10 Tips to Predictable Implant Therapy

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INTRODUCTION

Contemporary Implant dentistry requires surgical precision and adequate prosthetic acumen to provide results that meet various biologic, functional and esthetic criteria. Not only is the initial pink and white esthetics important but equally important is the ability of the implant to survive in hostile oral environment for long periods of time without showing detrimental gingival changes or crestal bone loss.

Ten clinical tips in this article will allow clinicians to organize their thought process when looking at various edentulous situations from a point of view of long term success and survival of implants.

CLINICAL TIPS

1. Know Your Medicine

It is imperative for the clinician today to keep abreast with various advances in medicine so that adequate precautions can be taken in the implant patient prior to surgery. It is prudent to refer to the concerned medical specialist for a written consent prior to instituting implant therapy in these conditions. A specific consent regarding failure policy in the conditions mentioned in **Table 1** is required to safeguard the clinician from future medico legal episodes.

Table 1: Systemic Risk Factors in Implant Therapy

Medical Conditions/ Drug Therapies	Consideration/ Possibility of Complication
Cardiovascular	Anticoagulant therapy, excessive bleeding, stress on heart
Diabetes	Delayed wound healing, prone to infection, peri implantitis in long term
Scleroderma, Ectodermal dysplasia	Limited mouth opening and severe bone atrophy
Sjogren's Syndrome	Difficulty with removable prostheses, increased risk of implant failure (collagen metabolism affected)
Neuropsychiatric disorders/ Parkinsons	Difficulty in record making and hygiene
AIDS/ HIV	Risk of transmission and impaired immunity
Crohn's Disease	Increases risk of early implant failure
Osteoporosis	Delayed healing, increased fracture tendency, weaker bone implant interface
Bisphosphonate Therapy	Incidence of osteonecrosis is reported after IV bisphosphonate therapy
Radiation Therapy	Osteoradionecrosis

2. Know the Anatomy

The practical knowledge of anatomy has to be utilized during surgical execution of implant therapy. The palpation of bone to help identify undercuts especially in the mylohyoid region is important to prevent perforations of lingual cortex in the mandible **(Figure 1)**. Equally important is accurate measurement of the distance between the crest of the ridge and the floor of the nasal and maxillary sinus cavity in the

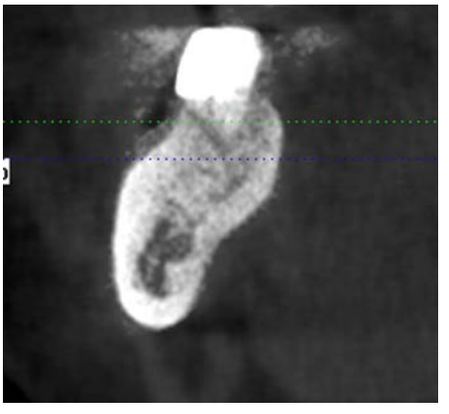

FIG 1: Mylohyoid ridge presenting severe undercut

maxilla and the inferior alveolar nerve in the mandible **(Figure 2)**. The greatest difficulty is faced by the clinician if knowledge of anatomy is inadequate and complex cases are to be dealt with.

3. Estimate Bone Volume

The most common error in judgment when

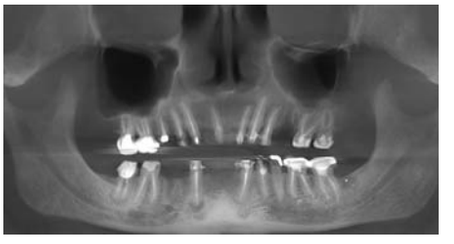

FIG 2: Nasal floor, Maxillary sinus, Inf Alv nerve are important Anatomical landmarks

assessing bone volume is to estimate the length of the proposed implants directly from an uncalibrated OPG. There are three aspects to bone volume.

The first is the Mesiodistal width **(Figure 3A)** of the edentulous span. In several cases migration of adjacent teeth in the edentulous space decreases the length of the span and thus placement of an implant keeping in mind adequate space from adjacent periodontium becomes difficult. 2mm space is mandatory between an implant and the periodontium of adjacent teeth **(Figure 3B)**.

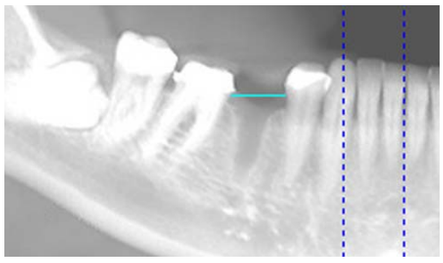

FIG 3A: Adequate Mesiodistal width (8mm) for implant placement

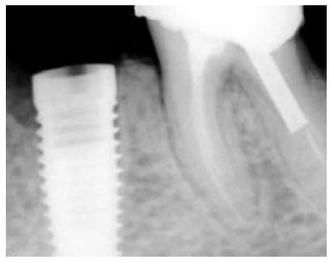

FIG 3B: Correct Distance between implant and adjacent tooth

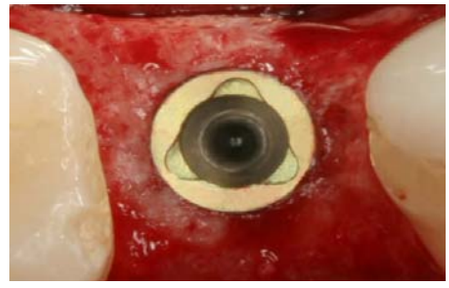

FIG 4: Buccolingual width with adequate bone surrounding implant

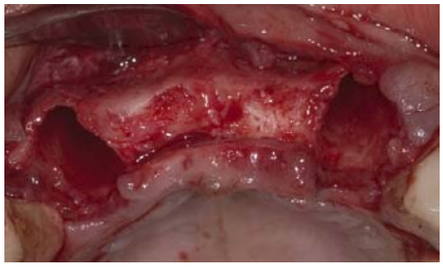

FIG 5A: Depicts severe resorption in maxillary ridge in 11, 21 region just 4 months after extraction

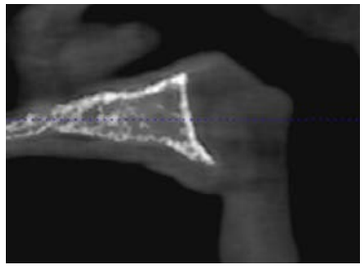

FIG 5B: Severely resorbed maxillary ridge

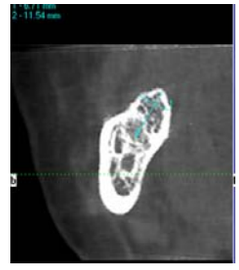

FIG 6: Occluso Cervical dimension of available bone upto Inferior Alveolar Nerve

So if you have 35 and 36 missing and you want to place 2 implants of 5mm diameter you would need almost 17mm of space from distal of 34 to mesial of 37. Measurement of this dimension is done on a preoperative study model.

The second is the Buccolingual width **(Figure 4)**. As a matter of fact almost 40 percent bone volume from buccal bone is lost in the first 6 months. Multiple extraction sites loose buccal bone faster. A common error of judgment is to estimate the buccolingual width by visually looking at the edentulous span. While this error may not cause too much trouble in the mandible, the clinician is advised extreme caution in the maxilla. The maxillary edentulous areas maintain the overall thickness of the ridge by compensating with greater increase in soft tissue thickness as the underlying bone resorbs. This can be very misleading as you open up the site thinking you will place a regular platform (4.3mm diameter) implant and may end up aborting the procedure as the bone has resorbed severely and there is no width available to placement **(Figure 5A** and **B)**.

The guideline to follow is to decide the width of the implant in such a way that at least 2mm of sound bone remains on the buccal and the lingual cortex **(Figure 4)**. Caution is advised in immediate extraction and implant placement especially in the anterior zone as the implant tends to be inserted at the expense of the buccal cortex and risk of resorption of the already thin buccal plate become higher due to this.

Table 2: Formula used to calculate distortion in Xrays

$$\text{Actual length of bone} = \frac{\text{Actual diameter of marker X Radiographic length of bone}}{\text{Radiographic diameter of marker}}$$

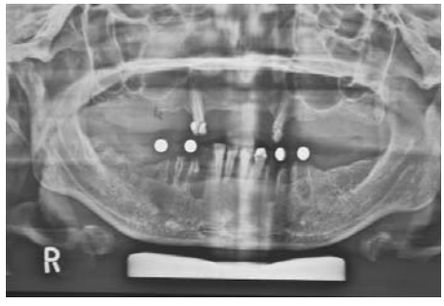

FIG 7: OPG with Ball Bearings to calculate distortion

The third dimension required for adequate bone volume is the Occluso cervical length **(Figure 6)**. This is the distance from the crest of the edentulous ridge to nearest anatomical landmark minus 2mm. In the maxilla the floor of the nasal cavity and the maxillary sinus define the anatomical limits while in mandible the inferior alveolar nerve along its entire path has to be cautiously kept away from while implant placement. The most common error in judgment is to try and gain adequate length of the implant resulting from a radiographic diagnosis that is done using measurements that are not calibrated. The simplest method to use is to have radio opaque markers (ball bearings) of known diameter when taking IOPA or OPG for implant patients **(Figure 7)**. The distortion in the diameter of the marker will reveal the actual length of bone using the formula shown in **Table 2**. The simplest check method is to always take a radiograph with pilot drill at the desired depth. This will allow the proximity of the proposed implant to the nearest anatomic landmark to be accurately assessed.

4. Assess Bone Density/ Bone Quality

Bone density is an important governing factor in various stages of implant therapy. Posterior maxilla generally has soft bone and the anterior mandible is endowed usually with dense bone. Various implant systems address this diversity in bone density by designing drilling protocols that will enable the clinicians to achieve the required primary stability in the range of 35-45 Ncm. Most systems have a dense bone drilling protocol that also includes a drill that can tap the bone and prevent implant insertion at a very high torque. High insertion torque can lead to over tightening of the implant and can result in compression necrosis and subsequent implant failure. Another issue with very dense bone is that the drills will take a bit longer to drill to the desired depth. An error at such times is to increase the speed of the drill and apply a lot of pressure on the hand piece. This leads to overheating of the drill tip where the saline

FIG 8: Mesial implants placed too close to each other

coolant may not effectively reach and provide cooling. A pecking motion during drilling allows the drill to cool well. Needless to say, the pilot drill of any system that does the maximum cutting should be disposed off after 3-4 implants in the dense bone.

On the other hand over zealous drilling protocols in soft bone can leave the implant spinning in the osteotomy and failure to achieve primary stability. In the posterior maxilla it is wise to 'under' drill and try the implant insertion. At the most if the implant encounters too much resistance it can be removed and drilling to full protocol carried out. Use of osteotomes to condense the bone in posterior maxilla while preparing the bone bed for implant placement is a valid technique and one that must be employed in most cases. Osteotomes too generate heat by friction and hence external irrigation is advised. Preparation of implant beds with osteotome and mallet transmits percussive and vibratory forces capable of detaching the otoliths from their normal location; moreover, the patient's surgical head position favors the displacement of otoliths into the posterior semicircular canal of the hearing apparatus. Implant surgeons should be aware of this possible complication following closed sinus lift procedure and patients should always be informed before undergoing surgery[1].

5. Fabricate a surgical stent

Improper distancing between implants is a very common problem **(Figures 8** and **9)**. The repercussions of this are biological as well as restorative and esthetic. Implants placed too close together (<3mm) may lead to inadequate bone support between implants. In the long term should there be any peri implant bone loss, both implants will suffer as the quantity of bone between them is not enough to allow the bone loss to get restricted to only one of them. Restoratively too, implants placed too close to each other complicate impressions and other prosthetic procedures. The designing of gingival embrasures between implants is tougher and this leads to a situation where hygiene is compromised. In the worst case scenario implants placed too close to each other in the esthetic zone would be a disaster as it would be difficult to retain a papilla between them.

FIG 9: Improper distance between implants

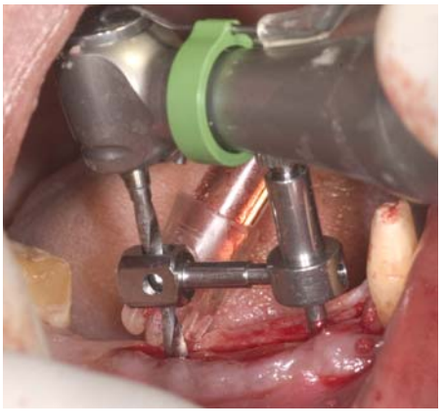

FIG 11: Drill Guide used to place implants at desired distance from each other

FIG 13: Stent for Guided Implant placement determines all three dimensions of implant position

FIG 10: Implant placed too close to adjacent tooth #22

FIG 12: Vacuum pressed stent made on duplicate of waxed up models

FIG 14: Inadequate attached gingiva with inflammation around implants

Implants placed too far away also could lead to restorative problems where the crown contours could become unnatural and lead to excessive mesial or distal cantilevers that will be putting extra stress on the screw mechanics of the implants.

Implants violating the periodontal space of adjacent teeth **(Figure 10)** could cause

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devitalization of pulp of those teeth and may necessitate intentional endodontic therapy.

All these problems can be avoided by making use of various types of guides as depicted in **Figures 11, 12** and **13**.

6. Flap Vs Flapless placement

Marketing trends that tend to oversimplify implant dentistry encourage clinicians to go for flapless placement of implants these days. These flapless procedures are themselves a misnomer as you need to punch out the soft tissue and then place the implants. Flapless placements have a very big advantage as they can be done cleanly without tissue reflection and suturing and thereby surgical time is reduced. The patient also is very comfortable post operatively and this itself is a strong reason to advocate flap less placements.

A few lines of caution are worth mentioning with regards to flapless placement. The first requirement is case selection. The edentulous site should have adequate attached gingiva (>5mm) so that you can cut out precious gingival tissues and consider a flapless placement. If the attached gingiva is inadequate **(Figure 14)** it can create problems with hygiene maintenance around implants and subsequent peri implantitis and bone loss in the long term. In fact if the attached gingiva is inadequate, surgical procedures **(Figure 15)** should be carried out to improve the situation rather than doing a flapless placement and worsening it. The other major risk of flapless placement is that the irregular bony architecture cannot be visualized and hence the implant may get placed with a part of its body supracrestal. Although functionally the implant will integrate, this may become an esthetic nightmare if it is in the anterior zone. It is also common to miss defects in bone like dehiscence's or fenestrations when flapless procedures are considered and thus an opportunity to carry out guided bone regeneration during implant placement is missed. This will only become evident at a later date and by that time the implant will already have integrated in the surrounding bone. It is our humble opinion that flapless placements should be discouraged for inexperienced operators. Surgical stents for guided surgery may be used for flapless placements but only after careful case selection **(Figure 16)** and with the understanding that even these methods can be inaccurate especially if the CT scan has some inaccuracies due to incorrect scanning protocol followed or if the surgical stent is fabricated by less than required manufacturing standardization. For all practical purposes flapless placements require much higher surgical skill than a flapped approach.

7. Observe the relationship of jaws

As the maxilla resorbs in a centripetal pattern it becomes narrower than the mandible that will resorb in a centrifugal pattern. This leaves the maxilla in cross bite with the mandible **(Figure 17)**. Rehabilitating these situations becomes a restorative challenge. The first instinct we have is to set the upper teeth in correct horizontal relation with the lowers. As a result of the resorption of maxilla in many cases this leaves the teeth to far facially placed as compared to the residual bone. This facial cantilever leads to non axial loads on implants that are placed in relatively softer bone and it may be detrimental to the long term success of the implants. In such cases it may be considered prudent to leave the teeth in cross bite or augment support to the prostheses with greater number of implants if fixed restorations are necessary. Considering grafting options to undo the bone loss is however a better choice as it will allow the implant to be placed in the position that is conducive to its long term survival. The situation may also arise in cases where the mandible is resorbed and become much wider than the maxilla. In these cases if the patient accepts a removable implant retained prostheses it will be useful as the teeth can be set in normal overjet overbite relation meeting the esthetic and phonetic requirements of the patient and at the same time the implants can be placed where the available bone is and still not have them compromised in the long term.

8. Plan the type of prostheses before implant placement

All patients desire fixed implant anchored restorations. The advantages of these are that they psychologically feel like their own teeth. The main advantages for the dentist in such situations is that maintenance is generally lesser and overall longevity is good if the designing of the prostheses is done correctly and adequate number of implants are placed in adequate volume of bone.

The disadvantages of fixed implant anchored prostheses however are many. Firstly as the prostheses cannot be removed for hygiene the dentist has to take extra effort in providing a self cleansing design that does not entrap food. Moreover nocturnal parafunction is difficult to address and can lead to increased forces on the implants. In case of maxillary prostheses there is increased chance of phonetic problems due to air escape from under the prostheses in the anterior maxilla. In cases of severe atrophy of maxilla there is greater difficulty in providing lip support with the fixed prostheses. A removable implant retained overdenture on the other hand can easily provide the critical labial flange to

FIG 15: Free gingival graft to increase width of attached gingiva

FIG 16: Ideal case with abundant attached gingiva allowing flapless placement with guided surgical stent

FIG 17: Resorption of maxilla leaves it in cross bite situation with mandible

FIG 18: Screw retained prostheses

FIG 19: Cement retained prostheses

FIG 20: Milled Titanium Framework

provide better esthetics with lip support.

Overdentures overcome all these disadvantages of fixed prostheses and require generally lesser number of implants to achieve that. However they come with their own set of disadvantages. The main disadvantage being the need for very high maintenance in the long term. Problems mainly encountered are loss of retention due to fatigue and wear of retentive elements and also breakage of dentures that have been hollowed from within to house the retentive elements. The other aspect in types of fixed prostheses that is generally applicable to all implant cases is the factors that govern the choice between screw retained and cemented prostheses **(Figures 18** and **19)**. It is best to discuss the pros and cons on these under the following headings:

● Ease of fabrication and cost

In most situations the cemented prostheses is easier to fabricate. The laboratory techniques for the same are simpler. The screw retained prostheses on the other hand requires greater co ordination and skilled lab work to get the prostheses design correct. Generally the cemented prostheses will be more economical than its screw retained counterpart for a given situation.

● Passivity of the framework

Passivity is easier to achieve with cemented restorations. An active or tight cemented restoration can be adjusted in the laboratory to provide a more passive fit. Screw retained restorations will need to be tested for passivity in clinical conditions. The Sheffield test is carried out to check the passivity of metal framework in screw retained restorations. In this the distal most screw is tightened first and it should not lead to the framework being lifted of the remaining implants. If the framework gets lifted it has to be sectioned and soldered. For this purpose alloys rich in precious or semi precious metals are desirable. Milled titanium frameworks **(Figure 20)** manufactured by copy milling techniques seem to surpass the accuracy of casted non precious alloy frameworks and should be considered whenever possible.

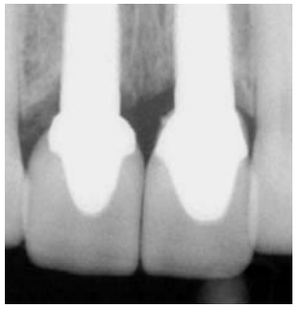

FIG 21: Excess cement evident on mesial on 21 implant abutment

FIG 22: Adequate anterior guidance in Implant Prostheses

● Retention

The retention capability of screw retained restorations is good. The cemented restorations when cemented with permanent luting agents provide very good retention. In cases where multiunit restorations are planned weaker cements should be used on retentive abutment preparations so that the restorations can be removed in case biological or technical complications arise in the future. The greatest difficulty in retention of cemented restoration presents when the interarch distance is too little (<6mm) and thus to have an abutment long enough to provide retention and resistance form is not possible. In such cases of reduced interarch distance it is better to consider screw retained restorations.

● Occlusion

Occlusion is easier to manage with cemented restorations in most cases. The occlusal scheme designed in the laboratory and confirmed during bisque trial will not change if cementation protocols are correctly carried out. Screw retained restorations that have their screw access paths **(Figure 18)** emerging from the occlusal surfaces of posterior teeth present clinical difficulties in adjustment of occlusion as these screw access paths are filled with composite resin after final torquing of the abutment screws. These problems are however small compared to the advantages that a screw retained restoration presents with.

● Esthetics

There is very little to choose between esthetic capabilities of both forms of restorations. In hands of a good ceramist with established protocols in dealing with implant prosthesis comparable esthetic results can be achieved in either case provided the implants are not malposed.

● Delivery

Delivery of screw retained restorations is generally much easier and less messy than a cemented restoration. Cemented restorations, during luting tend to push the excess cement along the abutment implant interface **(Figure 21)**. This excess cement if left in situ can easily cause biologic complications like peri implantitis and in some cases may lead to failure of an otherwise successfully integrated implant. Extreme caution is necessary to tactfully remove the excess cement and verify a clean abutment implant interface with an intraoral X-ray before discharging the patient. To enable easy detection of excess cement on X-ray's it is prudent to use radio opaque cements for implant supported restorations.

● Irretrievability

Screw retained restorations are generally easier to retrieve as compared to cemented ones. The main problem with using weaker cements in implant supported restorations

is that there can be a case of frequent depending of the restoration that can become a practice management issue thus forcing the clinician to choose stronger luting agents subsequently. This means that the cement retained restoration will then be technically irretrievable and thus cause difficulty in management if biological or technical problems like screw loosening or screw breakage arise in the future.

9. Occlusion! The final frontier

The principles of stable occlusion should be ideally visible in any case that is being undertaken for implant therapy.

a) Centric occlusion (CO) (teeth - teeth relationship in maximum intercuspation) should be in harmony with centric relation (CR). Uniform equal intensity contacts on all teeth should be present in CO.
b) When the mandible leaves the centric relation and goes into protrusive relation, the incisors should disclose the posteriors (Anterior Guidance) **(Figure 22)**.
c) When the mandible is in lateral excursion, the canines (as in mutually protected occlusion) or canines and premolars (as in group function occlusion) only should be in contact on the working side thus disclosing all remaining teeth in the mouth.

If the existing dentition has issues of severe wear of teeth, loss of guiding surfaces of anterior teeth or derangement of occlusal plane due to supra eruption of a few teeth opposing the edentulous span it should be addressed before restorations on implants are fabricated. This will help in controlling the forces on the implants as implants lack the crucial proprioception that the natural teeth are blessed with as they have a periodontal ligament loaded with sensory perception. It is prudent to stay away from implant therapy in a patient that presents insurmountable occlusal problems.

10. Keep Learning

Any form of education is good to begin with, as long as the clinician comes out believing that he has taken only his first step towards understanding the vast subject of implant dentistry and keeps his quest alive to acquire more knowledge and training in various procedures that are needed to successfully finish an implant case. With the distance between cities shrinking it is not unusual to consider training in implants in other countries thereby providing ourselves with comprehensive learning in a subject of choice within the vast implant curriculum. A team approach is a great way to learn and execute advanced to complex implant cases. Identifying your limitations and employing the right specialist to fill in the lacunae in your own skill levels is a huge step towards building up a successful implant practice.

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