Выводы. Чувствительности маммографии состоялся 97,6%, специфичность 76,7%, точность 81,1%, ультразвуковое исследование - 97,8%, 92,5% и 95,5% соответственно. Рак грудной железы у мужчин имеет рентгенологические и эхографические симптомы, аналогичные таковым при раке молочной железы у женщин. Чаще РГЖ встречается на фоне гинекомастии и липомастии. Микрокальцинатов может не встречаться.

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APPLICATION OF DIGITAL TECHNOLOGIES IN DENTAL IMPLANTOLOGY

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Restoration-driven implant placement is a key factor for successful implant therapy. In this context, Computer-assisted Implant Surgery (CAIS) offers an additional instrument for treatment planning, surgical placement and prosthetic rehabilitation in an interdisciplinary team approach. Indications for guided surgery may include the following: the need for minimally invasive surgery or flapless approach, optimization of implant planning and positioning, and immediate reconstruction. The aim of this paper is to review the CAD/CAM systems used in implant dentistry, and describe its application in the construction of implant abutments and surgical templates.

Key words: CAD/CAM systems, surgical templates, flapless surgery, accurate implant surgery.

Traditionally, determining implant position, size, number, direction, and placement depended on the presurgical diagnostic imaging, which often, was limited to two-dimensional radiographs, and on the guiding acrylic stents usually prepared over duplicated casts of diagnostic wax-up. However, limitations of two-dimensional imaging and inaccuracies in the stent fabrication or guide channels often lead to erroneous implant placement, which results in complications and implant failure, especially in anatomically complicated situations. To overcome these limitations, many advancements have taken place, which have computerized the implant-dentistry. These include:

- Three-dimensional computed tomography (CT) imaging
- CT-based implant-planning software
- Computer-aided-design/computer- aided-manufacturing (CAD/CAM) technology
- Computer guided implant surgery (CGIS)
- Computer navigated implant surgery (CNIS)
- Robotic-implant-dentistry.

CAD/CAM (computer-aided design/computer aided manufacturing) systems have evolved over the last two decades and have been used by dental health professionals for over twenty years. In 1971, Francois Duret introduced CAD/CAM in restorative dentistry and, in 1983, the first dental CAD/CAM restoration was manufactured. (Christensen GJ, 2006) The introduction of CAD/CAM technology and computer planning based on images obtained using computerized tomography (CT) has been an important development in implant dentistry. Introduction and advances of CAD/CAM as well as acquisition of cone beam computed topography (CBCT) imaging and intraoral scanning data makes implant placement to be virtually planned using (3D) model of the treated jaws.

This virtual 3D model gives the surgeon a realistic view of the anatomic bony morphology of the patient, allowing the surgeon to virtually execute the surgery in an ideal and precise manner. A virtual model of the patient is created by superimposing the DICOM (Digital Imaging and Communications in Medicine) and STL (Standard Triangulated Language) files, allowing for a detailed visualization of the remaining dentition, surrounding intraoral soft tissue, and underlying bone structure. In the software, the implant fixtures are selected, and the drilling protocol is planned with respect to the final restoration and bone anatomy. This planned information is then transferred with stereolithographic (STL) rapid prototyped (RP)2 or computer numeric control (CNC) milled templates (Klein M, 2001) or through a computer controlled surgical navigation system. (Widmann G 2007) Three-dimensional imaging allows the clinician to study the area of interest and place virtual implants into the computer model of the jaw. This information can be used to manufacture a physical surgical template for (guided) surgery. The surgical template then dictates the actual implant positions atthe surgical sites. This surgical template for guided surgery, or guided surgical template (GST), will ultimately control the precise outcome of the implant placement with eliminates possible manual placement errors and matches planning to prosthetic requirements in a precise manner. Conventional Surgery's(CS) allow for potential clinician-mediated positioning errors due to inadvertent angular and linear deviations during osteotomy or drilling sequences, reducing the degree of accuracy. Furthermore, CSs have limited capability to control precise depth location of the implant in the apico-incisal position. The use of CSs can be a significant disadvantage during placement as proper angulation and depth of dentalimplants are critical factors related to the final esthetic and functional outcome of arestoration. (Belser UC, 2004; Vermylen K 2003) The potential limitations of 2- dimensional radiographic imaging and CS are amplified when planning implant placement near critical anatomical structures such as nerves, blood vessels, and sinus cavities. (Curley A 2009)

Alternatively, GSTs are virtually planned and designed using data accrued from 3D imaging utilizing computer software and digital workflow for planning and manufacturing. (Marchack CB. 2007) The proposed advantages of guided implant surgery are durability, predictability, safety and accuracy. (Kapos T, 2009, De Almeida, E.O.; 2010) The GSTs have metallic sleeves that direct and allow precise implant placement in the x, y, and z axes. CBCT scanning and digital imaging techniques, which allow visualization of the placement of dental implants in three dimensions, have gained popularity in their applications given their ability to achieve predictable and accurate results. (Farley NE 2013) Hence, utilization of GSTs allows for efficient and precise implant placement, reduced morbidity, and the potential for improved patient satisfaction. (Sament et al. 2003, Di Giacomo et al. 2005, Widman and Bale 2006, Van Steenberghe et al. 2002) To protect anatomical structures, such as the mandibular nerve, the foramen mentale or the sinus floor, surgical guides are used to achieve the optimum position under prosthetic considerations (J Neugebauer 2010). If immediate loading is planned, the prosthetic procedure can be prepared with a master cast and performed using a surgical guide (SF Balshi, 2006). If augmentation procedures should be avoided, special implants can be placed in the zygoma or in an angled position next to the sinus or the mental foramen (J Neugebauer 2010). Surgical guides manufactured on the basis of 3D data can also be used for extraoral implants. The 3D radiographic analysis of the remaining teeth and the available bone allows the dentist to gain spatial orientation and estimate bone quality volume prior to implantplacement. In addition, a surgical guide is fabricated according to this information. The advantage of the surgical guides is mainly derived from a precise knowledge of the anatomical findings and optimal preparation of the surgery without the riskof intraoperative changes of the protocol. They are a prerequisite for the flapless procedures, for implant placement in difficult anatomical positions and in case of tilted implant positions chosen to avoid more invasive grafting procedures (J Neugebauer 2010). In immediate loading, it is always difficult for the laboratory- technician to provide the superstructure in a very short period of time after the implant placement. Detailed preoperative planning allows the laboratory- technician to work ahead to shorten these processing times. In addition, this improved precision and accuracy reduces the need for flap reflection.

Limitations: Possible failure reasons may include poor resolution of the 3D radiological image, which is influenced by the design of the device and by artifacts. In particular, multiple prosthetic restorations made from metal or zirconium oxide ceramics lead to difficulties in evaluation of these 3D data due to so-called metal scattering. In addition, movement artifacts may result in incorrect metric information, as determined by several in vitro studies (J Neugebauer 2010). Surgical guides planned with a reduced security distance to the anatomical structures or in an area with limited available bone were found to be associatedwith risk; deviations of these surgical guides may harm anatomical structures, or reduced coverage of the implant with bone may result, thus increasing the failure rate (T Kermavnar 2021). The use of these surgical guides demands that the user is familiar with implant treatment; minimization of surgical trauma requires that the surgeon can still estimate the local findings to protect these structures and achieve an implant placement, which fulfills the prosthetic requirements. The results of the accuracy testing showed that deviation increases if the base of the guide and the position of the sleeve are at larger distances to the entrance point of the bone (M

Cassetta 2015). In case of thick soft tissue, bone-anchored surgical guides or optical tracking systems may be favorable. (S Dusmukhamedov 2021) The previously cited range of accuracy is not acceptable for prosthetic restoration, as this requires an accuracy of 0.02 mm. One potential way of compensating for this inaccuracy is to use abutments with a spacer and a resilient part as guided abutments. The prosthetic outcome was also compromised by early complications, including loosening of the prosthesis, speech problems and bilateral cheek biting. Late complications included loosening of screws, fracture of the prosthesis and pressure sensitivity during chewing (LT Yong 2008). Fractures of the surgical guide were also reported, as were misfits between abutment and fixtures, and the need for extensive occlusion adjustments. As known from standard treatment planning, flapless surgery requires special training and involves a learning curve toachieve optimum results (J D'haese 2017).

Today, implant treatment has primarily been improved by immediate loading or reduced healing time (Ganeles 2004). These treatment options focus on minimally invasive techniques to reduce the postsurgical trauma and improve the general acceptance of the complex implant treatment (J Neugebauer, 2010). Routine cases with a large flap preparation showed high postoperative morbidity, with pain and discomfort for the patient (N Brodala 2009). This is clinically relevant in older patients with compromised general health (M Schimmel 2017). Recuperation time should also be as short as possible to permit the patient to returnto work quickly. Minimally invasive procedures, such as flapless surgery, require detailed information about all anatomic structures to avoid injury due to the limitedsurgical overview. When placing dental implants, a flap is traditionally elevated to better visualize the implant recipient site, providing that some anatomical landmarks are clearly identified and protected. When a limited amount of bone is available, a flap elevation can help implant placement to reduce the risk of bone fenestrations or perforations (Ozan O, 2007). More recently, the concept of flaplessimplant surgery has been introduced for the patients with sufficient keratinized gingival tissue and bone volume in the implant recipient site. The alleged reasonsto choose the flapless technique are to minimize the possibility of postoperative peri-implant tissue loss and to overcome the challenge of soft tissue management during or after surgery (Rocci A,2003). Other alleged advantages of the flapless implant surgery include less traumatic surgery, decreased operative time, rapid postsurgical healing, fewer postoperative complications and increased patient comfort (Arisan V, 2010), (Sunitha RV, 2013). A disadvantage of this technique is that the true topography of the underlying available bone cannot be observed because the mucogingival tissues are not raised, which may increase the risk for unwanted perforations which in its turn could lead to esthetical problems or implant losses (De Bruyn H, 2011). Moreover, there is the potential for thermal damage secondary to reduced access for external irrigation during osteotomy preparation (Sunitha RV, 2013). Nevertheless, guided surgery may add precision to flapless surgery. In the late 1970s, Brånemark established the use of extensive surgical flaps to visualize the surgical field during implant surgery. Over the past three decades there have been several alterations to this flap design, now integrating esthetic considerations in the critical esthetic zones of the dentition. In situations with limited bone quantity, the elevation of a mucoperiosteal flap can facilitate implant placement by allowing the surgeon to visually assess bone quantity and morphology at the site. The feasibility of achieving an ideal implant position in conjunction with primary stability and maximum bone-to-implant contact could then be assessed. Furthermore, visualization of the surgical field withflap elevation may reduce the risk of occurrence of bone fenestrations and dehiscences. However, flap elevation is always associated with some degree of morbidity and discomfort, and requires suturing to close the surgical wound. In the early 1970s, studies demonstrated a correlation between flap elevation and gingivalrecession, as well as bone resorption around natural teeth. (Wood DL, Hoag PM1972) Furthermore, there has been a report of postsurgical tissue loss from flap elevation, implying that the use of flap surgery for implant placement may negatively influence implant esthetic outcomes, especially in the anterior maxilla. (Van der Zee E 2004) Over the past 30 years, flap designs for implant surgery havebeen modified, and more recently the concept of implant placement without flap elevation and exposure of the bony tissues was introduced. Flapless procedures have already been used for some time with tooth extractions and site preservation, and have shown less morbidity. (Sclar AG.199) In addition, surgeons have also considered a flapless approach for immediate implants in order to preserve the vascular supply and existing soft tissue contours. (Sclar AG.2007) Surgeons use either rotary instruments or a tissue punch to perforate the gingival tissues to gain access to bone. Over the past few years, dental radiographic imaging has made large technological advances, with sophisticated compilations of three-dimensional(3D) imaging in the form of computed tomography (CT) as well as newly developed dental implant treatment planning software allowing 3D evaluation of potential implant sites. These new developments have contributed to the popularization of flapless implant surgery. Although the flapless technique was initially suggested for and embraced by novice implant surgeons, a successful outcome often requires advanced clinical experience and surgical judgment. (Sclar AG.2007) Flapless surgery has several potential advantages, including *(1)* reduction of complications at the patient level, ie, swelling and pain, *(2)* reduction of intraoperative bleeding, *(3)* reduction of surgical time and need for suturing, *(4)* preservation of soft and hard tissues, and *(5)* maintenance of blood supply. However, despite these advantages, the flapless technique also has several potential shortcomings. These may include *(1)* the inability of the surgeon to visualize anatomical landmarks and vital structures, *(2)* the potential for thermal trauma to the bone due to limited external irrigation during preparation of the osteotomy with guided surgery, *(3)* an inability to ideally visualize the vertical endpoint of the implant placement (too shallow/too deep), *(4)* decreased access to the bony contours for alveoloplasty, *(5)* difficulties in performing an internal sinus lift with a stabilized template (screw fixated), and *(6)* inability to manipulate the circumferential soft tissues to ensure the ideal dimensions of keratinized mucosa around the implant. The importance of keratinized mucosa around implants is debated, as some studies have shown that the absence of keratinized gingiva is not critical to the health of the gingiva and the implant outcome, (Wennström JL,2004;van Steenberghe D.1988) while others suggest that the failure rate is higher when there is a lack of keratinized gingiva or only a small amount is present. (Block MS,1990,1994; Buser DA,1990,1988)

When dental implants are placed by raising a surgical mucoperiosteal flap, there is an associated slight bone loss at the site. Scarring and other complications are of concern. In the esthetic zone these may lead to an unsatisfactory outcome. (Sclar A, 2003; Tarnow DP, 1996) Placing implants by using a flapless or envelope incision may eliminate some of these concerns. However, the true quality and quantity of bone underlying the mucogingival covering cannot be directly observed. (Kraut RA, 1991) Plane film radiographs can depict some information about the bone site but there is no 3-dimensional information as to actual bone contour or quality. The topography of the underlying available bone is key information in the decision for a flapless procedure. Sites that are narrow in length can be obviously seen and corrected by orthodontic movement or extraction of imposing teeth. However, a narrow bone ridge width may be obscured. A thick epithelium and submucosa may hide a narrow atrophic ridge, a poorly healed extraction site, or even a nonexisting bone ridge. The implant surgeon must be circumspect. The flapless approach may be less traumatic and time consuming, have fewer complications and faster soft tissue healing, and be restoratively appropriate when compared to an open flap approach.

Classification of GST Based on Support

Surgical templates are often categorized based on their mode of support: teeth-supported, teethmucosa supported, mucosa supported, and bone supported. Inall these situations, additional stabilization may be obtained by bone-retained screws or pins. 1. Teeth supported templates are typically used in partially dentulous sites such as a single missing tooth with flapless implant placement.

Tooth support of the surgical guide renders the highest accuracy of the procedure. 2. Teeth-mucosa supported templates are used when multiple teeth are missing and when the surgical template is supported partially by the mucosa and the soft tissue as in a Kennedy classification I situation.(1928) 3. Mucosa supported templates are used in completely edentulous patients and with flapless implant placement. Mucosa-supported guided surgery procedures offer higher accuracy than bone supported procedures. 4. Bone supported templates are used in either partially or fully edentulous sites but typically require extensive flap elevation so that the surgical template is placed directly on the bone.

Conventional implant planning is a model-based workflow that begins with a preliminary impression and diagnostic wax-up on the plaster model (Higginbottom, F.L.;1996; Tsuchida, F.;2004). Before the development of digital technology, a radiographic template had to be fabricated over duplicated casts of a diagnostic wax-up. In computed topography (CT) imaging with templates, radiographic templates outline the proposed ideal prosthetic outcome relative to the patient's anatomic structures and topography. The radiographic template can then be manually modified to the desired surgical template. With significant achievements accomplished in the field of computerized implant dentistry, two types of techniques are now available, the "static" (Computer-guided surgery) application of surgical templates, and "dynamic" (computer-navigated surgery) transfer of the selected implant position to the surgical area via a navigation system(Jung, R.E.; Schneider, D.; 2009). While the latter provides real-time visual guidance in various situations during surgery with reproducing the virtual implant position from computerized tomographic data., the former guided method of surgery is less flexible in regard to changing the surgical plan amidst the surgery, as the information is only transmitted through the surgical template. Static guides are produced by computer-aided design/computer assisted manufacture (CAD/CAM) technology, such as stereolithography or manually in a dental laboratory (using mechanical positioning devices or drilling machines) (van Steenberghe et al. 2005; Vercruyssen et al. 2008). With computer-navigated surgery the current position of the surgical instruments in the surgical area is constantly displayed on a screen with a 3D image of the patient. In this way, the system allows real-time transfer of the preoperative planning and visual feedback on the screen (Widmann and Bale 2006; Brief et al. 2005). In the review of Jung and co-workers, a statistically significant higher mean precision was found in favour of dynamic systems compared with the static surgical guides. However, this difference could be explained by the fact that there were more preclinical studies on accuracy for the dynamic systems and more clinical studies for the static systems. because it does not require additional expensive pieces of equipment and complicated software. In addition, there are no time and space limitations. Despite such advantages, technical errors can cause serious problems in clinical applications (Vercruyssen, M. 2014). The computer-navigated surgery systems were not included in the current systematic review. Within the systems working with surgical guides significant variations can be observed (e.g. for example the guidance of the drills in the surgical templates). Some use for one patient different templates with sleeves with increasing diameter, others apply removable sleeves inone single template (with removable sleeve inserts or sleeve on drills). Some systems design special drills or drill stops to allow depth control whereas others have indication lines on the drills. After the preparation of the implant osteotomy, other systems allow a guided placement of the implant whereas for other systems the template has to be removed before implant insertion.

Implant positioning in relation to planned definitive prostheses can be enhanced using computer-guided static or dynamic systems. (Block MS, 2017, Tahmaseb A, 2017) Static guided implant placement surgery involves the use of a cone beam computed tomography (CBCT) generated surgical guide with metal surgical tubes. These static guides can either be supported by adjacent natural teeth, mucosa or alveolar bone. (Deeb GR, 2017; Cassetta M, 2017) Static guided surgery has been shown to be more accurate than free hand implant placement. (Scherer U, 2015) Recent development of inexpensive three-dimensional (3D) printers allows cost-effective static guide fabrication and therefore have popularised the method. (Deeb GR, 2017) Implant positioning is predetermined ina static guide; however, the static guide does not allow for real-time adjustments when needed or visualisation of the osteotomy. While tooth-supported or mucosal-supported static guided surgery is indicated with flapless surgery when bone grafting or osseous modification is not needed, static guided surgery can be difficult in patients with limited mouth opening, implant sites with difficult access or direct visualisation, as well as implant placement in limited horizontal spaces between adjacent teeth. (Cassetta M, 2017) Dynamic navigation surgery allows theoperator to fully visualise the osteotomy and implant site on the computer screen while preparing the osteotomy site and placing an implant fixture. The accuracy of dynamic navigation has been observed to be comparable to that of static guided placement. (Block MS,2016) Dynamically guided implant placement has been shown to be more accurate than freehand implant placement in terms of angular deviation, platform positioning and apical positioning. (Block MS,2017; Somogyi-Ganss E,, 2015)

Protocol Involved in Fabrication of GST

The standard protocol for guided implant placement is comprised of a diagnostic phase (clinical and radiographic examination), planning phase, (designing and fabricating the guided surgical template), and the surgical phase. Steps involved for fabrication might differ depending on the various software options available and their individual applications as prescribed by respective manufacturers. The following steps describe the basic protocol utilized in fabrication. Step 1: Fabrication of a radiographic template. The radiographic template is a prototype of the CST typically made from acrylic resin with radiopaque markers incorporated to allow assessment of the relationship of the bone to the planned prosthesis. For some systems, radiographic templates are not mandatory. These systems would alternatively offer the option of a virtual diagnostic wax pattern. Step 2: When scanning the patient for guided surgery, artifacts (e.g., metallic scatter) can be introduced. Therefore with most systems, a dual scan procedure is followed, to improve the overall accuracy. The first scan is of the patient's maxilla and/or mandible. There are four options for the second scanto capture the teeth.

- Option 1: A CBCT scan is obtained of a radiographic template
- Option 2: A CBCT scan is obtained of the patient's cast
- Option 3: An optical scanner is used to scan the patient's cast
- Option 4: An optical scanner is used to scan the patient's teeth directly

Optical scans produce STL files, and CBCT scans produce Digital Imaging and Communications in Medicine (DICOM) files. Until now, most of the planning software and companies offering surgical guides have required radiological data transfer by the Digital Imaging and Communications in Medicine (DICOM) protocol The STL or the DICOM files are then imported and superimposed with the DICOM files from the CBCT scan of the patient. The digital planning is carriedout at this stage using the software features, which are specific to each system. However, most systems will allow planning for multiple implant manufacturers' products. Step 3: The clinician must initially plan the implant positions accordingto the proposed implant sites. For fully edentulous templates, anchor pin placement should be considered, since soft tissue supported templates will be less stable during surgery. Two to four pins can be placed around the arch by the technician, and the template will be eventually secured to the patient utilizing these anchor pins. Once an initial plan is completed, the clinician then submits the planning filesto the company that will fabricate the templates. In a few business days, a final planning file will be available for review. The clinician should review the final planning file and, if acceptable, sign the consent for GST fabrication. If unacceptable, changes must be made and the modified file resubmitted to finalize the surgical plan. Surgical templates typically take seven business days to fabricateand ship, and rush services are available. The information is accepted and signed by the planning dentist to comply with the legal and liability requirements for each manufacturer. When this information is received, along with the payment, the order for the GST is complete. Depending on the manufacturer, the GST is fabricated by rapid prototyping, CNC milling or utilizing a surgical navigation system. It is then returned and tried in prior to surgery, except in the case of a bone supported guide. A cumulative deviation error may occur during the multiple phases of the procedure, for example, by the cross-sectional imaging scan, the image segmentation, the virtual planning, the fabrication of the guide, the positioning of the guide, and the surgical procedure itself.

Table 1

ADVANTAGES OF GUIDED SURGERY	DISADVANTAGES OF GUIDED SURGERY
Could offer improved precision (consistency in achieving the same implant position each time) and better accuracy (achieving desired implant location) when protocol is followed precisely, with detailed attention toevery step and with appropriate patient selection,	Longer initial treatment time (multiple steps and appointments for radiographic template fabrication)
Flapless surgery is possible (potential for lower morbidity)	Technique sensitive (precise data collection is important and each step in the fabrication process is critical for a successful outcome)
Efficiency (reduced surgical time)	More radiation exposure to the patient from 3-D imaging (which is required for fabrication) compared to routine 2-dimensional imaging
Faster initial healing time (reduced trauma to soft tissues)	Instrumentation can be awkward in limited interarch space situations (difficult in posterior region, especially

	in patients with limited mouth opening)
Safety (avoidance of important anatomical structures)	Reduced cooling efficiency during osteotomy (Due to the close approximation between the drill and the surgical guide; less irrigant reaches the surgical site)
Provisional restorations can be fabricated prior to the surgery	Increased cost
Could help control and maintain drill trajectory when implants are placed immediately in a fresh extraction socket	Limited application when insufficient bone is present and bone grafting is needed.
	Increased complexity especially when considering the number of systems and software programs available on the market, each with their own unique characteristics and guide fabrication methodology

In order to evaluate the accuracy of a guided implant surgery system, both the planned and actual positions of the implant are required. The most significant problem in guided implant surgery is "deviation" between the planned and actual implant placement position. A number of factors may contribute to these inaccuracies. The possible causes for errors include spatial resolution problems in CT, merging techniques in CT, and scan data, errors in template manufacturing, inadequate stability of the surgical template, drilling errors from the clearance between the sleeve and the drill, as well as other factors, such as soft tissue thickness, patient movement, and the types of software used (Behneke, A.; 2012). Therefore, clinical evaluation of the accuracy is essential to determine whether the inaccuracies of guided surgery are clinically acceptable.

During the past years, digital technologies have become of increasing importance in clinical dentistry including implant dentistry. On the one hand, this improves diagnosis of the state of health or disease of the patient, and on the other hand, working with these digital data supports planning and execution of the different steps of treatment. Taken together, this renders implementation of the planned treatment more precise and predictable. In particular, computers enhance the control over the design of the provisional and final reconstructions and they provide the possibility to manufacture dental reconstructions using industrially controlled fabrication processes. In 1971, Francois Duret introduced CAD/CAM in restorative dentistry (1) and, in 1983, the first dental CAD/ CAM restoration was manufactured. During the last few years different strategies have been developed to transfer the digitally planned implant positions to the patient. Today, some clinicians favour guided implant insertion whereas others still have doubts about their usefulness and especially their accuracy. The protocol involves several steps including a radiographic template, scanning procedure, planning, and surgery (with or without a surgical template). The accuracy at the end is the overall deviation from the start until placement of the implants. Mistakes can occur at each individual step and can accumulate. Therefore, it is crucial to understand the significance of each step, and especially to realize the magnitude of the cumulated inaccuracy. The latter is important not only to prevent damage of vital structures, but also to keep the implants within the bony envelop and especially to prevent adverse events.

Interdisciplinary Planning

CoDiagnostiX ensures the planning of the implant position using Cone Beam Computed Tomography (CBCT) with DICOM data (Digital Imaging and Communications in Medicine) and the subsequent transfer of the virtual situation into reality with an interdisciplinary team approach including the restorative dentist, the implant surgeon and the dental technologist. The conventional workflow includes the fabrication of a dental set-up, a radiographic template and the secondary adaptation to a surgical template. Here, the fully digital process represents a further development: computer-assisted planning of the implant position by means of a virtually constructed prosthetic set-up and on-screen designing of an implant-guided template. The number of operational steps is shortened significantly compared to the conventional workflow. Moreover, costly and time-intensive preparations can be avoided for the patient in advance of the CBCT. In addition, existing 3-D radiographic images should already be used, if possible. The clinical case presentation demonstrates step-by-step the fully digital implant workflow with CAIS (Computer-aided implant surgery), including intraoral surface scanning and prosthetic rehabilitation in a five-step approach

Step 1

3-D radiographic diagnostics are performed without any template. An intraoral surface scan supplements the imaging sequence. The scan allows the generation of a high-resolution portable STL file (Surface Tesselation Language) of the intraoral patient situation.

Step 2

The DICOM data and the STL file are implemented and superimposed in the CoDiagnostiX planning software. A virtual set-up of the prosthetic reconstruction, as well as a surgical template with optimal 3-D implant positioning can be realized using a restoration-driven backward planning concept, whilst considering the individual anatomical situation. Once the planning phase is finished in CoDiagnostiX, a 3-D printer can plot the virtual construction of the surgical template with the rapid prototyping technique without the need of any physical model. Finally, CoDiagnostiX delivers an individual drilling protocol with sequenced CAIS instruments for a safe 3-D implant placement (Fig. 4a & b).

Step 3 Surgery

Prior to implant surgery, the plotted template is checked for a gap-free fit in the patient's mouth. Built-in viewing windows adjacent to the implant site and in contralateral position improve the level of control that can be clinically achieved. After anesthesia and soft tissue punch, the cortical bone is perforated with a round bur in central position.

Afterwards, the preparation of the implant bed is made, successively using specialized guiding tools and corresponding spiral drills that could clinically be inserted into the slots of the sleeves. A flapless approach is only recommended if the local bone anatomy is adequate in volume, and if a wide band of keratinized mucosa is present at the implant site.

An implant depth gauge is placed after the first drilling to confirm accurate positioning of the osteotomy. Early error detection can be noticed at this initial stage and a possible deviation of the proposed implant position must be corrected manually.

Afterwards, the guided drill sequence can then be continued. The present bone density will determine, if thread cutting is necessary, or not. The placement of up to RN/RC-diameter-implants can be made directly, guided via the integrated 5 mm drill sleeve. Implants with larger diameters must be inserted manually by guidance of the finalized drill bed. The post-operative radiograph shows the correct prosthetic positioning of the implant with sufficient safety distance from the Nervus alveolaris interior and the adjacent dentition.

Step 4 Prosthodontics

Based on an additional intraoral optical impression using an implant scanbody, a second STL file can be created immediately after implant placement. This STL file is then also implemented into CoDiagnostiX. Differences between the actual implant location and the virtually planned position can be correlated and compared. Moreover, the implant-supported prosthetic suprastructure can be designed and fabricated during the healing period. All the necessary information of the actual implant position is still included in the second STL file at this time. The CAD/CAM-fabricated monolithic implant crown can be finalized based on the virtually generated patient situation in a model-free technical approach.

Step 5

The full-contour reconstruction is tried out and reveals a functional treatment outcome without the need for any interproximal or occlusal corrections and a pleasing clinical appearance.

Conclusion:

During the past years, digital technologies have become of increasing importance in clinical dentistry including implant dentistry. Computers may help improve patient treatment in various ways and at different time points during therapy. On the one hand, this improves diagnosis of the state of health or disease of the patient, and on the other hand, working with these digital data supports planning and execution of the different steps of treatment. Taken together, this renders implementation of the planned treatment more precise and predictable under consideration of the individual patient situation. In the full digital workflow, the overall treatment time is shortened and technical work steps can be saved in advance in a total of five stages with only three patient appointments. In addition, computer technologies help improve the quality of the final reconstructions. In particular, computers enhance the control over the design of the provisional and final reconstructions and they provide the possibility to manufacture dental reconstructions using industrially controlled fabrication processes. This approach simplifies clinical procedures in implant patients. Guided implant surgery clearly reduces the inaccuracy as compared to free-hand surgery, defined as the deviation between the planned and the final position of the implant in the mouth. It may be recommended for the following clinical indications: complex anatomy, need for minimal invasive surgery, optimization of implant placement (e.g., critical esthetic cases), and immediate loading. Planning should always be based on the need to achieve a prosthesis that respects the biological, functional,and esthetic requirements. guided surgery. The possible errors occurring and their magnitude in each procedural step should further be investigated.

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СОВРЕМЕННЫЙ ВЗГЛЯД НА ПРОБЛЕМУ ФЕТОПЛАЦЕНТАРНОЙ НЕДОСТАТОЧНОСТИ

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MODERN VIEW ON THE PROBLEM OF FETOPLACENTAL INSUFFICIENCY

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ФЕТОПЛАСЕНТАЛ ЕТИШМОВЧИЛИК МУАММОСИГА ЗАМОНАВИЙ ҚАРАШ

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