



Review Article

A literature review on sensory motor control mediated through implant: Osseoperception in dental implants

Swati Rana^{1*}, Ragini Katyal², Manveer Singh³, Mansi Sharma³

¹Dept. of Prosthodontics Crown Bridge and Implantology, Swami Devi Dyal Hospital and Dental College, Barwala, Haryana, India.

²Private Practitioner, Haryana, India.

³Dept. of Prosthodontics, Crown Bridge and Implantology, Bhojia Dental College and Hospital, Baddi Himachal Pradesh, India.

Abstract

Now a days implants being the first choice of treatment option in replacing the missing teeth. implants can be used in replacement of single missing tooth to replacement of multiple missing teeth in the oral cavity. There are different studies which stated that, there can be regain of sensation in the early missing tooth space area, when it is restored with dental implant, which is properly osseointegrated in the alveolar bone. Implants are available in market with different designs, some implants are surface treated which shows better or fast process of osseointegration to the alveolar bone. The process of motor sensation is totally dependent on the survival of the implant, and the survival of the implant depends upon different conditions like, whether the protocol of sterilization is maintained or not properly, helps in survival of the implant, systemic condition of the individual, bone type of the individual, presence of any hard or soft tissue defect near the implant site, presence of any infection near the implant site, all these factors determine the survival of the implant and ultimately determines the sensory motor control which is mediated through the implant.

Keywords: Implant, Full mouth rehabilitation, Osseoperception, Active tactile perception, Passive tactile perception.

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1. Introduction

Literature has revealed that, dental implant therapy is one of the most common treatment modality in replacing the missing single or multiple teeth with a survival rate of 95%.¹⁻⁴ Overall success of dental implant is determined by the stability of the dental implant, the more stable the dental implant, more will be the success rate. The stability of the dental implant is otherwise known as osseointegration, and it is defined as a direct functional and structural connection between the alveolar bone and the surface of load carrying implant.⁵⁻⁷

When the implant which is osseointegrated well, get loaded in the oral cavity in full occlusion to perform the mechanical function a sensory action got evoked, which is known as osseoperception. Branemark coined the osseoperception and it can be defined as a conscious perception of stimuli which is external and is transmitted via

a bone anchored prosthesis by the result of activation of neural endings or different receptors which are present in the peri neural areas. Mechanoreceptors which are present in periodontal ligament areas helps in determining the relationship of maxillary as well as mandibular teeth in function. In a normal tooth there is a well and intimate contact between the collagen fibres and ruffini like endings that plays a very important role in the sensory pathways. As the tooth got extracted, for any reason, these sensory pathways got damaged and ultimately results in damaged of periodontal ligament receptors.⁸⁻¹¹

There are various mechanoreceptors are present in human periodontal ligaments, which all helps in exteroceptive function. The primary role in tactile function of teeth is played by mechanoreceptors which are present in periodontal ligament and these receptors are very much sensitive to all the external forces which are applied over the teeth.¹²⁻¹⁴

*Corresponding author: Swati Rana
Email: Swatirana@gmail.com

Now different mechanoreceptors which contribute to the process of osseoperception are as follows:-

1.1. Joint mechanoreceptors

These are the mechanoreceptors which are present in the temporomandibular joint along with the other joint of the body and are low in threshold frequency. These receptors helps in providing the information that too in detail in positioning of the jaw, as well as movement of the jaw, and these receptors are classified as limited range receptors.¹⁴⁻¹⁹

1.2. Muscle mechanoreceptors

At the junction between the musculo tendinous joint, golgi tendons organs are found that too with limited number of muscle fibers which are extrafusul. And these got activated with the pull of the muscle fiber as well as with the contraction of the muscle fiber. These golgi tendon fibers falls in to the category of mechanoreceptors which are appropriate in nature for signaling the contraction which are voluntary in nature such as biting action.

The somatosensory receptors which are complex in nature are muscle spindles, they helps in providing very detailed information in relation to length of the muscle as well as rate of change of length. These receptors also helps in assessment of the jaw position and the movement of the temporomandibular jaw.⁷⁻⁹

1.3. Cutaneous mechanoreceptors

The mechanoreceptors which are activate dover the skin are known as cutaneous mechanoreceptors. And these receptors got activated by touching the skin or by stretching the skin or by the action of contraction of skin.

1.4. Mucosal mechanoreceptors

When the natural teeth are present in the oral cavity, these periodontal mechanoreceptors are of very much importance, they help in refining the interdental discriminative function. On the other hand in terms of implant supported fixed prosthesis, this kinesthetic perception can come from the result of activation of mucosal receptors or mucosal mechanoreceptors which are present in the vicinity of the implant fixture.¹¹⁻¹⁴

1.5. Periosteal mechanoreceptors

These are the mechanoreceptors which are present in the periosteum over the alveolar bone. These receptors also plays an important in transmitting the sensory motor response with the well osseointegrated dental implant after loaded in function. The periosteum contain numerous free nerve endings in it along with complex unencapsulated and encapsulated nerve endings. When the pressure is applied over the periosteum by the action of mastication, the free nerve endings gets activated. When the force is applied over the osseointegrated dental implant in occlusion, it can be assumed that, the pressure which is build up in the bone, is

some time large enough to allow the deformation of the bone and its surrounding periosteum. After the activation of mechanoreceptors, nerve impulse result in generation of action potential which ultimately results in activation of the motor response.⁶⁻⁸

1.6. Various concepts of osseoperception

Generation of periodontal ligament in partial:-

Takata et al revealed that, a new attachment of connective tissue can be achieved or can occur over the hydroxyapatite surface when the derived cells of periodontal ligament with the ability to form ne connective tissue attachment are allowed to gather at the surface of the implant which is treated by hydroxyapatite.

A different study by warrer et al stated that, periodontal ligament can be form over the surface of the well osseointegrated dental titanium implant in those areas where a void is present between the alveolar bone surrounding and the dental titanium implant at the time of insertion.

Jahangiri et al stated in their animal study that there is formation or attachment of periodontal ligament fibers over the surface of the bio active titanium implant.

Histologically, it has also been seen that, there is re innervation of free nerve endings over the surface of the titanium implant. According to bonte et al in an animal study stated that, when the forces are applied over the natural tooth, mechanoreceptors which are present in the periodontal ligaments gets activated and send the impulses of sensation through the neural endings. They also stated that there is evidence that mechanoreceptors which are situated at some distance from the periodontium under force can also evoke such type of reflexes. It has also been documented that re innervation along with association with controlled forces which are directed to the implant can result in proprioception. This phenomenon is due to regeneration of nerve fibers around the titanium dental implant which is physiologically loaded.¹¹⁻¹⁴

Implant bone deformation in peri implant area responsible for tactile sensibility:-

According to a study done by saul weiner et al, stated that, stated that loading of implant in occlusion function results in a sensory response in the area of inferior alveolar nerve, which is observed in neurophysiological recording.

Another study which is done by fujii et al, stated that innervation in the area of peri implant epithelium shows the same innervation as that was seen in normal junctional epithelium.

It has also been stated that, implants which are placed immediately just after the extraction of the tooth that too which is followed by immediate loading shows better tactile function due to the reason of better peri implant innervation

in comparison to implants placed in delayed loading protocols or conventional loading protocols.⁴⁻⁷

2. Discussion

It has been concluded that, those implants which are osseointegrated very well in the alveolar bone shows better tactile sensibility even though in the absence of the periodontal ligament, implying being there will be partial substitution of sensory feedback in the presence of the titanium dental implants. Implant mediated sensory motor response has its better clinical implications.

3. Conclusion

As it provides netter masticatory efficiency and also helps in preventing traumatic occlusion. It also give patient a psychological benefit of having fixed prosthesis. Implants should be chosen very well according to the patient. As the success of the implant prosthesis depends on various factors. And the most important factor for the success of the implant prosthesis is maintenance of good oral hygiene. Patient should always be motivated for oral good oral hygiene, and for regular follow up after every desired period of time.¹⁻¹⁹

4. Source of Funding

None.

5. Conflict of Interest

None.

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