EFFECT OF LASER ON IMPLANT OSSEOINTEGRATION AFTER POSTERIOR MANDIBULAR RIDGE EXPANSION

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ABSTRACT

Aim of the study: was to evaluate the effect of laser on implant osseointegration after posterior mandibular ridge expansion.

Patients and Methods: 14 postmenopausal females having posterior mandibular atrophic edentulous ridge seeking dental implants were included in this study. They were divided into 2 equal groups 10 implants in each. All patients had dental implants after the ridge expansion by motor screw expansion while, study group only received three LASER sessions after insertion of the implants. The bone density were evaluated, immediately, 45 days, 3 & 6 months postoperatively. The collected data were analyzed by t-test.

Results: Immediately after surgery, the mean values of bone density was 1056.1 ± 96.95 for control group and 1065.0 ± 116.14 for study group respectively. At 45 days, 3 & 6 months postoperatively, the mean values of bone density in the study group showed a statistically significant increase (p = 0.001) compared with the control group.

Conclusion: Application of LASER with motor screw expansion may play a positive role in the success of implant osseointegration after posterior mandibular ridge expansion.

INTRODUCTION

Many factors play important role in the success of implant like implant length, implant diameter, bone quantity and quality. Narrow ridge (horizontal bone defect) as a result of traumatic extraction or long standing period after extraction produces big problem for the operator to provide adequate space for the implant insertion and establish good prognosis for the implant osseointegration. The methods used to resolve this issue are the following: narrow implant placement, horizontal veneer block bone graft, horizontal guided bone regeneration (GBR), and the ridge splitting procedure (1,2).

So ridge splitting technique depends on splitting the bone trabeculae between two dense cortical bone present in the posterior mandibular region and
the expansion occurs rely on the concept of bone plasticity. This surgery restores the morphology of the lingual side of the alveolar bone and obtains not only aesthetic results, but also a housing effect exerted by the cortical bone of the bucco-lingual side, which improves the osseointegration of implants by providing an ample supply of blood circulation\(^3\). The ridge splitting technique involves a longitudinal osteotomy on the residual ridge with the use of hand instrument, microsaw, or ultrasonic device (piezosurgery)\(^4\)-\(^6\).

Osteotomes, chisels, horizontal spreaders or screw spreaders can be used for ridge expansion and lateral repositioning of the buccal bone plate in order to create a wider implant bed\(^7\). The ridge splitting technique requires a minimum of 3mm of bucco-lingual width with at least 1 mm of cancellous bone between the two cortical plates, which would allow introduction of instruments and the maintenance of good blood supply to the split parts\(^8\),\(^9\). Disadvantages of this technique are fracture and separation of the buccolinguinal bone during surgery are potential risks, so it is crucial to minimize these complications\(^10\) laser application associated with dental implant treatment have evolved significantly in recent years, aimed at affording comfort to patients by the use of lasers to reduce postoperative pain, edema and to solve postoperative problems such as paresthesia and peri-implantitis\(^11\).

Laser has also been studied as a biostimulator of osseointegration. Pinheiro et al. observed the effect of a laser diode, at 830 nm, 40 mW of potency and a 4.8-J/cm\(^2\) dose, on bone repair after implant placement in the tibiae of dogs; their results suggested that laser may improve bone healing at the tissue-implant interface in the early phases of wound healing.\(^12\) Khandra et al. observed the effect of low-level laser therapy (LLLT) on implant wound healing in an animal study with rabbits by using a GaAlAs diode laser device, and they reported that the results of tensile testing, histomorphometry and X-ray microanalysis showed that LLLT had a positive effect on the functional fixation of titanium implants in bones.\(^13\)

### AIM OF THE STUDY

Was to evaluate the effect of laser on implant osseointegration after posterior mandibular ridge expansion.

### PATIENTS AND METHODS

This study was carried out on 14 female patients age ranged 48-55 years with mean 52 years old. Patients were selected from those who were referred to the department of oral and maxillofacial surgery. The preoperative width of the alveolar ridge measured by cone-beam computed tomography ranged from 3-4 mm, which meant that there was sufficient cancellous bone (at least 1 mm) between the two cortical plates for separation while the width of the ridge was less than the optimal diameter for implantation (Fig 1). All patients were fit and had no systemic or local disease. Clinical and radiographic examinations have shown missing mandibular posterior teeth a long time ago. They have good oral hygiene, the patients were randomly divided into two equal groups (7 in each). Ten implants were inserted in each group following mandibular ridge expansion by rotatory screw expansion. In the study group the patient received LASER application sessions after insertion of the implant, while the second group acted as a control.

All patients were informed about the study procedures and the application of LASER. The principles of Helsinki Declaration involving human subjects were followed. All patients received thorough explanations and signed a written informed consent prior to surgery.

All patients were prepared preoperatively by scaling and root planning. For every patient a mouth wash (Chlorexidine glucomat 0.12%) was...
prescribed 4 times per day for a period of one week before surgery. One hour before surgery, all the patients received orally 2 gm of amoxicillin / clavulanate potassium and Dexamethasone via IM injection. Using local anesthesia, a slightly lingual crestal incision was performed. A buccal full-thickness flap was reflected to expose the alveolar ridge. The width of the alveolar Crest (2 mm below the summit) was measured using calipers. An initial osteotomy was made on the midcrestal bone and under copious irrigation with sterile saline the proposed implant site was marked with an initial bur (1.8 mm in diameter) at 800 rpm & torque 30Ncm. An initial rotatory tapered screw expansion (started by 1.8mm and ended by 2.6mm; Mr. Curette split master made in Korea) was used to expand the narrow ridge (Fig 2, 3). Successively larger rotatory tapered screw expansion in diameter were used to expand the osteotomy area to the desired diameter. Speed between 30-50 rpm with no irrigation. Then, the implant (Dentium implant system) was seated manually by screw driver to reach 2/3 of the implant length and completed by using wrench to be submerged 2mm below alveolar crest (Fig 4). A covering screw was used to plug the implant. Finally, the reflected flap was repositioned and sutured using 3/0 black Silk. Post-operatively antibiotics (amoxicillin / clavulanate potassium tablets 1 gm/12hr and anti-inflammatory drugs (Cataflam tablet 50mg two times/day) were prescribed for five days. At the second day after surgery, all patients were instructed to rinse 4 times per day with a mouth wash (chlorhexidine glucomat 0.12 %). Sutures were removed 7 to 10 days post-operatively. Two weeks after surgery, the dental prostheses were adjusted and refitted to be used by the patients.

Regular checkups were made on weekly bases during the first 45 days then at 3- 6 months post-operatively to evaluate the healing process of the surgical site and the osseointegration of the implants. For every patient, CBCT examination was made immediately after surgery and at 45 days, three and six months later. The CBCT was used to measure the bone density around implant (Fig 5). The LASER sessions (three sessions, one every 2 days) were started 2 weeks after surgery for the study group. The pre-adjusted time was 5 minutes. The buccal, lingual and the crestal aspects of the implants were subjected to the LASER beam (diode LASER 904 nm and average power 500 m watt, Gallium Arsenide system) while the applicator tip was moving in a continuous slow circular motion without touching the tissues (Fig 6).

For both groups, delayed loading the implant was done after three months. All gathered data for the two investigated groups were statistically analyzed via T-test.
RESULTS

In general, all the patients have tolerated uneventfully the surgical procedures and attended the follow up periods regularly. No serious complications have occurred either during or after surgery. A normal healing process of the soft tissue and bone around the implant was observed throughout the study.

As shown in table 1, the Immediate postoperative mean values and standard deviation of bone density in the control group, were \(1056.1 \pm 96.95\) while, they were \(1065.0 \pm 116.14\) in the study group. At 45 days after surgery, the mean values of bone density have increased to \(1416.7 \pm 92.70\) for study group and \(1155.6 \pm 120.4\) for control group. The difference between the two groups was statistically significant \((p = 0.001)\). After three months postoperatively marked increase in the mean and standard deviation values in study group more than that of control group as \(1888.9 \pm 105.9\) and \(1567.8 \pm 116.6\) respectively. At 6 months after surgery, the mean values of bone density have become \(2298.9 \pm 150.9\) for study group and \(1809.4 \pm 104.5\) for control group respectively. While t-test 63.974 and p-value was 0.001. The bone density values showed a statistical significant difference between the control and the study groups. This may indicates a positive role for LASER application in increasing the bone density at 45 days, 3 and 6 months after surgery.
DISCUSSION

The resultant longstanding of edentulous posterior mandibular ridge is the reduction of the alveolar ridge dimensions due to bone resorption, height is complicated by the presence of inferior alveolar canal which will add reduction in the height of alveolar ridge available for the future implant, also alveolar ridge width becomes more narrow which needs additional surgical techniques for reconstruction implant placement. All these factors affect on the prognosis of implant osseointegration.

Many techniques can be used for expansion of the narrow ridge as ridge splitting technique in which a chisel, microsaw, or screw expander can be used. Ridge expansion provides normal facial contour of the ridge as the buccal surface expanded laterally to gain wider bed suitable for implant placement. Jensen et al reported that ridge splitting should be applied primarily to the maxilla as the outcomes are poor in the mandible due to abundance of the cortical bone and if slow mandibular expansion was performed manually rather than with mallet successful results can be obtained.\(^\text{14}\) Young-Kyun and, Su-Gwan concluded that the ridge expansion technique is a stepwise technique using screws of gradually increasing width, so it has a lower risk of cortical bone fracture than the ridge splitting technique. Therefore, ridge expansion technique is considered to be an acceptable method to use on the mandible.\(^\text{15}\)

While Nishioka and Souza mentioned that improvement in ridge expansion techniques using screw spreaders appear promising for increasing the bone width of a ridge. All fixtures in the their study achieved strong primary stability with a suitable bone-to-implant facial and palatal contact when the screw spreading technique was used.\(^\text{16}\)

This in agreement with the present study results as the bone around the implants showed high bone density values measured by CBCT recorded in control group. Also the clinical results of the present study showed no serious complications have occurred either during or after surgery. This agrees with the study results by Nishioka and Souza as they reported that this technique represents a means of shortening surgical time, lessening the financial cost of treatment, and limiting surgical trauma to the patient. Yong-Deok et al concluded from their experimental study that the application of low-level laser (LLL) during the osseointegration of the dental titanium implant and the surrounding bone tissue resulted in the expansion of metabolic bone activity and increased the activity of bone tissue cells.\(^\text{17}\) El-Kholey and El-Shenaway mention their study results that low laser therapy appears to produce highly reactive and vital peri-implant bone tissue that can be expected that it could reduce healing times and speed up osseointegration of the implants, they concluded that The application of the diode laser to the endosseous implant can preserve the

<table>
<thead>
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<th>Study</th>
<th>Control</th>
<th>T. test</th>
<th>P. value</th>
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<td>Bone Density Immediately</td>
<td>1065.0 ± 116.14</td>
<td>1056.1 ± 96.95</td>
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<tr>
<td>Bone Density 45 days</td>
<td>1416.7 ± 92.70</td>
<td>1155.6 ± 120.4</td>
<td>26.574</td>
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<td>Bone Density 3 months</td>
<td>1888.9 ± 105.9</td>
<td>1567.8 ± 116.6</td>
<td>37.411</td>
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</tr>
<tr>
<td>Bone Density 6 months</td>
<td>2298.9 ± 150.9</td>
<td>1809.4 ± 104.5</td>
<td>63.974</td>
<td>0.001</td>
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bone around the implant and may aid in improving the longevity of the implants. This agrees with the present study results as the bone density around the implant in study group showed marked significant increase in values more than that of control group throughout study intervals.

CONCLUSION

Application of LASER with motor screw expansion may play positive role in the success of implant osseointegration after posterior mandibular ridge expansion.

REFERENCES