e-ISSN:2320-7949
p-ISSN:2322-0090
Research and Reviews: Journal of Dental Sciences

Restoration Driven Implant Placement, Key to Predictable Dental Implant Success: A Review.

Manu Rathee[1]*, Mohneesh Bhoria[1] and Amit Kumar Tamrakar[2].

[1]Department of Prosthodontics, Post Graduate Institute of Dental Sciences, Pt. B. D. Sharma University of Health Sciences, Rohtak, Haryana, India.
[2]Faculty of Dentistry, Jamia Milia Islamia, New Delhi, India.

Review Article

Received: 12/11/2013
Revised: 13/12/2013
Accepted: 19/12/2013

*For Correspondence

Department of Prosthodontics, Post Graduate Institute of Dental Sciences, Pt. B. D. Sharma University of Health Sciences, Rohtak, Haryana, India.

Keywords: Abutment, Dental implant, Gingival biotype, Osseointegration.

ABSTRACT

The elusive dream of replacing missing teeth with artificial substitute has been part of dentistry for a thousand years. Since, the co-incidental finding of osseointegration, implant dentistry evolved with aim to achieve primary implant stability and improve bone-implant contact. However, critical determinants with potential to improve success rate falls on prosthetic as much as on surgical phase. During the past several decades, a plethora implants-abutment designs and materials have been introduced to facilitate better prosthetic rehabilitation under individual clinical situation which focuses to achieve an ideal esthetic and functions that it completely indistinguishable from natural teeth and stable over time. This 'restorative driven' implant placement protocol provides long term synergy between implant-prosthesis unit and peri-implant hard & soft tissue. This paper propose a 'Synergy Triad' that facilitate hard and soft tissue enhancement around implant prosthesis and discusses the various concepts that modulate peri-implant tissue characteristics through appropriate abutment selection for individual clinical need.

INTRODUCTION

The functional and esthetic replacement of missing teeth with artificial substitute has been part of dentistry for thousand years and the coincidental discovery of osseointegration by Dr. Per Ingvar Branemark, forged dentistry into a new era of reconstructive dentistry with predictable success rate [1]. The last few decade improvement towards perfecting designs, surface characteristics and surgical techniques of dental implant has been observed. The advancement in surgical phase fuels simultaneous revolution in prosthetic phase resulting in indistinguishable implant-prosthetic unit from natural teeth as they more closely imitate lost natural emergence profile and contour. This 'restorative driven' implant placement protocol is considered to be an important factor in achieving long term synergy between implant-prosthesis unit and peri-implant hard & soft tissue.

An important factor in determining the success of implants is the integrity of the peri-implant hard & soft tissue. Therefore, the implant surgical protocol and the restorative protocol should be designed to favor the formation and maintenance of the peri-implant hard and soft tissue. The aim of this paper is to present a "Synergy Triad" that will facilitate hard and soft tissue enhancement around implant prosthesis and to discuss the various concepts that modulate peri-implant tissue characteristics through appropriate abutment selection in individual clinical need.

Factors Affecting Implant Abutment Selection

Based on the available literature, a myriad of factors are available that gear towards selecting appropriate implant abutment to achieve stable and sustainable peri-implant tissue characteristics. This article proposes a 'Synergy Triad' of implant abutment selection which includes: Three-Dimensional Implant Orientation, mending Soft Tissue Architecture, Abutment Characteristics.

e-ISSN:2320-7949
p-ISSN:2322-0090

Three-Dimensional Orientation of implant

Implant-abutment position/Angulations

This evaluates the relation between implant-prosthesis unit with surrounding anatomical structures. Usually, in cases, clinician is focused to establish a balance between implant-prosthesis unit and surrounding anatomical structure during implant placement. If clinician focuses more on anatomical barrier, may end up in malpositioned implant. Interestingly, to compensate for the anatomical deficiencies, various techniques evolved such as augmentation of the ridge (PRF, PRP with or without bone graft), change the intended location of an implant, or insert an implant with angled trajectory or with angled abutment. The latter technique provide variety of advantages: facilitating placement of an implant with greater dimensions in width & height, permitting a greater numbers of patients to be treated because the procedure is not as restrictive as that used with straight implant abutments, avoiding guided bone regeneration (GBR) procedures, allowing circumferential insertion of implant into the bone, facilitates paralleling nonaligned implants, thereby making prosthesis fabrication easier, aid the clinician in avoiding anatomical structures when placing the implants, reduced treatment time, easier execution of procedure & reduces treatment fee[2].

Like natural teeth implant are also designed for long axis loading. Angled abutment significantly influenced the load direction which in turn influences the implant bone interface. Clinical reports have documented that implant sustained a lesser stress under along long axis load. To access the practicality of using angled abutment various investigators used abutment with angulations ranging from (0º-35º),[3] (0º-25º), [4,5] (15º and 25º), [6] (0º,30º, and 60º) [7] to evaluate the strain on bone around implant and prosthesis components. In general, data indicate that there is increased stress on implants if angled abutments are used; however, these increases were within physiologic limit.

Finally, most anatomical variation influences the implant body angulations and hence, the abutment selection. The clinician should consider angled abutments when such abutment would facilitate placing an implant in the bone in proper position and would reduced the need of additional procedures (for examples, GBR) and the expense.

Mending peri-implant soft tissue architecture

Gingival Biotype

Healthy peri-implant mucosa i.e. harmonious with surrounding gingiva, mucosa and accompanied by an intact interproximal papilla is important for implant-prosthesis unit long term success. Healthy peri-implant soft tissue architecture is largely dependent on:

Gingival biotype: based on current literature thick biotype around implant is geared up against thin biotype variety as its effect:

- Surgical part:
    - Thicker biotype available with thick labial plate,
    - Regeneration around implant (holding bone graft and soft tissue graft in position, enhances primary wound closure, enhance revascularity, site protection).
- Prosthetic part:
    - Resistant to mucosal recession or mechanical irritation, henceforth, better peri-implant soft tissue depth can be achieved.
    - Better at concealing titanium/metal margin,
    - More accommodating to different implant position and resultant abutment angulation.

Although, cases with thin biotype variety, the selection of abutment provides more concerns due to its inability to barricade to conceal titanium/metal margin and highly prone to mucosal recession on irritation/insult. Hence, for thin tissue phenotype variety, minimally invasive or flapless surgery is more appealing because it minimizes compromises to the blood supply of underlying bone and decreases the risk of recession after implant placement[8].

e-ISSN:2320-7949
p-ISSN:2322-0090

Available soft tissue height to enhance emergence profile

Tissue height/sulcular depth/running room should be sufficient to ensure good emergence profile of the restoration. Tissue height/sulcular depth/running room is the vertical distance from the implant's prosthetic platform to the free gingival margin.

For partially edentulous patients, appropriate healing abutment selection, which usually conforms to the size of tooth being replaced, is must. Healing abutment can be placed either during single stage surgical procedure or at two-stage surgical protocol to guide the healing of soft tissue with the intent to replicate the contours and dimensions of natural tooth that is being replaced and to ensure access to the implant restorative platforms for impression and definitive abutment placement. Selection of 1mm collar high esthetic abutment makes it possible to place prosthesis margin infragingivally and esthetically.

In area with optimum esthetic requirement, intrim/ provisional abutments may be used to contour the peri-implant soft tissue and to develop optimal, anatomic, emergence profile.
Importantly, when using the angled abutment, there should be a sufficient running room to ensure good emergence profile of the restoration. In esthetic zone, it is imperative that correction of angulation issues should be combined with sufficient running room[9]. Otherwise, unlike ceramic abutment, a metal abutment may be exposed, which may be esthetically displeasing and gives "gray gum syndrome". Also, it is evident that internal connection can be beneficial to use with angled abutment to help reduce stresses that are placed on implants.

Abutment Characteristics

Abutment characteristics have been perceived as factors affecting the stability of the mucosa and crestal bone which in turn influences the long-term success of implant-prosthesis unit.

Biological considerations

- Material Selection (abutment material) for mucosal barrier formation around implant abutment [10]: The materials used in the abutment fabrication plays an important role in the prevention of crestal bone and soft tissue recession. Various materials used are C.P titanium, Gold alloy, Ceramic (zirconium or aluminum oxide), with aim to establish formation of an attachment that included one epithelial and one connective tissue portion with about 2 mm and 1-1.5 mm high. Biological reliability of these materials has been tested where several authors have studied the effects on soft tissue by using implant components of different materials. Several studies were conducted to evaluate whether titanium abutments maintain peri-implant tissue stability at higher level than any other prosthetic abutment materials.

    - Titanium versus gold: The prominent conclusion cannot be drawn whether titanium is superior to gold as an abutment material. Due to contradictory finding of animal histologic evidence and clinical trials as showed similar peri-implant tissue dimensions around both abutments materials. No differences were noticed between gold alloy abutments and titanium abutments with respect to peri-implant bone stability. Although, a gold/palladium alloy abutments showed signs of "apical shift of the barrier epithelium and marginal bone between 2 and 5 months of healing," which may result from lower amounts of collagen and fibroblast and greater amounts of leukocytes than in titanium and zirconia abutments Therefore, it can be concluded that use of gold abutments should not be considered a risk factor for crestal bone loss and soft tissue recession [10].
    - Titanium versus aluminum oxide: Data from animal studies and clinical trials indicate that peri-implant tissues around aluminum oxide abutments show stability similar to titanium abutments. No statistically significant differences in crestal bone loss were found in the examined studies.
    - Titanium versus zirconium: the prominent conclusion cannot be drawn as there appeared lack of studies comparing zirconium oxide abutment and titanium abutment in clinical trials. Although, animal histologic studies showed very similar reaction of periimplant soft and hard tissues to titanium and zirconium oxide abutment. Whereas, human histologic studies indicated an even better reaction of human mucosa to zirconium as compared to titanium. In vitro studies, analyzed and indicated favourable biological properties, resulting in favourable mucosal conditions and marginal bone levels around zirconia when compared to feldspathic ceramics.

e-ISSN:2320-7949
p-ISSN:2322-0090

Mechanical considerations

Implant-Abutment Connection type and geometry (Internal/External):

One of the key to long term predictable result is the stability of implant-abutment connection. If implant-abutment connection is not stable marked discomfort to patient and inconvenience to treating clinician results and may contribute to a failure of the implant prosthetic unit.

Early implant–abutment connection configuration was external hexagon, but, over the year, it demonstrated some pitfalls including screw loosening and screw fracturing. Hence, marginal bone remodeling and, consequently, soft tissue levels around implant attributed to limited, not very effective configuration when subjected to off axis load resulting in implant prosthetic unit failure. Nevertheless, external hexagon implant showed long, successful history[11].This is primarily attributed to its extensive use since the evolution of implant dentistry, because long term data on performances have been reported continuously. Also, improvement in screw material science with respect to screw finish, introduction of newer screw materials (gold alloy instead of titanium) and enhanced surfaces [12]markedly increased the success rate of external hex design.

Despite appreciable success investigations proceed further and modified from external hexagon to internal hexagon joint configuration with significant enhancement in joint strength with engaging internal axial wall creating a uniform, unified joint.

Various studies carried out and indicated that with increase in the length and depth of connections joint strength is markedly enhanced.

The internal hex connection has following characteristic features:

- To distribute intraoral forces deeper within the implant to reduce stress on crestal bone. [13,14]
- Protect screw from excess loading.
- Reduces the potential microleakage by resisting joint opening by reducing amplitude of micromovement. [15, 16]
- Significantly influence the strength of abutment especially ceramic [49] when compared with external hex design.

Internal hex design provides greater strength to implant abutment joint when compared to the strength of external hex connections. Included in such effort is the “Morse” taper with predictable clinical success rate. [17, 18] Conclusively, internal hex implant abutment connection may be advantageous with regard to distributing forces when compared with external hex design. In general, data indicates that implants with internal connection may be advantageous with regard to distributing forces, protect abutment screw from stresses, direct widely spread force down to the fixture tip compared with external hexes, in which forces were concentrated in the coronal portion. The taper joint-type connection exhibits no rotation when compared with external hex connection. Internal connection may be beneficial to be use with angled abutment to help reduce the stresses that are placed on implants. This effect may be due to the fact that internal connection can be longer and project deeper within the implants than can external connections.

Abutment dimension (implant- abutment restorative platform/Platform Switching):

Implant-abutment restorative platforms are the interfaces for implant-abutment connections. Platform switching, a term introduced by Lazzara and Porter, involves connecting a narrow-diameter abutment to a wider implant platform. This difference in the diameters of implant-abutment components have demonstrated horizontal shifting of implant-abutment microgap towards the centre of implant thus, have positive impact on overall bone heights of the surrounding implants, allows soft tissue ingrowth and hence, reposition the papilla to a more esthetic and an opposite level and ensures restorative stability. Marked reduction in crestal bone loss around dental implant reported after using platform switching technique [19, 20]. Such remodeling of soft tissue at abutment connection level will enhance the emergence profile of the restoration by enhancing “horizontal biologic width”.

CONCLUSION

‘Synergy triad’ is cumulative but one step in the process of successful prosthetic rehabilitation of implant. Individual tissue varieties is an inherent trait that varies from patients to patients, considering factors involved in ‘Synergy triad’ will positively affect the functional and esthetic outcome of an implant-supported restoration that is better at tolerating surgical insult and prosthetic phase. Clinician has to be mindful as all these factors are interrelated and not considering any factor can surely jeopardize the best abutment selection and ultimately the implant success rate.

Finally, individual clinical need influences the abutment selection and hence, treatment planning. The clinician should consider selection of abutment with appropriate characteristics at prior appointment that would facilitate 3-dimensional orientation of implant in the bone at proper position/angulations and consequent, mending of peri-implant hard and soft tissue such that desired esthetic and functional outcome could be achieved.

REFERENCES

1. T Albrektsson, P Worthington. The Long Term Efficacy of Currently Used Dental Implants: A Review and Proposed Criteria of Success. Int. J Oral Maxillofac Implant. 1986, 6:11-25.
2. John Cavallora, Gary Greenstein. Angled Implant Abutment- A Practical Application Of Available Knowledge. Jam Dent Assoc. 2011; 142(2):150-8.
3. Sethi A, Kaus T, Sochor P. The use of angulated abutment in implant dentistry: five year clinical results of an ongoing prospective study. Int J Oral Maxillofac Implants. 2000; 15(6): 801-10.
4. Celland NL, Gilat A. The effect of abutment angulations on stress transfer for implants. J Prosthodont. 1992; 1(1): 24-8.
5. Brosh T, Pilo R, Sudai D. The influence of abutment angulations on stress and strain along implant/bone interface: comparison between two experimental techniques. J Prosthet Dent. 1998; 79(3): 328-34.
6. Kao HC, Gung YW, Chung TF, Hsu ML. The influence of abutment angulations on micromovement level for immediately loaded dental implants: a 3-D finite element analysis. Int J Oral Maxillofac Implants. 2008; 23(4): 623-30.
7. Hsu ML, Chen FC, Kao HC et al. Influence of off loading of an anterior maxillary implant: 3-D finite element analysis. Int J Oral Maxillofac Implants. 2007; 22(2): 301-9.
8. Jia-Hui Fu, Angie Lee, Hom-Lay Wang. Influence of tissue biotype on implant esthetics. Int J Oral Maxillofac Implants. 2011; 26: 499-508.
9. Graziono D. Gigiio. Abutment Selection In Implant-Supported Fixed Prosthodontics. Int J Periodontics Restorative Dent. 1999; 19:233-41.
10. Tomas Linkevicius, Peteris Apse, Dip Pros, Dr Hab Med. Influence of Abutment Material on Stability of Peri-implant Tissues: A Systematic Review. Int J Oral Maxillofac Implants. 2008; 23: 449–56.
11. Carl Drago. A clinical study of the efficacy of gold–tite square abutment screw in cement-retained implant restorations. Int J Oral Maxillofac Implants. 2003; 18: 273-8.
12. Martin and Woody. Implant abutment screw rotations and preload for 4 different screw materials and surfaces. J Prosthet Dent. 2001; 86: 24-32.
13. Y. Maeda, T. Satoh & M. Sogo. In vitro differences of stress concentrations for internal and external hex implant–abutment connections: a short Communication. J Oral Rehab. 2006; 33: 75–782.
14. Chun HJ, Shin HS, Han CH, Lee SH. Influence of Implant Abutment Type on Stress Distribution in Bone Under Various Loading Conditions Using Finite Element Analysis. Int J Oral Maxillofac Implants. 2006; 21: 105-202.
15. Lars Steinebrunner, Stefan Wolfart. In Vitro Evaluation of Bacterial Leakage along the Implant-Abutment Interface of Different Implant Systems. Int J Oral Maxillofac Implants. 2005; 20: 875–81,
16. Anna Theoharidou. Abutment screw loosening in single implant restorations: a systematic review. Int J Oral Maxillofac Implants. 2008; 23: 681-90.
17. Merz BR, Hunenbart S, Belser UC. Mechanics of the implant/abutment connection: An 8-degree taper compared to a butt joint connection. Int J Oral Maxillofac Impl. 2000; 15(4): 519-26.
18. Perriard J, Wisckott WA, Mellal A, et al. Fatigue resistance of ITI implant-abutment connectors - A comparison of the standard cone with a novel internally keyed design. Clin Oral Impl Res. 2002; 13(5): 542-49.
19. Grunder U, Gracis S, Capelli M. Influence of the 3-D bone-to implant relationship on esthetics. Int J Periodontics Restorative Dent. 2005; 25(2); 113-9.
20. Lazzara RJ, Porter SS. Platform switching: a new concept in implant dentistry for controlling postrestorative crestal bone levels. Int J Perio Restorative Dent. 2006; 26(l): 9-17.