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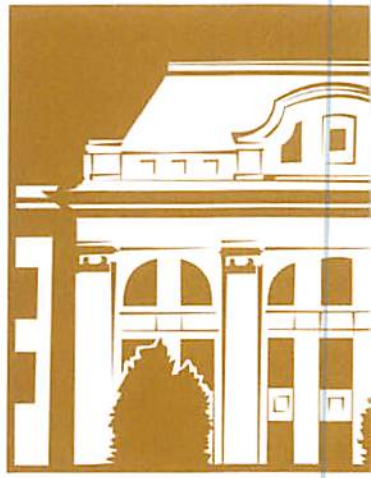

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Effect of Low Level Laser Therapy on Repair of Extraction Sockets Grafted with a Particulate Bone Allograft (Histologycal Study)

S. Boeriu

Phd Student, Private Practice in Cosmetic Dentistry and Implantology, Kitchener, Ontario, Canada

The aim of this study was to asses the clinical effectiveness of a low level laser therapy with respect to the acceleration of bone regeneration in dental post-operative particulate bone grafting of the extraction sockets. The stimulating effect of the red and near-infrared laser phototherapy on bone regeneration and growth has been shown in a number of in vitro and in animal studies. The stimulating effect of the red and near-infrared laser phototherapy on bone regeneration and growth has been shown in a number of in vitro and in animal studies.The effect of low level laser therapy on the regeneration of particulate bone allograft bone treated extraction socket has not been previously demonstrated. An OsseoPulse device Model AR 300 Bone Regeneration system was used daily for 21 days post extraction and socket grafting with a particulate allograft material (MinerOss, Biohorizons, Canada). Bone regeneration of the phototherapy treated and non treated sites were compared histological at different time intervals.
Histological evaluations of the extraction sockets grafted with a particulate allograft showed enhanced bone formation and a faster resorption rate associated with the low level laser therary treatment compared with the non low level laser therary treated socket. The acceleration of the bone healing in the low level laser therary treated sockets grafts may provide a faster implant placement compared to the non treated sites.

Keywords: low level laser, bone regeneration socket augmentation

Introduction

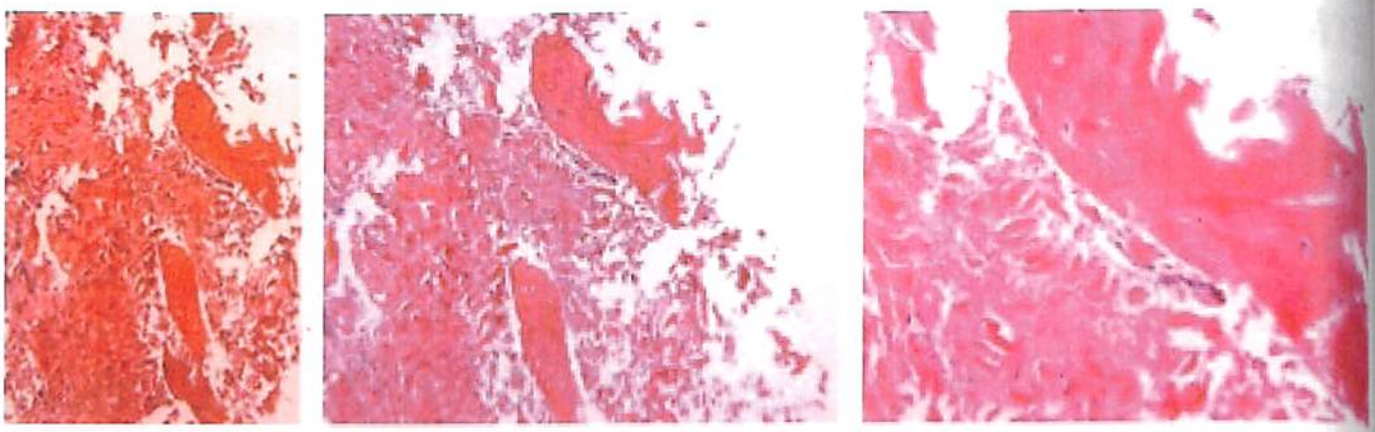
The successful placement and integration of the dental implants in the previously grafted extraction sockets require adequate time for the healing and sufficient regeneration of the bone. Multiple bone graft procedures and studies have been evaluated for socket augmentation at the time of the extraction. Some authors [1, 2, 3, 4] reported mixed results between different reports and also within each study groups. This range of results occur for several reasons and especially because not all extractions have the same clinical conditions. Different clinicians suggested different graft materials and different techniques based on the number of bonny walls remaining after the tooth extraction [4, 5, 6, 7]. A number of different studies showed that the healing time of an extraction socket grafted with a particulate allograft material can range from 4-6 months depending on the site of the defect [8, 9, 10, 11, 12]. A decrease in the time interval between the extraction /grafting time and the implant placement would be very beneficial to the patients. Experimental research has shown different methods to enhance bone regeneration such as mechanical stimulation [13, 14], electromagnetic fields [15, 16] low intensity ultrasound [17, 18] biological growth factors [19] and low level laser therapy [20].
The aim of the study is to asses the effectiveness of OsseoPulse (Bioloux extra oral light emitting diode) with respect to the acceleration of bone regeneration in dental postoperative particulate bone grafting (socket regeneration) and to collect qualitative feedback from the patients on the use of the device.

Material and method

The investigation aims at successfully evaluating a total number of 50 patients divided in two groups (25 in each group). Each patient will have a socket grafted with a particulate allograft material either in the maxilla or in the mandible. The patients selected for this study were between 20-60 years of age, non smokers, ASA classification II (one systemic condition controlled) with no active infection present at the time of the surgery. All the patients involved in this study signed an informed consent .
Treated group – will receive postoperative treatment with the OsseoPulse phototherapy with an intensity of 20mW/cm2 for 20 minutes per day for 21 consecutive days
Untreated group – will receive no treatment with the OsseoPulse device
The assessment of the percentage bone formation will be done in both groups at, 45, 60 days after the surgery by the means of a trephine biopsy of tissue sampled at midpoint followed by a histostomorphomeric analysis.

Surgical procedure protocol

An atraumatic extraction protocol was followed for all the patients. After the extraction , a close examination was performed to ensure that all the soft tissue or the infected granulation tissue was removed from the socket. Scraping of the socket wall with the curettes or a No. ½ round bur also produces a profuse bleeding known as the e regional acceleratory phenomena [7]. The particulate bone – MinerOss – wetted with saline was placed in the curetted socket and condensed with a Buser elevator. The socket was packed till 1-2 mm bellow the bone level to ensure the preservation



A B C

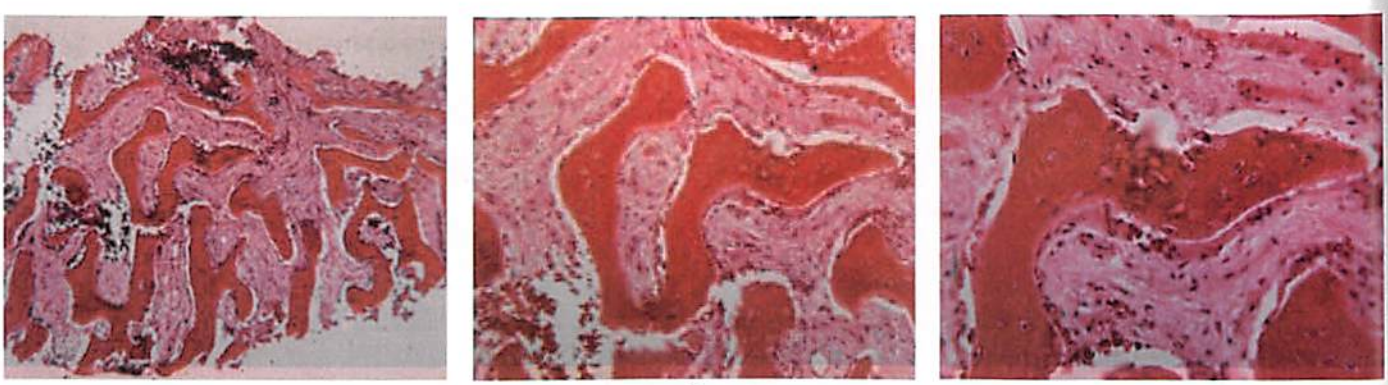
Fig. 1. Lamelar bone in a loose connective tissue and milde signs of inflammation
A: Magnification 6.3x, B: Magnification 10X, C: Magnification 25X

of the alveolar bone. A bioabsorbable collagen wound dressing – Colla Plug was placed over the bone graft to prevent the wash away of the augmentation material. The use of the collagen was suggested not only to protect the graft material but also to induce blood clot formation and stabilization of the wound [6, 7]. A cross mattress suture with 4.0 Vicryl was applied over the collagen dressing to ensure a complete wound coverage. The postoperative instructions include daily rinses with warm salt water for the next two weeks. The pain medication indicated was Ibuprophen 600mg as needed. Systemic antibiotic was not recommended since no active infections were present at the time of the surgery. The healing was uneventfull and two weeks after the extraction the sockets showed complete soft tissue coverage. For the patients in the treated group an OsseoPulse device was fitted in such a way to direct the light directly to the grafted site. The patients from the treated group were instructed to use the device daily for 21 days for 20 minutes per day. After a healing period of 60 days the patients were scheduled for a core biopsy (with a 2 mm trephine bur) and immediate implant placement. All the treatment performed was in the best interest of the patients. In such conditions no biopsies were taken without the immediate placement of a dental implant. If a site could be biopsied without compromising the long term success of the dental implant it was performed in a manner described above. If the situation dictated otherwise (not proper healing time) the site was not biopsied until a later date. The trephined biopsy cores collected from the middle of the sockets and stored in 10% formaldehyde fixative were submitted for histological analysis. All specimes were decalcified with 50/50 formaldehyde/formic acid sectioned and stained with hematoxylin-eosin (H&E) with longitudinal slides taken in the middle of the sample. Various anibodies were used to identify vascular (endothelial cells) structures (CD 31) and the CD 68 test was used to detect the presence of osetoblasts.

Results

Figures below reveal bone biopsy harvested 60 days after extraction and socket grafting of the control non phototherapy treated tooth. The specimen consists of irregular fragments of vital bone in loose fibrous connective tissue as well as shavings from calcified material wich is accellular. The fibrous connective tissue contains patchy chronic inflammatory infiltrate in dilated vascular channels. The avascular calcified shavings are interpreted to be remnants of the graft material. The diagnosis of this tissue sample is interpreted to be a vital lamellar bone with mild chronic inflammation of the marrow spaces (Figure 1).

Figures 4, 5 and 6 show the histology of the core sample taken at 60 days after the augmentation of a socket treated with LLLT phototherapy for 21 days.



A B C

Fig. 2. Abundant new bone formation without inflammation.
A: Magnification 6.3x, B: Magnification 10x, C: Magnification 25x

The specimen consists of abundant new bone formation without inflammation including immature bone with occasional partially nonviable bone consistent with regenerating bone. The diagnosis of the tissue was interpreted to be a vital reactive bone. Histologically the phototherapy treated site consisted of fragments of vital woven bone with plump osteocytes and osteoblasts in a loose fibrous stroma. No evidence of the grafted material is present. Furthermore there was no inflammatory cells present. The bony trabeculae seen are irregular in shape and are interpreted to represent reactive bone formation showing a large number of osteoblasts and osteocytes within woven bone.

Discussion

In this clinical study we have demonstrated the ostegenic response from the particulate allogenic grafted extraction sockets. The histological results showed that the sockets grafted with an allogenic material and treated with a low-level laser therapy produces significantly more bone and resorbed the particulate bone more quickly than the non treated sites. The acceleration of the bone formation and allogenic bone resorbtion is thought to occur through the increased metabolism and ingrowth of fibroblasts , neovascularisation and the increase in the local blood and lymphatic flow. The increase in the blood flow to the area increases the oxygen and also the nutrient concentration in the healing socket which leads to an optimal function of the fibroblasts, osteoblasts in the area and the formation of the new bone. Furthermore the increase in the respiratory chain in the mitochondria increases the level of the ATP production which results in a better function of the cells involved [21, 22, 23].

Conclusion

MinerOss is a suitable bone graft material for the socket augmentation technique. Grafting an extraction socket with MinerOss and covering the defect with a collagen dressing either a collaplug or a membrane results in the formation of new bone and the preservation of the alveolar ridge. The histological analysis shows that the sockets grafted with a particulate bone augmentation material (MinerOss) and treated with a photography device produces significantly more bone that the non treated sockets. Histological evidence suggests that in 60 days there is new bone formation in the extraction sockets treated with LLLT. Furthermore the treated sites exhibit much less residual bone graft material compared to the non treated sites. Clinical evidence shows that there is a faster healing and wound closure (soft tissue healing) for the sites treated with the LLLT versus the sites that are non treated. In the site treated with LLLT there is very limited or no inflammatory reaction. By treating the bone augmented socket with the OsseoPUlse device is possible to sped up the healing time and to safely place an implant at a earlier date resulting in a faster treatment of the patient.

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