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Comparison between Natural Teeth and Dental Implants: A Literature Review

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Abstract: ***The main goal of clinicians who use dental implants in the treatment of their patients require an understanding of the nature of osseointegration and the important fundamental differences between dental implants and natural teeth. A dental implant acts as an abutment for a prosthesis, which is similar to a natural tooth root and crown. A prosthodontist designs and fabricates a prosthesis similar to one which is supported by a tooth such that, the dental implant acts as a similarly to a natural tooth. Yet, the fundamental differences in the support system have to be recognized.***

Keywords: Natural tooth, Implant, Treatment, implant survival, peri-implantitis, periodontal disease

1. Introduction

The main objective in dentistry today, is to restore normal contour, function, comfort, esthetics, speech, and health, regardless of the atrophy, disease, or injury of the stomatognathic system. A practitioner's attention is now being drawn toward providing tooth substitutes, as equal or even superior to that of the natural teeth. Most clinicians have to implant dentistry as the new mode of treatment for missing teeth, so much so that the rapidity of this transition has ultimately become the topic for concern.

While it is true that implant dentistry holds a great deal of promise, when given a choice between endodontic treatment and implants, a cautious approach to embracing this technology has to be followed, especially since a dental implant is an invasive procedure, is financially more demanding to the patient, and involves the psyche of living with a foreign material within oneself.

Implants are fundamentally different from natural teeth. The factors which are involved in the decision-making process, on whether a tooth should receive endodontic treatment or be extracted and replaced by an implant, are pertaining to the patient, the tooth and periodontium, and treatment-related considerations.

Once we achieve a rigid fixation with proper crestal bone contour and gingival health, the mechanical stress or strain beyond the physical limits of hard tissues is a primary cause of bone loss around loaded implants. A successful surgical and prosthetic rehabilitation with a passive prosthesis are related to noxious stresses and loads applied to the implant and surrounding tissues result primarily from occlusal contacts.

Compared with an implant, the support system of a natural tooth is better designed to reduce the forces distributed to the tooth or restoration and the crestal bone region. Therefore, it is the responsibility of a prosthodontist to design and fabricate a prosthesis similar to the one which is supported by a tooth such that, the dental implant acts as a similarly to a natural tooth. Yet, the fundamental differences in the support system have to be recognized.

S. No		Tooth	Implant
1	Composition	Made up of Calcium and Phosphorus (Hydroxyapatite)	Primarily titanium and titanium based alloys
2	Nature	Living	Non – Living
3	Connection	Cementum, bone and periodontal ligament	Osseo integration, bone functional
4	Gingival sulcus depth	shallow	Depends upon abutment length and restoration margin
5	Junctional epithelium	On enamel	On titanium
6	Connectivity issue	Perpendicular to tooth surfaces	Parallel and circular fibers. No attachment to implant or bone
7	Gingival fibres	Complex array inserted into cementum above crestal bone	No organised collagen fiber attachment
8	Biologic width	JE: 0.97 to 1.14mm CT: 0.77 to 1.07mm BW: 2.04 to 2.91mm	JE: 1.88mm CT: 1.05mm BW: 3.08mm
9	Crest of Bone	1 to 2mm apical to CEJ	According to implant design
10	Probing depth	3mm in health	2.5 to 5mm (depends on soft tissue depth)
11	Bleeding on probing	More reliable	Less reliable
12	Vascularity	More	Less
13	Nerve supply	Present	Absent
14	Proprioception	Highly sensitive	No ligament receptors

15	Physical characteristics	Physiologic mobility caused by viscoelastic properties of the ligament	Rigid connection to bone – as if ankylosed
16	Adaptive characteristics	Width of ligament can alter to allow more mobility with increased occlusal forces	No adaptive capacity to allow mobility. Orthodontic movement impossible

Teeth Vs Implants

Clinical parameters comparing implants and natural teeth:

- Longevity
- Pain
- Mobility
- Percussion
- Crestal bone loss
- Radiographic evaluation
- Keratinized tissue
- Probing depths
- Bleeding index
- Periimplant disease

Peri-implant soft tissues

The implants are surgically placed within the jaw bone, and is one of the few prosthetic devices that has been shown to successfully and permanently breach the surface epithelium with minimal or no complications. It has a transmucosal element (an abutment, neck of the implant or the restoration) protrudes through the overlying mucosa which heals and adapts around it without a cementum attachment. The collagen fibres within the peri-implant mucosa run parallel to the abutment with no insertion into the abutment surface. In some situation some fibres appear to run at right angles to the implant surface, but there is no good evidence of an attachment mechanism.

Longevity

Implant survival and the associated prosthesis survival rates need to be evaluated together because the most important aspect to the patient is the restoration.

Criteria for implant success

- An individual unattached implant is immobile when tested clinically.
- The radiograph does not demonstrate any evidence of periimplant radiolucency.
- Vertical bone loss is less than 0.2 mm annually after the first year of service of the implant.
- Individual implant performance is characterized by an absence of persistent or irreversible signs and symptoms such as pain, infections, neuropathies, paresthesia, or violation of the mandibular canal.
- Success rates of 85% at the end of a 5-year observation period and 80% at the end of a 10-year period are minimum criteria for success.

Pain

Pain and tenderness are subjective criteria and depend on the patient's interpretation of the degree of discomfort. Pain is defined as an unpleasant sensation ranging from mild discomfort to excruciating agony. Tenderness is more an unpleasant awareness of the region. Percussion and forces up to 500 g (1.2 psi) are used clinically to evaluate tooth or implant pain or discomfort.

Implant

Usually pain does not occur unless the implant is mobile and surrounded by inflamed tissue or has rigid fixation but impinges on a nerve. The most common condition that causes discomfort is when a loose implant abutment is entrapping some of the soft tissue in the abutment-to-implant connection. Once the soft tissue in the region is eliminated and the abutment is secured, the discomfort subsides.

Mobility

Rigid fixation is a clinical term that means the absence of observed clinical mobility. Osseointegration is a histologic term defined as bone in direct contact with an implant surface at the magnification of a light microscope. Rigid fixation indicates the absence of clinical mobility of an implant tested with vertical or horizontal forces under 500 g, similar to evaluating teeth.

Teeth

A "nonmobile" posterior natural tooth actually moves horizontally 56 to 73 micron. Once the cause of trauma is eliminated, the tooth may return to zero clinical mobility and a normal.

Implant

A healthy implant moves less than 73 micron; hence it appears as zero clinical mobility. Rigid fixation usually means that at least a portion of the implant is in direct contact with bone, although the percentage of bone contact cannot be specified. A mobile implant indicates the presence of connective tissue between the implant and bone.

Percussion

Teeth

Percussion often is used on teeth to determine which tooth is sensitive to function or is beginning to abscess.

Implant

In the past, percussion was used to evaluate the presence of rigid fixation. Percussion may be used to diagnose pain or tenderness with an implant but is misleading if used to determine the status of rigid fixation.

Crestal Bone Loss

The crestal bone area is usually a significant indicator of implant health

Implant

Crestal bone loss after prosthesis delivery is a primary indicator of the need for initial preventive therapy. Early loss of crestal bone beyond 1 mm from the microgap of the abutment after prosthesis delivery usually results from excess stress at the permucosal site or implant crest module design. The dentist should evaluate and reduce stress factors

such as occlusal forces, cantilever length, and especially parafunction on observation of initial bone loss.

Radiographic Evaluation

Teeth

The radiographic assessment of natural teeth assists in determining the presence of decay, lesions of endodontic origin, and periodontal bone loss.

Implant

Implants do not decay and do not develop endodontic-related conditions. A radiograph only illustrates clearly the mesial and distal crestal levels of bone. However, early bone loss often occurs on the facial aspect of the implant which is less diagnostic.

Parallel periapical radiographs are more difficult to obtain for implants than for teeth. The implant is often apical to the apex of the preexisting natural tooth beyond muscle attachments or in regions almost impossible to capture with a parallel radiographic method.

A periimplant radiolucency indicates the presence of surrounding soft tissue and is a sign of implant failure. The cause may be from infection, iatrogenic, nonrigid fixation, or local bone-healing disorders.

Keratinized Tissue Concerns

The absence or presence of a zone of keratinized gingiva around a natural tooth or an oral implant is controversial.

Teeth

The presence of keratinized tissue next to an oral implant presents even greater benefits than those with natural teeth. Some reports indicate the lack of keratinized tissue may contribute to implant failure. An absence of keratinized mucosa increases the susceptibility of periimplant regions to plaque-induced destruction.

Probing Depths

Probing depths around teeth are an excellent proven means to assess the past and present health of natural teeth. Likewise, probing depth indexes often are used to evaluate dental implants.

Only titanium or plastic instruments be used to probe or scale the implant because of a risk of contamination of the two metals and the resulting galvanic corrosion that may develop and cause crestal bone loss.

Bleeding Index

Gingival bleeding when probing correlates with inflammation and the plaque index. A bleeding index is an indicator of sulcus health. Easily ulcerated sulcular epithelium representing inflammation from plaque is the primary cause of bleeding when probing.

The most common bleeding gingival index used for implants is the Loe and Silness gingival index.

Periimplant Disease

Gingivitis is a bacteria-induced inflammation involving the region of the marginal gingiva above the crest of bone and next to a natural tooth.

The bacteria in gingivitis around a tooth may affect the epithelial attachment but without loss of connective tissue attachment.

Periodontitis around teeth is characterized by apical proliferation and ulceration of the junctional epithelium, progressive loss of the connective tissue attachment, and loss of alveolar bone.

The term periimplantitis describes the bone loss around an implant. The loss may be stress induced, bacteria induced, or a combination of both. The papillae which form around a single tooth implant may be supported by collagen fibres attached to the adjacent natural teeth. However, in cases where there are adjacent implants rather than teeth, the formation of soft tissue papillae is less predictable and their form is dependent upon the presence of an adequate thickness of soft tissue, bone height, implant spacing and careful contouring of the crown profiles to encourage the appearance and maintenance of a papillary form. The soft tissue between multiple posterior implants is more likely to have a flat contour but again may be influenced by soft tissue thickness and crown morphology.

Peri-implanlitis affects the entire circumference of the implant resulting in a 'gutter' of bone loss filled with inflammatory tissue extending to the bone surface". In contrast, periodontitis affected teeth commonly have irregular loss of supporting tissues, often confined to proximal surfaces and resulting in complex infrabony defects.

Junctional Epithelium

In healthy teeth the junctional epithelium is attached to enamel by hemidesmosomal contacts and a basal lamina-like structure formed by the epithelial cells. The biological attachment mechanism is now thought to be mediated through particular adhesins or integrins, which are fundamental in cel to cell adhesion as well as cell to matrix adhesion, it is well established that a junctional epithelium will also form on root surface cementum, dentine and various dental materials including implant component. A normal junctional epithelium can be regenerated from adjacent oral mucosa/gingiva following excision, and the new junctional epithelium is indistinguishable from that which previously existed. It is thought that the properties of the junctional epithelium are dictated by the influence of the underlying connective tissue, the presence of an inflammatory infiltrate and the presence of a tooth/implant surface to which it adheres. The junctional epithelium is a particularly high turnover and is permeable to both the ingress of substances and to components of the immune and inflammatory system. It is therefore well equipped to deal with the problems of a breach in the epithelial integrity caused by an emerging tooth or implant.

Implant

The junctional epithelium may be found on the implant itself or on the abutment. This will be because of differences in the designs of implants, the biological requirements of the attachment of the soft tissue cuff and the level of the junction between abutment and implants.

Biological Width

In teeth, the concept of the biological width is well established, in that a zone of attached connective tissue separates the underlying alveolar bone from the apical termination of the junctional epithelium. The connective tissue zone is about 2 mm wide and the length of the junctional epithelium about 1.5mm.

2. Conclusion

An osseointegrated implant restoration may closely resemble a natural tooth. However, the absence of a periodontal ligament and connective tissue attachment via cementum, results in fundamental differences in the adaptation of the implant to occlusal forces, the structure of the gingival cuff, and an understanding of the attachment mechanisms of hard and soft tissues and their responses to the harsh environment of the oral cavity is essential to the dental surgeon who is involved in providing this form of treatment.

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