

Low Intensity Pulsed Ultrasound (LIPUS)- The Future of Dental Therapeutics

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Abstract: Low intensity pulsed ultrasound has been a therapeutic modality in various fields for many years.LIPUS has shown to have beneficial consequences on treatment of fractures, treating mal union and non-union of bone,condylar growth, repair and regeneration. LIPUS is one of the methods of tissue engineering which can help in the repair and regeneration of tooth supporting tissues. The aim of this paper is to enlighten and make clinicians aware of this newer modality and its uses. Also it aims at addressing the need for more research in this area for promising results.

Keywords: LIPUS,repair and regeneration, tissue engineering.

I. Introduction

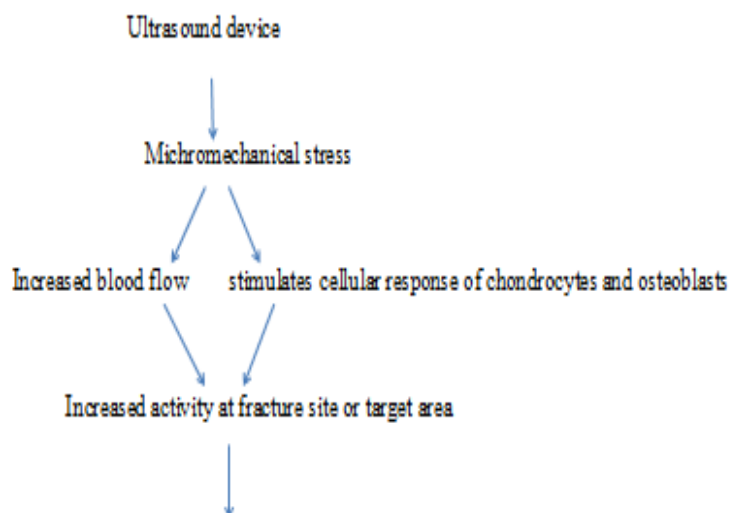
Dental diseases still remain to be one of the most common disease affecting millions of people. Pulp and periodontal diseases,decay and root resorption cause premature loss of teeth and compromises the quality of life. In the past few decades tissue engineering has been used in the dental field to get promising results. Tissue engineering is mainly any action taken to improve the biologic functions of any tissue. Out of the innumerable methods of tissue engineering available low intensity pulsed ultrasound (LIPUS) has shown promising results.¹Short bursts of ultrasound when targeted on a specific area such as root of tooth or bone have shown fracture healing acceleration and growth of tooth.

It has been found to be useful in:-

- 1.Repair of small fractures in the mandibular region.
- 2.Repair of root damage
- 3.Treatment of delayed union and bone non-union
- 4.Regeneration of the bone,periodontium, cementum, gingiva
- 5.Implant Osseo integration²

II.Method

A LIPUS device is a small handheld device with an attached cord head that emits ultrasound of 1.5 MHz frequency which sends pulses of width 200us, repeating for 20 minute sessions/day.



Fracture healing and repair

III. Mechanism

1.1 LIPUS and biologic mechanism-

Bone and cartilage cells in vitro are stimulated which indicates that direct anabolic effects are exerted by ultrasound like the production growth factors and other signaling molecules, osteogenic differentiation and extra cellular matrix production.³

1.2 LIPUS and bone regeneration-

Bone repair and regeneration, accelerated bone fracture healing, and enhanced osteogenesis at the distraction site have been demonstrated by in vivo studies. Also bone formation-related genes such as collagen type I and X, aggrecan, transforming growth factor beta , runt related gene-2, osteocalcin , insulin-like growth factor-I, bone sialoprotein and alkaline phosphatase have shown enhanced expression.¹

1.3 LIPUS and periodontal ligament regeneration-

Early cementoblastic differentiation of human immature cementoblasts from the periodontal ligament was induced by LIPUS because of the formation of substrate and increased alkaline phosphatase (ALP) activity which in turn caused regeneration of periodontal tissue destroyed by periodontal disease and the acceleration of the repair of root resorption.⁴

1.4 LIPUS and cementum regeneration-

COX-2mRNA expression and PGE2 production was significantly up-regulated because of LIPUS which in turn through through EP2/EP4 prostaglandin receptors pathway induced cementoblastic differentiation and matrix mineralization.⁵

1.5 LIPUS and gingival regeneration –

A report by Ikai et al. (2008) stated that LIPUS had a benefic effect on gingival epithelium cells, accelerating periodontal wound healing after flap surgery by a treatment protocol of 20 minutes for a period of 4 weeks.⁶By increasing the expression of connective tissue growth factor (CCN2/CTGF), an important gene for wound healing and angiogenesis in periodontal tissues LIPUS accelerates soft-tissue healing according to a study by Shiraishi et al. (2011).⁷

1.6 LIPUS and implant Osseo integration-

Area, bone volume and bone-implant contact ratio values significant parameters of histomorphometry have increased by LIPUS stimulation in tibial bone according to a study by Ustun et al. (2008) which further implied that healing around implants and osseointegration was better and faster.⁸

IV. Advantages

- 1.Less toxic
- 2.Low immunogenicity
- 3.Non-invasive
- 4.Target specific
- 5.Repeated application¹

V. Conclusion

LIPUS has shown to be a promising tool for the treatment of fractures of the hands, legs, and maxillofacial region. Literature still lacks the information regarding the potential effects of LIPUS on periodontal tissues. Few of the studies carried out enlighten us about the positive effects that it has on the tooth cell metabolism which suggests that LIPUS can be a very promising and friendly tool for tooth supporting tissues regeneration. The negative influences of LIPUS need to be studied further to eliminate any potential risks. When all these areas are studied and well researched upon, we believe that LIPUS can be an excellent biophysical technique and therapeutic as well as diagnostic tool for treating challenging maladies.

Acknowledgment

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