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Tooth Implant Supported Fixed Partial Denture

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Abstract

The aim of this review is to summarize and discuss the biomechanical behaviour of the implant and the natural teeth, nature of connection, potential complications associated with splinting of implants and teeth, and guidelines to be followed in fixed partial denture. Implants are connected to the natural teeth in the management of partially edentulous patients. Although implant-supported prosthesis (ISP) has substantial biological and biomechanical advantages, certain potential complications associated with splinting implants to natural teeth were discussed. The articles published only in English, randomized clinical trials, prospective and retrospective clinical studies and computer-generated research were included. The literature published was searched through PubMed, Medline, Google and indexed journals. The existing studies reveal that there are certain conditions in which this method is applicable. The main advantage of the method based on literature reviewed is reducing the need to the removable prosthesis in patients that otherwise require it. Various complications associated with tooth implant supported prosthesis has been reported with intrusion and implant overloading being the cause of concern. The reports also suggested no significant differences between various types of connections utilized and to use the non-rigid connections with caution. Whenever possible implant supported prostheses should

be the treatment of choice. However, certain clinical situations demand connecting teeth to implants.

Keywords: Fixed partial denture, implant-supported prosthesis, intrusion, nonrigid connection.

Key messages (Provide appropriate messages of about 35-50 words to be printed in centre box):

• The difference in the biomechanical behaviour between Osseo integrated implants and teeth and the efficacy of the different modes of connection that have been employed are explored.

• Evidence based decisions could be made concerning utility of connecting teeth to implants.

Introduction: Implant is connected to natural teeth when there is an anatomic limitation of space for` implants or failure of an implant to Osseo integrate. The advantages of tooth implant supported prosthesis include splinting of a natural tooth to an implant, increased mechanoreception, and additional support for the total load on the dentition. There are methods of attaching natural abutment teeth to an implant. One is rigid connection and the second is non-rigid connection[1].Fixed partial dentures supported solely by implants or by teeth and implants were reported to provide fully satisfactory function and had similarly high levels of predictability[13].

This review article correlates the studies done on tooth implant connection. Relevant clinical studies written in English were reviewed. **Breeding L, Dixon D, Sadler J, McKay M[2]** conducted a study on the implant tooth-supported fixed partial denture presents the movement of the natural tooth abutment was not found to change substantially with the fixed partial denture designs tested. **Fugazzotto A, Kirsch A, Ackermann A, Neuendorff G[3]** conducted a study to examine the incidence of natural tooth intrusion in consecutively placed natural tooth/implant–supported prostheses utilizing screw-fixed attachments over 10 years in 2 practices and concluded that such a prosthetic design can prevent intrusion of the natural-tooth portion of the prosthesis.**Lindh T, Back T, Nystrom E, Gunne J[4]** evaluate the biological and mechanical consequences when implants placed in the posterior maxilla were connected to teeth and concluded that tooth–implant supported prostheses is a safe and predictable treatment. No increased implant failure rate was found for this design. **Block M, Lirette D, Gardiner D, Li L, Finger I, Hochstedler J, Evans G, et al[5]** compared rigidly or non-rigidly connected implant and teeth supported fixed prostheses in a cross-arch model and concluded that the high incidence of intrusion and suggest that alternative treatments without connecting implants to teeth may be indicated.**Gowda S, Quadras D, Sesappa R, Katapadi V, Kumar L, Kulkarni D, et al[6]** evaluate the effect of connector designs on scale and distribution pattern of the stress generated in the supporting bone of implant tooth-supported three-unit fixed partial denture in distal extension situation and recommended that the flexible connector may be placed on the distal aspect of the pontic. **M. Hosny, J. Duyck, D. Van Steenberghe, and I. Naert**[14] reported similar levels of bone loss, 1.08mm for the first 6 months and 0.015mm annually, around implants regardless of being connected to teeth or not and regardless of the number of connected teeth or implants.

Text

Discussion

Reasons of connecting tooth to implant:

The reasons of connecting the teeth to the implant are given in four categories:

1**. To maintain proprioception**: Which may help to reduce applied stress to the implants.

2. **The absence of other options**: Because of systemic, local or financial limitations, bone augmentation and insertion of additional implants are not always possible.

3**. To provide stability** against rotational forces.

4. **For aesthetic reasons**: Implants unlike natural teeth always present challenges with regard to aesthetic.

The advantages and disadvantages of connecting the tooth to the implant:

Advantages:

In the literature, the benefits of tooth-implant connection have been listed as follows:

• Broadened treatment possibilities

• Reduced cost (reduction of implant numbers)

• Protective value of proprioception provided by tooth

• Desire to splint a mobile key tooth to an implant

• Additional support for total load on dentition

• Reduction of the need for a cantilever

• Preservation of the papilla adjacent the tooth for aesthetic and phonetic reasons

• More favourable bone reaction when the bridge is connected to both the implant and teeth.

Cavicchia reported that problems such as loosening and fracture of fixation screws and abutments, ceramic fracture and tooth migration seem to occur more frequently in free standing implants compared to the tooth connected restorations. This result can be related to the decrease bite force in tooth-implant supported prosthesis because of tooth related proprioception.

Disadvantages:

• Peri-implantitis

• Tooth intrusion

• Tooth/implant mobility

• Tooth/implant fracture

• Screw loosening[7].

To avoid this quandary **Clarke et al** has advised:

I. Selection of the appropriate patient

ii. The use of rigid connections

iii. Avoid making coping on teeth which will be used as an abutment

iv. Preparing the abutment to ensure maximum retention and resistance

v. Permanent cementation of prostheses[8].

The methods of connection of natural teeth and implant are as follows:

Celso Hita-Carrillo has classified the methods of connection into two main groups: Rigid and nonrigid connection. Nonrigid connections could be in the form of attachment or intermobile element (IME).

Types of connection

The type of connection used in tooth implant supported prosthesis is of three types:

1. **Rigid connection**: The tooth is rigidly connected to the implant with a fixed dental prosthesis. (Fig-1)

2. **Non rigid connection**: The tooth is non-rigidly connected to the implant by means of precision attachments, non-precision attachments and telescopic restorations. It acts as a stress breaking element. (Fig-2)

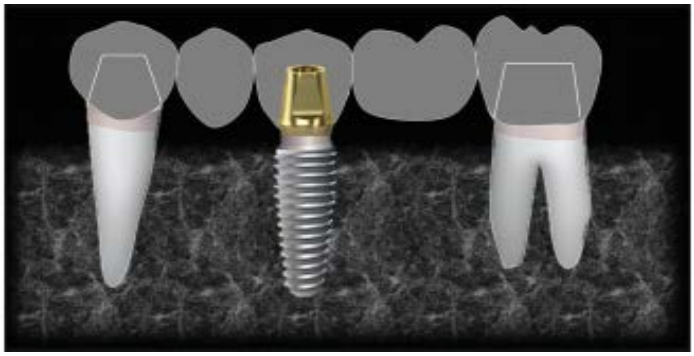

Fig. 1: Coping and superstructure assembly

3. Resilient connection: It incorporates a flexible component that simulates the periodontal ligament. It acts as a stress absorbing element.

• Rigid connection

Authors have different opinions about rigid connection. The presented opinions are as follows:

• Some authors believe that rigid connection of the teeth to the implants is not rational due to the adverse effects on the implant in long-term.

• Rigid connection achieves better outcomes with regard to avoid dental intrusion.

• Finite element analysis showed greater stress concentrations on the neck of the implant and the connector near the tooth.

• Lin CL in 2006 reported micro gap formation between the implant abutment and the fixture under the lateral occlusal forces. The types of such a connection consist of: Rigid screw retained abutments, coping with permanent cement and soldered connectors.

• Nonrigid connection

A. Intermobile elements (IME)

There are few studies about these elements. It has been said that these elements provide flexibility to compensate for the mobility of the tooth.

Uysal in 1996 reported that these elements reduced the strain up to 60% compared to the rigid internal elements. In an in vitro study, it was demonstrated that IME did not contribute to the flexibility of the system and the bending force were transmitted to the retaining screw of the implant abutment.

B. Attachments

It has been mentioned that the attachments reduced the level of stresses in the bone, because it breaks the stress transfer process and more efficiently compensates for dissimilar mobility of the tooth and implant but intrusion in 3 to 4% of the cases has been reported to cause cantilever formation on the implant and increase the unfavourable stress values in the implant and prosthesis.

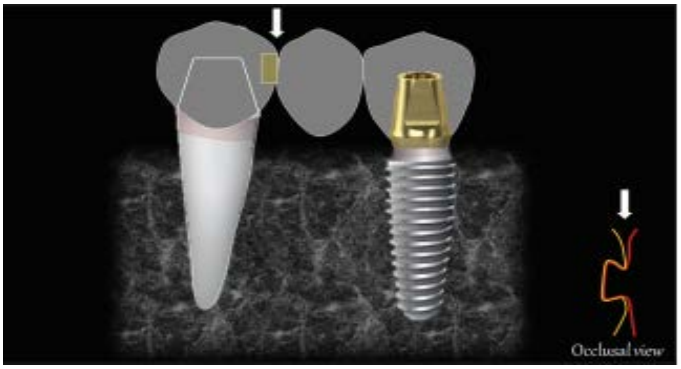

Fig.2: Non rigid key and keyway attachment

Finite element analysis showed stress concentration around the non-rigid connector.

Von Oosterwyck, Naert and Nishimura mentioned that rigid connection compared to free-standing implants or nonrigid connections overstress the implants and result in greater bone loss around the implant; however, along with most of other authors, they expressed their preference for rigid connection over nonrigid connectors.

Hoffmann reported that nonrigid connections drastically reduce the stress on the superstructure while increasing the forces on the supporting teeth and implants[10].

Based on the above studies every surgeon should follow these guidelines for success of the tooth implant supported prosthesis.

The following guidelines can help prevent intrusion of teeth and enhance patient care when contemplating fabricating a TISP:

1. Select healthy teeth—periodontally stable and in dense bone.

2. Rigidly connect the tooth and implant (no stress breakers), employ large solder joints to enhance rigidity, or use one-piece castings. (Fig-3)

Fig. 3: Metal assemblage of rigidly connected four-unit TISP demonstrating substantial occluso-gingival dimensions of solder joints.

3. Avoid telescopic crowns (no copings). (Fig-4), (Fig-5)

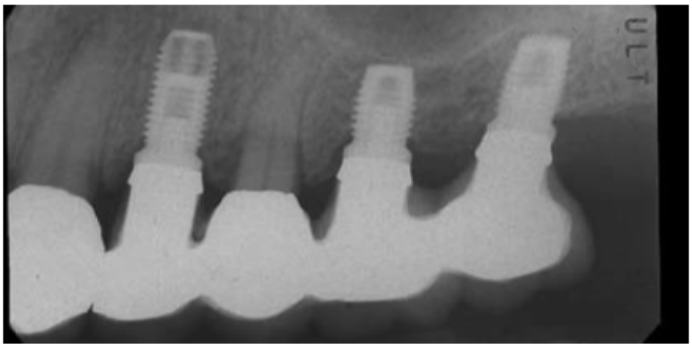

Fig.4: TISP on teeth Nos. 12 through 15. Tooth No. 13 is a natural tooth with a telescopic crown.

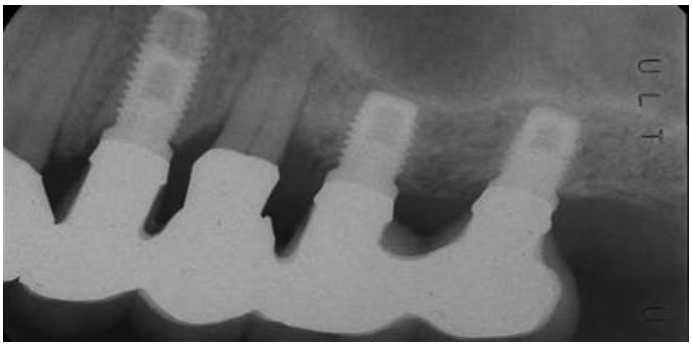

Fig .5: The natural tooth has intruded, and the telescopic crown is now visible beneath the crown.

4. Provide retention form with minimal taper of axial walls on abutment teeth. Enhance resistance form with boxes and retention grooves if the clinical crown is not long. (Fig-6)

Fig. 6: Intraoral view of four-unit TISP (teeth Nos. 2 through 5); implant is acting as pier abutment No. 4. Note retentive boxes placed on tooth abutment No. 2.

5. Parallel the implant abutment to the preparation of the tooth and use a rigid connection.

6. Use permanent cementation (no screw retention or temporary cementation).

7. The bridge span should be short. Preferably, place one pontic between two abutments. However, with additional tooth or implant support or cross-arch stabilization, additional pontics can be used.

8. Occlusal forces should be meticulously directed to the opposing arch.

9. In general, do not use TISPs in patients with parafunctional habits. If they are treated with TISPs, overengineer the case by maximizing the number of implants and splinting.

10. Cantilever extensions should be used cautiously; however, they may be employed when tooth or implant support is adequate, e.g., cantilever-implant-implant pontic-tooth-tooth. (Fig-7)

Fig.7: Cantilever TISP (teeth Nos. 8 and 9, No. 10 is a

pontic, Nos. 11 and 12 are implants, and No. 13 is a cantilever) with intact interim cement seal at 3 months.

11. TISPs in patients with uncontrolled caries should be avoided; ISPs are preferred. (Fig-8)

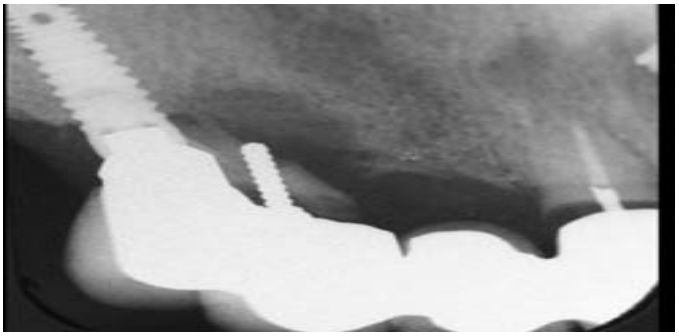

Fig. 8: Patient with TISP at 5 years who demonstrates extensive recurrent caries. Patients with high caries rates would benefit from restoration with an all-implant supported prosthesis.

12. Pulp less teeth with extensive missing coronal tooth structure or root canal anatomy that is inadequate to predictably retain a core or post and core should not be used in a TISP.

13. High-risk TISPs (e.g., multiple adjacent pontics, double cantilevered pontics) or prostheses with minimal abutment support should be expected to have a higher failure rate even though these treatment plans may benefit certain patients. (Fig-9), (Fig-10)

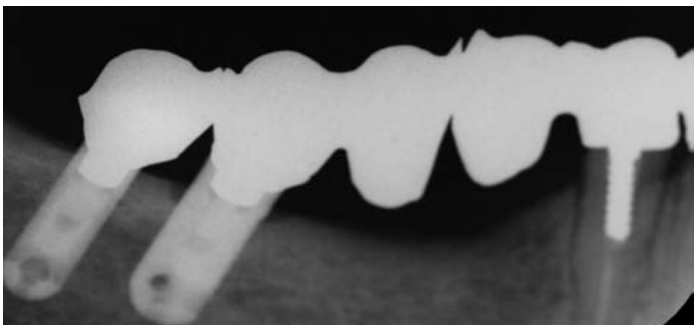

Fig. 9: Radiograph in 1998. A TISP was created with two pontics because the implants used as terminal abutments were placed too posteriorly.

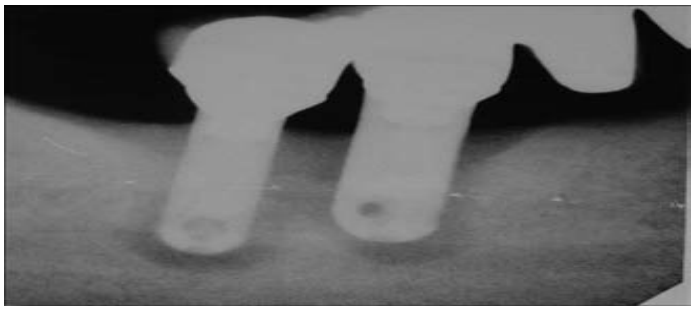

Fig. 10: Radiograph in 2002 demonstrating de-osseointegration of both implants supporting the TISP.The patient had parafunctional habits.

14. In the aesthetic zone, if a papilla or papillae is crucial for aesthetics or function (e.g. Phonetics), consider using natural teeth (TISPs) because the supracrestal gingival fibres associated with healthy teeth will provide interproximal soft-tissue support. (Fig-11)

Fig. 11: TISP after 5.5 years where the papilla between tooth No. 11 and No. 12 implant has been preserved by the presence of the tooth. Distal buccal recession around the implant is evident between the implant and cantilever pontic No. 13. The supracrestal gingival fibres of the tooth are a benefit to preservation of the papilla while the implant has no such effect.

15. If appropriate case selection principles are applied (e.g. minimal caries rate, good root anatomy, minimal tooth mobility, adequate retention and resistance form, rigid prosthesis design, adequate overall abutment support for the prosthesis), then combining implants and natural teeth may permit segmentation of a prosthesis into smaller sections, which may provide an alternate treatment plan to a large one-piece bridge[10].

Limitations: Connecting teeth to Osseo integrated implants presents a biomechanical challenge. This is due to the implant being rigidly fixed to the bone with a periodontal ligament. This contributes to a greater mobility of teeth than Osseo integrated implants. In this type of restoration, because of the physiological movement of natural tooth, some amount of movement is expected from within the implant system.

In addition, the amount of support offered by a natural tooth will also be altered. To reduce these torqueing forces on the implant, different attachment mechanisms have been proposed by various authors. These methods include:

a. Key and key-way type attachments (semi-rigid)

b. Rigidly connected implant and tooth-supported segments

c. Telescopic attachments[11]

Conclusion

Joining teeth and implants during the rehabilitation of partial edentulism is indicated to provide clinicians with more treatment options where proprioception and bone volume are maintained and distal cantilevers and free end saddles are eliminated. Whenever suitable and justified, such treatment option becomes a valid alternative especially if it makes the treatment less complex, of less cost, and more acceptable for the patient. This treatment paradigms associated with some risks and complications including loss of osseointegration, periapical tooth infection, tooth intrusion, ceramic fracture, prostheses decementation, and screw loosening. In order to improve treatment success rate, it is better to avoid using short implants, poor bone quality, and endodontically treated teeth when this treatment paradigm is considered. Also, using rigid connection and permanent cementation are associated with less tooth intrusion and less complications. Further research is still required on many aspects of this treatment paradigm[12].

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