IMPLANT MALPOSITIONING: REASONS AND PREVENTION

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Abstract

The increased risk of biomechanical issues with implants, components, and prostheses is a result of implant malposition. The bending moment acting on the implant restoration is created or amplified by the displacement of the implant axis from the imposed functional load. The effects of this can take many different forms, and they can include biological, mechanical, and aesthetic issues as well as implant failure. Dental implant restorations have a high success rate, but to reduce difficulties, they need to be carefully planned and managed. The most frequent reasons for the restorative and mechanical failure of dental implants are covered in this article, along with possible preventative measures.

Keywords: implant, malpositioning, reasons, prevention

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INTRODUCTION

The elusive goal of creating prosthetic teeth to replace missing ones has ushered in a new era of implant-based reconstruction in dentistry.[1] Dental implants have been gaining a lot of general interest in recent years.[2]

Prosthodontic management with implants has found its rightful place in the rehabilitation of dental cripples and is recognised as one of the predictable modalities available to the dental profession. The capacity to replace missing teeth permanently with function and look that are nearly identical to those of the normal dentition has never been higher thanks to the development of osseo integrated dental implants.[3]

The number of implants, materials, and procedures has greatly risen with the development of technology.[4]. There is a paradigm shift from the old mass production of implants to the new customized patient specific 3 dimensionally printed implants with the use of different materials even.[5] All these variables have contributed to an increase in there use, including the fact that more and more patients are becoming aware of the treatment modalities utilising implants.[6]

The implants should be positioned correctly with the proper angulation and inclination in order to achieve the best results with prosthodontic rehabilitation. In order to avoid difficulties, the well-established concept of restorative-driven implant placement suggests situating implants in accordance with prosthetic and cosmetic requirements.

Dental implants are made to be loaded along their long axis, hence extreme caution must be exercised to avoid or reduce off-axial loads since they can increase implant loads beyond what the body can tolerate physiologically, which can lead to bone resorption and eventual implant failure. [7,8,9]

Therefore, all efforts should be made to redirect the loads on the implants, reducing the destructive transverse or bending loads, eccentric loads, and the treatment options should be selected based on various clinical parameters for the overall success and longevity of the restorations.[10]

REASONS FOR IMPLANT MALPOSITIONING:

A careful pre-surgical planning, and adequate pre-surgical prosthetic design is essential to the accurate placement of implants for an aesthetically pleasing and functional result. Also in cases of particular clinical situation of varying defect sizes and remaining tissues more research on what type of implants to be used is required.[11]

Between the implantation of the implant and the creation of the prosthetic repair, difficulties might happen at any time; some even happen after a long period of follow-up.[12]

Implant failures can be largely classified into:

- Loss of integration
- Positional failures
- Soft tissue defects
- Biomechanical failures.[13]

Positional failure is thought to be the most typical sort of failure brought on by subpar surgical or treatment planning. [13]

This kind of failure is thought to occur 10% of the time.[14]

Complications during or before implant surgery are possible in the case of implant placement. Following are some categories for typical implant surgery complications:

Treatment plan related:

- Wrong angulation
- Improper implant location
- Too far
- Too close
- Lack of communication

Anatomy related:

- Nerve injury
- Bleeding
- Cortical plate perforation
- Sinus perforation
- Devitalization of adjacent teeth

Procedure related:

- Mechanical
- Lack of primary stability
- Mandibular fracture
- Ingestion/aspiration

Other:

- Iatrogenic
- Human error[15]

Implant placement is typically determined by anatomical factors, bone morphology, and aesthetic considerations. Anatomical circumstances and bone shape can both contribute to implant malposition.

Implant malposition that may occur can be attributed to:

- Anatomical conditions and bone morphology
- Aesthetics
- Surgical and Technical factors
- Iatrogenic factors (poor planning) [16,17]

Skeletal morphology and anatomical conditions:

The anatomical factors that affect implant placement include the relationships between the maxillo-mandibular arches, the breadth, height, and angle of the remnant bony ridge, the presence

of bony undercuts, the form of the arch, and the shape of the arch.

Height of the available bone:
The minimum height of the available bone for endosteal implants depends in part on the bone's density. The less dense bone like atrophic maxilla needs a longer implant, like the zygomatic and pterygoid implants[18] while the more dense bone may be able to support a shorter implant.
Due to anatomical limitations, narrow and shorter implants are frequently employed in places where more stresses are generated and the natural dentition includes wider posterior teeth and even two or three pathways.

Available bone width :
It is the distance between the lingual and facial plates at the crest of the proposed implant site. The width of the accessible bone is the main factor impacting long-term survival, once sufficient height is available for implants.
For reliable survival, root form implants with crestal diameters of 4mm often need more than 5mm of bone width to ensure appropriate bone thickness & blood supply.

Available bone length:
A minimum mesiodistal length of 7mm is often sufficient for each implant in bone that is more than 5mm broad.

Available bone angulation:
The bone is parallel to the long axis of the prosthodontic restoration and is aligned with the forces of occlusion. The axial stresses of occlusion or the adjacent implant, natural teeth, or wider root form implants can be diverged up to 30 degrees.

A 20 degree angulation from the axis of the adjacent clinical crowns or from a line perpendicular to the occlusal plane is allowed by a narrow ridge.

Bone density and quality:
Bone quality has been categorised in a number of categorization systems, showing the variation in relative volume of compact cortical bone and trabecular bone, which is of vital importance to the result of implant implantation.
Lekholm and Zarb (1985) first suggested a classification that is well-known and frequently cited.

Type 1 refers to homogenous compact bone of high density but low vascularity; hence not an ideal clinical situation.
Types 2 and 3 describe bone that still has a dense cortical plate but also has a cancellous portion with good vascularity for ideal implant placement and stability.
Type 4 describes inadequate density, and caution in its use for implant placement is warranted.[19]

Bony undercuts:
The majority of the time, undercuts affect the facial bone, with the submandibular fossa in the posterior jaw being an exception. Therefore, implants are frequently tilted to the lingual to prevent insertion through the facial undercuts.

Neighbouring natural teeth to implant sites:
The placement of the implants may be compromised in cases of long-term edentulism because the natural teeth may tip, tilt, spin, or extrude from their normal placements.

Ridge connections:
The mandibular canal's location and the ridge's proximity to the paranasal sinuses are two additional anatomical features that could affect implant placement.[20]
Clinical therapy of these conditions may entail surgical correction, such as sinus elevation, nerve relocation, or bone augmentation of the alveolar ridge.[21]

Technical or surgical aspects:
The instability of the surgical template during surgery and fabrication flaws in the radiography template may both contribute to surgical mishaps.

Iatrogenic factors:
During implant placement, the operator's abilities are equally crucial. Implants may be positioned in less than optimum locations due to poor planning, bad judgement, and losing one's orientation during the implant surgery.[22]
Therefore, understanding implant biomechanics and the different aspects that affect an implant's and an implant-supported prosthesis' success or failure is crucial.

HOW TO PREVENT IMPLANT MALPOSITIONING

Meticulous pre-operative assessment
The amount and direction of force carried by the implant, aesthetics, intraoperative safety, and the patient's postoperative oral hygiene are all things to keep in mind while considering implant surgery.[23]

PRESURGICAL PROSTHODONTICS

Using a surgical template, the desired implant position is transferred, assisting the surgeon as they put the implant.

An implant-supported aesthetic restoration is predictable when a surgical template is precisely produced. Therefore, in order to enable a prosthetic-driven implant placement protocol, the transfer of information regarding the predetermined position and angulation for the implant fixture from the study cast in a 3D manner onto the surgery site becomes necessary and it helps in carrying out the treatment plan.

Requirements: According to Buer et al. (2004), surgical templates must be simple to apply and remove, robust and sturdy, allow for simple surgical access, and not obstruct tissue reflection, visualisation of the depth indications, or cooling of the surgical drills.[24]

An exact replica of the diagnostic wax-up made of clear resin serves as the most basic surgical template. It has guiding cutouts or grooves where possible implant locations may be. These are often made in accordance with the missing teeth's original position.

Dental implant implantation guides come in many different forms. Some are straightforward, like the **clear**

vacuum-formed matrix (Fig.1)with the hole for the implant bored through it. Although they are quick and easy to make, they can provide the implant's final placement too much latitude.

Fig.1 The basic transparent template.

Metal tubes are included into the implant placement guide in designs that have been described by several writers. [24] (Fig.2)(Kennedy et al., 1998; Becker and Kaiser, 2000). The benefits of this kind of template include the ability to precisely position implants and more precise parallelism due to the sleeves' assistance in maintaining parallel holes throughout the drilling process. Additionally, they stop the sharp frictional rotation of the surgical drill with the sidewalls of the template from distorting or chipping the acrylic resin at the surgical site. The sleeves' presence ensures that the drill is in a secure position and maintains a set angulation throughout the drilling process.

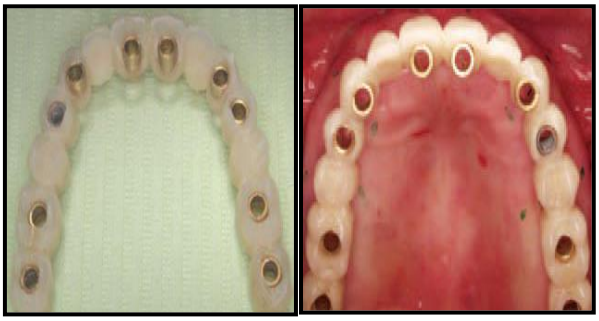

Fig.2 The metal sleeves attached to the acrylic template.

Computed tomography, laser welding, and guide wires have all been mentioned in other designs. These implant placement guidelines may offer a better 3-dimensional depiction of the surgical area and may be more accurate, but they also need complex technology that is typically not found in dental offices and may result in increased costs for the patient.[25]

With the use of CAD/CAM technology, which allows accurate positioning in terms of determining the axial location of the implant head within the alveolar ridge, new types of templates may be created.

An implant patient's mouth can physically receive the implant planning thanks to a stereolitho graphic drill guide. The scannographic template is made to be converted into a temporary fixed prosthesis or a final prosthesis for instant loading.

Factors influencing implant positioning are:

The grip (Fig.3)

The hand-piece's grip greatly affects how the implant is positioned optimally during the drilling process. The positioning method is optimised by the clinician's ability to maintain control of their hand while drilling, employing either a palm grip or a pen-grasping grip. The palm grip enables better control of the drilling technique in the maxillary posterior areas, according to Askary. This preference results from the distinctive characteristics of the drilling process compared to the standard turbine hand-piece grip utilised for cavity preparation. The palm grip can help with improved placement control due to the slow pace and high torque involved in dental implantology procedures, as well as bone resistance.

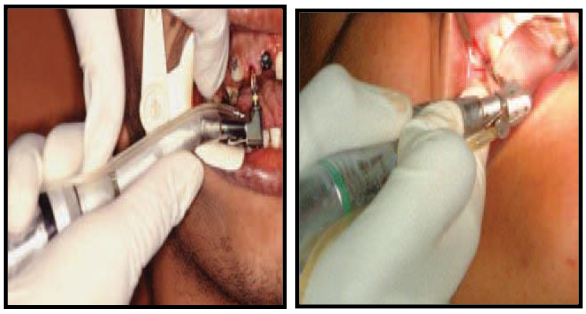

Fig.3 Palm grip Pen grip

Accuracy of the surgical template:
The location of the implant will be more precise the more precise the surgical template. The use of surgical templates enables the surgeon to choose the best position for implant implantation while taking into account the patient's unique anatomical characteristics and optimising implant placement.

Sharpness of the cutting drills:
Each implant manufacturer specifies the number of times a set of drills should be used before being discarded since drills grow dull with use. The drill's sharpness minimises wobbling at the surgical site and the ensuing departure from the planned angulation or location. The pilot drill or rosette used for the pilot osteotomy is the most valuable since it directs the main course that the other drill will follow.

The use of positioning devices:
There are positioning tools that support maintaining the ideal gap between the implant and the natural teeth. In order to help in preserving the correct implant position and angulation during the preparation of the surgical site, a revolutionary implant positioning system known as **IPS set (Storz am Markt GMBH, Emmingen-Liptingen, Germany)** was launched. It is made up of a number of sleeves and spreaders that help surgeons maintain the correct interproximal dimensions and choose the correct implant head apical level. The system makes it easier to choose an implant's diameter and axis, maintains an accurate distance between an implant and its neighbouring tooth or between two implants, and is compatible with any implant system.

Fig: IPS set.

The use of computerized navigation surgery:
To improve minimally invasive treatments, computerised navigation surgery is a new technique for intraoperative tracking and guidance of surgical tools. In situations where flapless implant placement may be seen as a blind treatment with a risk of cortical plate perforation, this surgery, also known as image guided implantology, can be used with flapless or flapped implant placement procedures.
The computerised navigation will allow the surgeon to precisely align the drill's position and angulation with the presurgical digital implant plan.[24]

CONCLUSION

Complications can occur at any stage of implant therapy and positional failure of implants is considered as the most common type of failure.
The clinician should not only have the knowledge to identify the complications but also should pose knowledge regarding the various treatment modalities available which are required to rectify the complications.
Malpositioned implants may not only pose an aesthetic challenge but also functional rehabilitation may be difficult. In such situations, a decision has to be made whether the rehabilitation will be purely prosthodontic or surgical intervention is required.
A careful evaluation and understanding of the bone anatomy and architecture, including the quantity and quality of available bone, are mandatory before implant placement.

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