Review Article

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Short Dental Implants: A Review.

Abstract:
Short dental implants appear to be a valid alternative with reasonable evidence of high success rate to bone augmentation procedures in the treatment of atrophic alveolar ridges. This paper reviews aspects of short implant literature to give some guidelines in making their use more successful.

Key Words: short implant, biomechanics, implant design.

Introduction:

Short implants are an increasingly alternative to other surgical techniques in areas where there is limited bone.[1]An implant less than 10mm in length is considered as Short Dental Implant and is usually placed in alveolar ridges with decreased bone height.[2]

The biomechanical rationale in support of SDIs is that the load bearing forces are concentrated on the crestal portion of the implant and an increase of implant length from 7 to 10mm doesn't significantly improve its anchorage.[3] With an increase of 1mm in the implant diameter, the functional surface area increases by 30-200% thereby, improving the dissipation of load.[4]

Short implants are usually referred to as short if the length measures $\leq$ 8 mm with diameter $\leq$ 3.75 mm whereas "Ultra-short" implants are considered to be those with length less than 6 mm.5

Biomechanical Considerations:

1. Diagnostic

Implant Diameter

As diameter of the implant increases, there will be better engagement of the buccal and lingual cortical plates and more bone-to implant contact, thus improving the stress distribution within the surrounding bone.[6]

Implant Width:

The wider the implant, the greater the contact area between implant surface and surrounding bone, thus improved mechanical stability and osseointegration.[7]

Crown/implant Ratio:

As crown/implant ratio increases, there will be crestal bone loss can and implant failure.8

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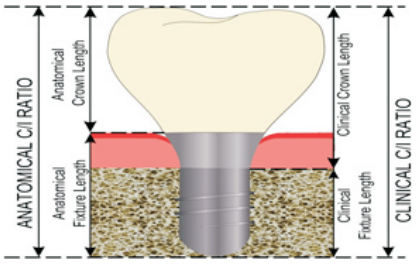


FIGURE 1 Diagram defining the anatomical crown (left) and clinical crown (right), adapted from Blanes et al. (2007).

Bone Quality:

The combination of short implant length and poor bone quality reduces the implant stability during implant placement and the healing period.[9]

Cantilever Forces:

The use of pontic or cantilever may be an alternative for clinical situations where the placement of implants is not allowed due to bone resorption or even due to economical reasons.[10]

Implant Design:

A) Implant Surface

Arlin reported that a success rate of 94% for 6 mm Straumann implants with a moderately rough surface after 2 years of loading. However, low success rate, (<80%) was noted for 7 mm implants with machined surface after 3 year and up to 6 years of followup .[11]

Implant Surface Treatment:

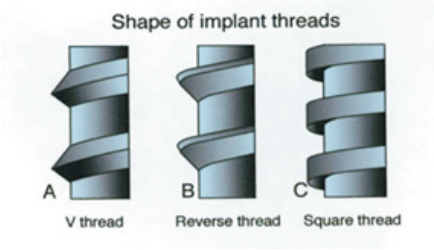
Implant surface treatment is another primary resource capable of increasing in up to 33% the bone/implant contact percentage, which is beneficial to tension distribution . Modifications in superficial morphology and rugosity were firstly developed aiming to improve the mechanical imbrications between bone tissue and implant's surface, favoring therefore the initial stability, its resistance, and the forces dissipation. Furthermore, surface treatments accelerate the osseointegration process, which enables an earlier prosthesis installation.[12]

]]The Implant Surface Area Can Be Increased By[13]:

a)Thread number: More the number of threads per unit length in the same axial plane more is the implant surface area in contact with the bone.

b) Thread depth: Deeper threads provide more implant surface area.

c)Thread shape: The square thread design has a higher bone implant contact when compared to v-shape and reverse buttress thread designs .



[Fig-2a-c]: a) V-thread b) Reverse thread c) Square thread

2. Surgical

Two step surgical protocol:

A two stage surgery is advocated for short implants as it provides good primary stability during healing phase. The time elapsed between the surgical and loading stage should be 4-6months for maxilla and 2-4months for mandible.14

Adapted surgical protocol:

Initial implant stability can be achieved by eliminating a step in standard surgical protocol such as eliminating the countersink drill or eliminating the final drill in the standard drilling sequence.[15,16]

3. Prosthetic:

a) Implant to abutment connection: Morse taper connection induces less marginal bone loss as compared to external hex abutment . Internal hex implant abutment connection generate wider force distribution as compared to external hex connection [Fig-3a-c].[17]

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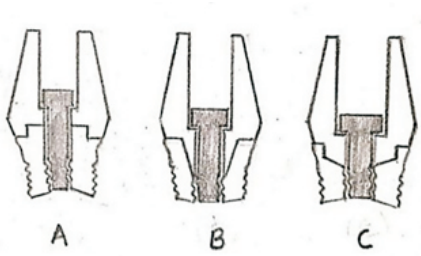

[Fig-3a-c]: a) External hex b) Morse taper c) Internal hex.

b) Occlusal table: Narrow occlusal table reduces the offset loads on the implant.

c) Incisal guidance: Incisal guidance of the anterior teeth eliminates lateral forces of the posterior teeth in all mandibular excursions.

d) Splinting: Splinting short dental implants in the posterior region mainly enhances their stability to eccentric forces.[18,19]

Discussion

Cheung (2004) recognized that "The implant maximized surface area as the main contributing factor for high success rate".[11]

Renouard and Nisand (2006) identified a surgical protocol optimized to achieve high primary stability as a prerequisite of their study on SHI survival; Fugazzotto (2008) and Anituaand Orive (2010) reported good results with SHIs, but recommended that they should be used "under strict clinical protocols".[3]

Telleman et al.(2011) conducted a systematic review on non-smokers and found a better prognosis of short implants in partially edentulous patients.[10]

Mijiritsky et al.(2013) found in their study that there is no correlation between the survival rate of implants and implant length and diameter. They also found high success rates of short and narrow implants in partially edentulous patients.[11].

Alberto monje et al.(2013) Conducted meta analysis on 525 short dental implants of which includes different widths of 3.5mm,4.0mm,4.1mm,5.1mm.It was found that the wider the implant the higher the failure rate.[7]

Pellizzer et al. (2015) suggested that increasing the length of implant is a factor that influence the biomechanical behavior of rehabilitation, mainly for the first premolar region.[20]

Luigi Svezia(2018) conducted study and concluded that small amounts of marginal bone loss noticed at both short (6 mm) and standard (10 mm) implants that are supporting single crowns in the posterior maxilla and mandible during 24 months of functional loading.[22]

Fouad Hassan Altaib.(2019) conducted 13 Randomized control trails and Meta-analysis. Meta-analyses of 10 trials showed a significantly higher rate of postoperative complications in the standard-length dental implant group at 1 year.23

XiaoranYu(2021) conducted study on clinical outcomes and complications between extra-short implants and long implants, with and without bone augmentation procedures and results showed that the placement of extra-short implants ($\leq$ 6 mm) is an acceptable alternative to longer implants ($\leq$ 8 mm) with bone augmentation in atrophic posterior arch.24

Conclusion:

Short implants (< 10 mm) seem to be a valid alternative, with reasonable evidence of high success rates compared to the surgical augmentation procedures in the treatment of atrophic alveolar ridges. Neither implant length nor width seemed to significantly affect the survival rate of short implants.High survival rates [99.1%] and low incidence of biological and biomechanical complications are reported.

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