DIGITAL DENTAL FORUM
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DIGITAL DENTAL TIMES

DIGITIZE 1.0 OUR SPEAKERS

FOUNDERS MESSAGES

Message From Our Co Founder

Dr Burzin Khan

The Digital Evolution In Dentistry Is An Inevitable Change Which We All Have To Imbibe In Our Profession. Intra Oral Scanners With Their Varied Applications Of 3d Printing And Aligners Are Currently A Boom And Catching Up With That Is Navigated Dynamic Guided Procedures With Robotics. Artificial Intelligence Is Taking A Great Leap From Chat Gpt To Our Dental Software Applications Which Is Improving The Essence Of Diagnosis, Treatment Planning & Hence Giving Us More Predictable Treatment Outcomes. Incorporation Of Augmented Reality And Virtual Reality In Patient Communication And Planning Is A Paradym Shift. Digital Workflows For Every Dental Speciality Is Ever Evolving To Improve Predictability. Digital Dental Forum Is Commited To Bring To You The Latest Technology Advances And Provide A Learning Platform For All New Hardware, Software And The New Age Biomaterials Which Are Used For These Processes. We Keep To Our Promise Of Providing Education And An Unbiased Sharing Platform For Information Exchange Online As Well As Offline Bringing Together The Synergy Of Clinicians, Technicians As Well As Technology Experts. We Have Collaborated With Idd (institute Of Digital Dentistry) To Provide Our Members .Various Advantage And Access To Webinars, Reviews & Publications For Self Learning. This Year We Also Launch Our Digital Fellowship Program, Which Will Be A Holistic Modular Training Covering As Branches Of Dentistry. Digitize 1.0 Is One More Example Of Our Commitment Of An International Conference. With Best In Its Field Stalwarts Coming Together To Take Digital Dentistry To The Next Level

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Message From Our Co Founder

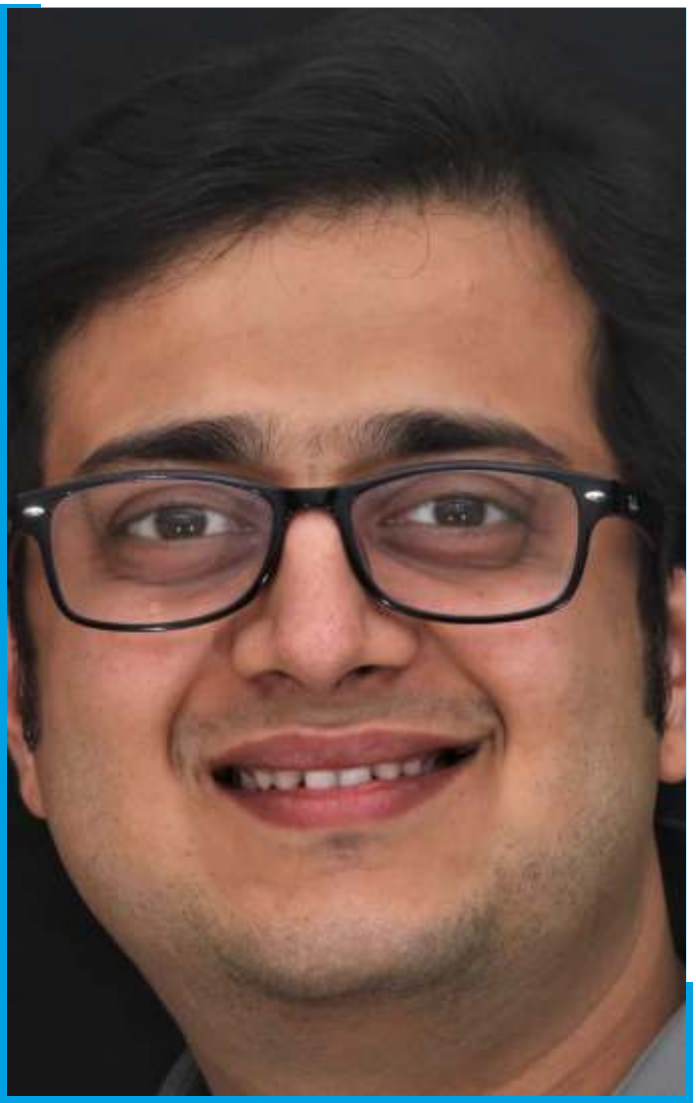
Danesh Vazifdar

We are excited to release our 2nd Publication of the Digital Dental Times in Conjunction with our 1st International Conference In Mumbai India. A Big Thankyou to the entire Dental Community that has supported this wonderful event and our Editorial board that has put together this Informative 2nd publication of our Digital Dental Times.

We want to encourage more articles in the future as Digital Dentistry is constantly evolving and we want the community on Digital Dental Forum to benefit from this information sharing platform, to get information that makes their Digital Journey as smooth as possible.

Looking forward to exciting "Digital Dental Times."

EDITORIAL MESSAGE



Dear Colleagues,

It is my privilege and great honour to address you as the editor of Digital Dental Times, a unique journal aimed at addressing all topics pertaining to the world of digital dentistry. This last decade has seen a gradual but tremendous rise in the use of digital technology in the field of dentistry. No longer limited to academia, digital technology has spilled over and revolutionized almost every practice of dentistry including, but not limited to, prosthodontics, implantology, periodontology, oral surgery, orthodontics, pedodontics and endodontics. Be it 3D scanners (intraoral, desktop and face scanners, CBCT) or computer-assisted design/computer-assisted manufacturing (CAD/CAM) software. Together with new aesthetic materials and powerful manufacturing and prototyping tools (milling machines and 3D printers), digital dentistry is radically transforming the dental profession and subsequently evolution of dental care and dental service to the patient. 3D planning opens the way toward a novel, accurate and biology saving dentistry that uses compatible and aesthetic solutions. Digital dentistry offers the dentist significant advantage of predictable treatment outcomes, accurate replications and overall improved efficiency in delivery of dental services. For the patients, embracing digital dentistry not only saves time but also cost in the long run, making digital dentistry a very viable option for both the service providers and the end consumers. I write with certainty, that in the coming decade, digital dentistry is going to flourish by leaps and bounds and enter every clinical practice, big and small, urban or rural. However, while digital methods have a firm position in the dental profession, it must be acknowledged that there are currently several limitations. A major challenge, we are facing presently, is that with the massive innovations storming the digital market incessantly, the digital dentistry industry is being led by the suppliers of the technology and not unbiased dental clinicians. This leads to an obvious conflict of interest in providing protocols and information to the dental professionals. There is a sizeable gap of digital dentistry guidelines for the dental practitioner, more so with unbiased and objective point of view free from sponsors' influence. Additionally, while many clinicians are familiar with digital technology, not many are versed with using digital workflows for their high-end cosmetic practices. “Digital Dental Forum” (DDF) aims at filling these gaps and streamlining various workflows in all dental fields using digital technology and objectively provide unbiased opinion on the technological front as well. DDF will play a crucial role in connecting the bridge between the new technologies that are coming up on daily basis, filtering them on a scientific basis and passing on the best of the knowledge to fellow dentists. With this end goal, I am pleased to announce “Digitize 1.0”, the first annual national conference, solely dedicated to digital dentistry. This conference will help connect hundreds of dentists, with a plethora of speakers imparting their knowledge and educating our fellow dentist all latest protocol for workflow in various digital dental procedures without any bias or company pressures. Our journal “Digital Dental times” is a platform where various dentists and laboratory technicians showcases various research articles, case presentations etc. We have enjoyed putting together this publication and tried our best to filter in the best of the publications showcasing step by step digital work flow in various clinical situations. I genuinely hope you enjoy reading this newsletter and it inspires you the take back immense knowledge and serve your patients to best of the digital technologies available to us. We are open to accept all diligently documented cases pertaining to digital dentistry and look forward to your cooperation and participation in the near future.

EDITORIAL TEAM

DR HEMAL SHAH , DR AMIR KHAN , DR ANIRUDHA NENE

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Digital Protocols in Bilateral TMJ Replacement Surgeries

INTRODUCTION

Temporomandibular joint is one and only movable joint of the face articulating mandible to the base of the skull. Ankylosis of the temporomandibular joint (TMJ) involves the fusion of mandibular condyle to the base of the skull. One of the commonest reasons for this kind of fusion is malunion after trauma. Post traumatic ankylosis can be reasoned by different pathologic mechanisms but most popular hypothesis is injury to the condyle especially intracapsular sagittal fractures leading to hemarthrosis and secondary hematoma formation leading to ankylotic mass formation.

Temporomandibular joint ankylosis is a disabling condition of the masticatory system that restricts the food intake and alters speech. Another result of this condition is poor oral hygiene resulting to rampant caries and destruction of the entire dentition.

There are various surgical modalities to correct the post traumatic ankylosis depending upon the type and extension of ankylotic mass. Treatment options are selected according to the severity of the ankylosis and restriction of the mouth opening. After determining the cause for restriction of mouth opening is due to bony fusion of the joint structures, various surgical options like gap arthroplasty, coronoidectomy and costochondral graft with rigid internal fixation, prosthetic joint replacements are considered.

Although there is no unanimous agreement on the treatment of ankylosis of TMJ. Most accepted surgical treatment procedures are prosthetic implants and autogenous grafts. The alloplastic reconstruction of temporomandibular joint have multiple advantages such as avoiding donor site, morbidity, reducing surgical time avoiding recurrence of ankylosis and closer reproduction of normal anatomy of the joint.

The surgical treatment of TMJ ankylosis complicated by the altered anatomy and increased injury to the structures within the cranial fossa that are in close proximity to the ankylotic mass. Most of the cases are with absence of normal bony landmarks making the recession of ankylotic mass challenging.

Digital revolution happening in the field of surgical planning using three dimensional reconstruction of facial structures and computer aided designing and surgical mockup help us in accomplishing these complicated surgeries at an ease. computer assisted TMJ surgery includes preoperative virtual surgical

planning and fabrication of surgical cutting guides, and custom made prosthesis for cranial and mandibular components to recreate the total joint.

CASE REPORT:

A 28 year old male patient (N.K.) was referred to our hospital for treatment of the post traumatic trismus six months after his road traffic accident. History revealed he was admitted in a neuro care centre after a road traffic accident and head on collision resulting in subdural haemorrhage (SDH), Subarachnoid haemorrhage (SAH) and subsequent craniotomy. During his initial days in intensive care unit, he was given mandibular symphysis fracture reduction and plating to stabilise fractured mandible.

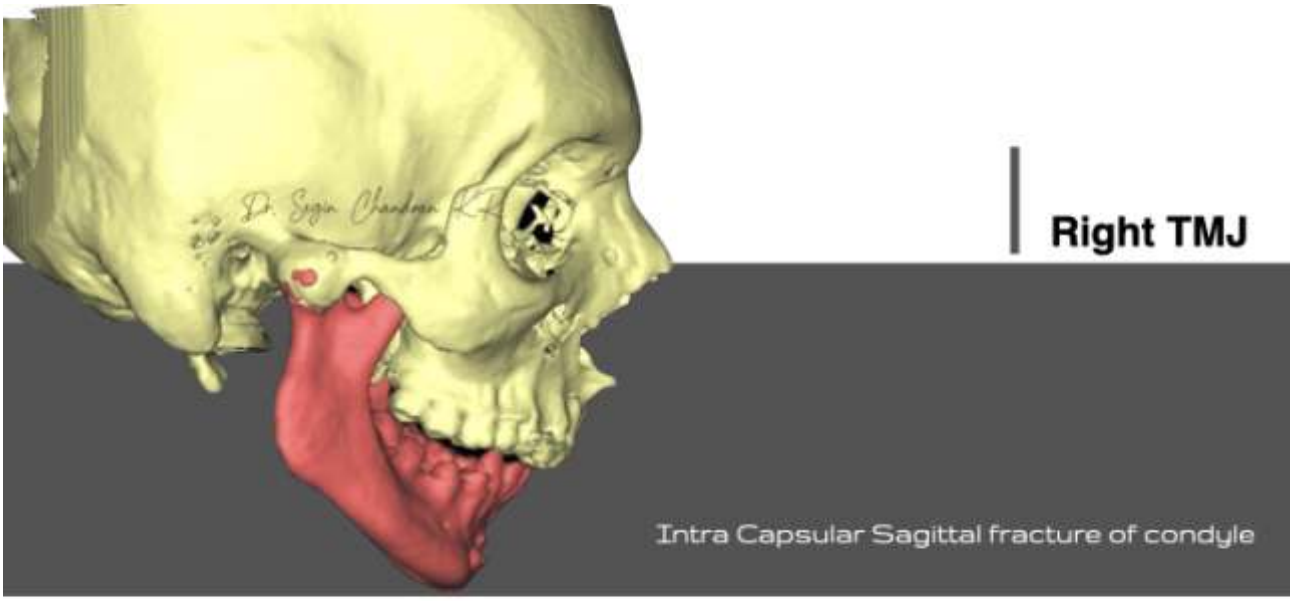
When reported to our dental office, he was with less than 2mm mouth opening and with totally mutilated dentition. Initial radiographic examination using CBCT revealed bilateral condylar fracture. Right TMJ showed sagittal fracture of condyle resulting in ankylotic mass fusing with glenoid fossa and left side TMJ showing medially displaced fractured segment resulting in malunion.

After counselling and discussing the options left for the rehabilitation, both the surgeon and the patient decided to go for virtual surgical planning, guided surgical protocol and to replace both the joints with the alloplastic custom made prosthesis.

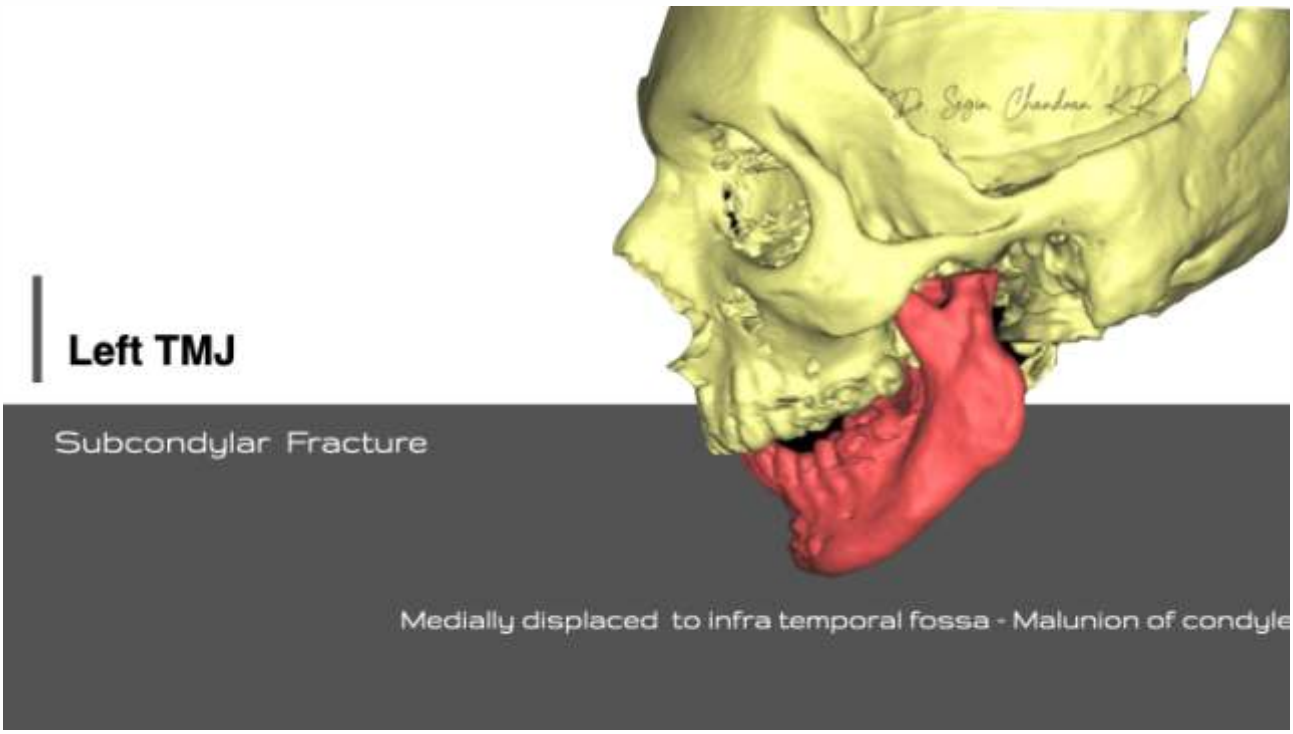
Sequencing in Virtual Surgical Planning and Execution is narrated here:

PRE OP OPG

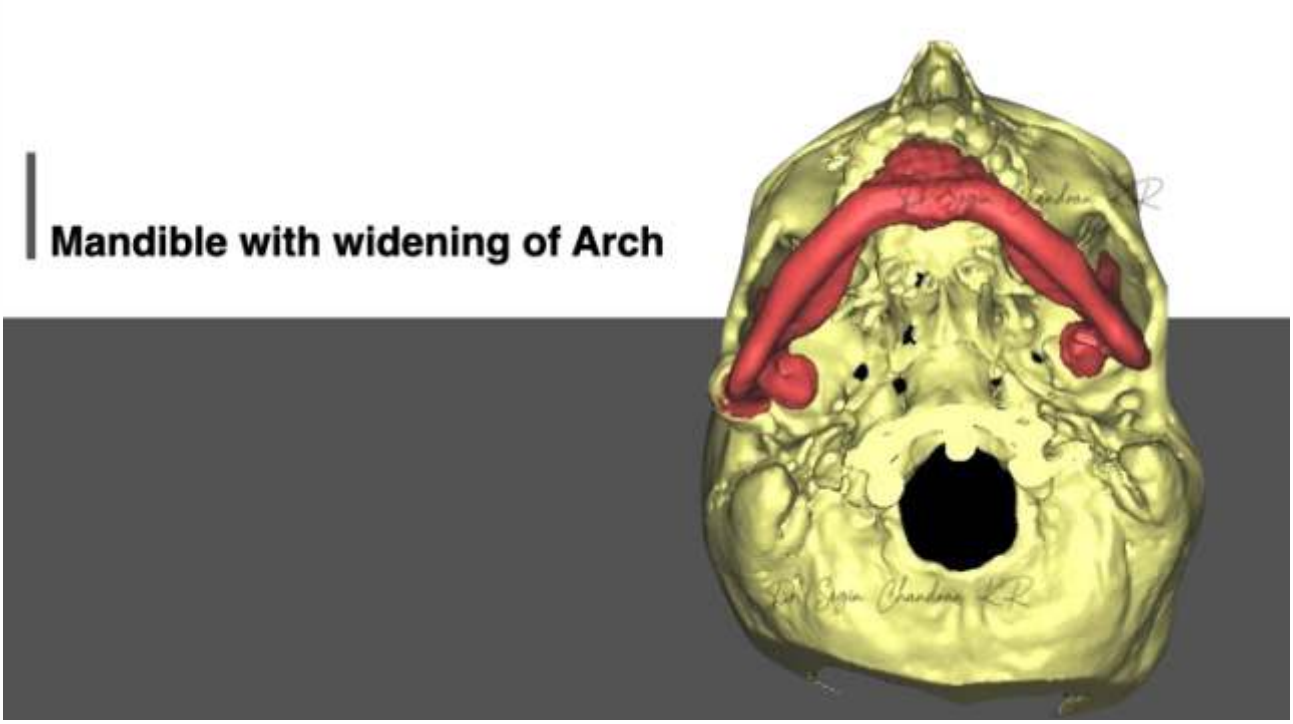
Radiographic evaluation of patient was done initially with panoramic 2D imaging that revealed presence of mini plates placed in the symphysis and right side ankylosis with the fusion to glenoid fossa and medially displaced condylar fragment on left side. The 3D imaging was done for virtual surgical planning and the diagnosis was confirmed in all planes.



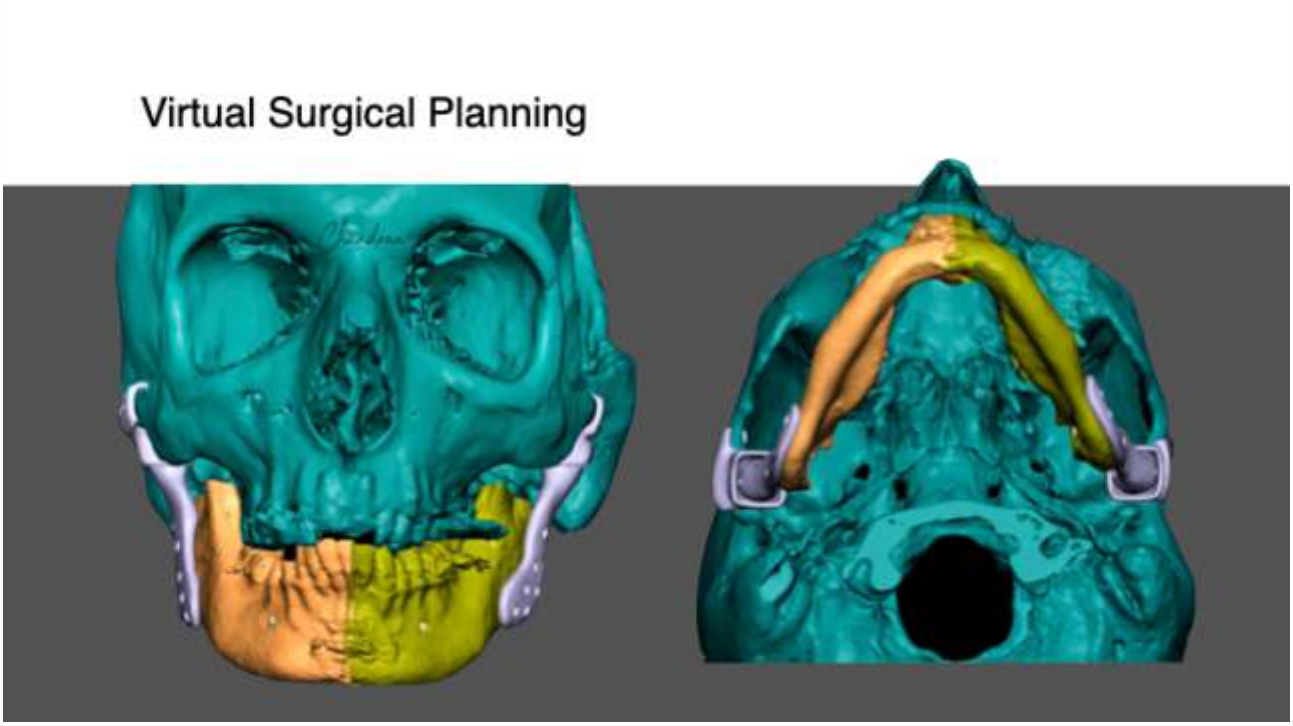
Medially displaced medial pole - Lateral pole fused with glenoid fossa



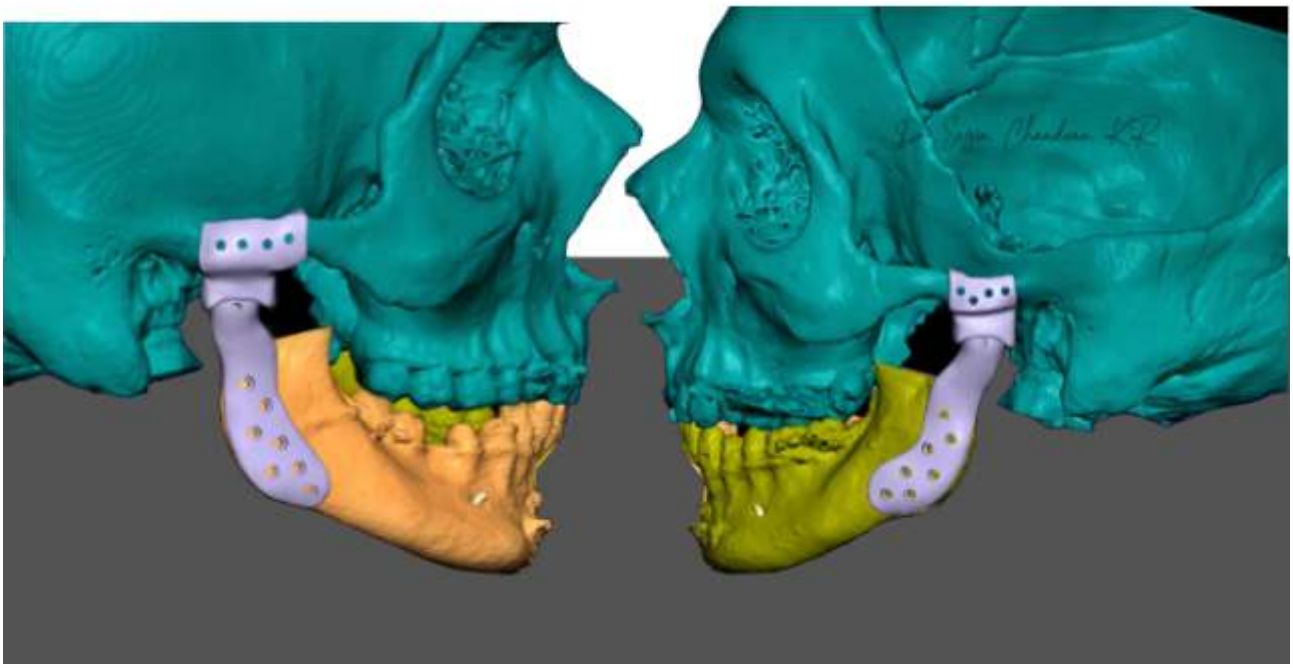
Disturbed occlusion and mutilated dentition was noted because of widening of mandible causing retrognathic chin and posterior cross bite.

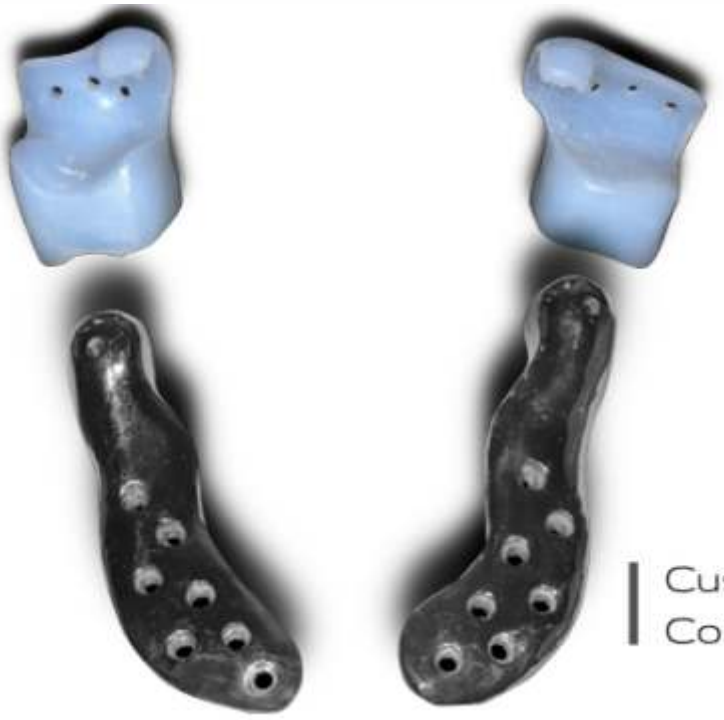


Improper stabilisation during the fracture reduction lead to widening of arch necessitating re-fracturing the symphysis, correlating the occlusal plane and correcting the arch form.



Custom made glenoid fossa and condylar segments were designed and suggestions from surgeons were incorporated into the design.



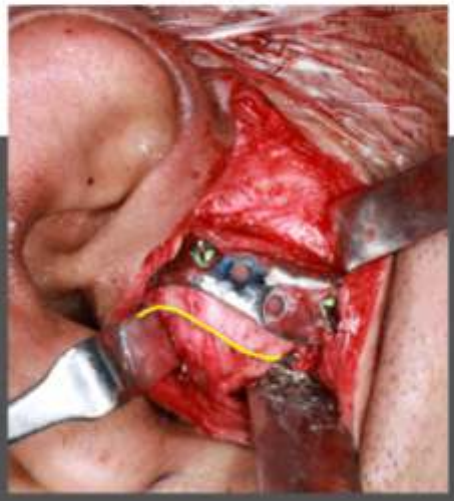


Custom Made Fossa and Condylar Segment

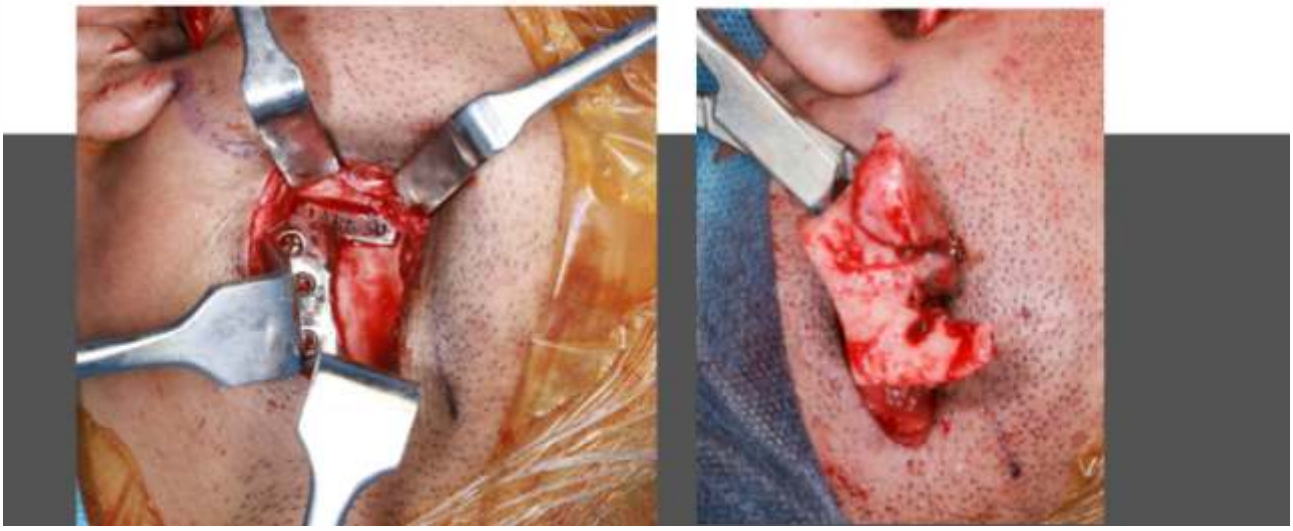
Titanium 3D printed condylar components and machine milled glenoid fossa components from blocks of ultra high molecular weight polyethylene were fabricated and kept ETO sterilised for the surgery.

Endaural Incision.

Cutting Guide



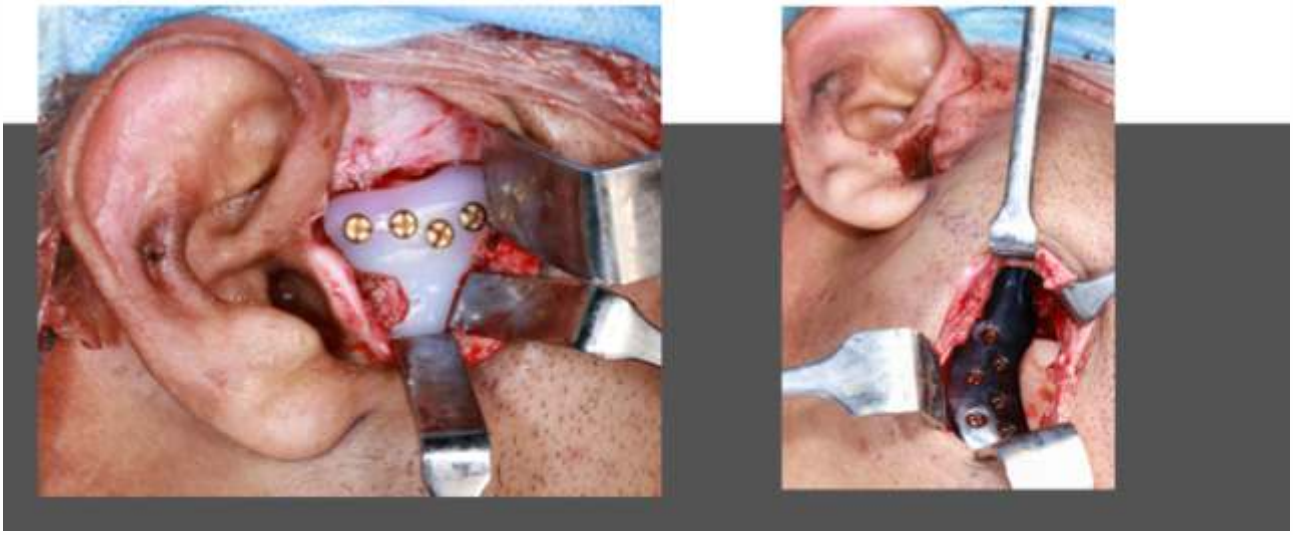
Mandible Cutting Guide and Resected condyle



The approach was made using endaural incision and by using titanium 3D printed cutting guides, the resection of ankylotic mass was done creating room for the prosthesis.

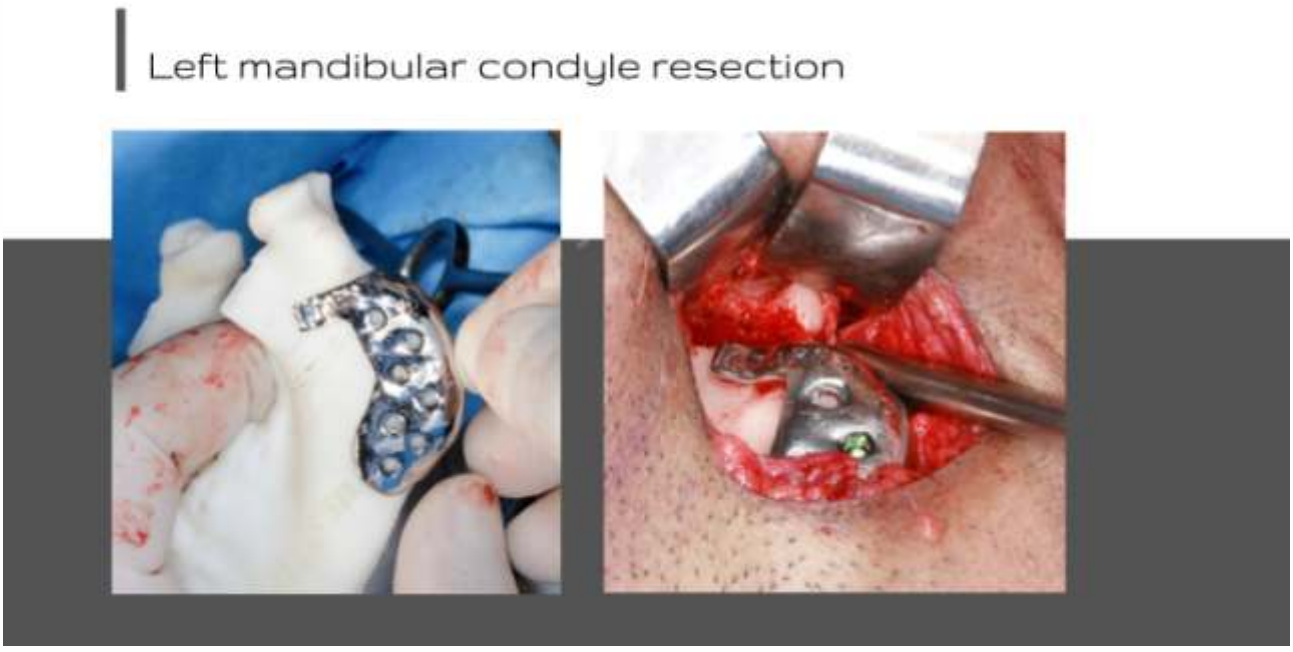
Fossa component Fixed

Condylar Component

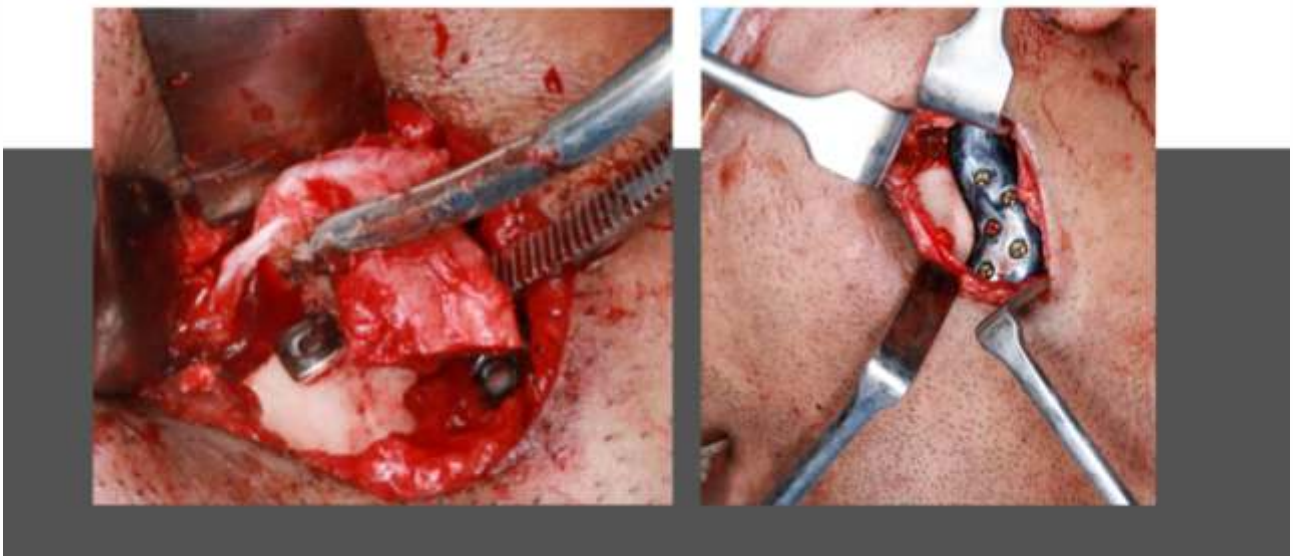


Fossa components were fixed to zygomatic arch in a predetermined position correlating the screw positions of guide.

The fractured and medially displaced condylar fragments were removed from left side using the end aural approach.

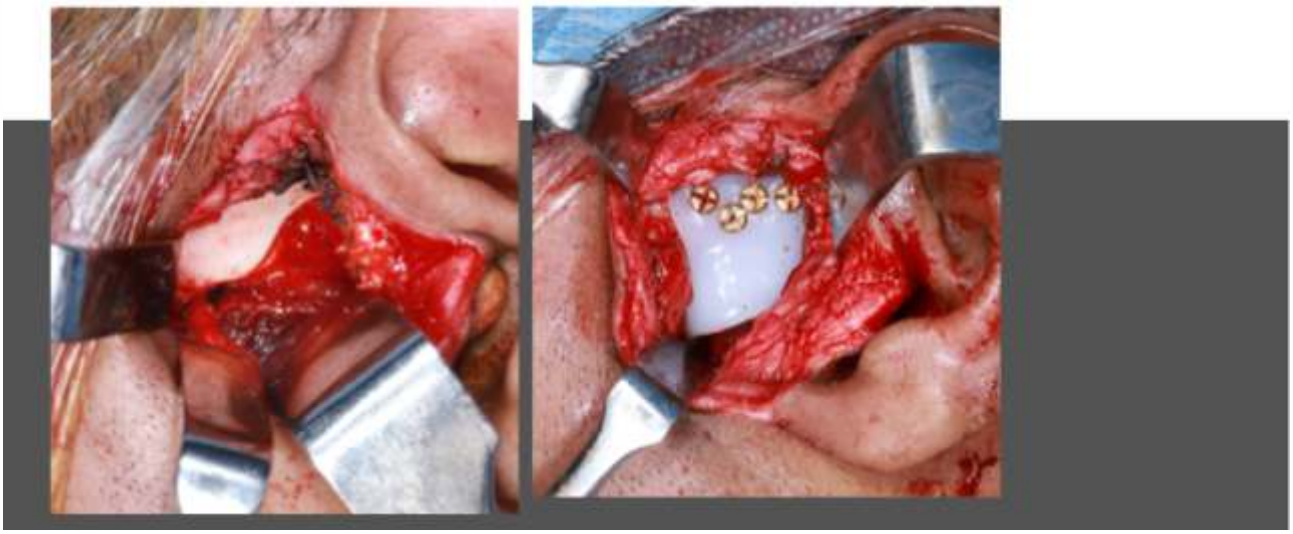


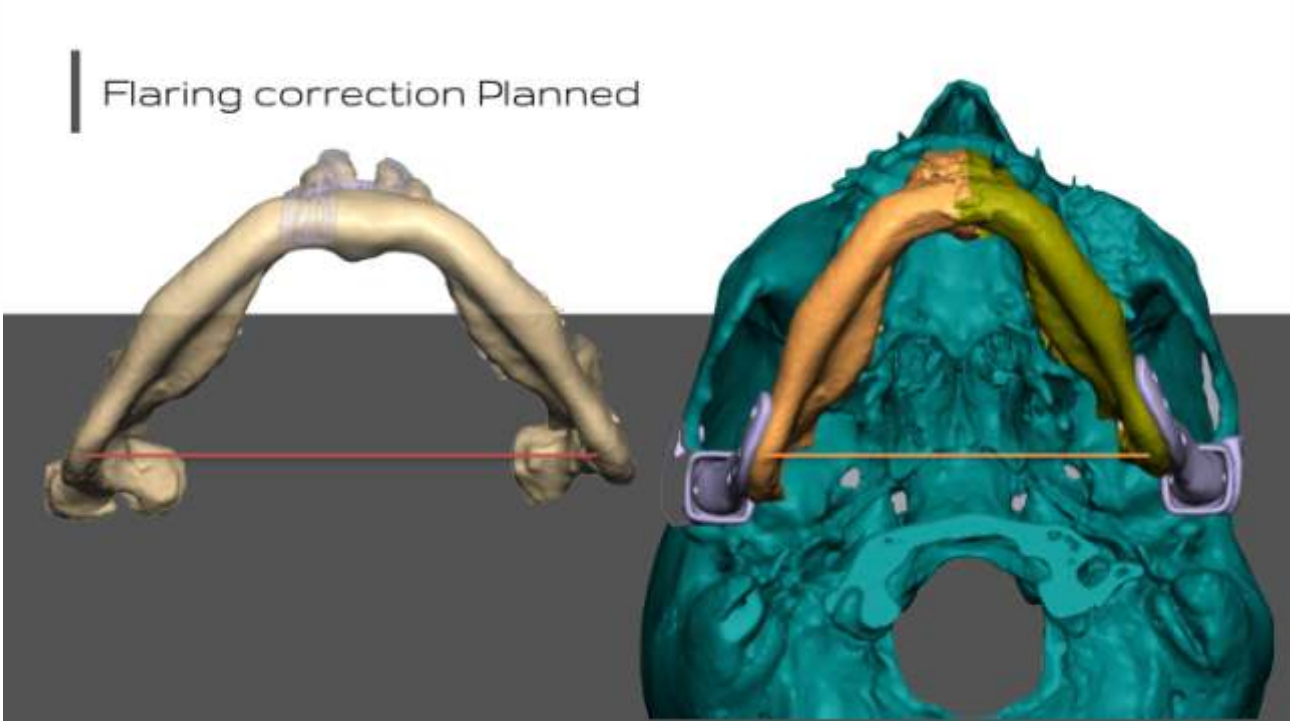
RESECTED LEFT CONDYLE



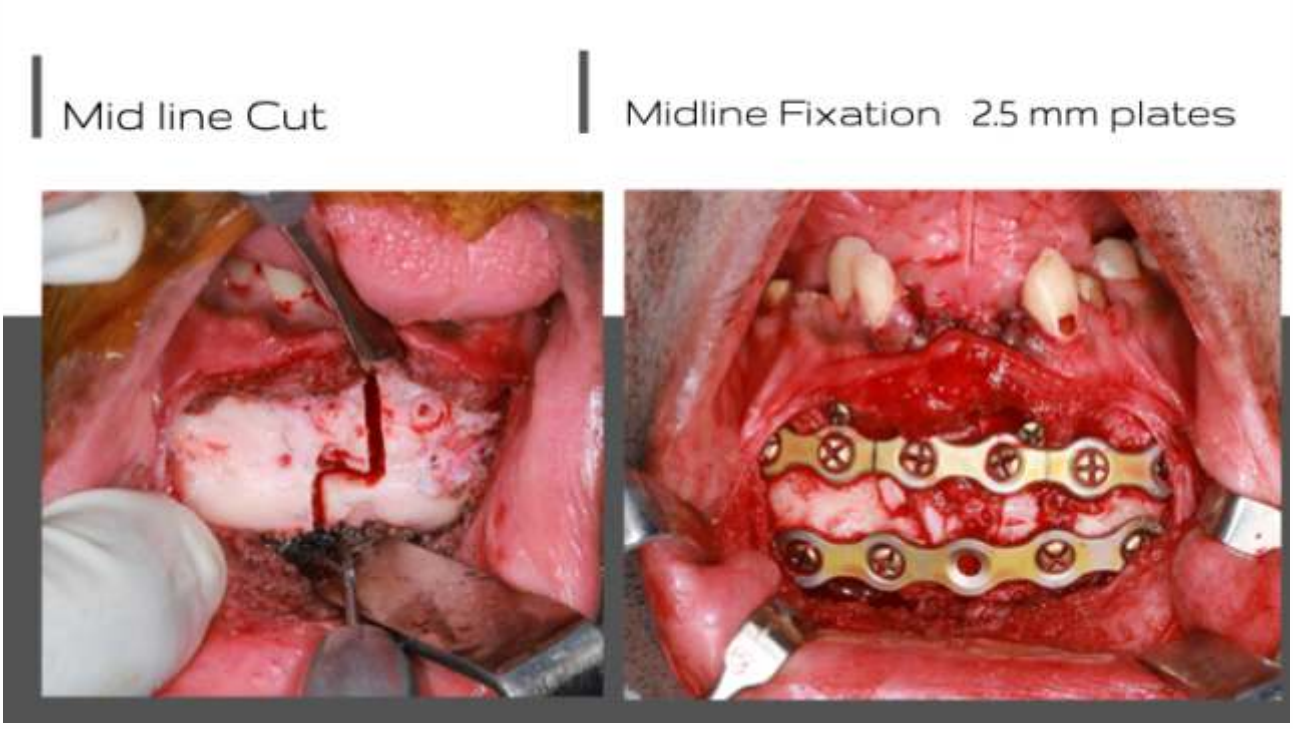
After fixing both condylar and fossa components, the refracted of mandibular symphysis was done after removing the plates and screws used before.

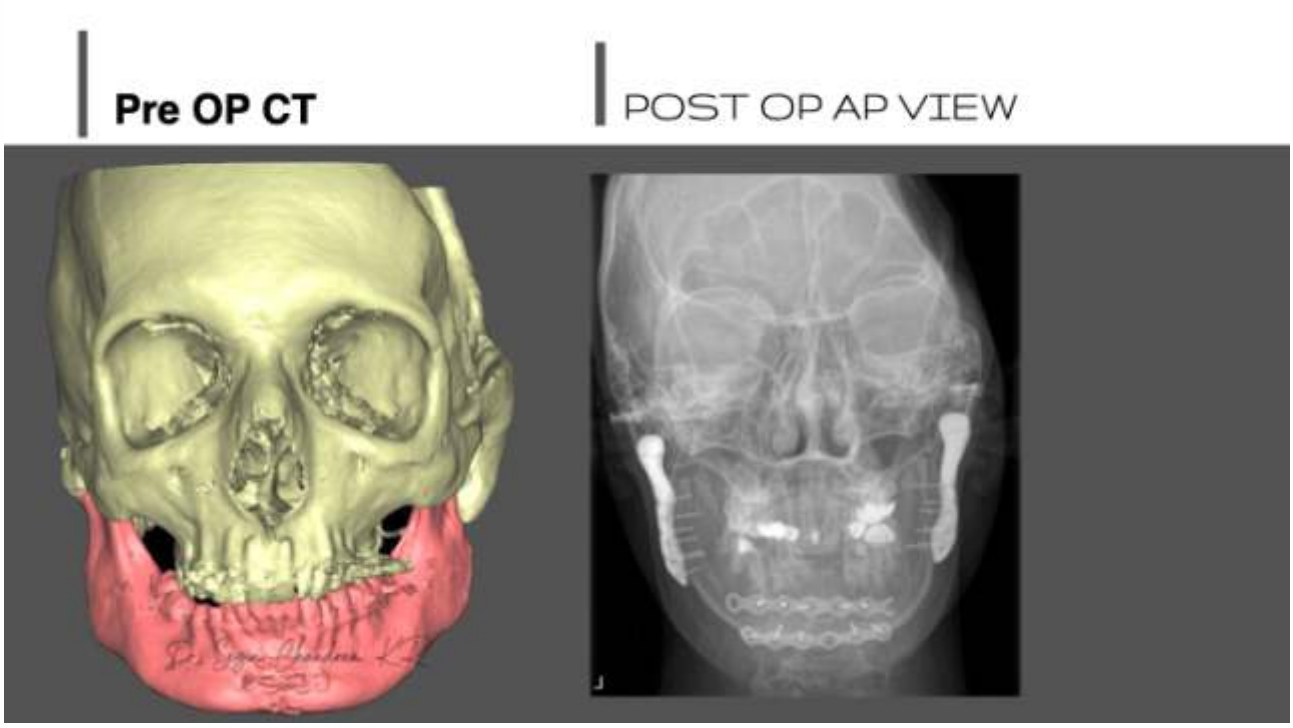
Left TMJ - Fossa Component Fixed





Mandibular flaring was corrected using the occlusal wafers made in ideal position using virtual planning.





Occlusion and mouth opening was checked intraoperatively and found satisfactory upto 30mm. After initial healing and post operative evaluation, jaw exercises and physiotherapy were suggested.

Patient was taken up for prosthetic rehabilitation and could able to get desired function, aesthetics and a stable mouth opening.

DISCUSSION:

Digital planning using virtual surgical planning (VSP) and Computer assisted surgeries (CAS) are becoming gold standard for the maxillofacial reconstruction. Though time consuming and a lot of pre surgical workup, surgeons are at an ease because of proper guidance for resection making it more safe, less procedural time and precise predictable components.

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Oral and Maxillofacial Surgeon Oral Implantologist

Dr.Segin Chandran is a renowned multifaceted Dental and Surgery specialist with experience of more than 23 years. He is an eminent Oral and Maxillofacial Surgeon and Oral Implantologist with special attention to Orthognathic Surgeries and Trauma Care.

He was awarded fellowship (FICOI) and Diplomate certification in Implantology from International Congress of Oral Implantologists (DICOI). He is a fellow (FISOI) and an invited speaker for Indian Society of Oral Implantologists (ISOI**)** from many years.

He is a key opinion leader for MegaGen Dental Implants (Korea) and Dentsply Sirona (Germany). He is the first international speaker for MegaGen from India MINEC Knight.

He has been awarded with the Famdent Excellence in Dentistry Awards Specialist dentist of the year Oral Implantologist in 2019. He was bestowed with the Dr APJ Abdul Kalam Life Time Achievement National Award in 2019 for his immense contributions in the field of Digital Protocols.

He is an active member of **AOMSI** (Association of Oral and Maxillofacial Society of India) and Digital Dentistry Society (**DDS**). He actively promotes digital solutions for Dentistry, Implantology and Surgery. He is currently doing his research in the field of accuracy levels of digital protocols.

He is the Chief Surgeon and Director of Kamala Dental Speciality Hospital, a premiere institution for Dental and Facial Surgical Corrections, a **NABH** accredited super specialty dental hospital in Kerala.

DIGITAL TOOLS FOR SMILE DESIGNING AND PERIO-ANALYSIS: CASE REPORT.

AUTHORS : DR BURZIN KHAN,
DR AMIR KHAN, DANESH VAZIFDAR.

ABSTRACT

Introduction:

A disharmonious smile results from excessive gingival exposure or gingival margin misalignment is a frequent finding in patients. The most common cause is altered passive eruption; This clinical report describes a comprehensive digital approach and its clinical use in diagnosing, planning, and fabricating surgical stent for crown-lengthening surgery for aesthetic rehabilitation with CAD milled Emax veneers. The digital protocol uses extraoral facial images, diagnostic intraoral digital scans, and CBCT Data to design a dual stent consisting of a gingivectomy guide and an alveolectomy guide used in periodontal surgery.

Clinical significance:

Rehabilitating anterior dental aesthetics should involve interdisciplinary and facial-driven planning for a pleasant long-term outcome and follow-up. Using digital tools allows clinicians to develop proper communication with the team and patient, leading to shorter more predictable and less invasive surgical techniques, reducing postoperative inflammation and increasing patient comfort.

Conclusion:

Digital smile design (Smile creator, Exocad, Gmbh) concept is a helpful tool in the aesthetic visualisation of patient's problem. It helps patients envision their treatment outcomes, improving the clinician's diagnosis and treatment planning. Computer-aided surgical stent for crown lengthening allows proper management of hard and soft tissue for achieving a predefined goal based on biological requirements and facially driven planning. In addition, digital quality control allows follow-ups compared with the preoperative condition and planned treatment plan.

INTRODUCTION

All desire a beautiful, confident smile, but when a patient wishes to attain that smile and is sceptical about undertaking the treatment and unable to visualise their treatment outcome, a clinician can use digital tools to guide in improving the aesthetic visualisation of the patient's concern, giving an understanding of the possible solution, educating and motivating them about the benefits of the treatment and increasing the case acceptance. Digital mode helps us to create and project the new smile by attaining a simulation and pre-visualization of the final result of the proposed treatment. A smile created digitally involves the participation of the patients in the designing process leading to the customisation as per individual needs and desires that complement the aesthetic and psychological characteristics of the patient, relating them to an emotional level, increasing their confidence in the process and better acceptance of the anticipated treatment.[1]

Coachman and Calamita described digital smile designing as a multi-use conceptual tool that can support diagnostic vision, improve communication, and enhance treatment predictability, by permitting careful analysis of the patient's facial and dental characteristics that may have gone unnoticed by clinical, photographic or diagnostic cast based evaluation procedures.[2,3]

Furthermore, Contemporary dentistry seeks to meet patients' expectations and promotes maintaining health and function. However, a patient's smile can often be aesthetically compromised by excessive gingival exposure or a compromised gingival contour. The most common cause of this is altered passive eruption (APE), in which the gingiva margin exceeds the regular limits of the anatomical crown, causing disproportion between the teeth and gum.[4,5] Thus, a crown-lengthening surgical procedure is applied to correct such gingival disharmony. Employing a digital tool such as 3D imaging and a computer-generated guide aids the surgical procedure and increases its predictability.[6]

Hence, this article aims to demonstrate how digital tools can treat a case involving APE with a compromised gingival contour and a distortion of the patient's smile due to excessive height, mesial-distal extension, and pronounced interdental spacing.

Case presentation:

A 32-year-old male dissatisfied with the appearance of his teeth visited our Clinic, opus dental specialities, India presented with discoloured teeth and spacing between the central incisor and expressed his determination to start a new smile makeover treatment (Fig. 1).


Fig. 1


Fig. 2

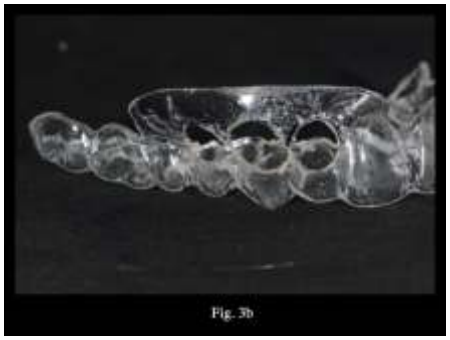


Fig. 3b

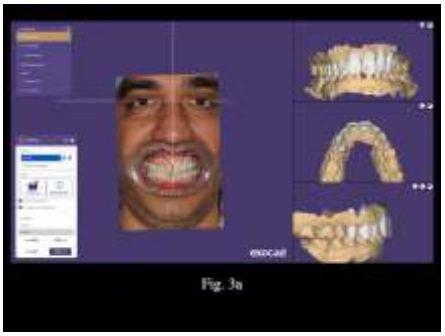


Fig. 3a

The patient presented in good general health with no known allergies or underlying medical conditions. No periodontal or tooth issues were detected, and he had reasonable expectations; his social history indicated he was a non-smoker. All procedures and examinations were conducted following informed consent. An attached 5–6 mm gingiva was observed during a clinical exam (Fig. 2). Photographs and intraoral scans were taken for data collection after the clinical and radiological assessment. A facially driven smile frame was designed using the Smile creator (Exocad, Gmbh), which revealed the need for crown lengthening to improve the smile appearance (Fig. 3a); therefore, a CBCT with retracted lips was required for perio-analysis and surgical planning. A digital patient was created by superimposing the clinical data, and a crown-lengthening stent was planned (Fig. 3b). The 3D simulation was presented to the patient, and the treatment plan was mutually agreed upon.

Perio-analysis and surgical planning:

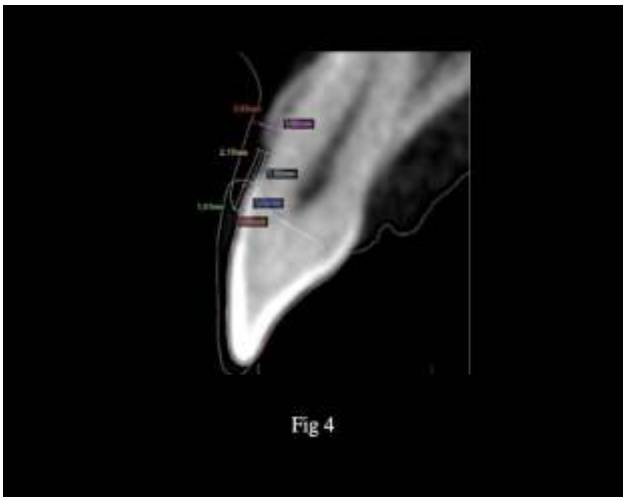


Fig 4

Taking the 2D facially driven smile frame as a reference, a 3D digital diagnostic wax-up was designed. Radiographic assessment was performed by measuring the distance between the bone crest to the gingival margin (pre-treatment biological width), Cement-enamel junction (CEJ) to the gingival margin, CEJ to bone crest, gingival and bone thickness, furthermore when superimposition of digital diagnostic wax-up was carried out (Exocad, Exoplan, Gmbh) following measurement was recorded (Fig. 4)[1]. Distance from the cervical margin of the wax-up to the gingival margin (determining the amount of soft tissue to be removed) and distance from the cervical margin of the wax-up to the CEJ (determining if the bone removal is required), thus this analysis allowed to determine the need of gingivoplasty associated with osteotomy and whether osteotomy could be performed with the flapless approach.


Fig. 5a Fig. 5b

Case Management

Based on clinical examination and CBCT analyses, the patient has a thick tissue phenotype Coslet's type IB warranting a gingivectomy and osseous surgery to establish 2–3 mm supra-crestal tissue attachment.[5] The patient presented good oral hygiene (without dental plaque and periodontal pocket). The proposed treatment plan included crown-lengthening with teeth 12 to 14 under local anaesthesia, eight laminate veneers along the upper arch from the first right premolar to the first left premolar and six laminate veneers along the lower arch from the right canine to the left canine. The surgical crown lengthening stent was designed using all the diagnostic data based on a digital wax-up. The lower margin of the labial band assists the incision for the gingivectomy. The top margin was used as a reference for bone removal, 2–3 mm above the cementoenamel junction (to create supracrestal tissue height). Local anaesthesia was induced using a 2% lidocaine solution with epinephrine at the ratio of 1:100,000. The stent was inserted, and internal bevel incisions for gingivectomy were made from 14-12 (Fig. 5a), followed by intrasulcular incisions with a 15c blade. A full-thickness flap was elevated to 4-5 m beyond the bone crest. Using the stent as a reference, an osteotomy was performed to attain a 2–3 mm distance from the future crown margins without removing the interproximal bone (Fig 5b). The flap was repositioned and stabilised using simple interrupted 5-0 vicyrl sutures.

Digital Smile Designing

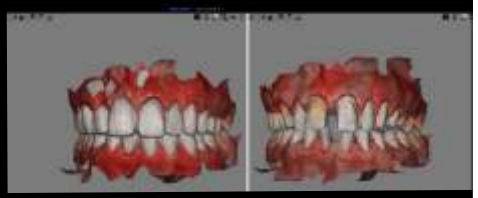
Photographs were taken in a forced smile, with retractors and at a 12 o'clock position to evaluate the distance between the teeth and the lip's vermilion. According to the Exocad smile creator workflow, two extraoral digital photographs were made in a frontal facial view with an exaggerated smile and a frontal facial view with full lip retraction and teeth in the maximum intercuspal position. Both photographs were captured using a tripod, with the patient's head held stable to achieve a consistent head position in both images (Fig. 6). The images were uploaded in a 2D digital smile analysis software (Smile Creator, Exo-cad) to perform the smile analysis and digital design of the proposed restorations. The Digital smile design started with three-line tracing, including facial midline and bi-pupilar lines, to verify the correct angulation of the photographs and the inter-commissural line, which showed slight lip asymmetry. The smile curve was then drawn, considering the shape of the lower lip. Further analysis showed that the ideal height-to-width ratio of the maxillary central incisors was 80%. Afterwards, the limits of each tooth were drawn to ensure that the esthetics of the smile was harmonic and an approximate simulation of the smile after treatment was generated. Esthetic and functional evaluation of the digital plan was performed by mounting the diagnostic wax-up models (Fig. 7) on a semi-adjustable articulator. The esthetic assessment was done by transferring diagnostic wax-up using an addition silicone mould (ExpressTMXT; 3M ESPE, USA) and Bis-Gmaacrylic resin (ProtempTM4; 3M ESPE, USA) and the anterior guides (incisive and canine) were checked for functional evaluation (Fig 8a).Following esthetic and functional approval of the mock-up, we performed minimally invasive tooth preparation (about 0.3 mm)with diamond tips through the acrylic mockup as a preparation guide (Fig. 8b). After that, polishing of the preparation was carried out. Subsequently, chair-side Bis-Gma Acrylic temporary veneers were fabricated, contoured and polished using an abrasive disc (Soflex, 3M, USA) and luted using the spot etch and spot bond technique (Fig. 9).

Fig. 6

Fig. 7

Fig. 8a Fig. 8b

Fig 9



Dual scan protocol:

Following tooth preparation, the dual-scan approach was taken to record the approved design of temporary veneers, followed by a definitive digital scan of prepared teeth using an intraoral scanner. Gingival displacement cord (size “0”, Ultrapak; Ultradent Products, Inc) was placed gingival sulcus to aid in gingival retraction (Fig. 10). The porcelain veneers were then fabricated using the 3D design previously accepted by the patient and CAD technology by incorporating a slight incisal cutback to allow for feldspathic porcelain veneering. The veneers were individually milled from lithium disilicate blocks (A1 Shade, IPS e.max CAD; Ivoclar Vivadent AG) and selectively layered with feldspathic porcelain (IPS e.max Ceram; Ivoclar Vivadent AG) to achieve the colour match. A bisque veneer trial was done to check the interproximal contacts and marginal adaptation using a shade try-in gel (RelyXTM Veneer Try-In; 3M ESPE, USA) (Fig 11).Luting the final veneers was performed under a moisture-controlled environment using an optra gate (Ivoclar Vivadent AG), enamel was etched with 37.5% phosphoric acid (Pulpodent Inc, USA) for 15 seconds, and a layer of dental adhesive was applied for 15 seconds, air-dried for 3 seconds and light-polymerized for 10 seconds (Fig. 12).

(Fig. 12)

Fig 11

Fig. 14

The veneers were etched with hydrofluoric acid 9.5% (Porcelain Etch, Ultradent Inc) and silane (Ultradent Inc). Translucent light-polymerizing resin cement (RelyXTM Veneer; 3M ESPE, USA) was used for the definitive bonding. Occlusion was evaluated and followed by intraoral finishing and polishing. Intraoral and extraoral images were obtained (Fig. 13a,13b,14). A soft silicone guard was provided for the patient with instructions to wear it at night.

Discussion :

This clinical report presented a digital workflow that enabled the clinician, patient, and dental laboratory technician to communicate effectively during treatment planning and to use the agreed- upon digital information to guide tooth preparation, the interim restorations, and the fabrication of the definitive porcelain veneers. The use of digital software, such as the smile creator (Exo-cad, Gmbh), provides benefits for the esthetic rehabilitation of patients. It allowed digital, almost automatic smile analysis and measurements and effective patient involvement in the design of the definitive restorations. It also simplified the conventional laboratory procedures by selecting tooth moulds from virtual tooth libraries that can be applied directly to the patient's facial images and serve as an effective 2D and 3D previsualization tool. The option to mill trial restorations from the digital files and evaluate them in the patient's mouth is another advantage of digital smile case planning.[7] However, Digital software systems are not free of problems. They have limitations and require a learning curve. For example, dynamic occlusal analysis and 3D facial or dynamic scans and videos still need to be incorporated into most systems to limit the use of third-party software to accommodate such features. Moreover, software purchases, updates, hardware, and training costs limit the broader use of such technologies. The cost-effectiveness of a digital workflow depends on not only the software's ease of use but also the user's dexterity, skills, training, and experience.[8] Studies reporting on clinical outcomes, patient-centred outcomes, and the cost- and time-effectiveness of digital workflows compared to conventional workflows are necessary. While several materials could have been used, this digital workflow necessitates using a prosthetic material, which can be milled or printed with available technology. Lithium disilicate has a record of successful clinical performance in terms of good marginal adaptation, lack of discolouration, gingival recession, secondary caries or postoperative sensitivity, and high patient satisfaction.[9]

Conclusion: The use of modern-day digital tools helps to accomplish precision and stability of esthetic outcomes, as it guides precise diagnosis, planning, patient motivation and treatment execution in both prosthetics and surgical. Particularly in challenging cases with high esthetic demand and complicated factors, such as the case presented here, the digital approach provides tools to attain excellent treatment outcomes.

SUMMARY : This clinical report describes a digital workflow using the Exo-cad smile creator and CAD-CAM technology with milled lithium disilicate veneers to restore the anterior maxillary teeth of a 32-year- old male.

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TRIPLE SCAN TECHNIQUE FOR IMPLANT IN THE AESTHETIC ZONE – CASE REPORT WITH FULL PROTOCOL

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ABSTRACT

This article describes the rehabilitation of an implant in the aesthetic zone using the triple digital scan protocol. In this technique the provisional is scanned both intraorally before it is removed (1st scan) and extra orally (2nd scan). Then the provisional is removed and the scan of the emergence and the implant impression using scan body is taken (3rd scan). Once these STL files are generated it is sent to the CAD software and is collected in a master file. This ensures that the lab can replicate the same contours and form of the provisionals, in the final restoration. The best results are obtained in this procedure, with monolithic zirconia crowns.

INTRODUCTION

The two most demanding areas in the oral cavity for any implantologist are the aesthetic zone and the rehabilitation of a terminal dentition / completely edentulous situation. In both these areas the patient demands immediate restorations. Of these two, the aesthetic zone demands both function and as the name suggests – aesthetic replacement as soon as possible. In this era of contemporary implantology, the clinician is able to fulfill these demands most of the times. With the immediacy concept (1), implant can be placed in the extraction socket with ease and predictability. Extraction of the tooth inevitably leads to buccal bone loss and subsequent soft tissue recession. This is attributable to the loss of periodontal ligament and the trauma, particularly at the buccal bone plate (2). This loss of alveolar bone and change in ridge contour is the result of the bundle bone - periodontal ligament (BB - PDL) complex lost following the removal of the tooth(1,3). Various techniques like socket preservation, ridge augmentation using various hard and soft tissue grafts, etc are adopted to address this problem. However, these techniques are corrective than being preventive. 'Socket shield' is a technique that can be called as a pre collapse intervention that uses the tooth itself to prevent the loss of alveolar tissue(4). Although a relatively newer technique, the intentional retention of the buccal aspect of the root with its periodontal apparatus during immediate implant placement can lead to predictable and sustainable osseointegration of implants placed in the maxillary anterior region of healthy adults(5). The procedure can be used to preserve the inter implant papilla by preserving the root shield in the proximal area(6). With the technique of socket shield perfect harmony of pink and white aesthetics can be attained. The socket shield technique can either be done free hand or the more recent guided protocol. In the guided protocol .. the guide can be a single guide to section the tooth or multiple guides to make a precise section between the buccal and palatal parts of the root. The implant placement too can be either free hand or guided. Irrespective of the technique, the most important criteria for success in the aesthetic zone is the ideal 3D placement. Apico cervically the implant has to be placed 3 to 4 mm apical to the free gingival margin, palatal to the imaginary line joining the adjacent buccal

surfaces of the adjacent teeth in the bucco palatal dimension and 1.5 to 2 mm away from the adjacent teeth in the mesio distal dimension. Immediate restoration after the surgery of a single implant in the aesthetic zone have several proposed benefits, including reduced overall treatment time, fewer surgical procedures, less traumatic surgery, and greater patient satisfaction(7). The placement of a provisional restoration on a single implant in the aesthetic zone has been advocated for creating a good soft tissue contour, especially in conjunction with immediate implant placement.(8). The temporary can either be pre-fabricated using the CAD software prior to the procedure or can be fabricated in the office using both the direct or indirect techniques. However, after all the effort that the clinician makes the most frustrating part is when the technician cannot replicate the exact contours, shape and form of the provisional. One regularly sees all the hard work in contouring the soft tissues with meticulously fabricated go down the drain. To some extent this information can be given to the lab by customizing the impression post. This may still not be enough to replicate the critical and the sub critical contours. The critical contour is of special importance as it has the maximum influence on the gingival margin and the final zenith of the restoration. (9) Another flip side of customizing the impression post is that the tissue collapses by the time the impression is made and the soft tissue impression is made in collapsed state. A triple scan digital impression overcomes these problems and captures the tissues in resting state. It streamlines the procedure by reducing the treatment time and the number of visits for the patient. The success of this technique depends on the accuracy of the scanner. However, comparative preclinical and clinical studies are currently emerging showing that partial-arch digital implant impressions display similar accuracy with conventional ones. (10-19)

CASE REPORTS

A 35 year old female patient reported with a broken down central incisor. (Fig 1)
The patient was a non-smoker with a
non- contributory medical history.
The patient had high aesthetic demands.


(Fig 1- Pre Op)

The patient was given several treatment options like
1) Root submergence with tooth supported partial denture
2) Orthodontic extrusion with post - core crown
3) Socket shield with immediate implant placement.

After due considerations, the patient consented with implant placement followed by immediate provisionalization. The CBCT showed presence of a very thin buccal plate that was almost fused to the tooth root. The RVG did not show any peri apical pathology. Partial extraction therapy seemed like the best option in this case (on the other hand, when is it not, eh? The bone was adequate to place a 4.0 x 16 implant palatal to the planned facial shield. After local anaesthesia, the tooth was sectioned mesio-distally as far as apical as possible using a long shank root resection bur (Komet Dental, Germany) attached to an airotor high- speed handpiece. (Fig 2) This was done with the intention of retaining the buccal root to preserve the bundle bone collapse. The palatal part was then atraumatically removed by placing a luxator in the palatal pdl space. (Fig 3)


(Fig 2- Sectioning of tooth)


(Fig 3- Tooth Luxated)

The retained buccal root (socket shield) was checked for mobility with a sharp probe. The shield was trimmed from the intaglio surface with a round diamond bur to a thickness of 1.5 mm and placed subgingivally at the level of crestal bone. The socket was mechanically curetted followed by saline irrigation. Using Densah bur (Densah® Burs, Versah Co. Llc) a 4.0 x 16 mm implant was placed palatally to the shield keeping a gap between the shield and the implant.

(Fig 4a - Osseodensification)

(Fig 4b- Implant)

(Fig 4c- Shield prepared, jumping distance maintained)

(Fig 5a- Stock abutment placed)

(Fig 5b – Direct layering technique)

(Fig 6- Concave sub critical zone)

(Fig 7 – Dual zone grafting)

(Fig 8 – Screw retained provisional)

(Fig 9 – Healthy emergence)

(Fig 10a- Scan of the temporary intra orally)

(Fig 4a, 4b, 4c) A provisional was fabricated chair side using a titanium stock abutment and direct layering with composite. (Fig 5a, 5b). The sub critical zone was kept concave to increase the bulk of soft tissue in the peri implant region. (Fig 6). Dual zone grafting was performed with a composite graft of xenograft and autogenous bone chips collected from the drill . (Fig 7) .The provisional was placed and was kept infra occlusion in both centric and eccentric movements. The patient was advised to avoid biting from the front tooth for a period of at least 6 weeks. (Fig 8). The patient was on provisionals for a period of 4 months. The provisional ensured stability of the soft tissues with respect to zenith and papilla. Once removed from the implant, the soft tissue emergence profile was noted to be healthy without any inflammation. The case now seemed to be fit to proceed to the final restorative stage. (Fig 9). A triple scan protocol was followed. A 3 shape trios 3 scanner -Cart version (TRIOS®, 3Shape, 3shape.com) was used for the impression. After adding the required information about the implant system, the type of restoration desired and the shade, the scan of the upper arch was done. The temporary was then scanned intra orally (First scan) (Fig 10a). This was followed by the scan of the scan body and the emergence (Second scan). Finally the lower arch was scanned. Apart from this information, the temporary was also scanned extra orally (Third scan) to send the information of the critical and subcritical contours of the temporary. (Fig 10c).

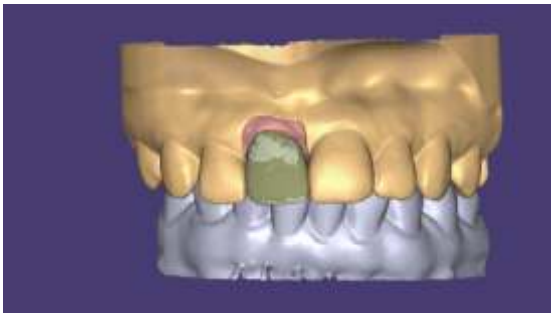
(Fig 10b- Scan of the emergence & scan body)

(Fig 10c- Scan of the emergence & scan body)

This would aid the lab to exactly replicate this information in the final restoration. These STL files were then sent to the lab for fabrication of the final restoration. The choice of final restoration was a screw retained monolithic zirconia restoration using the Ti base abutment. To enhance aesthetics, it was decided to do some micro layering at the incisal edge.

LAB STEPS

The three STL files derived from the triple digital scanning protocol were imported in CAD software (exocad® DentalCAD, exocad, exocad.com) and superimposed into one master file that contained all of the information from the implant 3D position, prosthesis contours, and transmucosal part of the peri-implant soft tissues. CAD software was used to design a screw-retained FDP supported by titanium-base abutment (hexed, 4.8 mm diameter ; GH 2 mm, Noris Medical), and then the prosthesis was copy-milled on a CAM milling unit (Arum 5x 450, ARUM Dentistry, Co.,Ltd.) from monolithic zirconia disc (Zircad prime, Ivoclar). (Fig 11a, 11b). The titanium-base insert was cemented to the zirconia FDP at the laboratory after the positional jig trial was done. (Fig 12) (To be frank, this step can be skipped if you are doing the digital protocol. However, to have no surprises during the final restoration we went ahead with this step too). The internal surface of the zirconia FDP were silica-sandblasted with 50 microns AlOx sand at 2 bar pressure. This was followed by MKZ Primer from Bredent (bredent GmbH & Co.KG, Germany). The ti base abutment was cemented with DTK Kleber adhesive cement (bredent GmbH & Co.KG, Germany). (Fig 13).The critical and sub critical contours were an exact replica of the temporary restoration (Fig 14). In the next clinical appointment, the crown was tried and checked for occlusion in MIP and lateral excursions and protrusive movements.As per the implant protected occlusal scheme, when checked with a12 micron articulating paper (Arti-Fol®metallic BK 28 Bausch) the implant crown was in very light contacts. (Fig 15). The zirconia FDP was then inserted by torqueing the abutment screw to 35 Ncm. The screw-access holes were filled with Teflon tape and composite resin. The patient was given oral hygiene instructions to assist her in cleaning around the crown. (Fig 16). The RVG shows the precise passive fit of the crown over the implant. (Fig 17a). The CBCT shows the relationship of the shield, implant and the implant. (Fig 17b). The pink aesthetic score (PES) was 14. (Fig 18)



(Fig 11a- Design on the CAD software)

(Fig 11b - Replication of the sub critical contour in the final restoration)

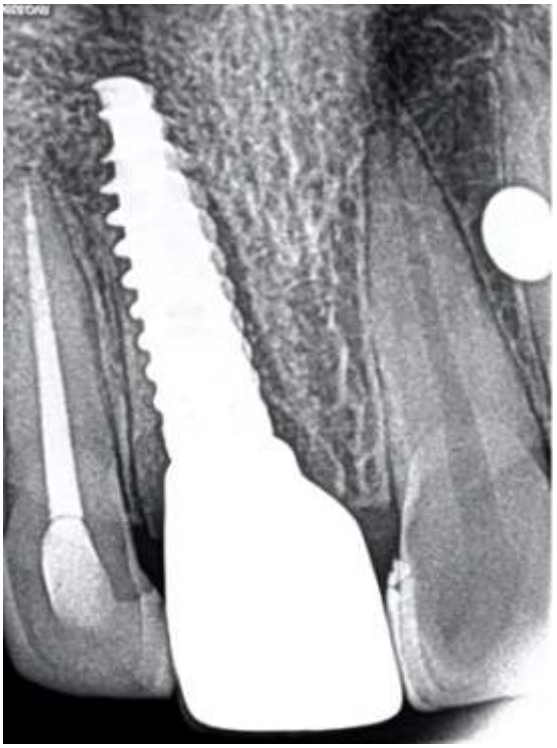
(Fig 12- Positioning jig trial)

(Fig 15- Checking the occlusion using 12 micron artifol)

(Fig 16-Final restoration)

(Fig 17b- Final CBCT)

(Fig 18- pink and white aesthetics – perfect PES score)



(Fig 17a- RVG showing stable bone levels)

DISCUSSION

The case discussed above represents the most contemporary surgical and prosthetic techniques to handle an implant in the aesthetic zone. The contemporary approach in the surgical phase are immediate implant , socket shield technique and dual zone grafting . To make it even more cutting edge the use of surgical guide would have been a great touch. However, the clinicians must understand that computer guided surgery has its own set of complications (20) and is not meant for novice clinicians. There could be inaccuracies in cone beam CT and in the 3D printers where the deviation could be inaccuracy between 0.85 – 1.1 mm.(21) Although minor, these deviations are enough to compromise the final aesthetic results..The traditional approach to handle an extraction site was to raise the flap and place the implant. This lead to greater buccal bone loss and soft tissue recession. Flapless procedure lead to preservation of periosteum and supra periosteal plexus and subsequently the blood supply of the alveolar bone. (22,23). The flapless surgery also maintains soft tissue health and maintains the peri implant papilla. (24) This approach will work with proper case selection which includes evaluation of morphology of alveolar process(25) and periodontal biotype. (26) Although immediate implant is a great solution for implant in the aesthetic zone , it does not reduce or stop buccal bone resorption.(27). Various techniques like socket preservation, ridge augmentation using various hard and soft tissue grafts, etc are adopted to address this problem. However, these techniques are corrective than being preventive. 'Socket shield' is a technique that can be called as a pre collapse intervention that uses the tooth itself to prevent the loss of alveolar tissue(4). Although a relatively newer technique, the intentional retention of the buccal aspect of the root with its periodontal apparatus during immediate implant placement can lead to predictable and sustainable osseointegration of implants placed in the maxillary anterior region of healthy adults(5). The procedure can be used to preserve the inter implant papilla by preserving the root shield in the proximal area(6). The intentional retention of the facial aspect of the root has been shown to minimize volumetric alterations at the implant site(28). In an in vivo study, Hurzeler et al reported that no resorptive process could be noted on the alveolar bone in the area of the root fragment(29). The dentogingival fibers remain attached to the retained root fragment and seem to increase the soft tissue aesthetics in the area by maintaining the mucosal zenith at a more coronal position(6) Grafting the jumping distance is relevant in the aesthetic zone, as without a bone graft it can result in significant horizontal and vertical facial bone loss and subsequently in facial gingival tissue loss (30, 31) Dual zone grafting is a technique in which both the bone zone and the tissue zone are grafted. It is shown to improve soft tissue profile and potentially improves soft tissue thickness (32) The contemporary approach in the prosthetic phase used in this case are immediate provisionalisation, digital impression, use of CAD CAM technology and finally using the new age restorative material (zirconia) as the choice of final restoration. The provisional prosthesis in implant prosthodontics aids in the sculpting of the emergence profile, the soft-tissue conditioning of the peri-implant tissues during healing, and the transferring of the mucosal architecture to the definitive restoration. Before the final restoration one can adjust the zenith by altering the critical contour and the shape of the provisional. A screw retained prosthesis greatly facilitate these alterations . Traditional impressions using customised impression come with their own set of problems including longer chair time, inaccuracies and imperfections in the impression, dimensional changes etc to name a few. Patient experience too is not very favourable with analog impressions. Digital impressions are now gaining popularity and are able to give consistent results for single and multiple edentulous situation (33- 47)The triple scan protocol explained in the above case enables the dental technician to replicate the exact contours and form of the final restoration. The advantage of this expedited protocol is that all of the information necessary for final prosthesis fabrication is acquired from the three scans, which leads to STL files that can be imported into CAD software, simplifying the design and fabrication of the final prosthesis. Prior to implementation of this protocol, it is incumbent that the provisional prosthesis has ideal contours and satisfies all requirements of function and aesthetics. (48) Finally, the last component in this contemporary protocol is the use of monolithic zirconia using the CAD CAM technology. The digital workflow using computer assisted designing and milling technology ensures a more passive fit of the prosthesis. Chipping of porcelain is one of the most common technical complications in implant prosthodontics, especially with full arches.(49-57) The modified monolithic design with minor cut back design reduces the chances of chipping of porcelain in the load bearing areas of the crown..Recent advances in the fabrication of multi layered blocks enable total monolithic design without cut-back, making the use of monolithic zirconia in the aesthetic zone feasible.(58)

CONCLUSION

The modern dentist is expected to remain updated. This encompasses embracing newer technologies like intra oral scanners and techniques like socket shield in their practice for better patient care. All of this requires time, investment in the form of procuring scanners, scan bodies and digital analogs and a learning curve. However, this streamlines and expedites the workflow for both the clinician and the patient. The triple scan protocol may be one of the most modern techniques in today's time to fast track the prosthetic phase in the aesthetic zone. The newer intra oral scanners have accuracy and the precision to deliver consistent results using this protocol. To sum it up finally .. this technique enhances patient comfort, makes the life of a clinician easier due to the streamlined workflow and simplicity, also is a great practice builder as it has high patient satisfaction and acceptability

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Current senario of 3D printing in the Indian dental Industry

Digital dental workflow refers to the use of digital technology to organise and optimize dental procedures, from diagnosis to treatment planning and final execution. Today, digital dental workflows are no longer a distant dream, but a present-day reality.

3D printing as part of the digital dental workflow has opened up new opportunities to enhance the precision, speed and efficiency of all dental procedures. 3D printing has revolutionized various industries, and dentistry with its need for custom solutions stands to benefit greatly. With the use of 3D printing, dental professionals can create accurate dental models, surgical guides, dental prostheses and much more. 3D printing in dentistry has opened up new opportunities to enhance the precision, speed, and efficiency for all dental procedures.

3D printing offers greater design flexibility, reduced material waste, faster production times, lower costs, and reduced labor costs compared to milling. However, each technique has its own advantages and limitations, and dental professionals must choose the most appropriate technique for each case based on its specific requirements. 3D printing or additive manufacturing requires a much smaller start-up cost as well as a reduced operating cost compared to milling or subtractive manufacturing systems. The reduced cost and ever expanding range of indications has not only lowered the entry barriers for small laboratories as well as the individual dentist but has also made it more attractive for them to integrate 3D printing as part of their digital dentistry workflows.

Ever since the crucial patents of 3D printing technology expired in 2013, the market has experienced an influx of a huge range of different printers. 3D printers range from inexpensive printers like the Anycubic Photon, to mid-range printers like the Ackuretta SOL, to the more professional printers like the Asiga Max.

Buying 3D printing equipment and supplies can be a daunting task, especially for those who are not familiar with the technology or the products available. With so many options to choose from, it can be difficult to know what to look for and which products offer the best value for money and the right products to meet their specific needs.

To simplify the process of comparing products, we have created a comparative chart that highlights the key features of few standard resin 3D Printers side-by-side. While the chart can be a useful tool in making an informed purchasing decision, it is important to keep in mind that not all features can be accurately represented through a chart alone. While charts can be helpful in providing information about the features of a product, it is important to note that not all features can be accurately represented through a chart alone. Some paramount features, such as ease of use, durability, performance and customer support may require additional context or user experience to fully understand their value. Therefore, it is important to supplement the comparative information with other sources, such as product reviews or expert opinions, to get a more comprehensive understanding of a product's features and overall quality.

While we have made every effort to compile accurate and up-to-date information in the charts, it is important to note that the information has been sourced from the public domain and may not be completely reliable or comprehensive. Therefore, we cannot guarantee the accuracy, completeness, or reliability of the information provided in the charts, and we do not take responsibility for any errors, omissions, or inaccuracies.

3D PRINTER MODEL / 3D PRINTER FEATURES	 NextDent 5100	 MAX UV	 PRO 4K80 UV
Manufacturer	3D Systems	Asiga	Asiga
External dimensions (WxDxH)	42.6 cm × 48.9 cm × 97.1 cm	26 cm × 38 cm × 37 cm	46.5 cm × 54 cm × 134.5 cm
Build plate dimensions (WxDxH)	12.48 cm × 7.02 cm × 19.6 cm	11.9 cm × 6.7 cm × 7.5 cm	21.7 cm × 12.2 cm × 20 cm
Maximum resolution (µm)	65 µm	62 µm	56 µm
Printing Technology	DLP	DLP - UV LED	DLP - UV LED
Wavelength of Light source	405 nm	385 nm	385 nm
Slice Thickness	30 - 100 µm	10 - 200 µm	10 - 200 µm
Environment Control	No	Yes	Yes
Indications	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Directly printed orthodontic aligners • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Directly printed orthodontic aligners • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides
Materials System	Manufacturer's resins and very limited 3rd part resins	Manufacturer's resins and wide rangeof 3rd party resins	Manufacturer's resins and wide rangeof 3rd party resins
Accepted File type	STL PLY OBJ	STL PLY	STL PLY
Software	Free from manufacturer	Free from manufacturer	Free from manufacturer
CAD Software Integration	Exocad 3Shape Dental Wings	Exocad 3Shape Dental Wings	Exocad 3Shape Dental Wings
Remote printing	No	Yes	Yes
Connection with printer	Ethernet	Wi-Fi Ethernet Wireless Direct	Wi-Fi Ethernet Wireless Direct
Pre-printing Resin process	Stirring device	Manual Shaking	Manual Shaking
Post-printing process	Wash and Cure	Wash and Cure	Wash and Cure
User service and support	Online Offline (Dealer Dependent)	Online (Lifetime support, unlimited and free) Offline (Dealer Dependent)	Online (Lifetime support, unlimited and free) Offline (Dealer Dependent)
Warranty (years)	1 year	1 year	1 year

3D PRINTER MODEL / 3D PRINTER FEATURES	 Form 3B+	 NextDent LCD1	 SOL
Manufacturer	Formlabs Dental	3D Systems	Ackuretta
External dimensions (WxDxH)	40.5 cm × 37.5 cm × 53 cm	27.1 cm × 29.2 cm × 41.6 cm	27.1 cm × 29.2 cm × 41.6 cm
Build plate dimensions (WxDxH)	14.5 cm × 14.5 cm × 18.5 cm	12.8 cm × 8 cm × 14 cm	12.8 cm × 8 cm × 14 cm
Maximum resolution (µm)	25 µm	49 µm	49 µm
Printing Technology	SLA	LCD	LCD
Wavelength of Light source	NA	405 nm	405 nm
Slice Thickness	25-300µm	30 - 150 µm	30 - 150 µm
Environment Control	No	No	No
Indications	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides
Materials System	Manufacturer's resins only	Manufacturer's resins and limited rangeof 3rd party resins	Manufacturer's resins and limited rangeof 3rd party resins
Accepted File type	STL OBJ	STL OBJ	STL OBJ
Software	Free from manufacturer	Free from manufacturer	Free from manufacturer
CAD Software Integration	Exocad 3Shape	Exocad 3Shape	Exocad 3Shape
Remote printing	Yes	No	No
Connection with printer	Wi-Fi Ethernet USB	Wi-Fi Ethernet USB	Wi-Fi Ethernet USB
Pre-printing Resin process	Manual Shaking	Manual Shaking	Manual Shaking
Post-printing process	Wash and Cure	Wash and Cure	Wash and Cure
User service and support	Online Offline (Dealer Dependent)	Online Offline (Dealer Dependent)	Online Offline (Dealer Dependent)
Warranty (years)	1 year	2 years	2 years

3D PRINTER MODEL / 3D PRINTER FEATURES	 XiP	 AccuFab-L4D	 Pro95/55 S
Manufacturer	Nexa3D	Shining 3D	SprintRay
External dimensions (WxDxH)	42 cm × 35 cm × 53 cm	36 cm × 36 cm × 53 cm	38.1 cm × 54.1 cm × 68.6 cm
Build plate dimensions (WxDxH)	19.5 cm × 11.5 cm × 21 cm	19.2 cm × 12 cm × 18 cm	Pro95 S: 18.2 cm × 10.2 cm × 20 cm Pro55 S: 10.5 cm × 5.9 cm × 20 cm
Maximum resolution (µm)	52 µm	50 µm	95 µm (Pro95 S), 55 µm (Pro55 S)
Printing Technology	LED	LCD	DLP
Wavelength of Light source	405 nm	405 nm	405 nm
Slice Thickness	50 µm / 100 µm / 200 µm	25/50/75/100 µm	50/75/100 µm
Environment Control	No	No	No
Indications	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides	• Study models • Working models • Castable Crown & Bridge • Castable partial frameworks • Custom trays • Night guards • Splints • Indirect bonding trays • Temporary restorations • Permanent restorations • Partial dentures • Complete dentures • Implant surgical guides • Endodontic surgical guides
Materials System	Manufacturer's resins and very limited 3rd part resins	Manufacturer's resins and very limited 3rd part resins	Manufacturer's resins and very limited 3rd part resins
Accepted File type	STL OBJ	STL OBJ	STL
Software	Free from manufacturer	Free from manufacturer	Free from manufacturer
CAD Software Integration	Exocad	Exocad	Exocad 3Shape
Remote printing	No	No	Yes
Connection with printer	Wi-Fi Ethernet	Wi-Fi Ethernet	Wi-Fi Ethernet
Pre-printing Resin process	Manual Shaking	Manual Shaking	Manual Shaking
Post-printing process	Wash and Cure	Wash and Cure	Wash and Cure
User service and support	Online Offline (Dealer Dependent)	Online Offline (Dealer Dependent)	Online Offline (Dealer Dependent)
Warranty (years)	1 year	1 year	1 year

About the author

Dr. Bhavin Patel completed his Bachelor of dental surgery from Mumbai University in 2002 followed by a Master's in business administration with a specialization in Marketing. A former registrar with the Centre for Advanced Dentistry, Breach Candy Hospital he is a certified instructor for the Bio Functional Prosthetic System since 2005 and a certified trainer for Dental Exocad on behalf of Bredent India

He set up one of India's first commercial CAD CAM Milling Centre in Mumbai in 2008 and has conducted several awareness programs, courses and workshops about digital dentistry among clinicians and laboratory technicians. He is also involved as a consultant, mentor and supervisor for several projects in the production of digital restorations.

In 2018 he commenced his journey into the new and developing technology of 3D printing for dentistry. He is an authorised partner of Asiga a certified member of the digital Dental Society and Digital Dental Forum and has to his credit several presentations and articles on numerous national and international platforms.

Guided and Micro-guided Endodontics- A Literature Review

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ABSTRACT

Introduction

Conventional methods and techniques in Endodontics have served well for decades. With changing times and the dawn of digitization, an upgrade to digital dentistry is the need of the hour. In Endodontics, the introduction of Guided Endodontics marked a renaissance in terms of the management of challenging cases like calcified canals. Since its inception in 2016, various studies, case reports, and systematic reviews have been published. The purpose of this review was to summarize the application of Guided and Micro-guided Endodontics.

Methodology:

An electronic search was performed from January 2016 to January 2023 on databases like PubMed, Google Scholar, Ebscohost, Cochrane, Embase, and Scopus. Original research, review articles, and case reports on guided and Microguided endodontics were selected. A summary based on the clinical application of Guided Endodontics and Microguided Endodontics was prepared.

Results:

Guided and Micro-guided Endodontics has application in Surgical as well as non-surgical endodontics. The most common application of Guided Endodontics was for the management of calcified canals. In addition, guided procedures were used for fibre post removal and the management of developmental disturbances

Conclusion:

Guided Endodontics is a futuristic approach for the management of challenging cases as well as the education of students through 3D printed models.

Keywords

3D printed guides, 3D Stents, CAD-CAM, Guided Endodontics, Micro-Guided Endodontics, Minimally Invasive Endodontics, Targeted Endodontic treatment.

Introduction

Digital technologies have broadened its horizon in all fields, including dentistry. The conventional approaches worked well in the past, but modern society's shifting requirements and technological advancements have made it essential to accept new approaches, particularly in the healthcare industry. Dental digitalization has resulted in less errors and shorter chairside time with more predictable therapeutic outcomes. Precision has been achieved through the use of machines and algorithms, allowing for the customization of techniques and treatments for each patient. The development of imaging technologies parallels digitalization as a key factor in contemporary dentistry. Cone beam computed tomography (CBCT), which was introduced in 1998, has completely changed dental imaging. – The new era of treatment planning is centered on the ability to reproduce and replicate human anatomy as three-dimensional (3D) models for improved diagnosis. The amalgamation of these has allowed the inception of Guided Endodontics (GE). GE is a cutting-edge technique for creating a precise and accurate endodontic access cavity to reach the targeted location.(2) The idea of guided access was first introduced for pre-surgical planning in implantology and then adopted by Endodontics.(3) In order to create a 3D-printed guide that assists in preparing the access cavity for the target site, GE incorporates superimposing CBCT and a digital scan on software. The diameter of drills used in GE was around 1.2–1.5 mm, which led to inadvertent loss of radicular dentin. (4,5) Thus, in 2017, Connert et al.(6) introduced Micro-Guided endodontics. Drill miniaturization in MGE led to their use in smaller teeth such as mandibular incisors and improved accuracy when compared to GE.(6)

GE and MGE are used in Endodontics in both surgical and nonsurgical situations. In Surgical Endodontics, GE makes sure that there is minimum bone removed and that vital organs and tissues are protected, which may result in less trauma and a quicker recovery. In non-surgical Endodontics, it leads to precise canal location and conservation of tooth structure.

Methodology:

An electronic search was performed from January 2016 to January 2023 on databases like PubMed, Google Scholar, Ebscohost, Cochrane, Embase, and, Scopus. The search strategy included words like Guided Endodontics, Microguided Endodontics, Targeted Endodontic treatment, 3D printed guides in Endodontics. Articles on the clinical applications of guided and micro-guided endodontics were included. A summary based on the clinical application of Guided Endodontics and Micro-guided Endodontics was prepared.

History:

As mentioned earlier, the concept of guided procedures was adapted in Endodontics from guided implantology. (3) In 2016, Krastl et al. (11) were the first to use GE for the treatment of obliterated pulp canals with apical pathosis. In 2017, Connert et al. (6) introduced the concept of MGE.

Workflow:

The workflow of Guided and Micro-Guided Endodontics may differ in relation to the software, but the basic components remain the same. The purpose of the 3D guide is to reach the target point. The target point can be determined based on the CBCT. A virtual drill path is then designed to the target point. Since CBCT provides information on the internal anatomy and a digital scan provides information about the external anatomy, both are superimposed to create a 3D model. Using this model, a virtual guide is created, which is then 3D printed.

CBCT (Internal Anatomy) + Digital Scan (External Anatomy) = 3D model

Various design software programmes are available for GE. The design of a virtual drill path is shown in figure 1 using BlueSkyPlan software. (12) Figure 2 shows the virtual guide, which is then 3D printed.

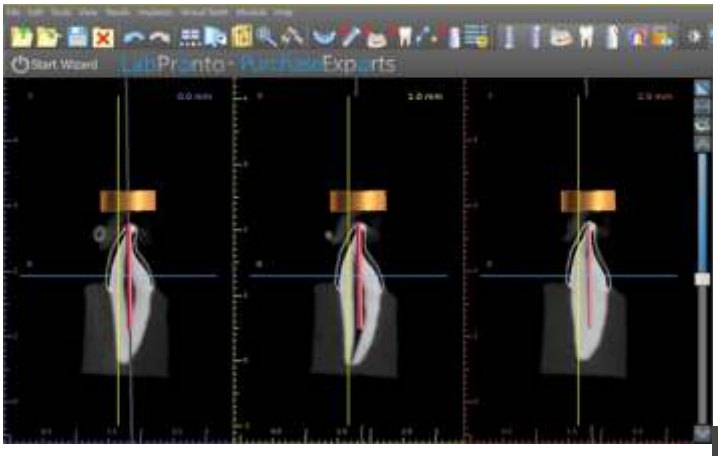


Figure:1
Designing of Virtual drill path
on BlueSkyPlan software

Figure 2:
Virtual Guide ready for 3D
Printing for 4 anterior teeth

Accuracy and success of GE and MGE:

The literature shows four studies that were conducted to determine the accuracy of GE and MGE. (4–6,13) Three of these studies were conducted in vitro. The results of in vitro as well as in vivo studies showed promising results. The accuracy was determined by superimposing the CBCT of the virtual drill path on the actual extended access cavity preparation. The accuracy of GE varied in mean deviation from 0.2 to 0.4 mm (4,5), and MGE varied from 0.1 to 0.3 mm. (6,14) Two studies reported excellent success with GE and MGE for canal location.(9,15) According to Connert et al. (9) regardless of clinician experience, GE demonstrated greater success than conventional strategies. According to this study, traditional methods take twice as long as GE to locate a root canal and result in five times as much tooth structure loss (Figure 3)

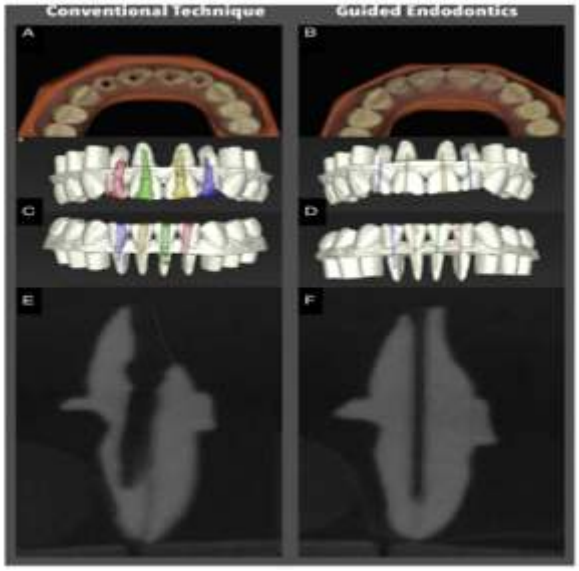


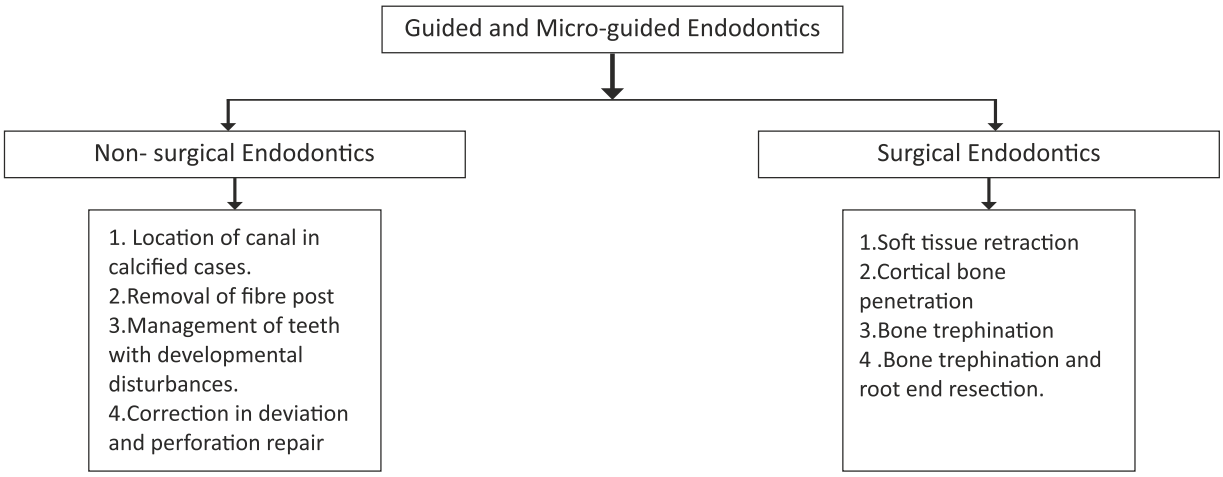
Figure 3: Amount of tooth substance loss in conventional procedure versus Guided Endodontics

Courtesy: Connert T, Krug R, Eggmann F, Emsermann I, ElAyouti A, Weiger R, et al. Guided Endodontics versus Conventional Access Cavity Preparation: A Comparative Study on Substance Loss Using 3-dimensional–printed Teeth. J Endod. 2019 Mar;45(3):327–31

Clinical Application

The clinical application of GE and MGE are mentioned in flowchart no.1

Flow Chart No. 1: Clinical Applications



Pulp canal obliterations

Pulp canal obliteration or pulp calcification is a common finding caused by lateral luxation (71%), extrusion (61%), and periapical lesions (7 to 27%). (16,17) Perforation most commonly occurs during localization and the negotiation of calcified canals, accounting for 20% of all perforations. (15) The operator's knowledge is a key component in traditional techniques for detecting and navigating obliterated canals. GE aids in eliminating this subjectivity. The virtual drill path in calcified canal cases extends till the beginning of the radiolucency. This location is known as the target point. Figure 4 illustrates the designing of virtual drill path for a calcified canal on coDiagnostiX™ software. Various. Various case reports have been documented on the use of GE and MGE for the management of pulp canal obliterations in anterior (4,18,21) as well as posterior teeth. (22,23)

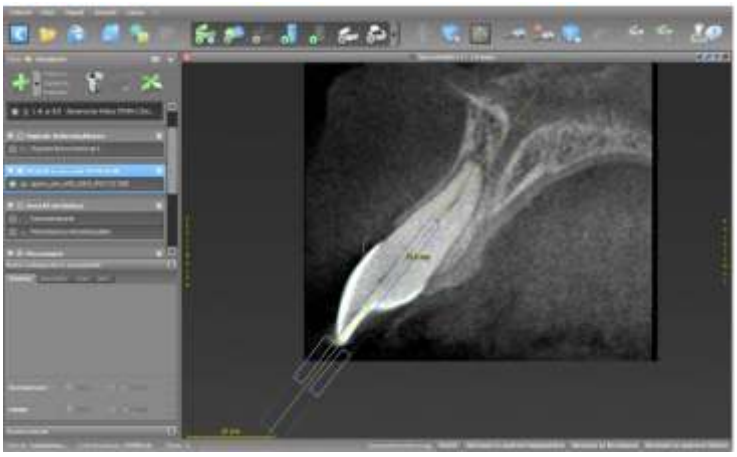


Figure 4: Designing of Virtual drill path for a calcified canal on coDiagnostiX™

Courtesy: Krastl G, Zehnder MS, Connert T, Weiger R, Kühl S. Guided Endodontics: a novel treatment approach for teeth with pulp canal calcification and apical pathology. Dent Traumatol. 2016 Jun;32(3):240–46

1. Removal of fibre post:

The fiber posts are bonded into the root canal space with adhesive materials, which are reported to be more difficult to remove. (24, 25) It is reported that the fibre posts can be fragmented and removed by using a microscope along with drilling with long-shank round burs, ultrasonic tips, and/or special removal kits. (26) These techniques frequently result in procedural errors such as excessive removal of intra-radicular dentin, deviation from the root axis, and perforation of the root structure. (26) The use of GE in these cases leads to the preservation of the dental structure and avoids such errors. Perez et al. (27) conducted a study to determine the accuracy of the removal of fibre posts and reported excellent results. The target point in such cases is the apical end of the fibre post or the coronal end of the remaining gutta percha. The success of GE for fibre post removal has been documented in various case reports. (26,28,29)

2. Management of Developmental disturbances

Literature demonstrates the use of GE for the management of dens invaginatus in two cases. (30,31) Dens invaginatus is a developmental anomaly resulting from the invagination of the enamel organ during soft tissue development. This forms a small tooth inside the future pulp chamber as the hard tissue matures. (32) The target point was determined on CBCT, and a virtual drill path was designed to the target point. (Figure 5) A 3D-printed guide was fabricated to reach the target point using drills of about 1.2 mm. Once the target point was reached, the root canal treatment was completed using the conventional method. Krug et al. reported management of dentin dysplasia using Guided Endodontics. (33)

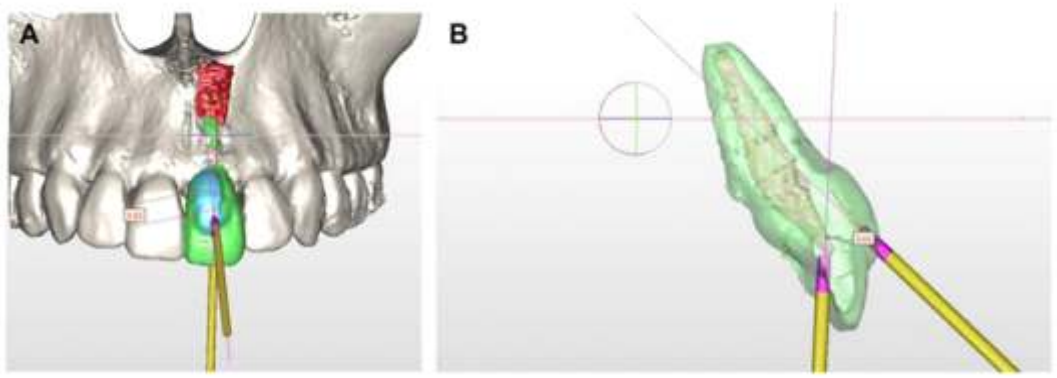


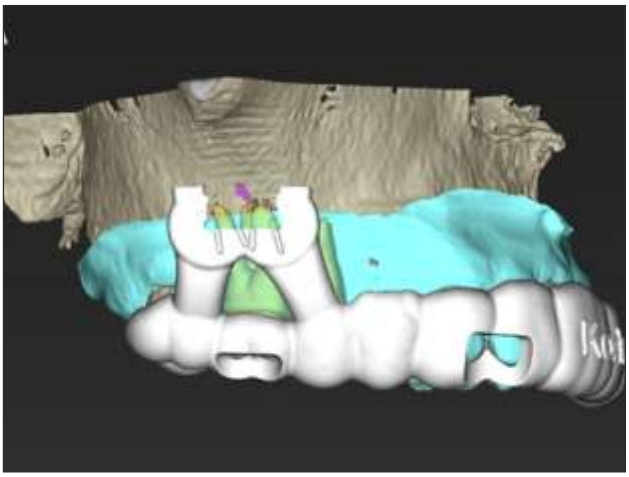
Figure 5: Virtual drill path designing for dens invaginatus
Courtesy: Mena-Álvarez J, Rico-Romano C, Lobo-Galindo AB, Zubizarreta-Macho Á. Endodontic treatment of dens evaginatus by performing a splint guided access cavity. J Esthet Restor Dent. 2017 Nov 12;29(6):396–402.

1.Correction in deviation and perforation repair

Casadei B et al. (34) used Guided approach to correct the deviation in the upper second right premolar. In this case report, an attempt to search for canals led to deviation and perforation. The drill path was virtually designed to locate the canal, and the perforation was repaired.

2.Surgical Endodontics

Apart from non-surgical cases, GE has a variety of applications in Surgical Endodontics. The implications vary from stents for retraction to guides that provide access for bone trephination and root resection. Patel et al. (35) developed a 3D-printed customized tissue retractor for periradicular surgery. A physical model of the jaw was fabricated using CBCT, and using CAD software, the retractor was designed and 3D printed. The purpose of the retractor was enhanced vision and better soft tissue handling. Strbac G et al. (8) , in a case report, surgically managed extruded gutta percha using GE.(Figure 6) GE in surgical endodontics leads to a minimally invasive approach, preservation of bone and vital structures, and thus faster healing and recovery.



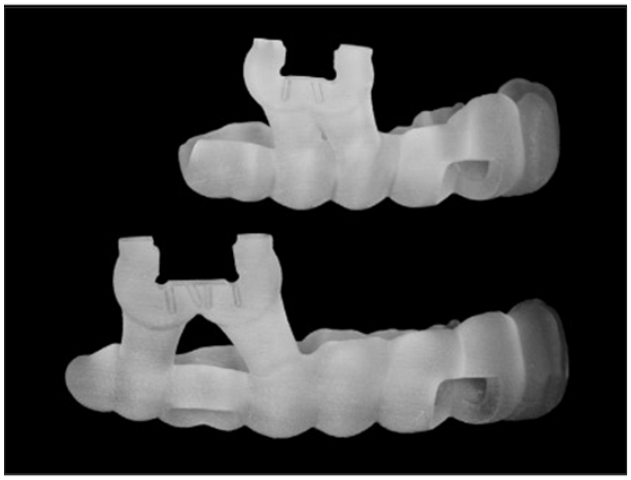


Figure 6: Surgical Guides
Courtesy: Strbac GD, Schnappauf A, Giannis K,
Moritz A, Ulm C. Guided Modern Endodontic\

Surgery: A Novel Approach for Guided Osteotomy
and Root Resection. Journal of Endodontics. 2017 Mar;43(3):496–501

Conclusion:
Guided Endodontics and Microguided endodontics lead to precise and predictable therapeutic outcomes. Apart from the management of calcified canals, it has varied applications in the management of a variety of cases. A predetermined drilling path eliminates subjective factors such as operator skills and experience, reducing human errors.The majority of the literature on this topic is made up of in vitro studies and case reports.Thus, evidence-based literature in the form of clinical studies is required.

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CASE STUDIES

LEADING REGENERATION

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Major Bone Augmentation

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Prof. Matteo Chiapasco
Dr. Grazia Tommasato

3D bone augmentation using CAD/CAM technology, biomaterials and autologous bone

The Situation

A 75-year old and systemically healthy female came to our attention presenting with absent mandibular second bicuspids and molars and requiring a fixed rehabilitation supported by implants as she refused a removable solution. The clinical and radiographic evaluation showed a relevant vertical and horizontal bone atrophy of such an extent that short or narrow implants were not considered a reliable option. The patient smoked 10 cigarettes per day.

The Risk Profile

	Low Risk	Medium Risk	High Risk
Patient's health	Intact immune system	Light smoker	Impaired immune system
Patient's esthetic requirements	Low	Medium	High
Height of smile line	Low	Medium	High
Gingival biotype	Thick – "low scalloped"	Medium – "medium scalloped"	Thin – "high scalloped"
Shape of dental crowns	Rectangular		Triangular
Infection at implant sight	None	Chronic	Acute
Bone height at adjacent tooth site	≤ 5 mm from contact point	5.5 - 6.5 mm from contact point	≥ 7 mm from contact point
Restorative status of adjacent tooth	Intact		Compromised
Width of tooth gap	1 tooth (≥ 7 mm)	1 tooth (≤ 7 mm)	2 teeth or more
Soft-tissue anatomy	Intact		Compromised
Bone anatomy of the alveolar ridge	No defect	Horizontal defect	Vertical defect

Note: Yxoss CBR® by ReOss® Screws 5mm – MCbio (G-fix system)

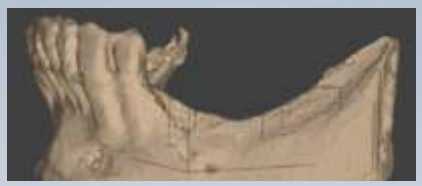
"While it is important to be an expert in guided bone regeneration, this technique reduces the difficulties to less than one-half and is predictable, effective, and precise„

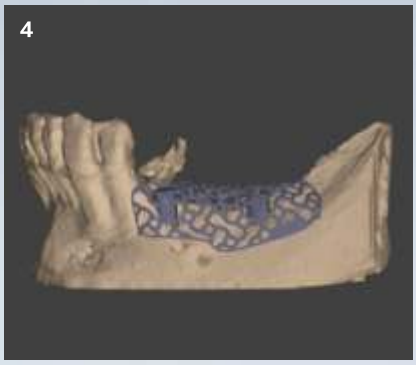
Prof. Matteo Chiapasco

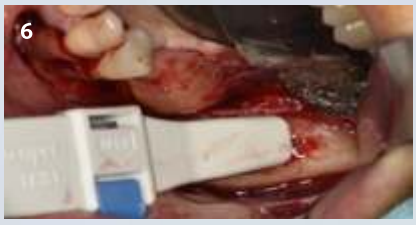
Prof. Matteo Chiapasco – Graduated in Medicine and specialized in maxillofacial surgery at the University of Milan, Italy. Professor, Unit of Oral Surgery, University of Milan; Associate Professor, Loma Linda University, Los Angeles, California, USA.

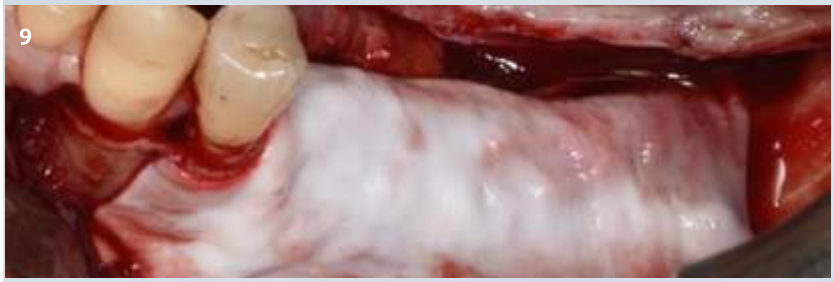
Dr. Grazia Tommasato – Graduated in Dentistry in 2013, specialized in Oral Surgery at the University of Milan magna cum laude. PhD student and a medical consultant of the Clinical Unit of Oral Surgery ("G. Vogel" Clinic, Milan).

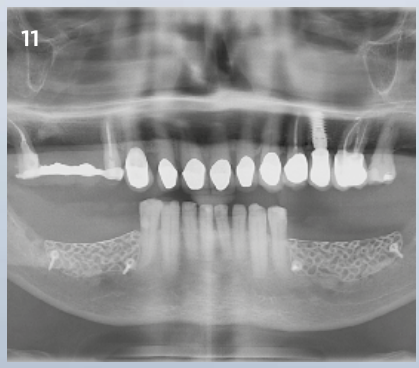











The Approach

The main goal was to obtain a horizontal and vertical reconstruction of the deficient alveolar bone in order to allow safe and prosthetically-guided implant placement.
Reconstruction was obtained by means of a customized titanium mesh (Yxoss CBR®) in association with a mixture of autologous bone chips harvested from the mandibular ramus and bovine bone mineral (Geistlich Bio-Oss®).
The customized mesh was stabilized with titanium screws and covered with a collagen membrane (Geistlich Bio-Gide®).

The Outcome

Post-operative recovery of this patient was uneventful (no complications such as dehiscence or late exposure of the customized mesh) with complete correction of the initial defect. The Yxoss CBR® allowed an easy and faster reconstruction thanks to the precision of the prefabricated mesh filled with autologous chips, Geistlich Bio-Oss® and Geistilch Bio-Gide®.

Click or Scan to access the webinar

| 1 Panoramic radiograph of initial situation showing the atrophic mandibular areas. | 2 CT scans showing a relevant vertical and horizontal bone deficit of the posterior mandible. | 3 Intra-oral view of the left side showing vertical resorption and the augmented inter-arch distance. | 4 The 3-dimensional reproduction of the left edentulous area permits the production of a precise and customized Ti-mesh. | 5 The final Yxoss CBR® ready for use. | 6 Bone harvesting with a bone scraper from the mandibular ramus. | 7 The customized Ti-mesh is filled with the autologous bone chips mixed with Geistlich Bio-Oss® granules in a 50:50 ratio. | 8 Intraoperative view at the end of the reconstruction showing the bone augmentation: the customized mesh was stabilized with 2 screws. | 9 A Geistlich Bio-Gide ® membrane is used to cover the customized mesh in order to increase the barrier effect. | 10 Intra-operative view after primary closure of the surgical wound. | 11 Panoramic radiograph after surgery. | 12 Clinical control 3 months later showing favourable healing of soft tissue and correction of the defect.

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Keys to Success

Precise pre-operative radiographic evaluation and accurate pre-visualization of the final shape of the customized mesh

Precise pre-operative radiographic evaluation and accurate pre-visualization of the final shape of the customized mesh

The Yxoss CBR® must be fixed with Titanium micro-screws

Regeneration with autologous bone chips mixed with Geistlich Bio-Oss® granules

Resorbable collagen membrane (Geistlich Bio-Gide®) in order to optimize the barrier effect

It is mandatory not to load with removable prosthesis during healing

---

GBR combining the use of Geistlich Bio-Oss®, autologous bone chips taken from the mandibular ramus associated with a customized Yxoss CBR® (covered with a Geistlich Bio-Gide®) is a predictable regenerative procedure allowing for the creation of an adequate volume suitable for a prosthetically-guided implant placement with optimization of the final restoration.

Prof. Matteo Chiapasco

cosmetic section

DIGITAL SMILE DESIGN WITH EMAX CAD

SHRAVAN CHAWLA AND RAHUL KAKODKAR

INTRODUCTION

Digital Smile Design(DSD) is a known concept in Dentistry. The ability to accurately predict the ideal Tooth dimensions for getting a bilaterally symmetrical smile window, different smile styles from the smile library helps choose ideal teeth dimensions prior to executing the case. However the ability to transfer this design digitally and accurately to individual crowns was limited to full contour zirconia that lack the depth in internal light characteristics that are desirable. This is only possible with LiSi in the form of Emax Press Ceramics. The ability to transfer the dimensions from the Digital Smile software to Exocad and then use these dimensions to fabricate printed and pressed Emax LiSi Crowns is the ultimate combination of Aesthetics and Technology.

Mentioned below are the holy trifecta of smile design and bonded ceramics for the years to come.

1)DSD +Exocad
2) 3D Printed Models for APT (Aesthetic Provisional Temporaries / Test Drive Smile)
3) Milled Emax LiSi CAD crowns and Veneers

EMAX CERAMIC RESTORATION

Ivoclar Vivadent offers a wide range of products for creating life like restorations which imitate natural tooth structure, it combines the benefits of lithium disilicate and fluorapatite glass ceramics and covers a broad spectrum of indications.

IPS EMAX CERAM

It is a consistent layering material which helps us to achieve a harmonious shade match, ease to handle and efficiency in the lab. The system comprises of a wide choice of materials for getting true colours transparency with supporting effect materials, and wide-choice of shade and stains to create a natural looking restoration.

CASE HISTORY, EXAMINATION AND TREATMENT PLAN

A 40 year old Chef from Italy, residing in Mumbai, India visited our practice unhappy with his smile done elsewhere. On Clinical Examination the following was noted:

- Upper anterior had multiple PFM restorations on 15, 14, 13, 12, 11, 21, 22, 23, 24.
- Metal Crown on 46.
- Lower anterior crowding.

He wished to change all his existing crowns and get an overall better looking smile w.r.t to his upper and lower teeth. His posterior teeth had root canals and posts but were without crowns.

Article Citation
Chawla, S. Kakodkar, R. (2020). Digital smile design. Dental Practice, 17(3), 38-44

FIG 1: Pre Operative Smile Presentation

FIG 2: Digital Smile Simulation

Our plan involved a thorough digital work up of the final result prior to beginning the case to determine the ideal length of teeth to get a desirable bilateral symmetry. We would go for crowns on all upper teeth. Lower posterior crowns with lower anterior 9 Emax Veneers. All restorations were digitally planned and milled Emax restorations.

DIGITAL PLANNING AND SMILE SIMULATION SOFTWARE

Prior to beginning treatment we made multiple simulations of dif-

FIG 3: Digital Smile Simulation

FIG 4a: Old PFM restorations

FIG 4c: Asymmetry in lowers

FIG 4b: Removal of PFM restorations

FIG 4d: Preparations done by APT technique (Dr Galip Gurreal)

FIG 5: Model ready for scan

FIG 6: Scanned model

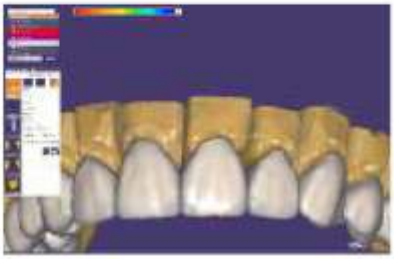

FIG 7: Designing done in exocad software

ferent smile types from our smile library and showed the patient. Based on his choice we went ahead with the Digital planning for ideal dimensions for the final restorations. Based on this the Lab prepared an Exocad Plan with 3D Printed Models for the case. (DSD by Coachman)

REMOVING ALL RESTORATIONS AND FINAL PREPS

We begin by removing all old PFM restorations from the patient's mouth by sectioning.

All Maxillary teeth are prepped for crowns and cord placed, impressions made with VPS (Ivoclar, Virtual). Lower posteriors are prepped for crowns. Lower anterior teeth (35, 34, 33, 32, 31, 41, 42, 43, 44) are prepped for Veneers. Lower double cord retraction and impression made with VPS (Ivoclar, Virtual). Impressions sent to the lab for processing, the stump shade was recorded and pictures were shared with the lab for better understanding of the ingot to be used. Aesthetic provisional Temporaries (APT) made for the patient with a Putty Index from the 3D printed Models. All records required, Jaw relation, Face bow transfer were taken.

Models were fabricated and mounted as per the records and were scanned for digitally designing the restorations with exocad software. The design files were shared with the clinic for approval, the next step was to print them in burnout resin.

The printing was done in 3D system Nextdent printer 5100. This gives us much better control and makes it more predictable and consistent in the final outcome.

The printed restorations were placed on model and checked for occlusion, and minor corrections were done with wax to get the corrected restorations. We call it ANODIGITAL, a perfect amalgamation of technology and hand skill.

An index was made with Siltec putty for

FIG 8a: Full anatomical printed resin

FIG 8b: Full anatomical printed resin

FIG 8c: Printed resin modified with minimal cut back

FIG 8d: Checked against index

FIG 8e: Final cut back

FIG 8f: Checked against index

FIG 8g: Final cut back

FIG 8h: Ready to be pressed

FIG 9a: Pressed emax laminates/crowns

FIG 9b: Crowns and laminates seated on the model

FIG 10a-b: Layering done with Emax Ceram and Emax Ceram selection

FIG 10c-d: Micro layering for fine details and internal translucency

FIG 10e: Topped with Transpa and enamel

FIG 10f: Various transpa and effect materials used as per colour mapping

analysing the further course of the pressed restorations.

The printed substructure was cut back for layering before the press and was checked against the index thus giving us a correct idea of the subsequent layering to be done.

The restoration were invested and pressed in Emax MT BL4, after sandblasting them carefully with 110 micron alox they were checked for any reaction layer and cleaned in an ultrasonic with Invex liquid from Ivoclar Vivadent.

The restorations were checked on articulator and against the index, the cutback was futher enhanced carefully for layering of ceramic material.

Posteriors were left monolithic and would be matched with shade and stains later.

The case was sent for try in after sharing all the pictures of each step with the clinic, this helps in better coordination and the clinic can be a part of the whole process.

TRY-IN APPOINTMENT

The crowns and veneers were tried in the patients mouth and photographs taken to

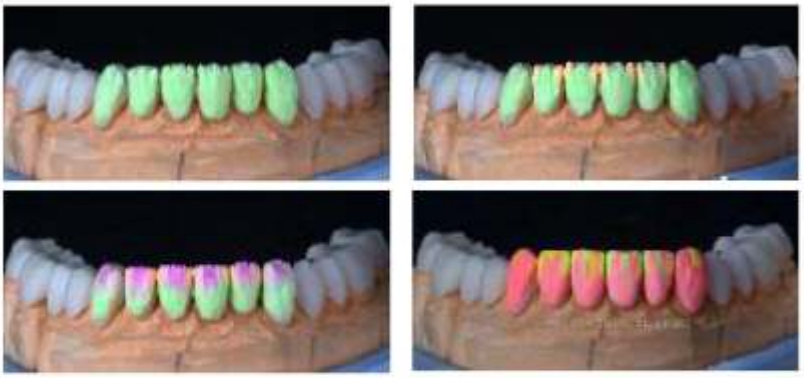

FIG 11: Layered Emax porcelain over the cut back laminates

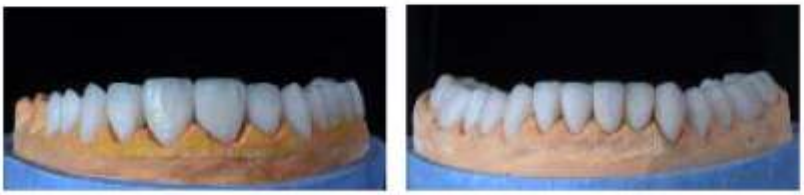

FIG 12: After firing and finishing of contacts

FIG 13: An over view of work flow from the pre-op to digital stimulation and trial to verify

compare with the planned digital smile template framework. The dimensions double checked and photo records taken and compared to the digital mock up. Patients feedback and desires taken into consideration and communicated to the lab. (Patients lower lip is anesthetised) the trail was compared with the DSD STIMULATION and the preop and was shown to the patient.

After analysing the smile and function minimal adjustments were done in contacts and occlusion.

The final work was further enhanced by adding correct surface texture for golden proportions.

Since it was bleach shade not much stain or shade was needed in anteriors and in the posteriors.

The restorations were polished manually for better results with EVE polishers brizzel brushes leather and cotton buff. Diamond paste from Shofu was used.

FINAL PROCESSING BY LAB

This process involved marking line angles, and finishing the restoration for final surface texture before the shade firing is done with Ivocolor shade and stains, subsequently the restoration is glazed using Ivoclar glaze paste and polished using fine grit silicon in addition to leather buff and cotton wheel along with diamond paste from Shofu Japan.

FINAL CEMENTATION

All Crowns and veneers were tried in the patients mouth for final fit, bite and patient approval. (Variolink, Ivoclar Vivadent Veneer Try in cement). Following final approval all crowns cemented using the following protocol:

Preparation of all ceramic internal surface pre-cementation preparation

1) Ceramic Etchant (Ivoclar Ceram Etch – 20 seconds + Wash + Dry)
2) Orthophosphoric Acid 37% (Ivoclar Etch – 1 Minute + Wash + Dry)
3) Ultrasonic Water Bath (1 Minute + Dry)
4) Ceramic Silane Coupling Agent (Coat + Dry)
5) Universal Bonding Agent (Ivoclar 8th Gen Bond + Dry)
6) Placement of Multilink Resin Cement (Dua Cure, Ivoclar)

FIG 14a-c: Fit finish and occlusion checked in situ

FIG 14d-g: Try in appointment (lower lip anesthetised)

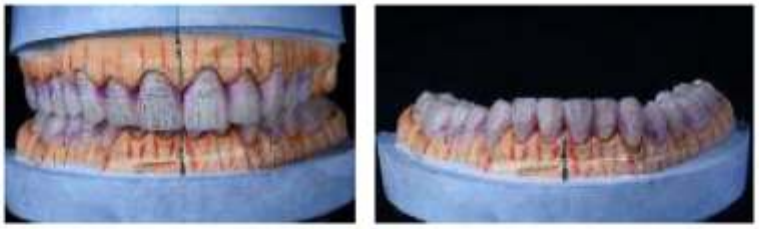

FIG 15: Final check for line angle, axial inclination, midline and surface texture

FIG 16a: Manual polishing after self-glaze with Silicon rubber wheel, Cone shaped silicon diamond impregnated polisher, Bristle brush, Leather buff and Cotton wheel

FIG 16b: Checking golden proportion

Tooth pre-cementation Protocol
1) Clean with water + Pumice Paste
2) Orthophosphoric Acid 37% for 20 Seconds
3) Application of A + B Liquid bonding agent (Multilink – Ivoclar resin Cement)

Variolink was used instead of Dual Cure Multilink for the cementation of veneers. Protocol for ceramic internal surface preparation remain the same. For veneers normal Bonding agent was used.

FINAL RESULTS

One Week post cementation the patient was recalled for final check-up and photographs and shows seamless integration with soft tissues, and bilateral harmony and symmetry as desired. The surface and light characteristics of the LiSi crowns are far more superior than any ceramic system currently available.

CONCLUSION

The ability to combine the precision of milled restorations with the ceramic characteristics of LiSi Crowns provides a dominating combination and force to achieve accuracy in teeth symmetry and ceramic aesthetics. The fit of Emax CAD and Milled Veneer is far more accurate and superior to Emax Press. Milled Emax CAD restorations are without doubt the future.



FIG 17a-c: Final restoration

FIG 17d Final on blacked out model for better understanding of the sillhoute

FIG 17e Final on blacked out model for better understanding of the sillhoute

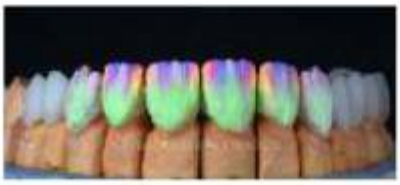

FIG 18

FIG 19

FIG 20

FIG 21

FIG 22

FIG 21-22 Ceramic Layering and Art Work (Precision Dental Studio Ltd)


FIG 23a-b Final situation

FIG 24: Before and After

FIG 25a: The complete workflow at a glance

FIG 25b: Surface texture

FIG 25c-d: Profile view

FIG 26: Final result before and after

About the AUTHORS

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BLOGS

exocad: DentalCAD 3.1 Rijeka
Reduce design time, improve design results

exocad, an Align Technology, Inc. company and a leading dental CAD/CAM software provider, released last year DentalCAD 3.1 Rijeka, the next generation of its powerful CAD software for labs and full-service clinics. With this release, exocad offers users more than 45 new and more than 85 further developed features to save time and optimize workflows. Dental technician Friedemann Stang, the supervisor of global customer support at exocad, presents five new features that are among his personal favorites

Design, save and reuse tooth models

Fig 1: Load previous tooth models
Previously set up tooth models are automatically saved by DentalCAD and, if desired, loaded into the scene.

Fig 1.2:
Load previous tooth models

Laboratories often need to create several prosthetic works for one patient—from the mock-up model through the provisional to the definitive prosthetics. Being able to return to the initial design, with the tooth shape and setup, in the course of a patient's case is practical and can save time. This is now possible with the DentalCAD 3.1 Rijeka release. The software automatically saves the tooth models for further work. If tooth models have already been designed and saved for a patient, the software automatically asks whether the saved tooth models should be used again for a subsequent restoration for this patient. This allows DentalCAD users to reliably and accurately reproduce design work over the course of a patient case for subsequent prosthetic restorations. (1.550 characters incl. spaces)

Virtual Articulator: Now also available in free-form mode

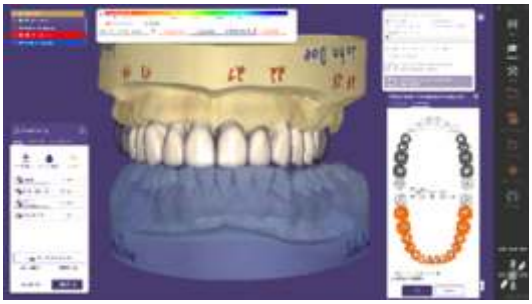

Fig. 2: Virtual Articulator in "free-form"
The Virtual Articulator is available directly in the free-form step.
This way individual occlusions can be easily adjusted to fit the situation.

The individualization of teeth from one of our more than 70 tooth libraries is part of dental technicians' daily tasks. To do this, users employ the free-form mode. Now you can open the Virtual Articulator directly in free-form mode and follow the articulator movements in an additional window that opens on the screen. Previously, experienced users could access this function via the expert mode. Now it is available to users directly in the free-form workflow without any intermediate steps. This is easier and saves time.
Opening the Virtual Articulator once again can be useful at this point in the workflow when, for instance, the dental technician is setting up opposing teeth. For example, canine guidance can be easily checked by looking at the articulator movements. This feature is available to anyone working with the Virtual Articulator add-on module. (1.107 characters incl. spaces)

Smile Creator: With the new “Smile Window” every CAD step can be seen in the patient's photo

Fig. 3: "Smile Window” option
After completing work with Smile Creator, the new "Smile Window”
is always available to easily check the appearance of the designs in the patient's mouth.

Smile Creator has several advanced features. For example, users have now even more options to select the right tooth color using a color palette and switch between the before-and-after views. To further improve communications between dental technicians and dentists, the esthetic planning process can be saved in a PDF document for a dentist in the laboratory. What I like most about Smile Creator, however, is the new "Smile Window” that users can launch once they have completed the smile design. The "Smile Window" shows the finished smile design as a two-dimensional preview in the patient's mouth. This has the following advantage: If dental technicians need to change the finished smile design again, they can simultaneously follow their corrections in the 2D patient photo in the "Smile Window” and check whether the esthetics continue to match the patient's face. This feature shows its advantages above all with experienced Smile Creator

when they want to check whether their restoration can be implemented as designed. (1.307 characters incl. spaces)

FullDenture Module: Adjust posterior teeth individually and precisely with just a few clicks

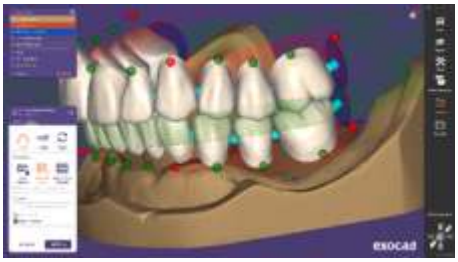

Fig . 4: Customization of prosthetic posterior teeth: Greater flexibility is provided because posterior teeth can now also be individually adjusted in the set-up of full dentures.

When setting up teeth for full dentures, users with DentalCAD 3.1 Rijeka are now more flexible when it comes to setting up posterior teeth. Previously, the prosthetic posterior teeth were loaded completely as a block for the upper and lower jaw in the correct occlusion. Now, with the newly added functions “Opposite as pair” and “Lower/Upper jaw separately,” users can either individualize and adapt individual pairs of antagonists or completely separate upper and lower jaw teeth in order to set up the antagonists freely and individually in relation to one another. With the new "Upper/lower separate" feature, individual tooth setups, such as a crossbite, can be implemented. This new tool is especially useful for experts in full dentures because they can now set up the posterior teeth for a full denture freely and flexibly according to the individual needs and requirements of a patient and can customize the function. (1.197 characters incl. spaces)

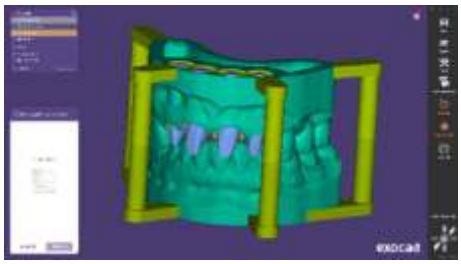

Fig . 5: Model Creator – with the new “Quick Models” feature, users can get to the printable model almost automatically. “Quick Models” rapidly increase the productivity of experienced technicians

Model Creator is the DentalCAD add-on module for creating physical models from a digital data set. The new "Quick Models" feature simplifies and automates the preparation for model printing: Users virtually define the preparation margins, select the type of model to be printed and, if the 3D data is appropriate, the new feature automatically calculates the printable model based on pre-set parameters. Users save having to click through the print-preparing parameters manually. The model production becomes a simple, reproducible work step. If it makes sense in a patient case to individualize the default settings for the specific case, users can still optionally do this.
In laboratories that produce numerous models every day, “Quick Models” can save time and make the model-making process much easier.

And another tip for beginners: If you start using Model Creator, you will have to enter some parameters for model production. The software allows for a lot of different options for parameters to be entered. The user gets an explanation of the meaning of every option via small, animated pictograms (Fig. 6) that appear on the screen. This feature is also useful for experts for the training of dental technicians as it is often easier to clearly present a parameter visually than to explain it verbally. (1.583 characters incl. spaces))

Fig. 6: Enter presets: Helpful animations show the exact function of each parameter.

Further information
exocad.com/en/our-products/ dentalcad-rijeka

Statements by Friedemann Stang about DentalCAD 3.1 Rijeka:
"DentalCAD 3.1 Rijeka is a release with many exciting features from which all users, from beginners to experienced users and high-end experts, will benefit. Our software developers have heard and implemented many suggestions from users. So there is something for everyone.” “I'm also amazed at how seamless DentalCAD and the implant planning software exoplan interact – this has been further developed with this release.”

Dental technician Friedemann Stang is the supervisor of global customer support for DentalCAD at exocad.

His tasks focus on the support and training of technology and sales partners as well as users of exocad. In online seminars, he shows the application of the DentalCAD software in depth.

Inspiring digital adoption and collaboration in India

March 1, 2023

What are the keys to good lab-clinic collaboration? Digital workflows and hands-on education, according to the two founders of the Mumbai- based **Digital Dental Forum** (DDF) , prosthodontist and implantologist Dr. Burzin Khan and lab owner Danesh Vazifdar. Burzin and Danesh share how they developed their lab-clinic collaboration and why they're both passionate about educating others in the field.

Q: What excites you about digital dentistry?

Danesh: What really excites me is the amount of information we can collect in advance today—things that we can preplan before the surgical phase or before we actually do any treatment on the patient. We have such accurate data to plan things better and faster for

the benefit of the patient.

Q: Which exocad software do you use and how does it influence your collaboration?

Burzin: I have been working with Danesh's lab for a long time, and he was my first point of contact with exocad. What I learned initially was ***exoplan*** for guided surgery because we use *exoplan* to do implant planning together, but I've recently started to discover more about exocad's software for single-visit dentistry ***ChairsideCAD***.

Danesh: I had used another software before switching to exocad. The first thing that really surprised me about exocad software was that it works with bigger cases. It is extremely intuitive. As a dental technician, if you have not done CAD work before, exocad is probably the easiest software to learn. It's self-explanatory. There are so many help options and resources to educate yourself. The software always guides you through the next step. That's something I really love about exocad. Once we got our first license, there was no looking back. We are currently at five licenses in the lab and plan more.

For implant dentistry, exocad has completely changed the way we work. It is extremely intuitive!

Q: Do you have any favorite modules?

Danesh: For implant dentistry, exocad has completely changed the way we work. It is extremely intuitive! I really appreciate the synergy between *exoplan* and ***DentalCAD***. We can easily collaborate on the design of custom abutments and full arch screw-retained restorations. exocad gives us the ability to take different scans from pre-operative data to the provisionalization and to plan everything in a constructive and predictable manner.

Burzin: I think the AI works very well. For beginners, like myself, who are newer to exocad, the "next, next, next" buttons are very good. At the same time, the software gives you the option in case you want to improvise.

Q: Tell us more about your collaboration and education project.

Burzin: Since we were early adopters of digital dentistry, we wanted to share our experiences with our colleagues—first in our country and then we slowly expanded to other countries. We formed the Digital Dental Forum in 2018 and conducted a few workshops locally in India, Mumbai and Delhi. Then we took it to an international level and did workshops and training on implant planning and other aspects of digital dentistry in Romania, Egypt and Greece. We saw that there was a lot of demand globally for new dental technology, and people wanted more education. Covid limited our in-person training options so we went online and created a **Facebook platform**. We started doing online webinars on Facebook using Zoom and gained popularity for our digital education. Last year, we had our first physical symposium in Mumbai. We also started offering membership to our forum and currently have around 200 members.

Danesh: As Burzin said, we were kind of early in the digital field. We would receive a lot of queries about which scanner and software to use. We realized that there is a real need for education in digital dentistry, especially because the market changes so fast. We formed DDF to collaborate and stay current on trends. Companies who are developing new products can showcase their technologies on our platforms, and this way our members stay up to date on the changes.

Burzin: The primary vision behind this education is to improve the patient experience. That's what we are looking at when we go digital—improving patient experience.

Q: Speaking of patient experience, do you have any memorable patient cases?

Burzin: With digital, we can provide services faster and easier than in the past. In fact, we've just formed a protocol of immediate loading with full arches. What we do is a complete treatment therapy, which is pre-planned, prefabricated, everything is kept ready, and then we deliver it all in one shot. The patient never has to look back on another surgical procedure or go through multiple sessions. In fact, we presented it during the European Academy of Osseointegration meeting.

Danesh: I remember a case of Burzin's. The patient was from Brazil. He had a very compromised situation. Before he stepped into Burzin's clinic he had a hard time getting any dentist to take on his case. Previous dentists were not convinced that they could restore him. But Burzin does a lot of work with tilted implants and immediate load. We had the software, the know-how, and we could pre-plan everything. This is something that amazed the patient—that we could show him a digital design. Then Burzin executed the surgery, and I remember him phoning me and telling me that the patient was so emotional just after his provisional. The treatment was quite life-changing.

What surprises me in India is how fast we've grown digitally and adapted to digital change. Almost 70% of the doctors that we work with today have intraoral scanners.

Q: How would you describe the market for digital dentistry in India?

Burzin: I think digitization has become a part of everyone's life in many ways, and dentistry is no exception. In India, many are looking for more education on these topics because the field evolves so quickly.

Danesh: What surprises me in India is how fast we've grown digitally and adapted to digital change. Almost 70% of the doctors that we work with today have intraoral scanners. We are doing a lot of digital workflows. That has really grown and continues to year-on-year.

Q: Like many software companies, exocad is making a push to cut down on software piracy. How big of a topic is that for you as software users and educators?

Danesh: I think that using the original software is always safer because whenever you have an issue, you can contact the right people. exocad has resellers. You have a ticket system, you can contact the resellers, you can download original libraries—all this by just putting in your original dongle number. There are a lot of benefits when you use original software, in terms of support and education from the company itself, that I think far outweigh the cost difference between buying pirated and original software.

Q: One word for exocad?

Danesh: Efficient.

Burzin: Inspiring.

Dr. Burzin Khan is a practicing implantologist, cosmetic dentist and prosthodontist with 30 years of experience in the dental field. Burzin completed his master's degree in Prosthodontics (MDS) at the Government Dental College and Hospital, Mumbai University in 1990. Burzin maintains the multi-center, multi-specialty clinical practice OPUS Dental Specialties at Fort & Bandra in Mumbai, with an emphasis on full digital workflows for immediate implant restorations, same-day teeth protocol, CAD/CAM teeth restorations, digital smile design for smile makeovers with veneers and full mouth rehabilitations. He is a founding member of Digital Dental Forum. You can follow him on **Facebook** and **Instagram**.

Mr. Danesh Vazifdar is a partner and technician specialist at Adaro Dental Laboratory, with a focus on CAD/CAM Dental Technology for crowns, bridges, implants and esthetic cases. He is on the faculty program for implant prosthodontics at the Interactive Eduhub Learning with Columbia University College of Dental Medicine and is a founding member of the Digital Dental Forum. Danesh's cases have been extensively published in the first book published on the socket shield technique called *Partial Extraction Therapy in Implant Dentistry*. He specializes in full-mouth rehabilitation implant cases and immediate loading solutions using guided surgery and one-time abutment concepts for single-tooth to full-arch implant solutions. You can follow him on **Facebook**.

by Caitlan Reeg

Writer at exocad

BLOGS

IN HOUSE ALIGNERS POSSIBILITIES AND FUTURE

Dr Aniket Gandhi
MDS Orthodontics

The clear aligner system is a modern adaptation of the systems described since the middle of the 20th century, therefore there were different devices and philosophies that have led to its creation and the system has evolved a lot over the decades. Clear aligner therapy has been a part of the orthodontic practice for years, but, popularity was increased since the introduction of Invisalign appliances (Align Technology) in 1998. There are almost 27 different clear aligner products currently on offer for orthodontic treatment. Nowadays, more people prefer clear aligner treatment because it is aesthetically superior to brackets and lingual orthodontics. The superiority of clear aligners lies in their aesthetics. The optical properties of the clear aligner material play a major role in aesthetics. The rising demand among adult patients for "invisible" orthodontic treatment has led to an exponential growth in the clear aligner market. Indeed, these aligners have a low aesthetic impact, as well as being able to effectively and progressively guide the teeth into their programmed positions. The rising demand of aligners has also made fabrication of In-house aligners as one of the value added services offered to the patient. They are removable and therefore do not hamper oral hygiene maintenance, in turn reducing the risk of white spots, caries, gingivitis and periodontal disease.

Q. Which are the different softwares available for orthodontic tooth movement planning?

1.3D maestro
2.3Shape Ortho System
3.Clear Correct
4.Dentsply Sirona Orthophos
5.Dolphin 3D Orthodontist
6.Invisalign ClinCheck
7.Planmeca Romexis Ortho Studio
8.SureSmile Aligner Planning
9.Delta face
10.Archform
11.Bluesky Plan
Autolign.. and many more..

These software options offer a range of features and capabilities for orthodontic teeth movement planning, including 3D modeling, virtual bracket placement, aligner planning, and treatment simulation. Some are specific to certain aligner systems, while others offer more general orthodontic treatment planning capabilities. Some are one time fee payment and some are pay per case. Orthodontists may ch

Q. Which are the different material available for aligner sheets ?

A

1. Polyethylene terephthalate glycol (PETG) - This is a thermoplastic polymer that is commonly used for clear aligners. PETG is known for its clarity and durability, and it can be easily thermoformed to create aligner trays.

2. Polyvinyl Chloride (PVC) - PVC is a synthetic plastic polymer that is sometimes used for aligners. PVC aligners may be less expensive than other options, but they are also less durable and can discolor over time.

3. Polyurethane (PU) - This is a type of polymer that is known for its flexibility and toughness. PU aligners are more resistant to stress and strain than other materials, making them a good option for complex orthodontic cases.(Most commonly used material for in-house aligners.)

4. Ethylene-vinyl acetate (EVA) - EVA is a copolymer that is often used in athletic mouthguards and orthotics. It is flexible and can be easily thermoformed, making it a good option for aligners. However, EVA aligners may be less durable than other materials.

Each of these materials has its unique properties, benefits, and drawbacks. Orthodontists may choose the material that best fits their patients' needs and preferences

Q. Future of aligners ?

There are several potential future developments in the field of aligners, including:

1.Smart aligners - There is research being done to develop aligners that can track tooth movement and provide real-time feedback to both patients and orthodontists. These "smart aligners" would use sensors or other technology to monitor treatment progress and ensure that teeth are moving according to plan.
2.3D printing - 3D printing technology is becoming more advanced and accessible, at present most of the softwares are offering option of direct printable aligners, thus reducing the steps in fabrication. The materials available for these aligners is available with Graphy, but the post processing after printing is technique sensitive. Eventually with advent of new materials maybe the processes may become easier and less technique sensitive.
3.Virtual consultations - With the rise of telehealth and remote patient monitoring, it is possible that virtual consultations will become more common in orthodontic treatment. Patients could reeive treatment recommendations and monitor their progress from the comfort of their own homes.
Overall, these future developments in aligners could improve the patient experience, increase orthodontic treatment efficiency.

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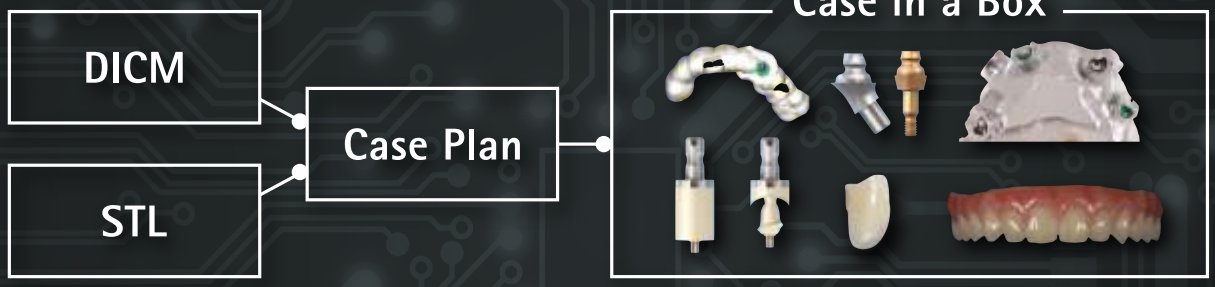

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COLLABORATING FOR THE FUTURE OF DIGITAL DENTISTRY

The Institute of Digital Dentistry is thrilled to partner with the Digital Dental Forum for its inaugural international conference - Digitize 1.0. We believe that both organizations share common values and beliefs, and feel this collaboration will help support digital dentistry in India for years to come. The Institute of Digital Dentistry was founded with a clear vision in mind - to make digital dentistry accessible to dentists all over the world and provide objective and unbiased information which can be used to improve patient care globally. Before the inception of the Institute of Digital Dentistry, there was a profound lack of unbiased information and courses available. Most of what was offered was extremely surface-level and didn't teach dentists how to get the most out of their equipment or how to invest without biased sales pitches. Equipment reviews were often sponsored by manufacturers and didn't tell the entire story. Most importantly, there wasn't a sense of community in the digital dentistry space, leaving a lot of dentists to feel like they were on their own. We have brought together over 40,000 passionate digital dentists and have become a world leader in digital dentistry news and education.

Our Membership training catalog has grown to over 70 digital dentistry-specific courses. We have also expanded our offerings to provide in-person courses around the Oceania region in the topics of intraoral scanning, 3D printing, CAD/CAM, digital implantology, with more to come.

By collaborating with the Digital Dental Forum, we are excited to help dentists in India confidently implement the digital workflow, reduce stress in their clinics, and provide their patients with optimal care. Digital dentistry has been growing rapidly in India in recent years, and we are excited to provide guidance and support to any dentist that needs it.

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