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SHORT IMPLANT'S: TREATMENT OPTION FOR ATROPHIC RIDGE IN ORAL IMPLANTOLOGY: A REVIEW

Prosthodontics

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ABSTRACT

Implant dentistry has seen rapid progress in recent years leading to its application as standard treatment modalities. While selecting treatment plan, bone mapping and selection of implant is very essential for a successful implant practice. In case of an atrophic ridge where bone height is less, then selection of short implant could be a good treatment alternative, as it is a conservative treatment option because it prevents the need of sinus lift, alveolar nerve repositioning, and bone grafting. This article will discuss about how? when to use short implants along with their advantages, disadvantages of short implants in details.

KEYWORDS

Short Implant, Atrophic ridge, Sinus lift, and Window tech

INTRODUCTION:

Dental implant is the most advanced well-recognized treatment modalities to replace the missing teeth in edentulous areas. An implant can be used to replace the missing single teeth, multiple teeth or completely edentulous arches. Placing implant and giving prosthesis is very challenging to any dentist especially when areas displaying severe resorption and bone height reduction[1,2]. Surgical protocols employing bone grafting, sinus lift, intra bony separation, and reconstruction, as well as, inferior alveolar nerve transposition is required for the placement of conventional implants[3] are quite expansive, invasive, technique sensitive, stressful and have longer healing period. To overcome this all, the short implant (6-8 mm) is a good treatment alternative. These are one of the technique that have developed due to anatomical barriers and lack of bone availability which prevent conventional dental implant treatment.

HISTORY:

There is a story behind every success and the same goes for the implant also. Implant dentistry has a very long and interesting history. Starting from the gold wire ligature tooth, bamboo peg, vitallium implant to the SLA (sand blast large grit acid etched), Hydroxyapatite coated implant and zirconia implant. The dental implant was more popularized after the discovery of osteointegration (1950) by Dr. Per-Ingvar Brenemark in Europe. Thomas Driskell invented the short implant in 1968 with the length of 8 mm under the company Bicon implant, which is the pioneer in the field of short implants shows 94% of the success rate of short implant[4], after the 10 years in (1979) Branemark also introduced 7mm short implant under Nobel BioCare. Nowadays many companies have come up with short implants and some with even surface modifications, 8mm or less than 8 mm is considered short, and less than 7mm is categorized as ultra-short implant system. Most of the ultra-short are used by orthodontists for taking anchorage, and prosthodontists for the implant-retained or supported overdentures[5]. However more recently, Straumann introduced a 4-mm implant, with 5-year data showing survival of 94% for these implants[6].

WHY AND WHEN TO USE SHORT IMPLANT??

Residual ridge resorption has varying rates in different individuals and in the same individual at different times. The most common site of resorption is maxillary and mandibular posterior due to decrease in bone density, volume and pneumatization of sinus, due to the presence of vital structures like maxillary sinus in the maxilla and mandibular nerve in mandible use of conventional implants is very limited when there is severe resorption. In that situation, the surgeon should go for appositional bone block graft, distraction osteogenesis, vertical guided regeneration, interposition bone block grafting, sinus lift for maxilla, nerve repositioning in the mandible for the placement of conventional implants. Although all procedures are invasive, costly, more time consuming so using a short implant is the treatment of choice to reduce the associated risk, patient's morbidity, and anxiety and cost[7].

ADVANTAGES

Followings are the advantages associated with the short implant that promote us to use the short implant to rehabilitate the atrophic ridges[4,8].

- Fewer surgical procedures are required, resulting in less morbidity and less swelling and pain to the patients post operatively.
- Fewer materials are required, which means economical treatment option for the patients.
- Less surgical time is required because of smaller osteotomy site preparation, which results in less operator stress and fatigue to the surgeons as well as less tissue damage for the patients.
- Few pre-operative and post-operative complications.
- Decreased risk of damaging adjacent tooth roots while surgical placement of implant.
- There is a greater likelihood of achieving optimal implant positioning in patient mouth.

DISADVANTAGES

Followings are the disadvantages associated with the short implants that limits the use of short implants in clinical practice in certain clinical situation[3,4].

- Achieving initial stability can be challenging because of length of implant.
- Type 4 bone may be at greater risk because of bone density.
- Submerged healing with subsequent reentry is generally recommended for better osseointegration.
- There is a possibility of more prosthetic complications.
- Because long-term data are still required (especially for ultrashort implants and single-crown short implants), there are potentially unknown long-term complications.

CLASSIFICATION OF SHORT IMPLANTS

1.According to Length by Douglas. D. (2014)[4]

Length	Implant
<6mm.	Ultra-short implant
6-8 mm	Short implant
>8mm.	Standard implant

2. Classification of dental implants based on diameter and length By Al-Johany et al (2016)[9].

Diameter	Implant
<3.0 mm.	Extra-narrow
≥3.0 mm to <3.75 mm.	Narrow

≥3.75 mm to <5 mm.	Standard
≥ 5 mm.	Wide

Length	**Implant**
≤ 6 mm.	Extra-short
> 6 mm to <10 mm.	Short
≥10 mm to < 13 mm.	Standard
≥ 13 mm.	Long

GUIDELINES FOR USING SHORT IMPLANTS

Whenever it is decided to use short implants then following things should be kept in mind for long-term success and also to avoid certain complications. Bone quality and quantity should be sufficient[6,7]. The thickness of remaining buccal bone should be 2 mm after final osteotomies to avoid post-operative complication. When primary stability is less than ideal (eg. < 35 Ncm), a submerged surgical protocol and extended healing period of 5 months or more should be allowed (according to bone density) prior to implant reentry[8]. When primary stability is less than (10-15 Ncm) then we should choose larger diameter implant and extended healing period should follow[8,9]. Usually type 2 and 3 bone is preferred, but when there is type 4 then we should go for wide diameter implant if possible, to increase bone implant contact (BIC). A crown-to-implant ratio of 1:1 should be used where possible. These implants should also be splinted wherever feasible using accurately fitted prostheses[10]. Cantilevers and balancing side contacts should be avoided if possible, and a harmonious occlusion established and maintained over time to prevent mechanical overloading and prevent the implant failure and mechanical fracture[11].

IMPLANT FACTOR

Implant shape, thread, taper, surface treatment these all things affect the primary stability as well as the rate of osseointegration so before choosing the short implant following things should be kept in mind.

SHAPE: - Root form screw shape threaded implant is the gold standard, but plateau root form [PRF] and the other with a sintered porous-surfaced geometry (SPSI) and topography instead of threads, both of these latter designs have a long history of successful use in short implant[12]. On the surface of implant the shape of thread, pitch, depth also affect the bone implant contact (BIC) more the surface more BIC[3,4].

TORQUE: - Currently available implant geometry thread of dental implant exhibit greater torque while placing in bone. Achieving primary stability is important to reduce the micromovement of implant for the proper osseointegration[5], but it is quite critical to achieve in short implants because of length. When implant is surface treated then it will increase the secondary stability also[13].

SURFACE TREATMENT: -

Surface treatment onto the surface of dental implants like sand blast large grit acid etched (SLA), titanium plasma sprayed (TPS), plasma sprayed hydroxyapatite (HA), and calcium phosphate (CAP) modified surfaces readily adsorb proteins, a property that facilitates fibrinogen binding and increased platelet adhesion and activation with accelerated healing[14]. All these surface treatments increase the osteoconductive activity and finally increase osseointegration. So, it is better to choose surface treated short implant for better clinical result.

OTHER: -

Other design considerations for short implants include implant diameter, collar design, prosthetic abutment connection type, and platform switching all these affect survivals of short implants[15]. Larger diameters will benefit short implant because increase in implant width appear to be more important than increase in length when it comes to improving stress transfer during off-axis loading and also increase the stability of implant[16]. Collar design will affect implant as it is important to establish biologic width—the peri-implant cuff of gingival epithelial and connective tissue that seals off the underlying bone[17]. Initially the many companies came up with smooth collar but later on rough surface collar showed better survival rates in short implant. Internal hex connection is preferred over the external hex connection for the short implant[16]. Platform-switch feature (ie, the diameter of the prosthetic abutment is smaller than the implant prosthetic table) in there with the intent of reducing crestal stresses. platform switched implant should preferred for short implant[18].

SURGICAL FACTOR

Some modification in surgical technique is also essential for long term results in short implant these all are follow.

MODIFICATION IN OSTEOTOMY: -

Most of the clinician prefer to do either undersize osteotomy or step back osteotomy to get good primary stability. Study done by Al-Marshood MM[19] concluded that, using final osteotomy drill 0.3mm smaller than the implant diameter can lead to increased cancellous BIC, peri-implant bone density and primary stability in short implant. sometimes excessively small osteotomies may cause macrostrains and microcracks in cortical bone, leading to delayed cortical bone formation, and possibly early implant failure[20,21].

Stepped osteotomy: -

In this procedure, as the bur diameters increase incrementally in sequence from initial drill to final implant drill, the depth of prepared osteotomy site is progressively lessened[22]. While doing this maximum recommended torque is 35 Ncm to prevent the microfracture.

AVOIDING BONE DAMAGE: -

Surgeon should prevent the damage of the bone while doing surgical preparation of osteotomy site to prevent the early implant failure and faster osseointegration of implant. Using low speed or new burs may reduce cancellous bone damage, meanwhile placing short implant in soft bone (D 4) using a hand ratchet without pre tapping the osteotomy site can also be use[23]. Most recently developed Osseo densifying burs that operate in reverse, compacting bone against the osteotomy walls, it has also showed reduced bone damage and increase the rate of osseointegration[24].

AUTOGENOUS BLOOD AND OSSEOINTEGRATION: -

Autogenous platelet-rich plasma (PRP) and platelet rich fibrine (PRF) preparations use with short implants because their inherent concentrated growth factors, antibacterial, anti-inflammatory action may enhance the speed and quality of integration and healing[25]. Short implants are mostly used in atrophic ridge especially in posterior maxilla and mandible, when posterior maxillary sites with less than 5-mm residual sub antral bone height[26]. Then PRF or PRP combination with bone-added osteotome sinus floor elevation can be used for better clinical result[27].

KERATINIZED GINGIVA: -

There should be a band of 2mm keratinized gingiva as the tissue responsible for the peri-implant biologic seal which will improve the likelihood of long-term in short implant success[28].

PROSTHETIC FACTOR

Knowledge of prosthetic portion is very essential for any implantologist which will decide how much implant will survive. Prosthetic factors like crown implant ratio, splinting, prosthetic design, occlusion all of these things will affects the survival of the implant.

CROWN TO IMPLANT RATIO: -

Short implants are mostly used in atrophic ridge and when we talk about the crown implant ratio most of the time it will compromised because of reduction of ridge. Earlier, the use of short or ultra-short implants was often ruled out due to the perception that implants with high C/I (crown implant) ratios considered as unfavorable[29] it was myth that they cannot survive as much as longer implants, because during offset load in short implants more stress is generated (as compared to conventional) toward the apex and crest that leads to resorption and finally loss of implant[30]. However, recent scientific evidences have led investigators to challenge and alter this thesis. Rokni et al[30] published data after a mean functional time approaching 4 years from 74 partially edentulous patients treated with short press-fit implants that had a mean C/I ratio of 1.5; 78.9% of the implants had C/I ratios of 1.1 to 2.0. It was concluded that higher C/I ratios did not result in crestal bone loss. Unexpectedly, same time they observed that more marginal bone loss in slandered length implants in same patients. After that Blanes R.[31] observed that after the certain limits of crown implant ratio, the implant abutment junction act as fulcrum and they lead to microfracture and finally loss of implant. they stated that crestal bone loss decreased as the C/I ratio increased within a certain range of values: 0.6 to 2.36, however precaution should be taken before doing prosthetic works because even 1 or 2 mm of loss of crestal bone can affect the prognosis of implant[32].

SPLINTING/NONSPLINTING

Splinting is done to reduce the nonaxial loads on implant, splinting of short implant with the conventional one, is very conventional treatment modalities in implant dentistry to reduce non axial loads. Lee KJ. et al[33] reported 5- to 10-year (mean 7.2 year) results with 6- to 8-mm-long implant used in posterior maxillary and mandibular sites and restored with single crowns. Overall survival was 98.3%, but when you are going for non-splinting then more screw loosening will be observed. Mendonça et al[34] compared splinted short threaded implants and no splinted short implants and showed a significant benefit for splinting, especially in male patients who showed 10 times higher failure in the no splinted group. While selecting short implant splinting should always be considered along with occlusal table reduction, flattening of cusp inclines, minimizing off-axis loading, and avoiding cantilevers.

SURVIVAL RATE

Survival rate of implant depends on type of implant, bone quality, surgical techniques, prosthetic factor, host factor and the skill of surgeon. However, short implant can perform as similar as the conventional implant, study done by the Akbulut N.[35] investigate the survival rate of short implant as compared of long implant in atrophic ridges and concluded that short implants have similar survival rates compared to long implants. Another study by Papaspyridakos P.[36] concluded that mean survival rate was 96% for short implants, and 98% for longer implants on 10 years of follow up.

BONE QUALITY			
IMPLANT TYPE GOOD POOR		FAIR	
6mm Splinted	LOW	MODERATE	HIGH
8mm Splinted	N/A	MODERATE	MODERATE
6mm non-Splinted	MODERATE	HIGH	HIGH
8mm non-Splinted	LOW	MODERATE	HIGH

Showing risk factor and survival rate wrt bone density and length of implant

CONCLUSION

Short and ultra-short implant can be a good treatment option especially in cases of atrophic posterior maxilla and mandible, even it shows better clinical results than using conventional implant after doing complex surgery. In case of resorbed anterior maxilla and mandible it can also be used for the overdenture treatment. Certain factors aid in survival rate of short implants, ie; election of active implant, minimum 2 mm of bone around the implant, thick keratinized gingiva, splinting the crowns if possible and not to provide cantilever.

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