**Peri-implant soft tissue response to implant-supported overdenture - a review of literature**

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**Abstract**

*Objectives:* This review aims to evaluate the response of peri-implant soft tissue around implant-supported overdentures.

*Data:* Original articles that reported on the health of soft tissues around implant-supported overdentures were included. The reference lists of potentially relevant review articles were also sought.

*Sources:* A literature search was conducted using the databases, Medline, EMBASE, Cochrane Library, Web of Science, Google Scholar, and Scopus databases for relevant studies. The search was carried out by using a combined text and the MeSH search strategies: using the key words in different combinations: ‘soft tissue’, ‘peri-implant tissue’ ‘dental implants’, ‘implant-anchored rehabilitation’, ‘overdentures’, ‘mucosa’, ‘dental prosthesis’ and ‘implant-supported’. This was supplemented by hand-searching in peer-reviewed journals and cross-referenced with the articles accessed. Articles published only in English language were included. Letters to the Editor, historical reviews and unpublished articles were not sought.

*Conclusions:* Within the limitations of the present literature review, it was observed that the soft tissue response was better for ball retained than for the bar retained implant-supported overdentures. However, contrasting opinions was reported on the role of keratinized mucosa, number of implants and the type of implant system for the success or failure of an implant-supported overdenture.

**Key words:** Dental implants; denture; edentulous mandible; edentulous maxilla; overdenture; soft tissue.

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**Introduction**

Implant-retained overdentures provide an effective treatment modality for edentulous patients who have persistent problems with the use of a conventional dentures. Implant supported overdenture therapy has been widely demonstrated to improve function, speech, comfort, diet and patients’ satisfaction [[1](#_ENREF_1); [2](#_ENREF_2)]. A high success rate have been reported for overdentures, with the use of different implant systems and a varying number of implants [[3](#_ENREF_3); [4](#_ENREF_4)]. It has gained popularity as the treatment of choice for edentulous patients with compromised alveolar ridge height [[5](#_ENREF_5)].

Overdentures are usually supported by the surrounding tissue along with the additional attachments [[6](#_ENREF_6)]. Successful long-term clinical results have been achieved with the use of attachment options involving ball, bar or magnet attachments [[5](#_ENREF_5); [7](#_ENREF_7)] and rigid anchorage systems with splinted or un-splinted implants [[8](#_ENREF_8); [9](#_ENREF_9)].

Peri-implant tissue is an adaptation of the masticatory mucosa to the different implant systems placed in the oral cavity. Soft tissues around the implant integrate with the surface of the dental implants, and can be used to assess the overall integration process [[10](#_ENREF_10); [11](#_ENREF_11)]. The decreasing health of soft tissue around the implants can be considered as a clinical sign of implant failure [[12](#_ENREF_12)]. The anatomy and soft tissue support around implants is different than that around teeth [[13](#_ENREF_13); [14](#_ENREF_14)]. The attached mucosa adheres to the surface of the titanium implant by means of hemi-desmosomes [[15](#_ENREF_15)]. There is no periodontal membrane or root cement around the implants, only a normal gingival like tissue, which consist of a dense, collagenous lamina propria, covered with a stratified, squamous, keratinizing oral epithelium. Of the various tissues in contact with the implant, the epithelium resembles the most to that of the natural dentition [[16](#_ENREF_16)]. Since there is no direct anchorage of connective tissue to the surface of the implant, the mechanical quality of the attachment is low [[13](#_ENREF_13); [14](#_ENREF_14)]. The first line of defense against microbial aggressions and their products are the junctional epithelium and healthy connective tissue inserted around the teeth [[17](#_ENREF_17)]. Therefore, the presence of keratinizing mucosa surrounding an implant is thought to be a positive factor in maintaining soft tissue health [[18](#_ENREF_18); [19](#_ENREF_19)]. Comparison of the results of different studies on soft tissue reactions around implants is difficult because of the different methods used to record soft tissue health [[20](#_ENREF_20)].

Overdentures have been extensively studied with respect to the number of implants, various clinical measures (including implant survival) and the patient satisfaction [[21-23](#_ENREF_21)]. However, only few studies are available examining the health of peri-implant soft tissue in implant-supported overdentures [[24](#_ENREF_24)]. This report aims to review the soft tissue response towards the implant-supported overdentures.

**Search Strategy**

Two reviewers conducted an electronic literature search of the database MEDLINE (PubMed) up to January 2014. The search was also restricted to articles published in English. Two authors independently searched the Medline, EMBASE, Cochrane Library, Web of Science, Google Scholar, and Scopus databases for relevant studies. The search was carried out by using a combined text and the MeSH search strategies: using the key words in different combinations: ‘soft tissue’, ‘peri-implant tissue’ ‘dental implants’, ‘implant-anchored rehabilitation’, ‘overdentures’, ‘mucosa’, ‘dental prosthesis’ and ‘implant-supported’. A completion of this electronic search was accom­plished by hand-searching within the references of selected full-text articles and other systematic reviews.

**The role of Keratinized Mucosa**

Gingival hyperplasia and inflammation are the two common complications associated with peri-implant tissue in overdentures [[25](#_ENREF_25); [26](#_ENREF_26)]. Few studies have identified that these complication are higher for overdentures when compared with any other prosthesis [[27-29](#_ENREF_27)]. Lang and Loe [[30](#_ENREF_30)] suggested a width of at least 2 mm of keratinized mucosa, of which 1 mm has to be attached gingiva. A higher chance of gingival inflammation is observed when only a narrow zone of keratinized mucosa is present in a teeth with sub-gingival restorations [[31](#_ENREF_31)]. Han et al. [[32](#_ENREF_32)] have shown the use of free soft tissue grafts to augment keratinized gingiva before or following the restoration of an implant. The objective of such procedures were to maintain effective plaque control, prevention of further recession by reducing frenal pull and to ease the impression procedures [[33](#_ENREF_33); [34](#_ENREF_34)].

Studies have evaluated the effect of the width of keratinized mucosa around implant-supported overdentures, on the health of the surrounding soft and hard tissues [[35-37](#_ENREF_35)]. Mericske-Stern et al. [[38](#_ENREF_38)] reported that keratinized attached mucosa provides better mechanical resistance, but clinically, no significant differences in the health of peri-implant tissues were observed between abutments surrounded with keratinized or non-keratinized mucosa. Adibrad et al. [[36](#_ENREF_36)] found that a wider mucosal band had less mucosal recession and periodontal attachment loss. However, they found no association between the width of keratinized mucosa and the alveolar bone loss around implants supporting overdentures. While probing peri-implantitis sites, the probe tends to penetrate apical to the epithelium and reach the base of the inflammatory lesion at the alveolar bone crest, thus giving a higher probing depth values [[36](#_ENREF_36)]. Also, it has been reported that the probing depth measurements around implant and teeth are different, and small alterations in probing depth around implants may reflect changes in soft tissue inflammation rather than loss of supporting tissues [[39](#_ENREF_39)].

**The type of overdenture and the soft tissue response**

The two main retainer systems used for implant-supported overdentures are: splinting (bar-clip constructions with various bar-shape designs) and non-splinting (various ball type attachments and magnet attachments). According to Cune et al. ([[40](#_ENREF_40)] the bar-clip attachments were the most used retention system. The non-splinting attachments are cheaper and transmit lesser loads to the implants [[41](#_ENREF_41)]

A finite element model, reported greater stress on the peri-implant bone with the clips/bar attachment than with the ball attachment [[42](#_ENREF_42)]. Higher rate of tissue hyperplasia is reported in the case of overdentures using bar clip attachment over implants [[43](#_ENREF_43)]. Assad et al. [[44](#_ENREF_44)] reported lower gingival inflammation for the mucosa-supported (magnet attachment), when compared with the combined mucosa–implant supported (bar attachment) overdentures. Similar results were reported by other studies as well [[45](#_ENREF_45); [46](#_ENREF_46)]. Even with regard to the aftercare, soft-tissue problems were more common with the bar attachment [[47](#_ENREF_47)]. This could be attributed to the hyperplasia of the gingival tissues under the bar and around the abutments trying to fill the space between and under the denture. Similar results were reported by Burns et al., [[48](#_ENREF_48)] and Naert et al. [[49](#_ENREF_49)]. The presence of inflammation and hypertrophy is mainly due to inadequate oral hygiene. A recent case report [[50](#_ENREF_50)], showed positive results on soft tissue response to implant-retained bar overdentures dentures that were evaluated 8 years after prosthesis delivery. Similarly, many other studies have reported no difference in the soft tissue parameters between the two retainer systems [[12](#_ENREF_12); [45](#_ENREF_45); [51](#_ENREF_51)]. Elsyad et al. [[52](#_ENREF_52)] compared the influence of resilient liner and clip attachments for bar-implant-supported mandibular overdentures on opposing maxillary ridge. 5 year follow up revealed less resorption and flabbiness of the maxillary anterior ridge when resilient liners were used in the mandibular overdenture.

**Soft tissue response between Maxillary and Mandibular Overdentures**

Maxillary trabecular bone provides the implants with poorer primary stability than the cortical layers in the mandible. In the maxilla, implants are also predisposed to more unfavorable occlusal forces [[53](#_ENREF_53); [54](#_ENREF_54)]. Local anatomic conditions are known to be the single greatest predictor for the success of implant therapy [[55](#_ENREF_55)]. For this reason, the success rate of implants in the maxilla is slightly lower than in the mandible [[56](#_ENREF_56)]. It has been suggested that a maxillary overdenture should rather be completely implant-borne than implant-supported and soft tissue-borne [[38](#_ENREF_38)]. A recent systematic review of maxillary overdentures concluded that the attachment system together with the number and distribution of implants determine the prosthodontic maintenance requirements of maxillary overdentures [[57](#_ENREF_57)]. The most common mucosal complications reported with maxillary implant overdentures were hyperplasia, irritations, and denture stomatitis, independent of the type of attachment system [[58](#_ENREF_58); [59](#_ENREF_59)]. Several authors advocated a superstructure design with reduced palatal coverage to avoid mucosal problems [[60](#_ENREF_60)]. Akca et al. [[61](#_ENREF_61)] compared the marginal bone loss, soft tissue conditions, and prosthetic outcomes of implants supporting mandibular and maxillary bar-retained overdentures. No difference in the peri-implant soft tissue outcomes were observed between mandibular and maxillary bar-retained overdentures.

**Soft tissue response to the type of implant system**

Numerous dental implant systems are used in the treatment of the edentulous patient. The choice of implant system should ideally be based upon data regarding the clinical performance of each implant. Cune et al. [[62](#_ENREF_62)] reported on the health of the peri-implant tissues while using different implant systems for mandibular overdenture treatment. They found that the tissues surrounding Bonefit ITI (Straumann, Cambridge, MA), implants appeared healthier when compared to the IMZ (Interpore, Irvine, CA), Brånemark (Nobelpharma AB, Gothenburg, Sweden), Screw-Vent (Core-Vent, Encino, CA), and Bosker TMI (Bosker TMI system, W. Lorenz Surgical Instruments, Jacksonville, FL) systems. They also reported that the type of supra-structure used had little influence on the peri-implant mucosa. A randomized clinical trial [[63](#_ENREF_63)] compared TMI (Bosker TMI system, W. Lorenz Surgical Instruments, Jacksonville, FL), the IMZ (Interpore, Irvine, CA), and the Brånemark (Nobelpharma AB, Gothenburg, Sweden) implants in mandibular overdentures. No significant difference between the different systems was observed with regard to the various peri-implant tissue health measures.

**The number of implants supporting the overdenture**

Various studies have compared the number of implants to the survival of overdentures [[47](#_ENREF_47); [64](#_ENREF_64); [65](#_ENREF_65)]. The basic concept of placing a limited number of implants to support an overdenture is generally followed. The implant-supported overdenture is supported by both implant and mucosa and hence fewer implants are recommended, than for the prosthesis that is supported only by implants [[66](#_ENREF_66)]. Mandibular overdentures can be stabilized by varying numbers of implants (usually two or four). Numerous studies have reported no significant changes in the peri-implant tissues of patients treated with an overdenture on two or four implants [[64](#_ENREF_64); [65](#_ENREF_65)]. However, some studies have reported better preservation of the alveolar ridge in a four-implant overdenture design compared to a two-implant design [[67](#_ENREF_67); [68](#_ENREF_68)]. Klemetti [[69](#_ENREF_69)] concluded that the maxillary overdentures with at least four implants independent of the type of retainers and mandibular overdentures with two implants and a bar had the least number of complications. Batenburg et al. [[70](#_ENREF_70)] conducted a focused review that emphasized on the number of implants for overdentures. They concluded that two implants supporting a mandibular overdenture and four implants supporting the maxillary overdenture are sufficient for most applications. The systematic review by Roccuzzo et al. [[71](#_ENREF_71)] , could not find any significant correlation between the clinical outcomes/patient satisfaction and the number of implants supporting the overdenture.

**Conclusion**

Literature on the effect of different anatomical considerations, attachment systems, and implant system on the peri-implant soft tissues in patients with implant-supported overdentures was reviewed. Within the limitations of the present literature review, it was observed that the soft tissue response was better for ball retained than for the bar retained implant-supported overdentures. However, contrasting opinions on the role of keratinized mucosa, number of implants and the type of implant system for the success or failure of an implant-supported overdenture have been reported.

As the implant-supported restoration is located beneath the oral mucosa, susceptibility of implants to infection is high. This calls for great care from the clinician regarding the amount of relief done and from the patient following strict oral hygiene measures to control plaque accumulation around the implant. Further systematic reviews are required, to analyze the influence of soft tissues on the success and failure of implant-supported overdentures.

**Conﬂicts of interest**

The authors declare that they have no conﬂicts of interest and there was no external source of funding for the present study.

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