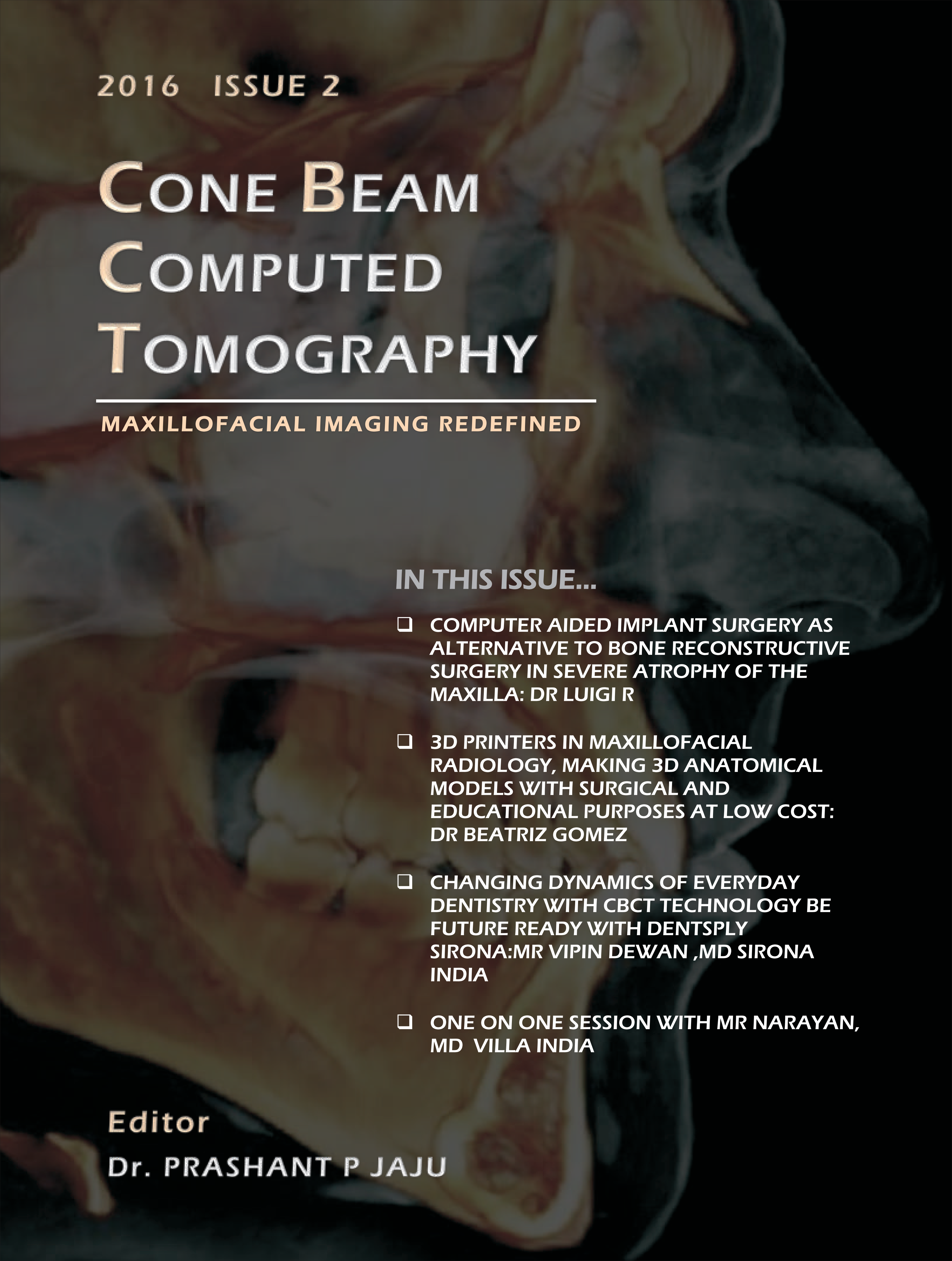

2016 ISSUE 2

CONE BEAM COMPUTED TOMOGRAPHY

MAXILLOFACIAL IMAGING REDEFINED

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Editor

Dr. PRASHANT P JAJU

CBCT

2

2016

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FROM THE EDITOR'S DESK

Dr. Prashant P. Jaju BDS, MDS (Oral Medicine & Radiology)

Dear Readers,

At the outset Team of CBCT magazine wish to thank one and all for the overwhelming response for our first issue. People applauded our efforts for this novel concept which will be assisting clinicians and academicians at large with CBCT technology. The current issue focuses on CBCT guided surgery, 3D printing and range of clinical cases. Also in this issue we have opinions from the heads of Sirona India and Villa India about their CBCT products and future they envision in India. Starting from this issue, we are encouraging post graduates students and internee of dental schools to put forward their views on the role of CBCT through their curious eyes. The GenX are going to be play an important role in digitial dentistry and they should be aware of new avenues and digital tools in dentistry. Next issue onwards we would be dedicating issues to specific topic, with third issue being on ROLE OF CBCT IN ENDODONTICS. We hope we will get the same critical response for this issue which would encourage us to improve further.

3D PRINTERS IN MAXILLOFACIAL RADIOLOGY, MAKING 3D ANATOMICAL MODELS WITH SURGICAL AND EDUCATIONAL PURPOSES AT LOW COST.

Dr. Beatriz Gomez

Author

Dra. Beatriz Gómez Bonilla. dentist, specialist in oral and maxillofacial radiology at the University of Valparaiso Chile (2007) , creator of the radiology center Begmax since 2009 , in Santiago, Chile , and university teacher of radiology

Co-author.

Dra. Catalina Balzo Berner, veterinarian , of the University of Chile , partner and responsible for image processing of the radiology center TCCB Begmax, since 2009.

Dra. Beatriz Gómez Bonilla

The increasing use of Cone Beam computed tomography as a tool for the diagnosis and treatment of patients in the dental area, has allowed us to capture volumes that can be processed in the computer into digital 3D models. Currently, thanks to the introduction and commercialization of 3D printers en the market, these models can be printed at low cost as anatomical plastic parts in full-scale in size.

The purpose of using 3D printers is to ensure access to a technique widely used in oral surgery, but limited by high costs until now, allowing its use and massification, either for physician-patient educational uses, education and training of dentists, or pre-surgical and surgical purposes.

The preparation of these models has three basic processes: Digitization, data processing and 3D printing.

Digitization:

For the development of anatomical models in 1: 1 scale of the patient, it is necessary to have three-dimensional exams, obtained either through Computed Tomography or CT Cone Beam, and processing DICOM files ("Digital Imaging and Communications in Medicine", files in which a CT is saved) into an STL printable file.

We can also acquire images from a Nuclear Magnetic Resonance (NMR) and intraoral scanner.

Data processing and 3D images.

The first step in designing the STL file for 3D printing is the use of specialized software for turning dicom CT files into tridimensional digital images. All of these softwares work on a grayscale threshold to create a tridimensional mask of the region of interest, then the user begins a process of "cleansing" the image to remove the "noise" and those structures that do not concern the 3D model (figure 1). Once the model is properly cleaned, the file is ready to be converted to STL format and be printed.

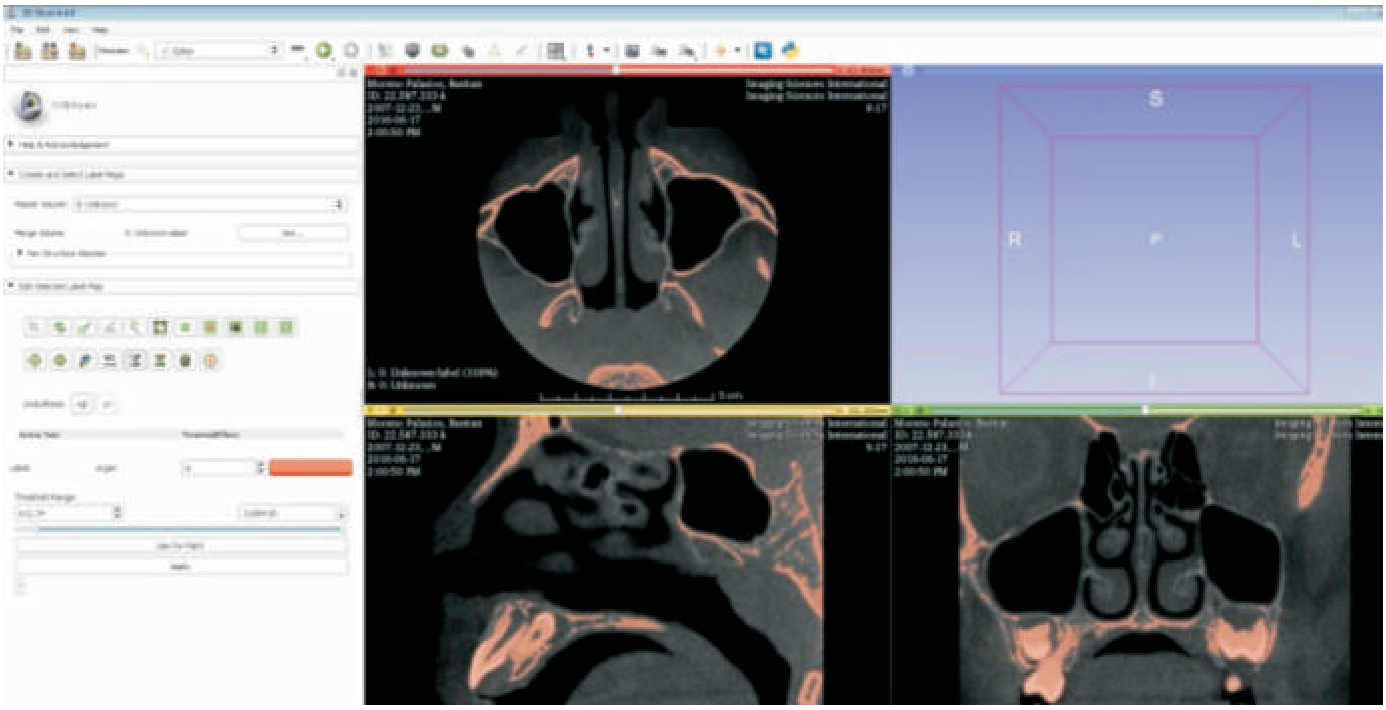

Figure 1: Some programs that convert Dicom files into STL files for 3D printing:

- Mimics (Materialise) (license)
- ScanIP (Simpleware) (license)
- Amira (FEI) (license)
- Osirix For MAC / OS (freeware)
- 3D Slicer (freeware)
- ITK-Snap (freeware)

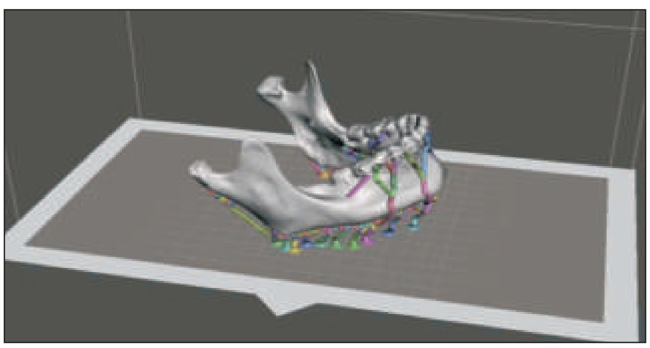

Figure 2: Designed model with printing supports.

Applications of 3D models in dentistry:

It is very useful in the field of surgery, these printed anatomical 3D models are ideal for surgical preparation, having a tangible model of the patient's anatomy available to study and simulate surgery, is preferable to be guided solely with an MRI or CT which are not so didactic since they are viewed in 2D or flat screens. These models not only allow the surgeon to study and design an operation previously, but also to simulate stages of surgery, mold osteosynthesis plates and surgical meshes.

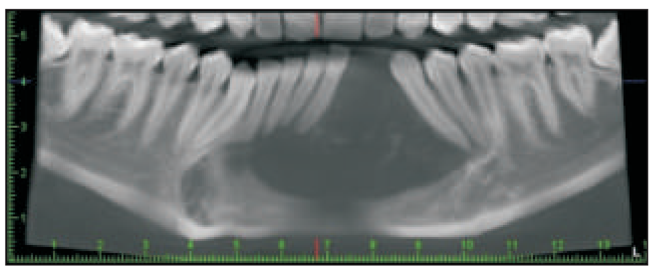

Figure 3

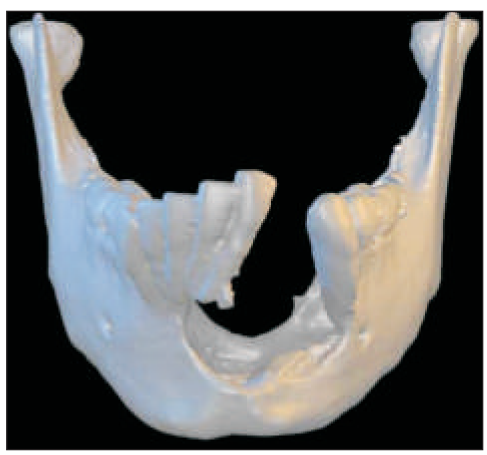

Figure 4

Figure 5

Case 1: Patient with mandibular Cemento-ossifying fibroma . DICOM files were extracted from Planmeca Cone Beam CT (figure 3). Digital 3D Model prior to printing (figure 4). Presurgical printed model (figure 5)

It's also possible to design mirror reconstructions of the patients and print them, in order to achieve better symmetry in the extensive facial reconstruction.

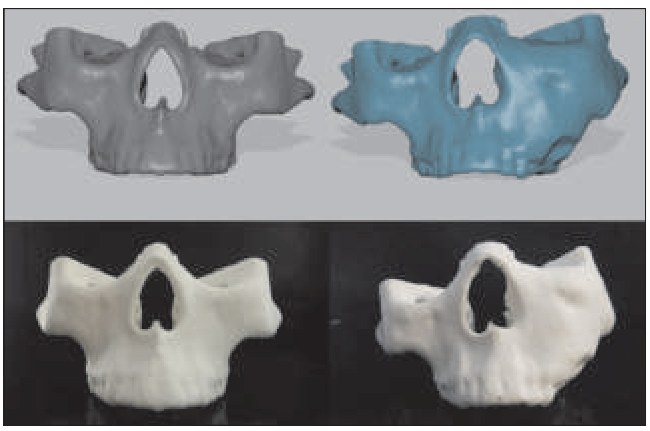

Figure 6

Case 2: Patient with Fibrous bone dysplasia, extensive facial assimetry affecting the left maxilla. Real 3D model (right) and mirror 3D model (left) for surgical planning (figure 6).

It's useful in bone diseases, trauma and craniofacial fractures, developmental abnorma-lities, syndromic patients, orthognathic surgery (Splint) and implant surgery (surgical guide and study models).

Figure 7

Case 3: Patient with severe alveolar atrophy and displaced fracture . Pre - surgical model (figure 7).

Figure 8

Figure 9

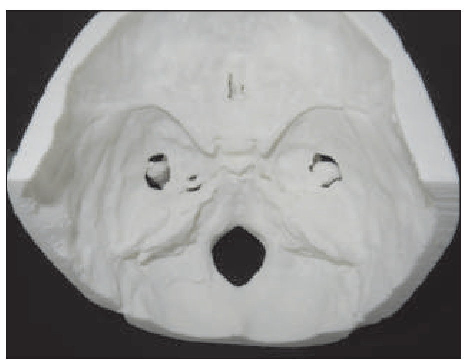

Figure 10

Case 4: Patient with mandibulo-acral dysplasia. Full Skull 3D model for evaluation and surgical planning (figure 8 and 9). Interior view of the skull where bilateral absence of the mandibular fossa is observed (figure 10)

Pre-treatment study models can be manufactured in Orthodontics (figure 11) and in rehabilitation it allows the manufacture of molds for the design of removable prosthesis for patients.

Figure 11

3D models can be educational for the training of dentists and specialists and are very useful for patients to understand in a better way their own treatments.

Figure 12

Didactic model that shows the relationship between the third molar and the mandibular canal

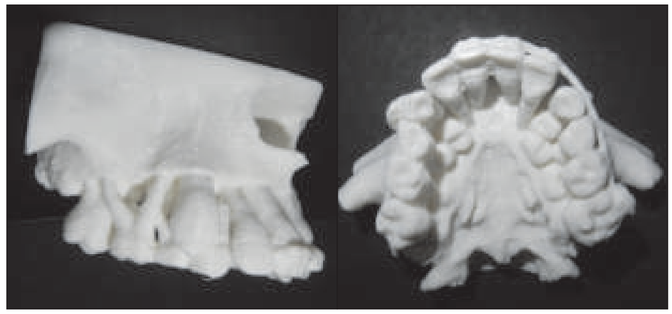

Figure 13

Didactic model where alveolar bone has been cleared and the position of roots and supernumerary teeth can be appreciated

Figure 14

Didactic model of the temporomandibular joint. While dentistry has been the slower area to adopt this technology, compared to the automotive, aerospace and metal industries, we are confident that it will be increasingly used in our area. The design and extraoral simulation allowed by these 3D models, reduces complications, unforeseen or errors in surgeries and treatments of patients. In implant procedures can address a personalized and minimally invasive way, reducing intervention time and increasing clinical success.

It certainly is a great resource for dentists, even more nowadays when it has become an accessible low cost tool with the potential of expanding its use in order to improve the conditions of the treatments.

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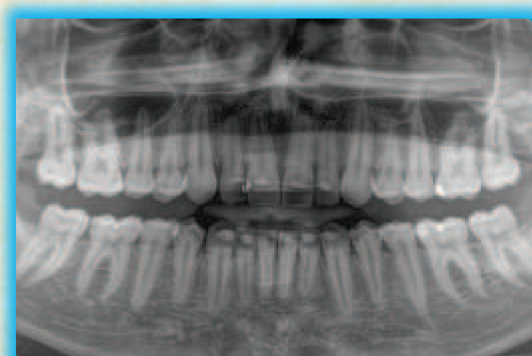

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COMPUTER AIDED IMPLANT SURGERY AS ALTERNATIVE TO BONE RECONSTRUCTIVE SURGERY IN SEVERE ATROPHY OF THE MAXILLA: REPORT OF A CASE

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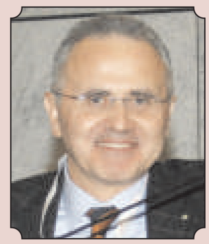
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Ugo Covani

ABSTRACT

The aim of this study was to introduce a new concept for computer aided surgery as an alternative to the reconstructive surgery in the treatment of severe atrophy of the maxilla.

This study as been conducted inside a case series in the clinical activity of an University Master Program in Computer Aided Implant Surgery of "G. Marconi" University of Rome in Italy

We report a single case of 25 consecutive patients case series selected for severe maxillary atrophy, all of them has been treated with immediate implantology and immediate loading without any bone graft addictions.

This patient presented a total maxillary edentulism with bone resorption of class 4 in the posterior and anterior areas following Cawood and Howell classification based on a cone-beam computed tomography (CBCT) study. The 3D data were imported in specialized software and used to analyze the residual maxillary bone volume. Computer software was used to plan and position 6 dental implants, taking maximum advantage of the remaining bone. Basal bone was sought by angulation and implant fixation in the buttresses, while rehabilitation was carried out by means of a fixed screw-retained upper prosthesis and a lower overdenture.

This technique optimized precise implant placement as planned without the need for more complex reconstruction techniques.

INTRODUCTION

The current functional and aesthetic standards of partial implant-supported were subject to constant improvement. The international literature currently makes available extensive documentation about the implant survival prognosis in the medium to long term. Modern dentistry can therefore boast the medium to long term success and implant survival rates ranging well over 90%[1-4].

In clinical practice, however, it is a common finding the difficulty, if not impossibility, to place dental implants of standard dimensions (height and diameter equal to or greater respectively to 10 mm and 4 mm) in edentulous sites with insufficient bone volume.

Multiple surgical techniques (sinus lift, autologous bone grafts to onlays/inlays, transposition of the inferior alveolar nerve, Distraction osteogenesis, through technical surgery splitting crest etc.) were completed in order to ensure adequate bone volume simultaneously or before implant placement. Nevertheless, these procedures appear susceptible to greater risks and costs for the patient, in addition to assume in many cases the necessity of seconds of bone harvesting sites, intra or extra-oral, and prolonged rehabilitation times. Alternatively to what has been described the use of prosthesis implant-supported with extensions, although the indications for this type of rehabilitation appear limited to cases adequately selected according to factors of bio-mechanical order related to the under-prosthetic structure (length of extension) and the patient (type of occlusion and parafunctions).

Considerable attention is currently placed in respect of the implant placement techniques tilted through design and the use of computer assisted surgery techniques whose successful prognosis and survival appears to be comparable to that of standard systems in view of the respect of some positioning prerequisites and prosthesis, such as the bone quality of the site, the type of prosthesis and especially the emergence prosthetic profile.

Bone grafts in severely atrophied maxilla is most often accomplished as part of a 2-stage surgery implant protocol, which is followed by a 4- to 8-month healing period to allow for integration of the graft prior to the placement of dental implants[5,6] . Once the implants have been placed, they have to remained submerged for several months, without any loading, prior to a second surgery to "uncover" the implants and place abutments for fabrication of the definitive prosthesis.[7,8] The time from the beginning to the final prosthesis for a patient requiring such bone grafting can be more than a year and include multiple surgeries, increased potential for complications, and a donor site morbidity [9-11].

The concept of immediately loading implants has been well documented in the international literature[12-16]. The maxillary bone can create difficulties for immediate loading that are not found for the mandible. These problems occurs mostly of type III and IV bone, shown to have responsible for an increased number of implant failures,[17,18] as well as the presence of the maxillary sinus and nasal cavity, which can limit the quantity of vertical bone necessary to place implants. To provide patients with a successful, immediately loaded prosthesis, these problems must be overcome.

Use of computer aided surgery facilitate the immediate implant placement and the use of the tilted implant has been shown by others to be a viable treatment modality to place longer implant screws able to support immediately loaded fixed prosthesis[19, 21]. Both of those enhances to create an anchorage on maxillary basal bone which has been shown to have a high percentage of dense bone relative to total bone volume [22], should also be considered, to provide additional stability during implant surgery and the provisional restoration phase. The purpose of the treatment described in this clinical report was to provide the patient with an immediately loaded, functional maxillary fixed prosthesis without bone grafting surgery in a single treatment, demonstrating that even the most severely resorbed maxilla can be restored and functionally loaded when all the available bone is made available for implant support[23,24].

CLINICAL REPORT

A 50-year-old man with good health status presented to Tuscan Dental Institute (Versilia General Hospital, Lido di Camaiore, Lucca, Italy) with the chief complaint that he was enable to wear his maxillary complete removable denture. He shows an important bone atrophy related to class IV according Cawood and Howell classification [25, 26]. The patient reports 3 years before was planned for a post extractive immediate screw-retained maxillary prostheses with a flapless procedure; the problem became when the equipe started to remove the teeth that results all in anchilosys so they perform an open flap procedure with a consequent important bone loss and the impossibility to perform the implant surgery; we had considered that as a consequence for the difficult to assess the information from the cone beam computed tomography (CBCT) [27,28].

In the last two years patient has been provided with several treatment, including bone grafting techniques that he believed were unacceptable to solve the problem. Prosthodontics treatment options were discussed, including bone grafting, implant placement, and delayed loading.

With the patient was discussed the possibility of being placed inside a clinical program of the University Master in Computer Aided Implant Surgery (University "G. Marconi", Rome) to optimize the timing and biological costs of rehabilitation for a treatment plan that would allow for fixed, screw-retained maxillary prostheses with immediate loading. An immediate, functionally loaded, maxillary fixed implant-supported acrylic resin prosthesis was planned for insertion immediately following implant placement[29,30].

The patient was evaluated clinically and radiographically using traditional panoramic and cephalometric x-ray[31, 32], which revealed the extreme degree of bone loss and the complexity of future prosthetic treatment.

A CBCT scan (Ortophos XP Dentsply Sirona) was performed to acquire additional radiographic data and to assist with surgical and prosthodontics treatment planning[33-35]. Prior to scanning, a new maxillary denture was made for the patient (Fig. 1-2), with particular attention on the accuracy of surface fit and esthetics[36,37].

Figure 1

Figure 2

Figure 3

The denture was duplicated using radiopaque acrylic resin and twelve perforations at the prosthetic ideal axes were made in the denture's teeth using a no.8 round bur (Komet Dental, Lemgo - Germany) (Fig. 3), according to a specific guided surgery protocol (Implant 3D-Bionova, Follo (SP) Italy) that uses a single scan technique[38] using radio-opaque resin denture's duplication (SR Orthotac-Ivoclar) bonded to Bionova Universal Stent 3.0® to acquire the pertinent information.

Figure 4

The digital imaging and communications in medicine (DICOM) formatted files that were exported from the CBCT scan were converted into a proprietary 3-dimensional (3-D) format so that further evaluation and virtual implant planning could begin. The software Implant 3D (Implant 3D-Bionova, Follo (SP) Italy) was used to plan implants locations for the maxilla.

The Implant 3D protocol expect to match DICOM data with STL file obtained from optical scans of model cast wearing the radiopaque denture duplication bonded to the radiological Universal Stent 3.0 and the STL file of denture duplication alone. Implants were planned for each area for a total of 6 screws (Premium/Khono System; Sweden & Martina, Due Carrare PD - Italy) in order to comply surgical and prosthetic needs using the information obtained by CBCT and STL data.

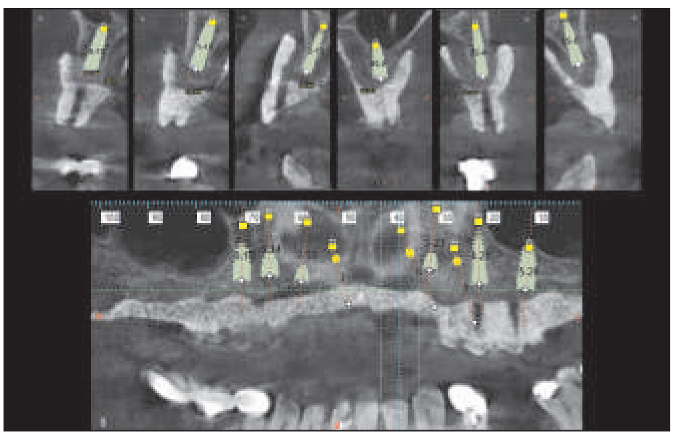
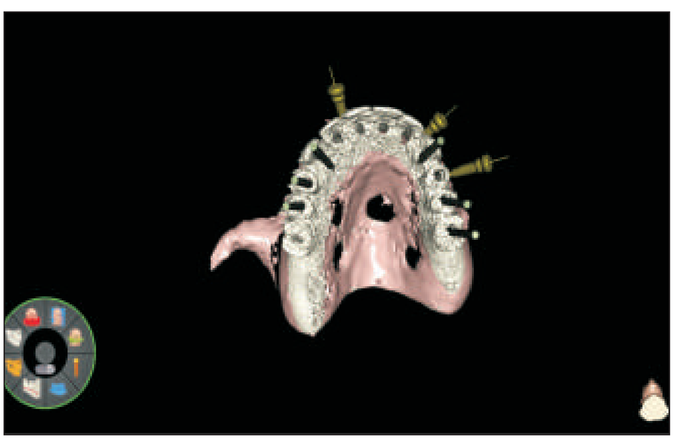


Figure 5



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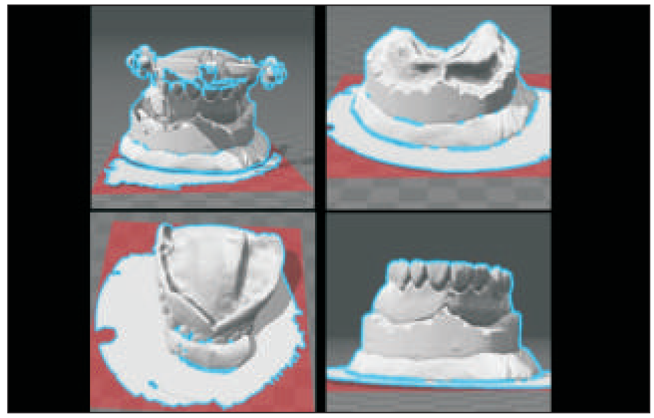

Figure 7

Three anchor pins (Sistema di bloccaggio®, ModelGuide Bionova) were planned to increase the stability of the surgical template. Following completion of the virtual implant planning, the data was uploaded to the manufacturing facility (Bionova) for fabrication of a surgical template.

Figure 8

The surgical guide is used before the surgical session to produce the temporary full bridge for the immediate loading. The surgical guide is used on the model cast or on a resin model duplicate made by the software company. Implant drivers from dedicated surgical guided kit allows the 3D correct planned implant position and implant laboratory analogs are positioned into the model cast, previously drilled [39].

Provisional prosthesis, with a metal frame, is made after conical abutments and temporary cylinders placing onto the implant analogs according to the virtual project performed with the software.

Figure 9

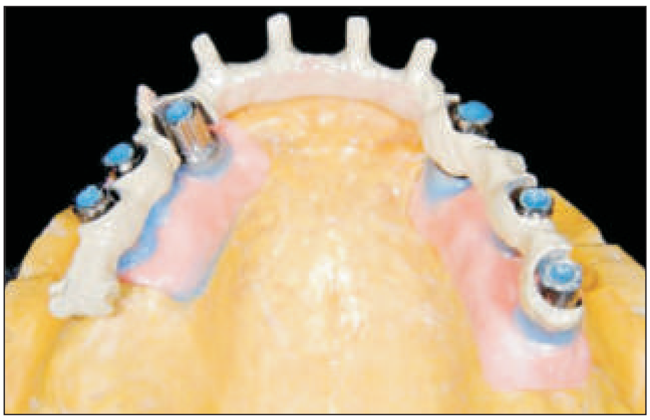

Figure 10

Figure 11

The patient was draped and prepared for implant surgery in the standard sterile fashion ad modem Brånemark. Local anesthesia, 6 carpules of Articaine, 4% with 1:200000 (Alfacaina® Dentsply), was administered high into the vestibular areas with a slow inoculation to avoid changing the volume topography of the palate, which could create instability of the surgical guide at the beginning of the surgery.

The surgical template was aligned intraorally using a surgical bite made by siliconic hard putty (Zetalabor-Zermack Badia Polesine (Ro) Italy) provided by the laboratory. A 1.5-mm twist drill (Bionova) was used to prepare osteotomies to place 3 anchor pins (Bionova, Follo (SP) Italy) designed to secure the surgical template (Fig. 12). The surgical bite was then removed to begin preparation for implant placement.

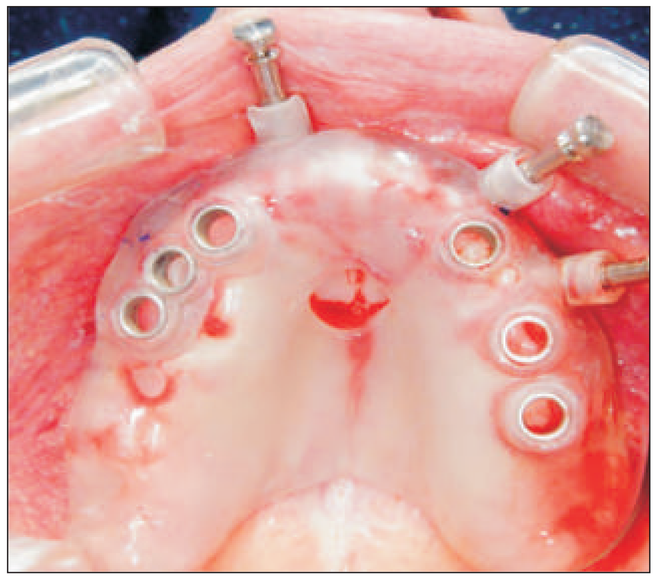

Figure 12

Soft tissue was cut using specific guided circular tissue punch, it was removed and crestal bone was profiled using a specific guided counterbore drill (EchoPlan Surgical Kit, Sweden & Martina - Italy) that provide to create the first pilot hole. A 2-mm guided twist drill was used, followed by a 3-mm twist drill (EchoPlan Surgical Kit, Sweden & Martina - Italy), to prepare the implant osteotomies with total drilling control: 3D direction and depth (Fig. 13). The following implants were placed using the surgical guide and guided mounter with depth control screwed onto the implant.

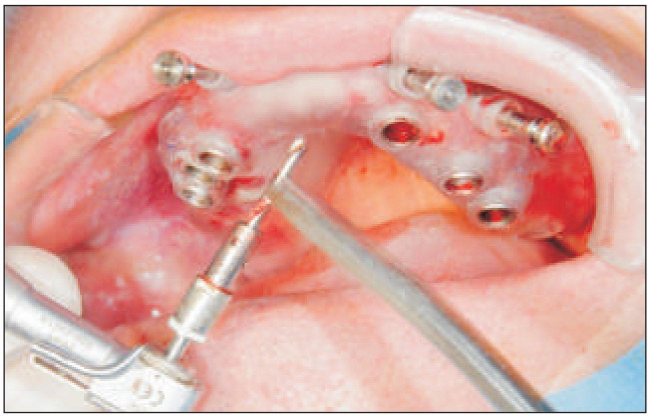

Figure 13

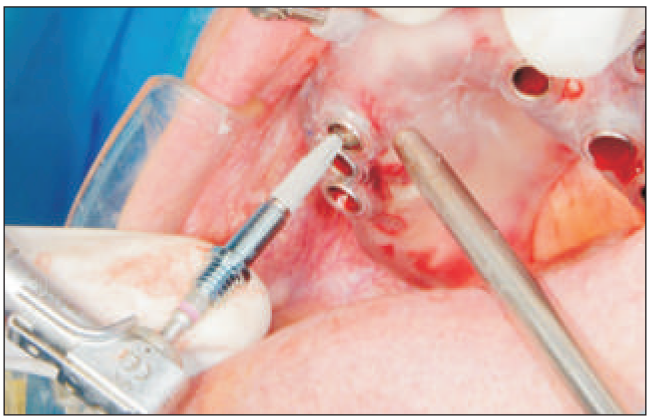

Figure 14

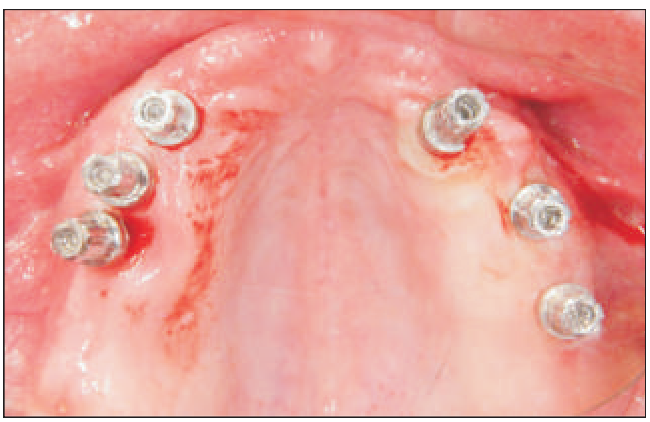

Figure 15

After implant positioning, conical abutments and temporary cylinders are placed respecting the virtual planning.

The prosthesis was inserted and fully seated on the 6 implants that were placed using the surgical guide. The provisional prosthesis was then removed from the patient, refined, and polished in the laboratory (EREA, Camaiore (LU) – Italy)(Fig. 16). The completed provisional acrylic resin prosthesis was then screwed into position with a uniform torque force of 15 Ncm (Fig. 17-18). All steps (implant surgery, intraoral adaptation of provisional, finishing after gluing, occlusal adjustment) were performed in 4 hours.

Figure 16

Figure 17

Figure 18

The patient was learned to clean the prosthesis twice each day using a toothbrush and interdental brusher designed for implant application (Curaprox, Switzerland)

Three months following the initial implant surgery and provisional prosthesis placement, a panoramic control exam was performed (Fig. 19, 20) and the provisional restoration was removed. All implants were clinically determined to be stable, with no mobility and with no soft tissue inflammation neither bleeding.

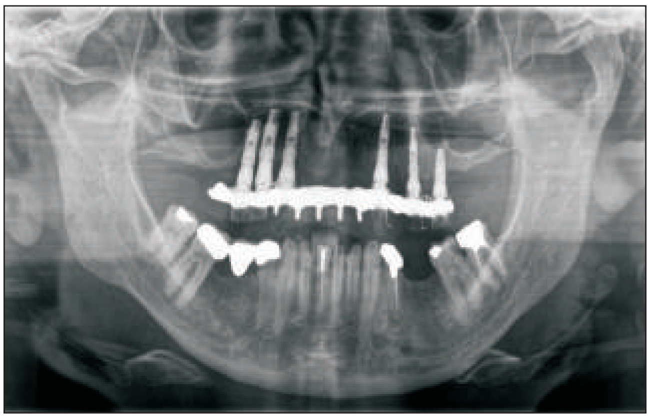

Figure 19

Figure 20

The patient reports great functional and esthetic satisfaction without any problems.

CONCLUSION

The use of CBCT in implant surgery, probably the most detailed radiological examination available, allows the surgeon to obtain a large amount of specific information such as bone volume, cortical thickness, density of cancellous bone and dangerous anatomical structures to avoid. Precision obtained by the rigid protocols of guided surgery producers allows the surgeon to work in a safe mode. Those amounts of data are not an easy mix for severe atrophy treatment.

We consider a continue education program a must for surgeons end general dentists to evaluated information from new technologies, like CBCT, and, at the same time, created new standard about CBCT information because is very difficult for dentists habituated to make diagnosis on 2d x-ray transfer to 3d x-ray's world.

These software allow you to customize the screens, simultaneously showing axial sections, cross sections, panorex and 3D reconstructions with matching STL obtained of optical scans of the patient's models. There are also complete libraries of implants and prosthetic abutments that can be integrated with the information of the final prosthetic design supplied by diagnostic prosthetic stent or by wax-up STL like ideal crown's positions, ideal prosthetic axes or abutment's morphology to simulate and program the best implant position.

All of that integrates with the information of the final prosthetic design supplied by diagnostic prosthetic stent or by wax-up STL like ideal crown's positions, ideal prosthetic axes or abutment's morphology

The “computer guide surgery software” is today the only diagnostic tools that allows to use prosthetic integrate to radiological exam within a dynamic tridimensional virtual environment.

These software allows clinicians to respond to the demands of the clinical case effectively: in case of immediate loading user can optimize implant lengths, selecting sites with better bone quality, impacting the implants against cortical bone walls and in more considering prosthetic result with the evaluation of the outputs of the implant axes and abutments; in cases where aesthetic goal is primary users chosen ideal implants positions and dimensions and related abutments for the final result. Eventually it's possible to evaluate the need and the amount of bone grafting.

Furthermore the flapless surgical approach trough surgical guide meets the frequent requests of minimal-invasive surgery for medical needs (hiring bi-phosphonates, anticoagulants, advanced age, etc.) or for special needs patients.

ACKNOWLEDGEMENTS

The EREA dental laboratory (Camaiore, (LU) – ITALY) directed by DT Pier Luca Mori and his staff are gratefully acknowledged for the prosthesis execution and their support during all the prosthetic procedures at the Tuscan Dental Institute, Versilia General Hospital, via Aurelia, 355 - Lido di Camaiore (LU), Italy

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CHANGING DYNAMICS OF EVERYDAY DENTISTRY WITH CBCT TECHNOLOGY BE FUTURE READY WITH DENTSPLY SIRONA

Mr. Vipin Dewan

Vipin Dewan, Managing Director of Sirona Dental Systems Pvt Ltd, India is a qualified engineer with Post Graduation in Business Management. He is currently pursuing his PhD research in 'Indian Medical Devices Manufacturers - Barriers and Enablers'. He is an innovative and results driven leader focused on achieving exceptional results in highly competitive environment and is a focused professional with nearly 23 years of rich experience in sales & marketing, general and senior management in Healthcare Devices Market. His specialization is in re-engineering of business processes, re-designing of commercialization plans and strong financial discipline under strict compliance have contributed significantly in Sirona India's business growth. He has been responsible to create CEREC as one of the 'Best Healthcare Brand' by 'The Economics Times' and was facilitated by Hon. Health Minister - Govt. of India. Before joining Sirona India in August, 2015, he was handling the Orthopedics and Traumatology business in Aesculap BBraun in India.

Vipin Dewan

Since over a decade movies, internet and a vast array of media have been suggesting futuristic technology and concepts. A life filled with faster cars, advanced medicines, engineering, easy to implement solutions in all walks of life. These futuristic movies were set in today's time. Some concepts are a reality today, while a few of them i.e. the flying cars are still an idea for future. The same applies to dentistry.

Innovations in the field of dentistry have led to many futuristic concepts and technology which were not taken seriously 30 years ago. Early adopters of technology understand the importance of being tech savvy, also the change and improvement it brought to their practice.

Dentsply Sirona is the driving force behind technical progress in dentistry. Beginning with the invention of the first electrically powered dental drill in 1887, the company has consistently spearheaded technological developments. Dentsply Sirona's product innovations set the standards for dental treatment and we are the global leader in the development of digital treatment modalities that drive improved workflow, a better patient experience and ultimately drive the success of dentists who incorporate Sirona technology within their practices.

As Dentsply Sirona we are the world's largest manufacturer of professional dental products and technologies, empowering dental professionals to provide better, safer and faster dental care. As The Dental Solutions Company™, Dentsply Sirona will provide dental professionals comprehensive end-to-end solutions offering. This offering includes some of the best-known and established brands in the industry. Amongst other products we develop, manufacture and market a complete line of digital intra-oral, panoramic and 3D imaging systems.

Digital technologies are changing our everyday lives. Even in dentistry they are necessary for modern solutions to treat many indications simply, quickly and economically. Practices and dental labs alike benefit from our 30 years of CAD/CAM and imaging experience: From digital impressions and design to the production of complete restorations, surgical guides and appliances for prosthetics, implantology and orthodontics, Dentsply Sirona offers standardized system technology with a seamless digital workflow. This makes exchanging data and information between the practice and dental lab both easier and quicker.

The exposure to internet has led to demanding and well-informed patients. They expect minimal invasive treatments in short span of time. Future practices will be more result oriented, focus on detailed diagnostics and solution will be priority. Due to time constraint, clinicians are looking at one-stop-shop solutions. Dentsply Sirona with unmatched offerings of integrated products and solutions is driving these key industry trends and setting the standard for the industry as the total solutions provider.

As a pioneer in dental X-ray technology, Dentsply SIrona continues to set the standard in modern, digital imaging. With its established ORTHOPHOS family, Dentsply Sirona offers sophisticated 2D and 3D X-ray systems for the general dental practice, which cover more than the entire bandwidth of all fields in dentistry, but also offer outstanding image quality and simple operation. Our 3D X-ray product range is completed by the high-end CBCT (Cone Beam Computed Tomography) GALILEOS Comfort Plus, with its large field of view and integrated face scanner. For intraoral X-rays, Dentsply Sirona offers intraoral X-ray tubes, a family of sensors led by our Schick brand, and a phosphor plate scanner in order to fulfil the requirements of any practice while providing customers the confidence to invest in technology providing clinicians with high quality products and images.

In the future, digital networking will play a fundamental role in dental practices, clinics and laboratories–influencing everything from treatment to patient management. That's why we place great emphasis on the research and development of digital, network-capable dental technology. It is just one more way in which we are helping to build a stronger dental community prepared for all future challenges.

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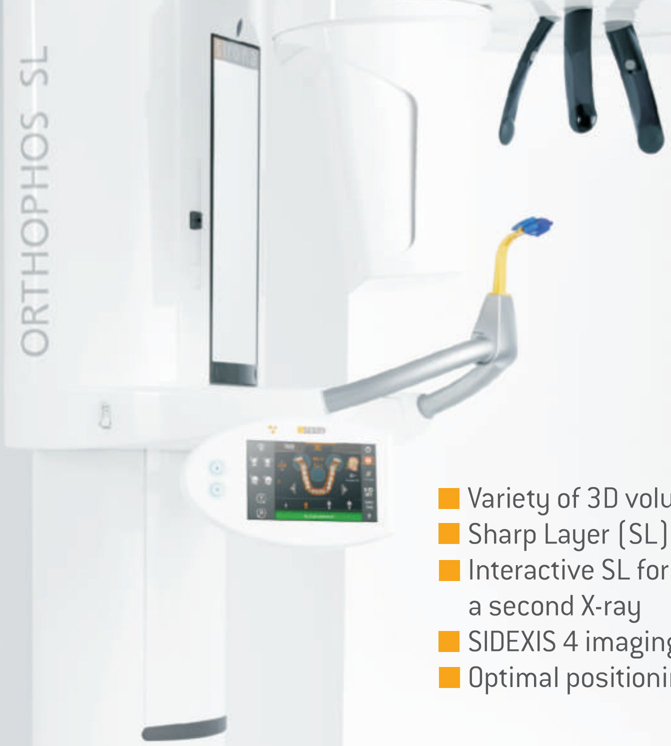

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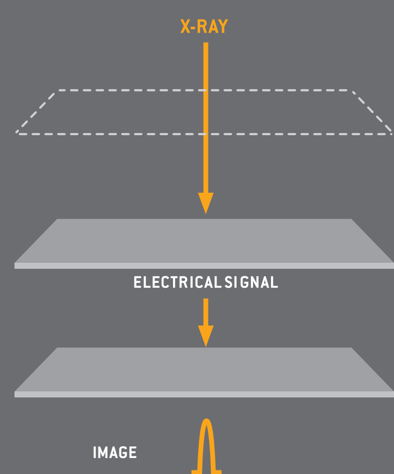

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Dr. Shikha Rathi, BDS, MS

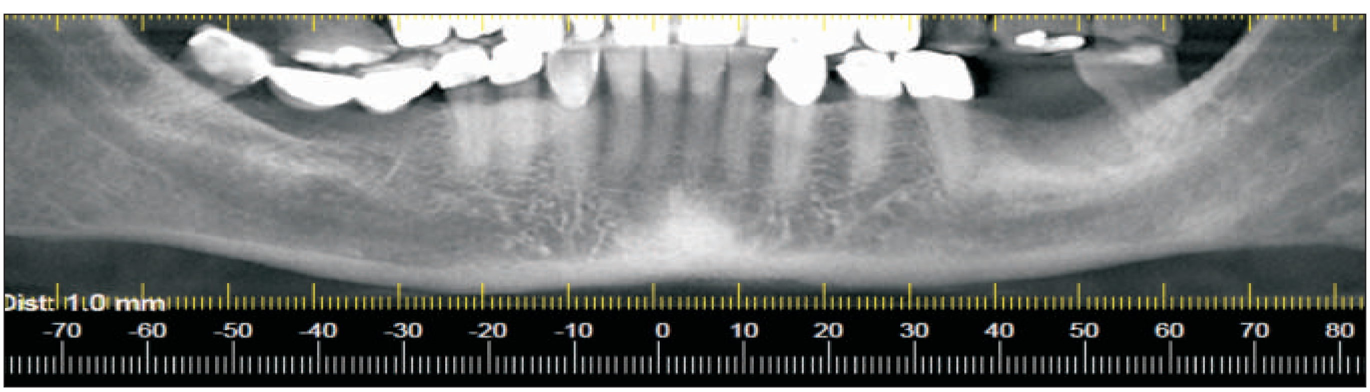
Dr. Shikha Rathi
BDS, MS

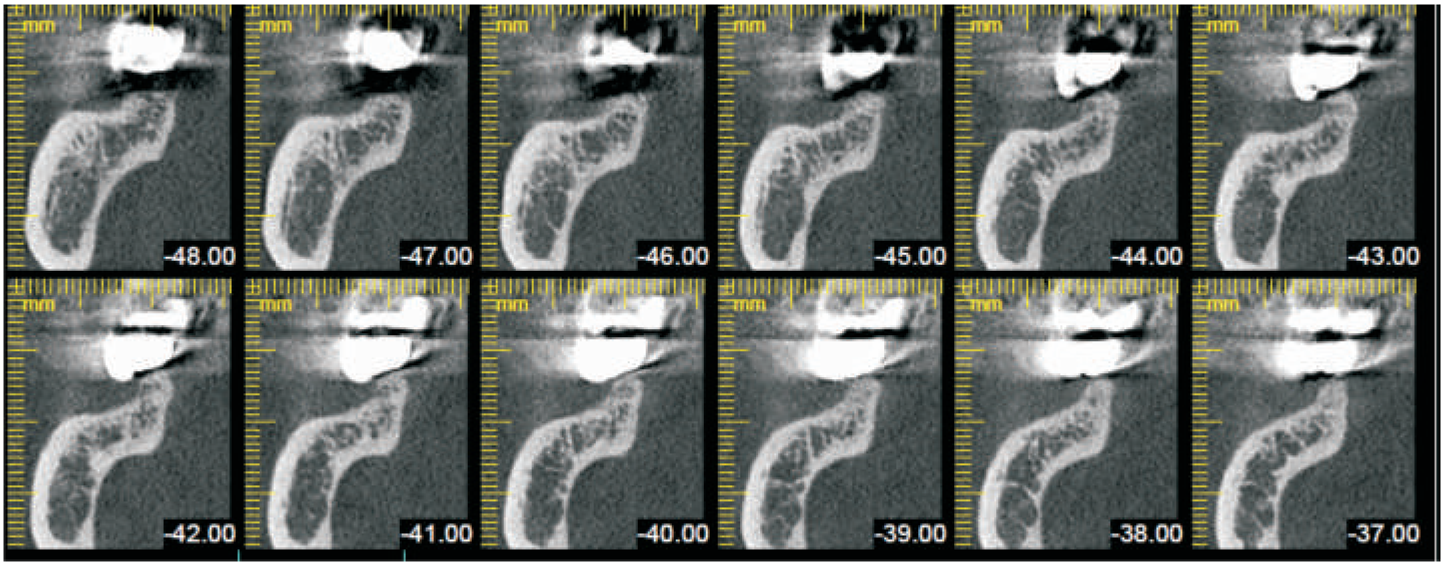
Dr. Shikha Rathi graduated in 2004 with a dental degree from D.Y. Patil University in Mumbai, India subsequent to which she enrolled in a Master's program in Oral and Maxillofacial Radiology at the University of Texas at San Antonio, USA. She received a certification and a M.S. degree in Oral and Maxillofacial Radiology in 2011. Dr. Rathi is a Diplomate of the American Board of Oral and Maxillofacial Radiology and currently maintains her private practice at DDI in Sacramento, California. She is an adjunct assistant professor in the department of Orthodontics at the University of Pacific, San Francisco. She is a co-author on "Specialty Imaging: Dental Implants", and a contributing author of "Horizontal Alveolar Ridge Augmentation in Implant Dentistry" and "Specialty Imaging: TMJ". She is also a recognized reviewer of the journal of Oral Surgery, Oral Pathology, Oral Medicine, Oral Radiology (OOOO).

Dentists traditionally practice in a bubble. Lacking the collegiality of large medical groups, hospital or multi-specialty dental clinics, dentists are often left to fend for themselves when faced with complex medico-dental issues. Although it is true that a model for referral to specialists is developed in most practices, a large number of general dentists are choosing to perform more complex specialty procedures. Educators at dental institutions are hard pressed to cram information into the average dental that is just enough to make them a "safe beginner". This has resulted in greater need and demand for quality continuing education courses to guide and train practitioners to deliver high quality care to their patients.

The advent of Cone Beam CT has proved to be an invaluable diagnostic and treatment planning tool in dentistry. In the last decade, it has been used with increasing frequencies in all branches of dentistry due to its availability, ease of operation, and clinical superiority over the existing modalities. Its ability to capture anatomy in 3-dimensions with submillimeter accuracy has opened doors to making precise diagnosis and predictable treatment outcomes.

Applications in implantology have been more profound than any other area of dentistry. Virtual planning on CBCT software permits a prosthetically-driven placement of an implant in available bone avoiding anatomic boundaries. This not only reduces the risk for complications and increases accuracy of implant placement, but also minimizes/ eliminates or recognizes the need for supportive procedures like bone grafts in many situations.

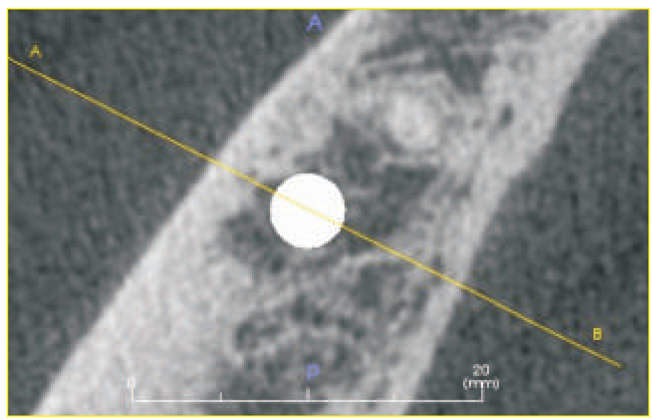


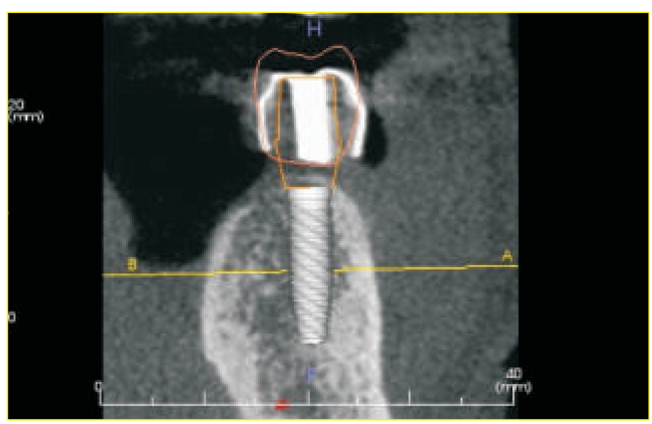


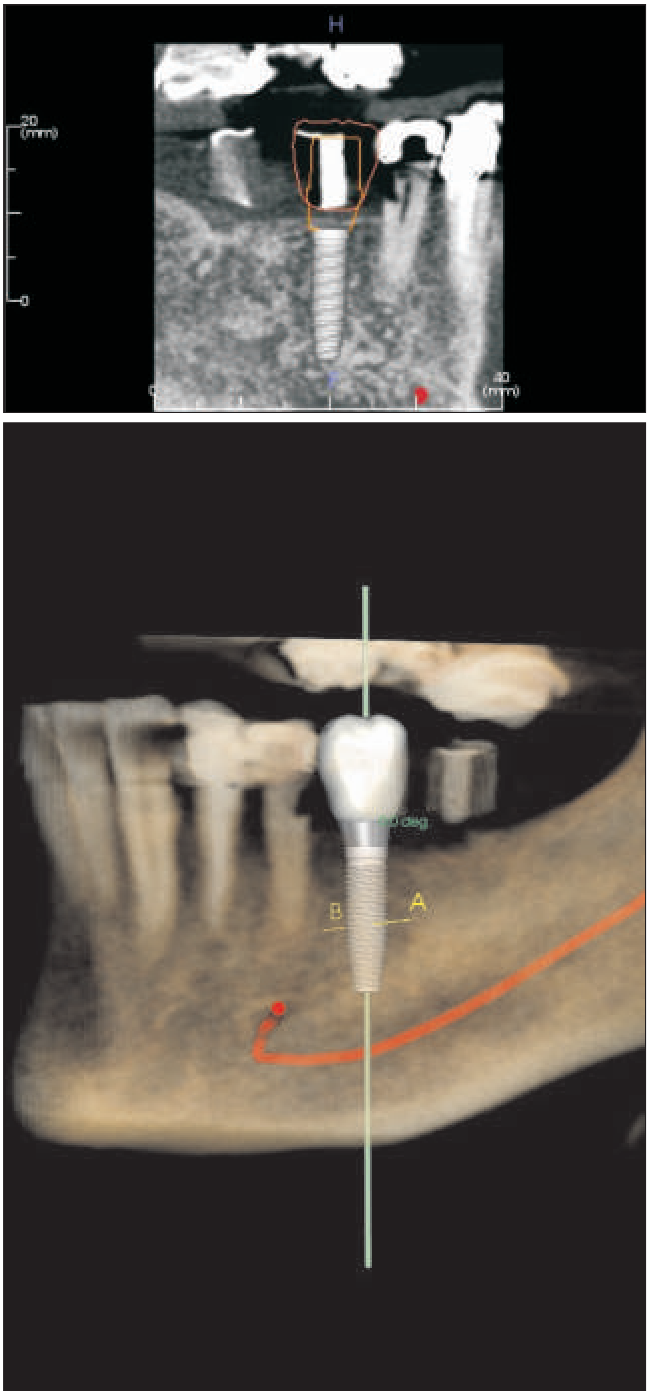
Top: Cropped panoramic of the mandible with missing teeth 36, 38, 46, 47

Bottom: CBCT cross-sections in the region of 46. Note lingual projection of the narrowed ridge and large lingual undercut representing the submandibular fossa. The major limitation of panoramic radiography is that buccolingual assessments cannot be made.

The transfer of the virtual treatment plan on a CBCT software can be facilitated by computer-aided manufactured (CAM) surgical guides that can be used at the time of the implant surgery. These surgical guides are used with implant-specific drilling instruments to place the planned implants in the same position, depth, and angulation as the virtual plan. They allow for accurate and predictable implant placement and can significantly reduce surgical time. A newly introduced alternate method to using surgical guides is dynamic navigation during live surgery (the X-Guide Surgical Navigation System: http://www.x-navtech.com/). These systems provide interactive, turn-by-turn guidance during osteotomy for precise implant placement in accordance with the CBCT virtual treatment plan. The continually updated position of the drill and the operating site is displayed on a monitor enabling the surgeon to control real-time movements with remarkable precision. Navigation surgery from CBCT plans will find applications in many other aspects of dentistry in the near future.





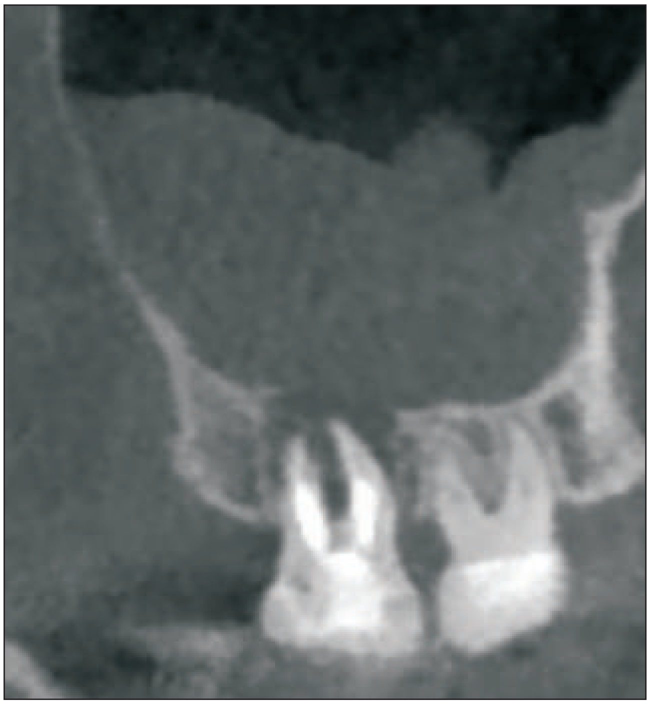


Virtual planning on CBCT software. Multiplanar reformats show trajectory of a planned implant. The 3D reformation is used as an adjunct to sectional images and shows the relationship of the planned implant with the adjacent anatomic structures. The course of the mandibular canal is marked in red; note the presence of an anterior loop of the canal.

Implant placement surgery using the X-Guide surgical navigation system. Note overhead cameras and display monitor. The surgery is performed in real time keeping track of the position, angle, and depth of the bur relative to the plan. There is a 360^0 view of the drill movements and anatomy on a single display.

Endodontic applications of CBCT include presence and extension of periapical lesions, visualization of normal/ aberrant canals and root configuration, calcification of canals, and detection of perforation, root fracture and internal/ external resorption.

Examples of root fracture, perforation through furcation, internal resorption with arrows pointing to areas of interruption in external root surface, bifurcation of canal, supernumerary root

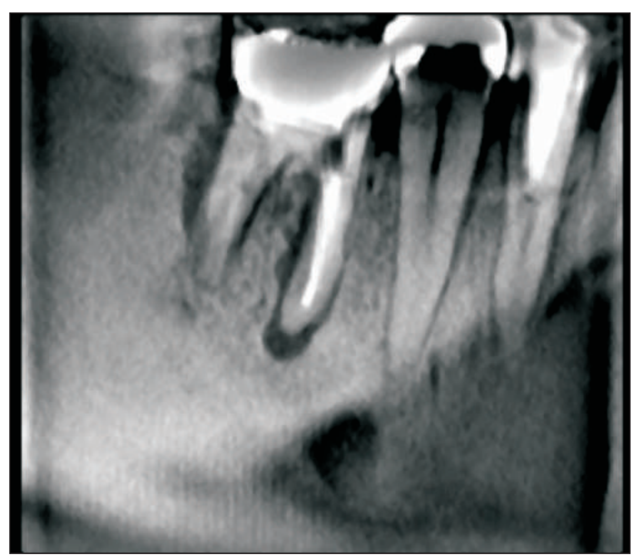


Interruption of sinus floor by periapical lesion on 17

Top: Periapical radiograph of patient with dull pain after endodontic treatment

Bottom: Axial view of CBCT showing untreated supernumerary distobuccal root

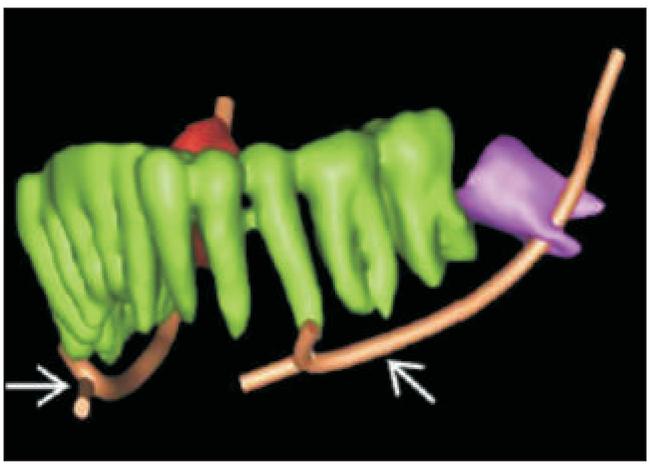
For **periodontal assessment,** CBCT can demonstrate alveolar bone morphology and measure periodontal bone levels, infrabony/crater defects, furcation involvement, fenestrations and dehiscence and periodontal cysts with accuracy. Several studies suggest that CBCT imaging has the potential to replace intraoral imaging for the evaluation of periodontal architecture.



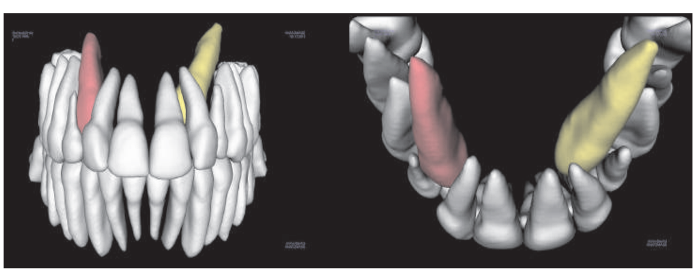
Top: Periapical radiograph of 36 showing apical PDL space widening

Bottom: CBCT sagittal image shows extensive periodontal bone loss

In the areas of **oral surgery and oral pathology,** the data from the CBCT can have significant impact on decision making. The location and angulation of impacted teeth and their proximity to adjacent structures can be seen with exceptional clarity. 3D rendering of a cone beam volume is particularly useful for assessment for dentoalveolar and craniofacial fractures and any displacement of fracture segments. For orthognathic surgery assessment, CBCT can play a pivotal role in evaluation of anatomy for planning plate fittings. 3-dimensional evaluation of pathologic conditions permits precise characterization of a lesion and its behavior and allowing localization of favorable sites for biopsy or surgical entry.

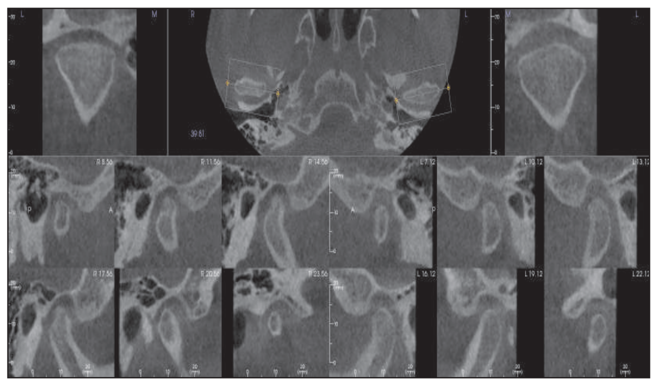


Segmentation of the mandibular teeth and the inferior alveolar canal (arrows) shows the relationship of the canal with an impacted 3rd molar (in purple). Segmentation permits extraction of anatomic areas of interest for better visualization of the spatial relationships.

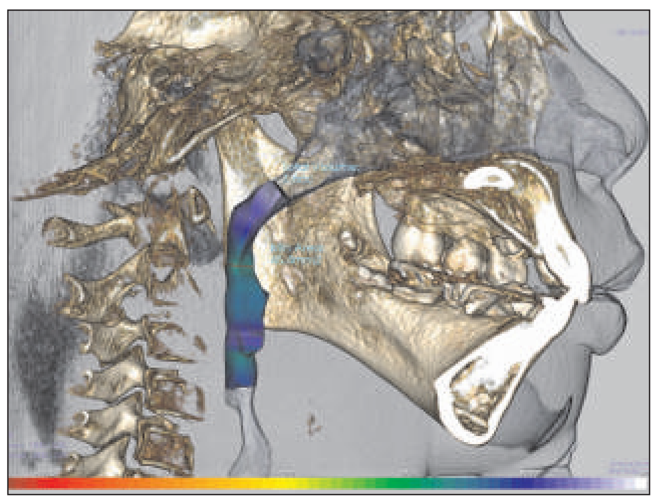


Segmentation of the teeth showing relationship of impacted maxillary cuspids with the roots of adjacent teeth

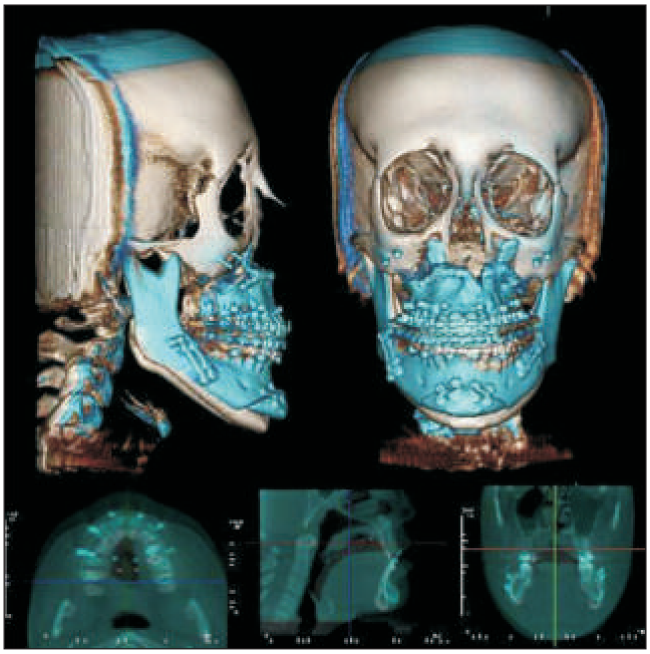
Besides assessment of impacted teeth, root angulations, and thickness of alveolar bone, **orthodontics** has benefitted greatly from CBCT in 3D assessment of facial growth patterns. The impact of TMJ and airway on craniofacial development can be studied with a 'systems approach' on a CBCT and will be the mainstay of the future of orthodontic treatment. Study of morphologic changes of the **temporomandibular joint** (TMJ) and the spatial relationships of the bony structures is useful in diagnosing articular disorders that can lead to bite changes and impact mandibular growth.



TMJ: Sagittal cross-sections and axial and coronal views

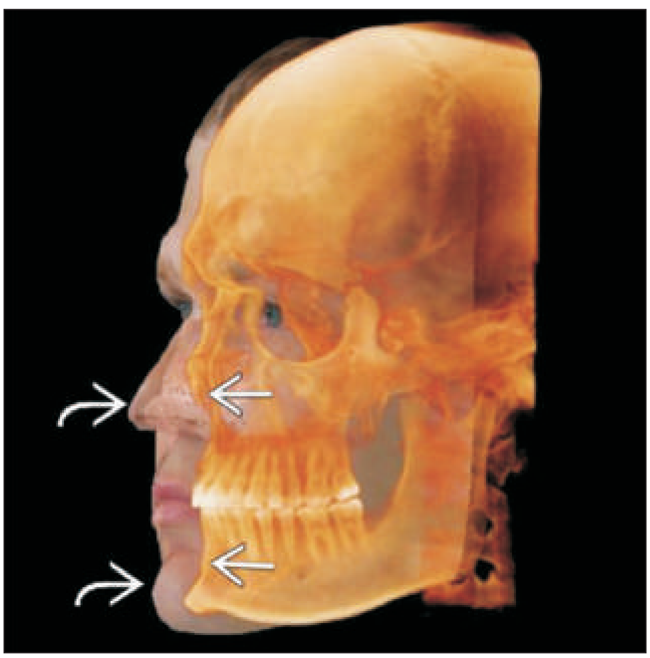


Airway analysis on CBCT software showing minimal cross-sectional area of oropharynx and total airway volume



Lateral and frontal volume renderings and sectional images in the orthogonal planes show superimposition of 2 CBCT volumes, before and after orthognathic surgery.

The postoperative data set is represented in blue. Superimposition permits comparison of data sets acquired at different times and can highlight treatment outcomes.



Superimposition of a CBCT scan with a 3D clinical photograph depicts the relationship of hard and soft tissue profiles.

CBCT volumes that encompass structures outside of the dentoalveolar region must be thoroughly evaluated for incidental pathology in the paranasal sinuses, airway, cervical spine, skull base and other maxillofacial regions. While these may or may not have dental implications, their identification and appropriate medical specialty referral could contribute to the overall well-being of a patient.

Cone beam CT has demonstrated its utilization for a variety of diagnostic tasks and treatment planning and simulation and is here to stay. With rapid technological advancement in software, newer applications of CBCT are at a rise. Adopters of this imaging modality have the opportunity to study and evaluate patients like never before seen in dentistry. This provides them with the prospect of expanding their dental turf, broadening their perspectives, and enhancing the clinical outcomes. A collaborative approach for complex cases will increase professional satisfaction for clinicians well beyond the financial incentive of attempting to treat them single-handedly. Its time to burst the bubble.

ONE ON ONE SESSION WITH MR NARAYAN VL-DISTRIBUTOR VIEW ON CBCT

Mr. Narayan VL

Mr Narayan VL did his honors in Physics and then went on to join Philips Medical Systems, where he was picked up inclination for medical imaging & radiology. He had successful stints with Trophy(France) & Villa(Italy) brought him into the realm of dental imaging & the birth of VILLA INDIA. Now, more than 3 decades into the imaging field, he finds it exciting to be dabbling in CBCT. In between, he got the opportunity to complete his MBA from FMS Delhi. Presently, having a dream run with NewTom, the pioneers in 3D imaging.

Mr Narayan VL

1: Currently what products related to imaging Villa india is distributing

Currently, we offer right from an Intra Oral Sensor, IOPA (AC/DC and handheld versions), PAN, PAN/CEPH in '2D' and CBCT (stand-alone, combo, supine version). These are primarily sourced from VATECH, South Korea and NEWTOM (QR, S.r.l.), Italy. This offers a comprehensive solution for all maxillofacial imaging & diagnosis.

2: Why do you think 3D imaging is the future of dental treatment

Initially started with implant planning, today 3D imaging offers highly accurate diagnostic information in Endo, Perio, Maxillofacial Surgery / Trauma and Ortho, in almost all dental specialities. The model scanning option + 3D printing solution will add more value to this modality. With all these exciting upcoming features, 3D imaging has a very bright future.

3: Do you believe in concept of digital dentistry, is India ready for it

The concept of digital dentistry has already found its roots and gaining worldwide acceptance, in totality. It is taking a while for it to get started in India. The initial capital expenditure required is one major hurdle. But the advantages of going into digital dentistry are so immense, that it can justify the investments. It will be some time before it becomes widely acceptable in our country.

4: What according to you is the major pluses of Newton CBCT machines

NewTom, being the inventor of the CBCT modality, they used it extensively for the Oral Maxillofacial region imaging. They had to write their own software / algorithm and also set standards for evaluation. This was a lot of hard work but in the long run, they became a self-sustained, fully integrated source of CBCT. That is why, world-over, even today, NewTom is a benchmark in 3D imaging.

5: What are the biggest hindrances for CBCT in India

High Capex, low penetrations of this technology in Dental Colleges, lack of awareness of referring dentists is the reason or slow start in India.

6: What new would be Villa India going to offer in near future in regards to CBCT

We are planning to offer additional packages to make CBCT more viable like solutions for printing surgical guides, 3D printing options, 3 party surgical planning softwares and more value ads.

7: Akshay , your son has earned a fellowship in biomedical imaging- can you tell the reader more

Akshay Narayan has completed his Bachelors in Bio-Medical Engineering and joined our organization in May 2015. Digital imaging is close to his heart as he feels this is an exciting opportunity to be pursued. He wishes to bridge the gap in knowledge between the clinical applications and physics behind this technology

8: What is the future of CBCT market in India

CBCT has a well chalked out plan for the future worldwide and in India. It will become the most sought after diagnostic resource for all dental specialists. The R&D / trials are on a small gantry, low field dedicated Dental MRI and Dental Ultrasound. This will bring soft tissue imaging into the realms of dental diagnosis. This calls for a great deal of knowledge augmentation effort, to be prepared to welcome a slew of Digital Dental Diagnostic onslaught.

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IS CBCT WORTH IN IMPLANT FAILURE CASES ?

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INTRODUCTION

In the recent years we have witnessed accelerated changes in the dental field due to maturation of 3D technologies in general which has significantly influenced dental implantology. Radiological examination is crucial in planning and assessing dental implants. In 1998, cone-beam computed tomography (CBCT) was introduced to dentistry. Depending on the specific machine, CBCT enables clinicians to obtain 3-dimensional (3D) images with a low dose of radiation.

CBCT is widely used in implant dentistry for several indications, including pre implant

Assessment of anatomy, implant placement, visualization of important anatomic structures, assessment of bone mineral density, and, recently, early assessment of implant failure. CBCT is helpful in assessing the stability of the implant site. However, little is known about the utility and validity of CBCT in evaluating peri-implant bone wall morphology, particularly after bone augmentation procedures performed to improve the implant site. This article presents a summary

of current knowledge about the use of CBCT in implant dentistry, evaluates the potential use of CBCT in detecting early implant failures, compares the performance of CBCT with that of other traditional imaging techniques, and examines the limitations of CBCT.

ROLE OF CBCT IN IMPLANT PLACEMENT

Early diagnosis of peri-implantitis is imperative, and initiating the correct treatment protocol depends on a proper diagnosis. The necessity for scanning should be decided based on the particular case. Performing an implant procedure without a CBCT scan can jeopardize a successful outcome, or result in other complication that can be avoided with the used information and measurement which a CBCT provide.

CBCT allows cross-sectional evaluation of the dental arch for a determination of the width, height, and quality of bone at the potential implant site. CBCT technology provides the clinician with the ability to fully assess the potential implant site using a relatively low radiation dose (compared with traditional computed tomography [CT]), and at a reasonable cost to the patient. Considering the quality of the images, the low radiation dose, and the favorable cost, CBCT is currently one of the most recommended imaging modalities for assessing potential implant sites. The use of 3D information in diagnosis and treatment planning has been enhanced by the availability of CBCT .

IMPLANT FAILURE

Implant failure is defined as the inability of the host tissue to establish or maintain osseointegration, which is clinically diagnosed by mobility of the implant. It is classified as early or late, depending on the time of placement and the implant's functionality. Early failure occurs before prosthetic rehabilitation and before the implant is placed into function. Early failures generally result from surgical trauma, overheating of the bone during implant surgery, insufficient bone surrounding the implant, early loading of the implant, or perioperative bacterial infection. Late failure occurs after prosthetic rehabilitation and indicates that established osseointegration has not been maintained. Late failures can further be classified as early or delayed depending on whether implant failure is observed before or after them first year of loading. Delayed late failures are generally associated with changes in loading conditions, the quality and volume of bone relations, and peri-implantitis.

CBCT AND IMPLANT FAILURE

Monitoring the condition of bone and tissue condition around dental implants is essential

not only during follow-up under functional loading but also during the assessment strategies for regenerating peri-implant bone. Periapical radiolucencies with a strict projection protocol can assess mesial and distal peri-implant bone levels almost as accurately as histologic studies, assuming that the project level of peri-implant bone is located in the sectioning plane of the implant or is of uniform height around the implant. Marginal bone loss is a crucial outcome variable in evaluating the success of implant therapy.

The crucial question is whether CBCT will detect these bone defects earlier than conventional radiographs and whether these early bone defects will have an effect on the overall success and prognosis of the implants[1]. In an experimental study, Sirin and colleagues evaluated the diagnostic potential and practical advantages of CBCT in detecting bone defects around dental implants. They created crestal bone defects around implants and compared images obtained with conventional periapical radiography, panoramic radiography, and CBCT. They found that periapical radiographs allowed a faster and more confident assessment of peri-implant radiolucencies than either of the other modalities. In an in vitro study using bovine ribs, Dave and colleagues compared the diagnostic accuracy of conventional periapical radiographs and CBCT in detecting peri-implant bone defects they found that digital periapical images (using a long cone) were better than CBCT images in diagnosing peri-implant bone defects when the bone defect was smaller than 0.35 mm. Panoramic films were accurate if the diameter of the bone defect was at least 1.5 mm larger than that of the implant.

According to the general principles of radiographic imaging, difficulties are evident in diagnosing a thin connective tissue layer lining the surface of an implant. The quality and density of bone vary, as does the contrast between implant radiopacity and adjacent bone radiolucency. CBCT offers the advantage that osseous structures can be represented in 3 planes, true to scale, and without overlay or distortion. Dental practitioners have made wide use of the 3D information obtained by CBCT in the areas of diagnosis and treatment planning; however, few studies have evaluated the role of imaging in detecting early implant failure. The success of an implant depends on the ability of the titanium implant surfaces to establish contact with the surrounding bone tissues at the cellular level, without the interference of a fibrous tissue layer. The gaps between the biomaterial and the host tissue may be of fundamental importance in predicting the outcome of implant treatment. Radiologic follow-up of dental implants is a standard of care in clinical practice. Predictable success rates for endosseous dental implants can be achieved through a careful combination of clinical and radiologic evaluations.

The postoperative use of CBCT must be restricted to specific situations (e.g., when implant retrieval is anticipated or a patient presents with implant mobility or altered sensation). Postoperative cross-sectional imaging is used to evaluate implant success based on 2 fundamental areas: integration and postoperative complications.

The placement of dental implants involves the insertion of metallic bodies into the jaw bone. The artifacts produced by the implants can cause significant interference when images are reviewed to assess implant placement and performance. Noise artifacts and beam-hardening artifacts caused by the titanium surface are the most prominent artifacts induced by high-density objects in the beam. For many high density dental filling materials, such as amalgam or gold, the complete absorption of the beam leads to extinction artifacts rather than to beam-hardening artifacts. Dental implants, however, are commonly made of titanium, a light metal with the atomic number of Titanium produces artifacts that interfere with the assessment of implant placement and performance. Decreasing the number of beam-hardening artifacts associated with CBCT will require more sophisticated mathematical modeling of the process used to acquire the actual physical image.

Radiologic examination is a crucial factor in the planning, assessment, and follow-up of dental implants. CBCT has become a helpful tool in assessing implant stability. However, little is known about the ability of CBCT in the evaluation of peri-implant bone-wall morphology or about its performance compared with conventional radiographic procedures, such as periapical radiography. For patients with postoperative complications, diagnostic imaging, including CBCT, must indicated as a supplement to the clinical examination.

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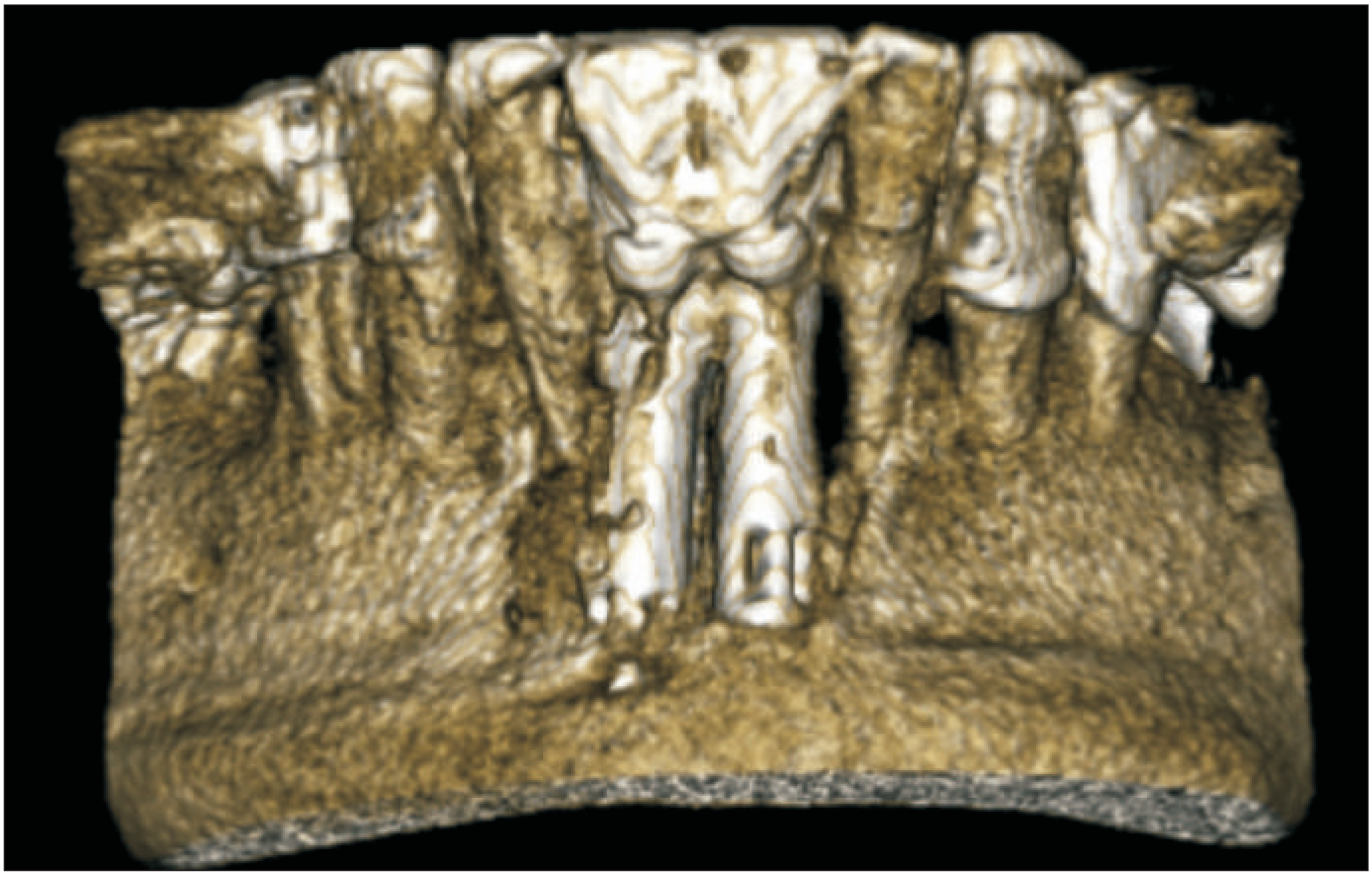

CBCT image showing implant failure

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CBCT in Oral and Maxillofacial Surgery : Review and Case Report

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Dr. Abhishek Mishra

ABSTRACT:

Cone-beam computed tomography (CBCT) is a new medical imaging technique that generates 3-D images at a lower cost and absorbed dose compared with conventional computed tomography (CT). This imaging technique is based on a cone-shaped X-ray beam centred on a 2-Ddetector that performs one rotation around the object, producing a series of 2-D images . The aim of the study to review various applications of CBCT in oral and maxillofacial surgery, and a case where application was used in TMJ ankylosis.

INTRODUCTION

Two-dimensional (2D) imaging modalities have been used in dentistry since the first intraoral radiograph was obtained in 1896. Since then, dental imaging techniques have advanced with the introduction of tomography and panoramic imaging. Tomography made it possible to isolate areas of interest within the scope of a radiographic examination, while panoramic imaging utilizes principles of tomography, making it possible to visualize the maxillofacial structures in a single comprehensive image[1]

More recent advances in digital diagnostic imaging have meant lower radiation doses and faster processing times without affecting the diagnostic quality of the intraoral or panoramic images. However, 2D images possess unique inherent limitations (including magnification, distortion, and superimposition) that can make it possible to misrepresent structures.

Cone beam computed tomography (CBCT) is capable of producing three-dimensional (3D) images that can guide diagnosis, treatment, and follow-up. Introduced in 1998 for dentoalveolar imaging, CBCT generates 3D data at a lower cost and with lower absorbed doses of radiation than conventional CT. CBCT's imaging technique is based on a cone-shaped X-ray beam that is centered on a 2D detector, which offers the advantages of a higher rate of acquisition; unlike conventional CT, a parallel shift of the detector system during rotation is not required, which results in a more efficient use of tube power[2]

The cone-shaped beam rotates once around the object (in this case, the patient's head and neck), capable of producing hundreds of 2D images of a defined anatomical volume rather than the slice-by-slice imaging found in conventional CT[3,4]

The images are then reconstructed in a visualizable 3D data set using a variation of the algorithm developed by Feldkamp et al in 1994.5 CBCT offers numerous advantages compared to traditional 2D radiography, including a lack of superimposition, 1:1 measurements, the absence of geometric distortions, and 3D display. It is important to note that by utilizing a relatively low ionizing radiation, CBCT offers 3D representation of hard tissues with minimal soft tissue information[4]

Applications in oral and maxillofacial surgery

3D images acquired with CBCT have been used to investigate the exact location and extent of jawpathologies and assess impacted or supernumerary teeth and the relationship of these teeth to vital structures[6,8]CBCT images are used for pre- and postsurgical assessment of bone graft recipient sites and to evaluate osteonecrosis changes of the jaws (such as those associated with bisphosphonates) and paranasal sinus pathology and/ or defect[9,10,11]

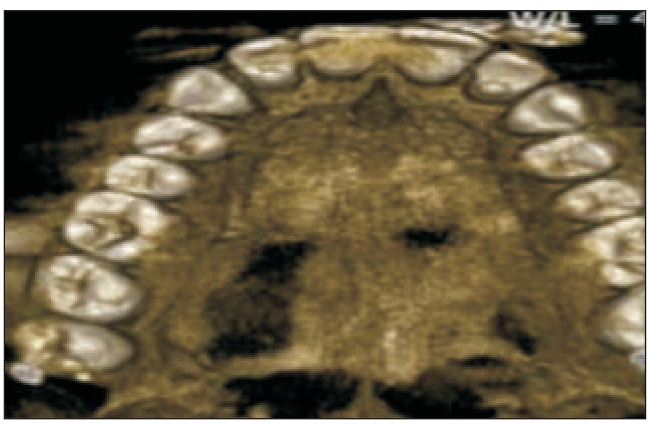

Fig 1. CBCT Showing radiolucency in palatal bone right side in case of pleomorphic adenoma of hard palate

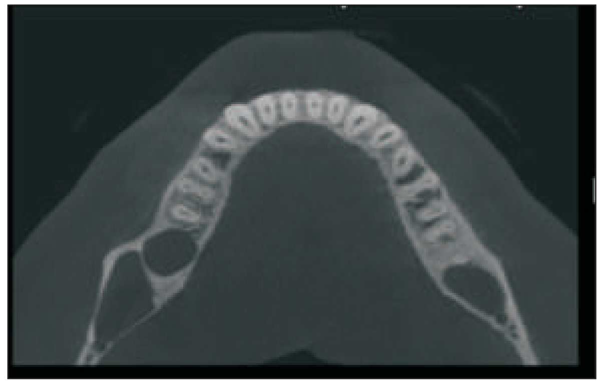

Fig 2. CBCT Showing bony expansion in axial view in case of periapical pathology

CBCT technology has also been used for thoroughpretreatment evaluations of patients with obstructive sleep apnea, to determine an appropriate surgical approach (when necessary)[14]

As CBCT units become more widely available, dentists have increasingly utilized this technology to evaluate maxillofacial trauma. In addition to overcoming the structural superimpositions that can be seen in panoramic images, CBCT allows accurate measurement of surface distances. This particular advantage has made CBCT the technique of choice for investigating and managing midfacial and orbital fractures, postfracture assessment, interoperative visualization of the maxillofacial bones, and intraoperative navigation during procedures involving gunshot wounds[13,14,15]

CBCT is used widely for planning orthognathic and facial orthomorphic surgeries[17], where detailed visualization of the interocclusal relationship and representation of the dental surfaces to augment the 3D virtual skull model is vital. Utilizing advanced software, CBCT allows for minimum visualization of soft tissue, allowing dentists to control posttreatment esthetics and evaluate the outline of the lip and bony regions of the palate in cases of cleft palate[16,17]

Prior to treatment of unilateral or bilateral temporomandibular joint ankylosis, the correct measurement and fusion of ankylotic mass i.e upto glenoid fossa to zygomatic arch, and lengthining of coronoid process and its relation to adjacent structure.is greatly enhanced by 3D imaging modalities of CBCT. Pre operative and post operative comparision rule out and discrepencies[13]

Case Report

A 17 yrs old femalepatient reported to the department with chief complaint of difficulty in mouth opening since three years. After detailed history and thorough clinical and radiological examination to rule out other differentials,she was finally diagnosed with unilateral TMJ ankylosis. Surgical management of gap arthroplasty interposition with temporalis muscle flap was planned. Prior to treatment CBCT was advised to visualize the 3D structure of Ankylotic mass and, any changes in coronoid process and relation with zygomatic process.

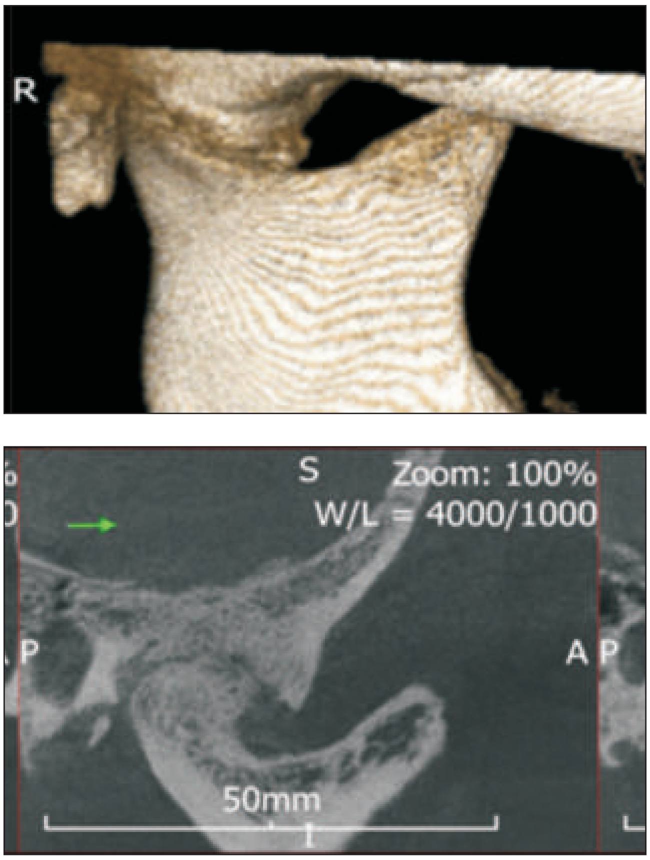

Fig 3. 3D CBCT AND SAGGITAL VIEW of TMJ (Preoperative)

After 3D visualization of the ankyotic mass with relation with glenoid fossa , ankylosis was grade under Shawney's classification of type IV. Also elongation of coronoid process seen. After the treatment with gap arthroplasty and interposition, Clear gap of 1cm seen in CBCT post operatively with free space between joint is nicely appreciated.

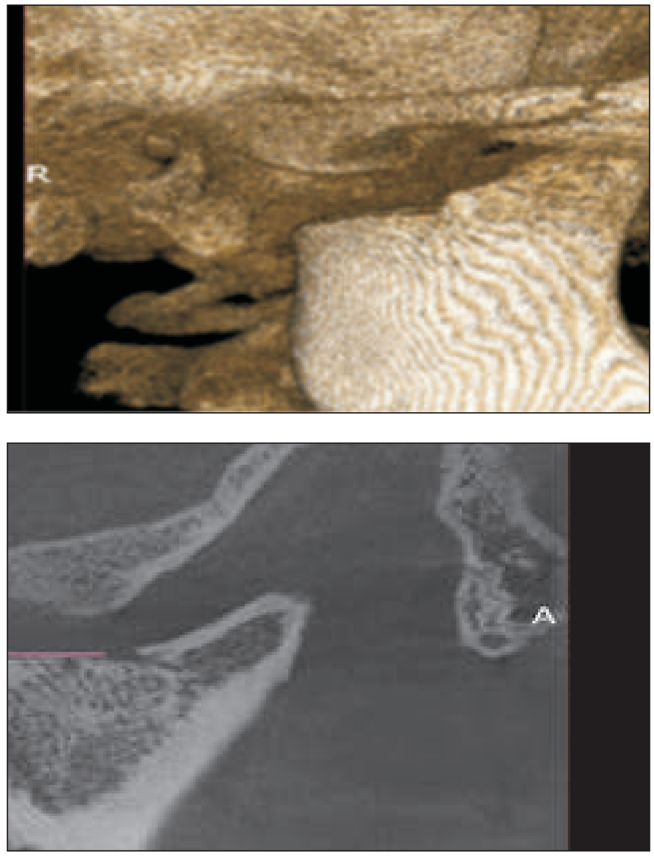

Fig 4. 3D CBCT and Saggital View of TMJ (Post operative)

Conclusion

The presented technique provides a complete radiographic investigation of the bony components of the TMJ.The reconstructed images are of high diagnostic quality, the examination time is shorter, and patient dose is lower than that with conventional CT. It may therefore be considered as the imaging technique of choice when investigation of bony changes of the TMJ is the task at hand..

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CBCT EVENTS ACROSS INDIA

CDE programme on CBCT conducted by Explora 3D Dombivili Mumbai - Dr Prashant Suvarna & Dr Hemant Umarji gave insight on CBCT

CDE & workshop on CBCT & CAD CAM integration by Dr Prashant Jaju & Dr Meghana Deodhar at Hitkarni Dental College, Jabalpur

CBCT workshop for internee of Rishiraj College of Dental Sciences and Research Centre, Bhopal by Dr. Prashant Jaju.