

Connecting Second Dentition to Third Dentition: A Review

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ABSTRACT

The partially edentulous cases can be restored with tooth supported bridge, cantilever or a resin bonded bridge conventionally, while the technological advances include implant-supported single crowns or bridge and/or a combined tooth-implant-supported bridge. However, the combination of teeth and implants for the support of fixed partial dentures has been investigated in many studies but remains controversial. In the recent years, the use of implants for prosthetic rehabilitation of partially edentulous patients is increasing. Connecting teeth to osseointegrated implants presents a biomechanical challenge, as in the natural dentition the tooth is attached to the bone with a periodontal ligament, whereas the implant is rigidly fixed to the bone. To overcome this problem, various connection types such as rigid and non-rigid connectors, has been proposed. The present review focuses on the long-term outcomes of restoration supported by implants and natural teeth with regard to complications associated with implants, teeth, and restorations, as well as the influence of connector on these parameters.

Keywords: Dental implants, Dental intrusion, Fixed partial denture, Removable partial denture, Tooth and implant connection

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INTRODUCTION

The present era of dentistry a range of prosthetic treatment modalities can be used to rehabilitate the missing or lost dentition. The mode of rehabilitation depends on the number of teeth to be replaced, current condition, and arrangement of residual teeth (e.g. periodontal health, remaining tooth structure), cost, patient needs, and sufficiency (e.g. quality and quantity) of the bone to support the treatment like dental implants. Dental implants are one of the most widely used treatment modalities for the purpose of rehabilitation. The implants are often considered as the third dentition. The missing teeth can be restored by taking an implant-support or with a combined tooth-implant-supported bridge the same can be considered as connecting second dentition to third dentition. However, this connection has been remained controversial which has been investigated in many studies. Many of them have reported some anatomic limitations, unfavorable conditions for reconstructive surgical procedures or the patient's economic conditions which may affect the treatment

planning and may include natural tooth abutments in the same prosthetic bridge.^{1,2}

The other matter of fact is natural teeth distributes the forces equally due to the presence of periodontal membrane, elastic modulus, nerve-blood vessels complex. Periodontal ligament (PDL) fibers that cover the natural teeth acts as a viscoelastic shock absorber, which minimizes the amount of stress inbound to bone structure in the crestal region. The connection of implant to bone is not as flexible as natural teeth. That's why forces generated by the occlusal load may not be distributed evenly. Thus, overloading on the bone which counterparts the implant region is fatal.^{2,3} The other side of this is the mobility of a natural tooth which may increase with the occlusal trauma as the stress is either distributed or conducted to prosthetic components and bone interface. However, tooth may return to its position, after eliminating occlusal trauma regardless of the size of the movement.^{2,3} The mobility of an implant may also increase under occlusal trauma but after elimination of the factor, implant either returns into its original rigid position or the mobility continues resulting in implant failure.^{2,3}

The present review focuses on the long-term outcomes of restoration supported by implants and natural teeth with regard to complications associated with implants, teeth, and restorations, as well as the influence of connector on these parameters.

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.^{1,4-6}
2. The absence of other options: Because of systemic, local or financial limitations, bone augmentation and insertion of additional implants are not always possible.^{7,8}
3. To provide stability against rotational forces.^{1,7-9}
4. For esthetic reasons: Implants unlike natural teeth always present challenges with regard to esthetic.^{8,9}

Potential Problems¹¹⁻²⁵

The main potential problem is the difference in the tooth and implant supporting mechanisms. It has been noted that the PDL causes greater movement in the tooth as compared to the implant when subjected to the force (Table 1).¹¹⁻¹⁵

Hence, this difference causes problems in endurance rates of the tooth and implant. The tooth, as opposed to the implant, might decay or need endodontic therapy and these problems may cause the whole system failure due to the following technical and biological problems.

- A. Technical problems
 1. Dental implant fracture
 2. Tooth fracture
 3. Prosthesis fracture
 4. Intrusion of supporting tooth
 5. Breakage of cement bonds.
- B. Biologic problems
 1. Tooth caries/root caries
 2. Peri-implantitis
 3. Tooth mobility
 4. Implant mobility.
- C. Marginal bone loss due to connecting tooth to implant
 Jemt *et al.*,¹³ concluded that concentration of stresses around the collar of implant leads to the bone loss.

Table 1: Difference between tooth & implant movement

Movements	Lateral movement	Apical movement
Tooth	56-108 µm	25-100 µm
Dental implant	10-50 µm	3-5 µm

To avoid this stresses flexibility of implant, tooth and bone should be comparably analogous for distributing stresses equally, and it was emphasized that periodontal ligaments of existing teeth have to be in good condition when planning to connect teeth to implant.¹³

The use of non-rigid connection is advised for homogeneous load distribution. The basis for this approach is the movement of teeth apart from implants. In contrast, finite element analysis shows successful results for non-rigid connections. Akça *et al.*,¹⁴ concluded that there is a minimal marginal bone loss in rigid connection.

- D. Tooth intrusion due to connecting tooth to implant
 The incidence of intrusion in implant-tooth-supported prosthetic designs may vary. The rate of intrusion is in between 3% and 5.2% as per the reports of various literatures.¹⁷ Rieder and Parel reported that the ratio of intrusion is nearly 50% in patients with parafunctional habits, and it is also concluded that there was intrusion in rigid connection as well.¹⁸

Many researchers pointed that intrusion is a more common in patients with non-rigid connected restorations than rigid connected restorations, and it is explained that the cause of intrusion is the use of natural teeth as a female part of stress breaker.^{1,18}

There are lots of theories to explain intrusion phenomenon. One of the hypotheses is “effect of Ratchet” which explains that Ratchet effect is teeth not returning to its original position after occlusal loading due to the friction resistance of the parts of attachment between the rigid connectors.²¹ and one other study is “debris impingement,” which explains that micro jamming of food particles at the bottom of the matrix cause a similar intrusion as impaction of particles prevent the tooth from reconnecting to its original position.²²

BENEFITS OF CONNECTING TOOTH TO IMPLANT

In anatomic limitations restrict insertion of additional implants,

1. e.g. maxillary sinus, mental foramen
2. When there is a lack of adequate bone support for placement of implant
3. Unfavorable medical condition of patient for undergoing bone reconstructive surgeries
4. A simple way of splinting a mobile tooth to an implant
5. Proprioception
6. Reduction of the number of implant abutments needed for a restoration.

ADVANTAGES AND DISADVANTAGES OF CONNECTING THE TOOTH TO THE IMPLANT

Advantages^{26,27}

- Broadened treatment possibilities^{26,27}
- Reduces the cost of treatment by reducing implant numbers²⁷
- Protective value of proprioception provided by tooth^{26,27}
- Desire to splint a mobile key tooth to an implant²⁷
- Additional support for total load on dentition^{1,8,9,26,27}
- Reduction of the need for a cantilever^{26,27}
- Preservation of the papilla adjacent the tooth for esthetic.

Disadvantages^{8,27-28}

- Peri-implantitis
- Tooth intrusion
- Tooth/implant mobility
- Tooth/implant fracture
- Screw loosening.

To avoid this quandary Clarke *et al.*, has advised:¹⁹

- 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.

DISCUSSION

An essential principle in established dental practice has been the preservation and restoration of natural teeth. Endodontic treatment modalities have played a major role in the retention and restoration to the function of teeth affected by necrosis of pulp and/or periapical pathologies. The removal of teeth has generally been supposed uninvited and as a treatment of final option due to the boundaries of alternative prosthodontic replacements such as fixed partial bridges and removable prostheses. In modern years, however, this hypothesis has been challenged by rising trends in implant dentistry, with implant replacements being touted as equal to or even superior to the preservation of natural teeth and that's the reason implant is also called as third dentition nowadays. This has led to concern among endodontic circles regarding the extraction of teeth which may otherwise be managed with sound contemporary endodontic and prosthodontic treatment procedures. Tooth to implant connection is not logical due to the undesirable effects on the implants in long-

term period. Some studies concluded that non-rigid connection has the probability of intrusion of teeth.^{28,17} This connection is used to potentially gain support from the tooth, to preserve the tooth or to provide stability to rotational forces directed at the screw joint of the implant supported part of the restoration. Clinicians who advocate connecting teeth to implants rigidly accept the differential mobility of the implant and natural tooth. They deem there is sufficient flexibility in the implant stack to allow sharing of the load.^{17,27-28} For this to occur, the implant components and their retaining screws must exhibit some degree of flexibility, the periodontal support of the natural tooth must be adequate and constant, and the amplitude of movement of the prostheses must be minimal. This amplitude of movement will also affect the magnitude of the force to the screw joint on the implant and must be less than the preload of the retaining screw to prevent screw loosening. Constant bending of the screw could lead to metal fatigue and failure of the implant components.

Others believe that a non-rigid connection placed between the pontic and the tooth will alleviate the biomechanical mismatch of mobility between the implant and tooth. Different methods of this connection have been described.^{8,20} However when this type of connection occurs, the phenomenon of intrusion of the tooth has been reported.^{17,28}

One rational method has been reported that can potentially allow sharing of load between tooth and implant and eliminate the problem of intrusion of teeth. In this method a non-rigid connection in the form of a deep removable partial denture (RPD)-type spoon-shaped rest was fabricated on the distal of the pontic; the corresponding rest seat was prepared on the implant.^{21,23,6}

CONCLUSION

It has been noted that even though there is potential difference exist between the mobility of the tooth and the implant, it is reasonable to connect the tooth to an implant rigidly. The problem of intrusion can be prevented by using rigid connectors while bone resorption can be reduced by using non-rigid connector in tooth-implant connection.

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How to cite this article: Jadhav SU, Khan SSM, Gopi A, Jain D, Mane P, Shukla S. Connecting Second Dentition to Third Dentition: A Review. *Int J Adv Health Sci* 2015;2(8):14-17.

Source of Support: Nil, **Conflict of Interest:** None declared.