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MINIMALLY INVASIVE IMPLANT DENTISTRY – A REVIEW

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Abstract:

Aim/purpose: The minimally invasive surgery is intended to reduce tissue trauma, resulting in decreased patient pain and swelling, thereby improving patient experiences post- operatively. The aim of this review was to condense the outcome of research conducted on the minimally invasive implant dentistry. In addition, future prospects of minimally invasive implant in the field of clinical dentistry have been highlighted.

Materials and methods: An electronic search was carried out via the PubMed (Medline) database using keywords 'minimally invasive implant', 'dentistry' and 'surgery' in combination. Original research papers published in English language in last ten year were considered.

Results: "Minimally invasive implant surgery appears to be a reasonable treatment modality for implant placement, demonstrating both efficiency and clinical effectiveness."

Conclusions: The digital presurgical plan accurately replicated during Guided implant surgery appears to be a significant aid in minimally invasive surgical procedures. The size, angulation ,location and depth of implant are planned before beginning the surgery, so that patients can undergo less invasive surgery without flap elevation leading to faster healing and early rehabilitation that makes it an acceptable treatment plan.

Introduction

Recently, dental implants have considerably contributed towards the rehabilitation of partially edentulous patients or completely edentulous patients, and has become a predictable way of tooth replacement. In order to improve treatment outcomes, original two stages surgical protocol has been proposed by Branemark[1]. The key factor for best prosthetic outcomes depends on angulation, depth and size of implant. Any discrepancy associated with implant malpositioning can cause peri-implant bone resorption, soft tissue loss and unaesthetic appearance. The concept of prosthetic driven Implantology is gaining attention in this modern era. It focuses on non-invasive surgical and restorative techniques[1]. The minimally invasive surgery is intended to reduce tissue trauma, resulting in decreased patient pain and swelling, thereby improving patient experiences post – operatively.

As rightly stated by Buser et al, correct placement of the implant is based on a three dimensional assessment of the site including mesiodistal, buccolingual and occlusogingival direction. With conscientious planning within these dimensions and maintaining a minimum of one thickness of 1.5 mm around implant, esthetic and achieving functional acceptance has become

highly predictable[1]. For perceiving accurate and precise implant position, the use of digital planning with guided placement offers valuable contributions, thus avoiding complications[2]. Today, the focus on the concept of osseointegration is diminishing and emphasising more on nature-like tooth replacement, minimally invasive surgical and restorative techniques, with time and cost efficiency. In order to attain these goals, the implant position should be guided by the desired prosthetic outcome—what has been termed a "crown-down" approach to treatment planning and implant positioning and can no longer be based solely upon bone availability. The advantages, include the preservation of circulation, hard tissue volume at the site and soft tissue architecture, reduced surgical time, improved patient comfort, and accelerated recuperation[3]. The aim of the present review was therefore to systematically scrutinize the current scientific literature and focus on various methods to achieve minimally invasive implant dentistry such as 3D Guided implant surgery, Angled implants, Mini dental implants, short implants and piezoelectric surgery.

3D– Guided Implant Surgery

With the development of flapless implant protocols, attention has been driven towards the minimally invasive approaches. Avoiding incisions and suturing allows for rapid mucosa healing, less bone loss, shallower gingival sulcus and higher implant stability, thus reducing pain and improved patient comfort. To achieve accurate and precise implant position, digitally planning with guided placement offers valuable contribution. The fabrication and development of corresponding surgical guides and implant specific guided surgical instrumentation gave clinicians the ability to place dental implants using truly minimally invasive, flapless techniques without sacrificing accuracy, precision or predictability. The computer-based Implantology involves the Dual scan technique which is based on virtual planning using a Cone Beam Computed Tomography of the associated jaw and radiographic stent[1].

INDICATIONS

- Multiple implant placements
- Proximity to vital anatomic structures (nerves, sinuses, teeth, nasal floor)
- Proximity to adjacent teeth
- Compromised bone volume
- Flapless implant placement
- Cases in which tilted implants are planned, including All on Four.
- Full arch cases or multiple unit cases with or without extractions and immediate placement in which immediate provisional restorations are planned.
- Significant alteration of the soft tissue or bony anatomy by prior surgery or trauma
- Patients with physical, medical and psychiatric co morbidities.

Virtual implant treatment plan

The 3D visualization of the implant recipient site characteristics and associated anatomy improves the clinicians insight into the surgical, prosthetic and aesthetic requirements of the treatment. This may enhance the decision-making and increases the reliability of the overall implant treatment. Computer-guided implant placement implies 3D imaging of maxillary and mandibular bone as well as the planned prosthesis. The estimated scanning time is 70 seconds. Errors have been reported mainly for elderly patients due to patient movement during the CT scan. This can be caused an angular deviation of approx. 3.1^0 in the maxilla and 2.4^0 in the mandible. Therefore it is essential to maintain proper patient position during scanning[2].

With the use of a double-scan technique with

fiducial marker-based matching i.e. gutta-percha or use of 20% to 30% barium sulfate mixture in the acrylic so as to allow for radiopacity of the planned restorations in the Computed Tomography/ Cone Beam Computed Tomography images, the unification of the prosthesis can be planned within the craniofacial model.[13] First, the patient is subjected for scanning with the prosthesis in the mouth, stabilised by an occlusal silicone index in the proper position. In order to allow its 3D visualization in the software independently or overlapped to the patient anatomy, the planned prosthesis is scanned separately, with different exposure parameters. The markers will be visible in both the sets of scans, so they can be fused and the prosthesis can be properly positioned within the maxillofacial structures. Surgical guides are used by the clinician to place the planned implants in the same positions, as those of the virtual treatment plan which was based on the size and type of the implant, position of implant within the bone, its relationship to the planned restoration as well as with adjacent teeth and its proximity to vital structures before performing surgery on the patient which allow for more accurate and predictable implant placement and reduced patient morbidity[3].

Advantages

- Considerably easy to perform and increased accuracy of implant placement.
- The clinician has control over the angulation and depth of the implant based on a virtual treatment plan.
- The osteotomy drills are guided by the sleeve in the template. Allows for a flapless surgery, which entails less bleeding, less swelling, decreased healing time and postoperative pain.
- By preserving soft and hard tissues which aids to maintain the blood circulation to the surgical site.
- Helps to avoid vital structures.
- Shorter period required for surgery.

Limitation

- Expensive as the use of special surgical kit designed for guided surgery and cost of surgical template fabrication.
- Patient's bone cannot be assessed during a flapless surgery.
- Long learning curve.
- Possibility of template break during surgery.
- Deformation of the stereo lithographic surgical guide may result in malpositioning of implant.

Angled implants

In the rehabilitation of edentulous maxillae,Tilted implants have been proposed as an alternative to traditional protocols. The first screw form implants placed by Branemark in 1965, at about a 300 angulation relative to the plane of occlusion[4]. Bone-grafting procedures to increase bone volume may be a viable treatment option, but they often imply demanding surgical procedures and can be associated with complications, morbidity, and high costs[7]. To overcome such limitations, implants could be placed in specific anatomical areas, such as the pterygoid region, the tuber, or the zygoma.

Nowadays, advancements in computer science and technology allow a combination of the conventional 'all-on-four' treatment protocol with 3D software planning after computed tomography examination, guided minimally invasive surgery, and immediate provisional prosthesis delivery[8].

Advantages

- Avoiding vital structures and bone grafting
- Improving biomechanical distribution for complete arch restoration
- Achieving biomechanical fixation into cortical bone

- Facilitating splinted complete arch immediate function
- Increasing implant resistance form
- Economy of implant placement for the complete arch
- Increasing patient acceptance of treatment
- Psycho social benefits

Mini dental implants

Nowadays, available implants diameter varies between 1.8mm and 7mm. Mini diameter implants (MDI) are the implants with diameter less than or equal to 2.7 mm, while those of 3 to 3.3mm diameter are called small diameter implants (SDI), and conventional implants are those up to 7 mm[5,6]. During early period, mini dental implants were used for stabilization of provisional construction for the time necessary for osseointegration before placing conventional implant or to secure temporary bridges due to the small ball on the top of these implants the SDI and MDI, which have been approved by the FDA in 1997 resulting in avoiding bone augmentation or enlarging the mesiodistal space and giving the opportunity for more patients with severe cases to gain implant therapy. While placing dental implants in partially edentulous patients care must be taken to avoid impinging or damaging the periodontal ligaments of the adjacent teeth, so it has been recommended to maintain 2 mm to 3 mm of available space between the residual dentition and the surface of the implant. It also gives the ability to apply less invasive surgical procedures when there is circumferential bone deficiency around the implants. The procedure is less time consuming, bleeding is minimal, reduced amount of bone loss, reduced severity of peri implant ridge resorption, and there is no need to place and remove sutures, which leads to decreased postoperative discomfort and shortened healing time.

These implants are affordable,provides excellent patient satisfaction and high reliability when compared with conventional diameter implants. Primary stability found sufficient for immediate loading for small diameter and mini-dental implants, and it can be used as an alternative treatment options with fixed partial dentures in terms of both clinical and aesthetic criteria, as well for retention of complete maxillary and mandibular overdentures.

Short implants

Renouard & Nisand suggested that the use of short implants with less than 8mm in length and which was associated with poor bone quality, inadequate bone height, and immediate replacement of nonosseointegrated fixtures or fractured fixtures. So use of short dental implants in edentulous sites having minimal bone height to make implant surgery less invasive. Short threaded implants perform better in mandible than posterior maxilla because of differences in bone density. It provide initial primary stability and minimize crestal bone loss.[9,10]

Piezoelectric surgery

Implant stability is one of the fundamental prerequisites for achieving successful osseointegration and must be maintained for the entire healing period in order to avoid micro-movements, which could lead to fibrous tissue formation around the fixture. Specifically, literature suggests that there is a critical threshold of micromotion above which fibrous encapsulation prevails over osseointegration (50–150 micrometer)[11]. The introduction of piezoelectric bone surgery paved the way to new possibilities in performing osteotomies utilizing an ultrasonic surgical system. Currently,the effect of ultrasounds is being widely investigated in various fields of medicine: in orthopedics, they are used to accelerate healing of bone fractures and

ligament damage by promoting cell proliferation and bone matrix synthesis. Lessens the risk of damage to surrounding soft tissues and structures such as nerves, vessels and mucosa. The cavitation phenomenon creates bloodless surgical site, improving visibility in working area.[12]

Conclusion

- The digital pre-surgical plan accurately replicated during Guided implant surgery appears to be a significant aid in minimally invasive surgical procedures.
- Planning software enhances patient awareness, education and compliance and is an instrumental component of success.
- Minimally invasive implant surgery appears to be a plausible treatment modality for implant placement, demonstrating both efficiency and clinical effectiveness.

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