Unifying dental restoration: the role of splinting in harmonizing implants and natural teeth: A review.

Palak Khanna[1], Rishi Ray[1], Surbhi Yadav[1], Tapan Kumar Giri[2], Debabrata Biswas[3], Bidhan Chandra Mandal[4].

[1]PG student, Department of prosthodontics and crown and bridge, Dr. R Ahmed Dental College and Hospital.
[2]Principal, Department of prosthodontics and crown and bridge, Dr. R Ahmed Dental College and Hospital.
[3]Professor and Head, Department of prosthodontics and crown and bridge, Dr. R Ahmed Dental College and Hospital.
[4]Associate professor, Department of prosthodontics and crown and bridge, Dr. R Ahmed Dental College and Hospital.

Abstract

Purpose: Connecting teeth to implants seems like a viable option to replace missing teeth in partially edentulous arches, but it leads to various biological and biomechanical complications. There are certain guidelines for splinting the implant and natural tooth. Critical evaluation of the situation is important to design a treatment plan and to decide if splinting of an implant to natural teeth should be done or a cantilever prosthesis from the teeth or the implant should be given. The clinician needs to be knowledgeable about the consequences of the proposed plan and potential complications and present them to the patient with their consent.

Data sources: The data has been sources by various text books and articles concerning implant prosthesis in partially edentulism cases.

Conclusion: A critical evaluation of each treatment option available for the replacement of teeth in patients with partial edentulism is important. Implant can be of great help as an abutment where insufficient teeth are present for prosthesis support, but splinting of implant and natural teeth has to be done in some situations but certain guidelines are to be followed.

Keywords: Implant cantilever, implant splinting, implant pier abutment.

Address of correspondence: 149A, AJC Bose road, Dr R. Ahmed dental college and hospital girls and boys hostel, Sealdah,
Email address: - pkhannaji@gmail.com **Phone no:** 7060799299. **DOI:** 10.5281/zenodo.8247273
Submitted: 28-May-2023 **Revised**: 12-Jun-2023 **Accepted:** 02-Jul-2023 **Published:** 15-Aug-2023
Bibliographic details: Journal of Orofacial Rehabilitation Vol. 3(2), Aug 2023, pp. 34-38.

Introduction

It is a common dental practice to provide a patient with missing teeth with a fixed prosthesis whenever possible. There are many options to restore the edentulous segment. over last few decades, the use of osseointegrated dental implants in partially edentulous patients has become a commonly accepted therapeutic option to restore dentitions, both esthetically and functionally.[1] Until 1990's implants were used as an abutment along with the natural tooth to provide fixed partial dentures, but then some complications were seen as the mobile natural tooth had a cantilever effect on the rigid implant.[2] The key benefit of distinct prosthetic units is primarily associated to decreased biological complications of the tooth and less to biomechanical consequences on the implants.

Biological complication: The commonest causative factor for failure of tooth-supported fixed partial denture (FPD) is the caries of the abutment teeth and endodontic failure.[3] Fixed prosthesis supported by both implant and teeth may result in failure due to the biological complications of the natural tooth. Implant supported FPDs have 25% more survival rate than tooth supported FPDs.

Biomechanical implication: Natural teeth and implants respond differently to the force applied. A light force can produce most of the

tooth movement, but the amount of implant movement is directly related to the force applied. Studies suggests that implants connected to natural teeth should be used with caution in softer bone regions.[4]

No splinting

To avoid the biological and biomechanical complications of splinting an implant with a tooth, there are two options: placement of an additional implant or a cantilever prosthesis. Whenever possible a complete implant supported prosthesis should be given, by the addition of an additional implant. It improves the implant–bone interface and hence decreases the amount of stress on each implant. Moreover, because of the addition of the retentive units, there is reduced probability of unretained restoration or abutment screw loosening.

Cantilever prosthesis are used more commonly for prosthesis supported by implants as compared to natural teeth. Commonest complication with a cantilevered prosthesis from natural teeth is de-cementation from the abutment which is most distant from the cantilever because the occlusal forces are exerted to the pontic, the nearest abutment acts as a fulcrum and the farthest abutment experiences shear and tensile forces (cements are weaker to tensile and shear forces).[5] This class 1 lever gets mechanical advantage when the length of the cantilever increases and the multiplied forces acts on the fulcrum abutment leading to its mobility or bone loss. Implants are even unyielding than the teeth, so the forces to the cement seal are higher with implant abutments than with teeth. Hence the implants just next to the pontic acts as a fulcrum to an even greater extent. Therefore, it is more unfavorable to provide a cantilever on implants as compared to natural teeth.

Unfortunately, providing the patient (partially edentulous) with completely implant-supported fixed prostheses is not always possible. Therefore, the natural tooth can only be regarded as a probable abutment when the surface area of supporting implant does not allow for the substitution of missing teeth and if further implant placement is not recommended. The biomechanical risk of attaching an implant to a tooth is typically lower than that of replacing missing teeth with a cantilever prosthesis.[5]

Splinting of implant and natural teeth

Mobility: vertical movement

Healthy tooth- without clinical mobility
Initial vertical movement- 28 microns.
Immediate rebound- 7 microns (takes 4 hours for full recovery).[6]
Rigid implant- 2 to 5 microns under 10lb load (due to viscoelastic property of bone)
Movement is not as quick as tooth movement.
Prosthesis movement- under 25lb vertical force and with 2mm connectors, 12 microns movement for 1 pontic and 97 microns movement for 2 pontic spans.[5]

The movement of implant, prosthesis, and abutment components somewhat compensated for a limited movement exhibited by the tooth in the vertical direction and hence decreases the risk of biomechanical complications.

Horizontal movement

Tooth mobility: usually greater than the movement in vertical direction.

Implant movement: 11-66 mm in labiolingual direction.[7] Mesiodistal movement is more than natural tooth because of the deficiency of cortical bone.[7] The relation of Implant mobility is to the viscoelastic nature of the bone and not the

physiological aspect of periodontal ligament.[8]

Prosthesis movement: Upon loading, the tooth moves immediately i.e., primary movement, and then the simultaneous movement of the tooth and implant i.e., secondary movement due to the viscoelasticity of bone.[9] Therefore, implant and tooth both moves in vertical and horizontal direction and also the flexure ofprosthesis occurs. However, the dimension of movement is responsible for the difference in the movement of implant and the tooth.

Guidelines of splinting implants

An implant-natural tooth system should not have any lateral forces acting over unilateral prosthesis. An Osseo integrated implant can be safely splinted to a healthy natural tooth (with no clinical mobility) with no lateral forces since compensation of tooth movement is provided by the implant, prosthesis and bone.
An isolated anterior tooth to implant connection is not preferable (anterior teeth display ten times more mobility than implants) as lateral forces are directed over natural tooth and implant during excursive movements. Severely mobile natural tooth connected to implant will lead to detrimental effects and complications. Cement adheres to dentin better than titanium so the adhesive failure occursat implant abutment seal.
A mobile attachment between a natural tooth and the implant is generally not beneficial since the mobile attachment moves more than either of both. The pontic acts as a cantilever from the implant with minimal support from the tooth. (Rigid connection preferred over non-rigid). Effect of horizontal forces on natural teeth can be reduced by placing additional implants or by splinting additional natural abutments.[7]

Guidelines of splinting of teeth:

The tooth which is last in the splint should be rigid to decrease the mobility.[10]
Crown of terminal or the last abutments of the splint must have good retention.[10]
Path of insertion of adjacent teeth in the splint and path of insertion of the prosthesis should beparallel.[10]
No crowding or overlapping of teeth should be present.[9]

Use of nonrigid connectors
Not usually indicated.
More efficiently compensates for the dissimilar mobility between implant and natural teeth under axial forces but with the risk of increasing unfavorable stresses in the prosthesis.[11] Implant supported part acts as a cantilever.
Displays migration of natural tooth, as the tooth is pushed vertically by 28 microns, but rebounds only by 8 microns, the fixed part of prosthesis pulls the tooth leading to breakdown of cement seal which is occupied initially by air and eventually by saliva, downward force exerted by hydraulics will ultimately lead to submerged tooth.[12]

PIER ABUTMENTS

Implants
The pier implant abutment exhibits a lesser amount of movement as compared to the terminal abutments and behaves as the fulcrum of a class I lever. When additional implants insertion is not possible, a mobile attachment can be used to avoid this.[13] The nonrigid attachment should be used between the implant and the tooth which is more mobile.

Natural tooth
The tooth usually has more mobility compared to the terminal implant abutments and doesn't offer much support, it is called as a pontic with a root, or a "living pontic".[14]
A stress-breaker is not recommended.[15]

Presence of natural tooth provides the proprioception.

Conclusion

Connecting the implant and natural tooth leads to various biological and biomechanical complications, but the benefit to risk ratio has to be assessed. In moststituations connecting an implant to a healthy natural tooth keeping in mind all the guidelines of splinting them can result in success of the prosthesis.

References

1. Anastasios Mamalis, Kleopatra Markopoulou, Konstatinos Kaloumenos, Antonis Analitis; Splinting Osseointegrated Implants and Natural Teeth in Partially Edentulous Patients: A Systematic Review of the Literature. *JOral Implantol* 1 August 2012; 38 (4): 424–434.

2.LauFer BZ, Gross. Splinting osseointegrated implants and natural teeth in rehabilitation of partially edentulous patients. Part II: principles and applications. Journal of oral rehabilitation. 1998 Jan;25(1):69-80.

3.Gross M, Laufer BZ. Splinting osseointegrated implants and natural teeth in rehabilitation of partially edentulous patients. Part I: laboratory and clinical studies. Journal of oral rehabilitation. 1997 Nov;24(11):863-70.

4. Lin C, Chang S, Wang J. Finite element analysis of biomechanical interactions of a tooth-implant splinting system for various bone qualities. Chang Gung medical journal. 2006 Mar 1;29(2):143Resnik RR, Misch CE. Treatment planning complications. In Misch's avoiding complications in oral implantology 2018 Jan 1 (pp. 54-147). Mosby.

5. Lin CL, Wang JC, Chang WJ. Biomechanical interactions in tooth– implant-supported fixed partial dentures with variations in the number of splintedteeth and connector type: a finite element analysis. Clinical oral implants research. 2008 Jan;19(1):107-17.

6. Stanley HR, Hench L, Going R, Bennett C, Chellemi SJ, King C, Ingersoll N, Ethridge E, Kreutziger K. The implantation of natural tooth form bioglasses in baboons: A preliminary report. Oral Surgery, Oral Medicine, Oral Pathology. 1976 Sep 1;42(3):339-56.

7. Grossmann Y, Finger IM, Block MS. Indications for splinting implant restorations. Journal of oral and maxillofacial surgery. 2005 Nov 1;63(11):1642-52.

8. Lin CL, Wang JC, Chang SH, Chen ST. Evaluation of Stress Induced by ImplantType, Number of Splinted Teeth, and Variations in Periodontal Support in Tooth-Implant–Supported Fixed Partial Dentures: A Non-Linear Finite Element Analysis. Journal of periodontology. 2010 Jan;81(1):121-30.

9. Becker CM, Kaiser DA, Jones JD, University of Colorado Health Science Center D. Guidelines for splinting implants. The Journal of prosthetic dentistry. 2000 Aug 1;84(2):210-4.

10. Misch CE. Natural Teeth Adjacent to an Implant Site: Joining Implants to Teeth. InDental Implant Prosthetics 2015 Jan 1 (pp. 403-419). Mosby.

11. Misch CE. Short dental implants: a literature review and rationale for use. Dentistry today. 2005 Aug 1;24(8):64.

12. Lin CL, Chang SH, Wang JC, Chang WJ. Mechanical interactions of an implant/tooth-supported system under different periodontal supports and number of splinted teeth with rigid and non-rigid connections. Journal of dentistry. 2006 Oct 1;34(9):682-91.

13. Chee WW, Mordohai N. Tooth-to-implant connection: a systematic review of the

literature and a case report utilizing a new connection design. Clinical implant dentistry and related research. 2010 Jun;12(2):122-33.

14. Shenoy VK, Rodrigue SJ, Prashanti E, Saldanha SJ. Tooth implant supported Prosthesis: A Literature review. Journal of Interdisciplinary Dentistry. 2013 Sep 1;3(3):143.

15. Resnik R. Misch's contemporary implant dentistry. Elsevier Health Sciences; 2020 Jan 25.