value of 75-78 indicating safe immediate loading of the implants. Implant Placement Torque values of >35Ncm were recorded for both the sites. Customised abutments were attached using the transfer jig and tightened to its final torque value of 25Ncm (Fig 11). Zir-cad Emax crown was luted following the recommended bonding protocol. Visiolign primer (bredent Gmbh) was applied on the Bio-HPP abutment and cured for 90 seconds each. The Emax ZirCad Crowns were pre-conditioned using MKZ prime (Bredent, Gmbh) and luted using self-adhesive dual cure (Rely X U200, 3M) resin cement (Fig 12). Case assessment and follow up: Post surgery CBCT scan was made and accuracy of the implant placement was assessed using surface registration protocol (Treatment evaluation tool, co-diagnostix, Dental Wing, Gmbh) and mean linear deviation of 1.7° at the apex of the implant and mean angular deviation of 2.2° (Fig 13) . Peri-implant health examined by visual analogue scale (Pink esthetic score) exhibited clinically non-significant difference for 12 months follow up (Fig 14)


(Fig 10)


(Fig 11)


(Fig 12)


(Fig 13)


(Fig 14)

Discussion :- Guided implant insertion allows a minimal invasive surgery without the necessity to elevate a surgical flap thereby maintaining periosteal vascularization aiding in stable peri-implant tissue.[7] Romanos et al suggested placement of the final abutment immediately after the surgical placement of the implants ("one-abutment at one-time" protocol) which is an important factor in achieving good crestal bone stability results.[8] José Eduardo Maté also reported that the use of BioHPP abutment in combination with guided surgery and immediate restoration (one-time-abutment) provides softer loading of the implant resulting in stable crestal bone and peri-implant tissue.[9] In clinical comparison to the results perceived in the present case report for rehabilitation in the esthetic zone with minimally invasive protocol, similar result could be achieved with various other techniques described in the literature, However, the proposed protocol seems to be associated with fewer complications such as marginal bone loss, decreased risk of peri-mucositis or peri-implantitis and allows a significant reduction in treatment time. Thus, the authors recommend the following treatment protocol in the management of challenging implant restorative cases.

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IPS e.max Press Ingots Lithium disilicate glass-ceramic for press technique

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Fracture Toughness[2]: 2.5–3 MPa m1/2

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