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The Effect Of Photobiomodulation Therapy In Alveolar Cleft Bone Grafting: A Case Report

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Abstract:
Background*: Alveolar cleft grafting (ACG) has grown in popularity and success, and it is now widely acknowledged as a critical component in the treatment of patients with clefts, as well as lip and palate repair.* [(1)] *Alveolar cleft (AC) is usually a cleft in the alveolar bone in the position of the upper lateral incisor or the upper canine. The AC should be closed by grafting for many reasons including providing bone for the upper canine or lateral to erupt through, directing the tooth into this position, thus avoiding any future prosthesis, helps closure of oro-nasal fistula and in case of bilateral cases, it aids in stabilizing the premaxilla, better hygiene, support for teeth roots during orthodontic treatment and allow for one-piece upper jaw for better stability during orthognathic surgery.*[(2)] *Photobiomodulation therapy is a form of light therapy that utilizes non-ionizing forms of light sources, including lasers in the visible and infrared spectrum. It is a non-thermal process involving endogenous chromophores eliciting photo physical (i.e., linear and nonlinear) and photochemical events at various biological scales. This process results in beneficial therapeutic outcomes including alleviation of pain, inflammation, immunomodulation, and promotion of wound healing and tissue regeneration.* [(3)]
Materials and Methods*: The Cleft Care Center (CCC) affiliated to the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Ain Shams University, Cairo, Egypt, operated on a patient with bilateral AC*
Conclusion: *Photobiomodulation (LLLT) is an adjunctive therapy can be used in alveolar cleft grafting Surgeries to enhance the success rate through assessment of soft tissue healing clinically and sufficient formation and bone fill in 2D.*
Key Word*: alveolar cleft grafting , Photobiomodulation therapy, low level laser therapy*

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I. Introduction

The incidence of cleft lip and palate (CLP), which affects 1 in 700 newborns, makes it one of the most prevalent congenital defects [(4)]. Secondary ACG is widely accepted among surgeons and is considered as the gold standard of care. The advantages provided by ACG includes providing the basic benefits of the ACG procedure. It also puts into considerations the important aspects of dental and maxillary development. [(5,6)] Iliac cancellous bone graft remains the gold standard in alveolar cleft grafting, no study showed the superiority of any other bone origin over iliac cancellous bone. [(7)] Photobiomodulation therapy is non-invasive and has been shown to decrease inflammation and provide pain relief. Therefore, treatments of tendinopathies, nerve injuries, osteoarthritis, and wound healing could all benefit from the use of laser therapy on tissues. Mild side effects from the therapy can include cutaneous irritation, itching, and redness, which are not very harmful and do not result in a rise in temperature of the target tissue. [(8,9)]

II. Material And Methods

The Cleft Care Center (CCC) affiliated with the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry,Ain Shams University, Cairo, Egypt, operated on, a patient with bilateral AC.

Study Design: Case report.

Study Location: cleft care center, department of oral and maxillofacial surgery, ainshams university.

Inclusion criteria:

- Patients having age group range from 8-13 years old.
- Unilateral or Bilateral
- Boys or girls.

- Sufficient transverse maxillary width was present before surgery.
- No history of malignancy
- No history of previous ACG operations
- Good oral hygiene

Procedure methodology

we'll be discussing the surgical procedures for better presentation ofthe proposed technique and LLLT application during our procedure. Patient operated under general anesthesia at faculty of dentistry, ain shams university, Egypt.

The Surgical technique:

There were two surgical teams operating simultaneously to minimize the time of the operation.

Alveolar cleft site preparation:

It included the creation of a pyramidal defect for ACG, based on the technique described by Morselli et al. [(2)] The cleft area was exposed widely through incisions within the cleft edges. Then flaps were designed and raised to reconstruct the nasal floor, palatal wall of the defect, attachedgingiva and the labial mucosa sufficiently.

Labial side preparation:

A sulcular incision was performed on both labial sides of the alveolarcleft, followed by papilla sparing sulcular incisions which is extended posteriorly to the first permanent molar toothon both sides, with vertical releasing incisions anteriorly, made within the cleft edges separating the oral and nasal mucosal layers.

The width of the flap was at least two times the width of the alveolar cleft to minimize tissue tension. In bilateral cleft lip and palate (BCLP) cases, it was critically important to preserve the mucoperiosteum over the premaxilla to prevent disruptingits blood supply, Thus, minimal mucoperiosteal elevation was performed on the edges of the labial surface of the premaxilla.

In addition, dissection between the labial flaps and the nasal mucosa within the area of the alveolar cleft increased coverage. This dissection was carried out with a combination of blunt and sharp dissection directed to expose the anterior nasal spine using Metzanbaum and Iris scissors.

Palatal side preparation:

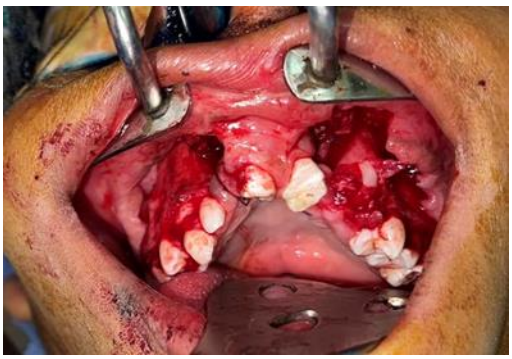
A palatal sulcular incision was made on each side of the alveolar cleft reaching at least two teeth mesial anddistal to the defect. The palatal mucoperiosteal flaps were reflected caudally with simultaneous dissection between the nasal mucosa and the palatal mucosa.

Once the palatal flaps were separated from the nasal mucosa, these flaps were sutured (using 4-0 Polyglycolic Acid suture with cutting needle.) together in interrupted manner (knot towards the oral cavity). Henceproviding the palatal wall of the pyramidal defect.

Nasal side preparation:

The nasal mucosa was reflected cranially to reconstruct the nasal floor and ONF was closed if present. (Using 5-0 Polyglycolic Acid suture with round needle.)

Methylene blue dye was injected from the nose to ensure watertight closure of the nasal layer in the alveolarcleft region before the graft placement.



Bone Harvesting:

The second team performed harvesting simultaneously with the alveolar cleft site preparation. Autogenous cancellous bone chips from the anterior iliac crest (AIC) were harvested via an open approach which is the "MedialCortico-cancellous Approach". [(10)]

Prior to the incision, injection of Bupivacaine Hydrochloride Local Anesthetic with vasoconstrictor subcutaneouslywas done.

A slight medial pull was done using the hand placed on the iliac fossa to elevate the skin over the iliac bone crest.The assistant role was pulling the skin during making the incision medially, thus making the scar

beneath the iliaccrest prominence and thus below the belt level for trousers and skirts. This was to prevent future irritation of the scar.

Incision was made initially over the AIC and extended to the deep fascia, which eventually was incised.

The wide musculofascial attachment of the abdominal wall muscles to the iliac crest was delineated and any fattycovering should be removed and cleared to allow better exposure of the attachment of this fascia.

The Periosteal incision was made between the External abdominal oblique and Tensor Fascia Lata muscles. Elevation of the External abdominal oblique abdominal muscle together with the Transversus Abdominus wasachieved and reflected to the medial crest edge, while leaving the Tensor Fascia Lata muscle intact without elevation; to avoid any gait disturbance.

At this point, a periosteal elevator was turned downward to reflect the Iliacus muscle to a length of 5 cm and aTessier retractor is placed to expose the entire medial cortex.

The osteotomies were then outlined in the medial cortex to correspond to the dimensions of the recipient site

The anterior vertical osteotomy was placed 2cm posterior to the Anterior Superior Iliac Spine; to avoid injury to theInguinal Ligament and fracture of the Sartorius muscle attachment at the fossa beneath the Anterior Superior Spine.Then superior horizontal, inferior horizontal and the posterior vertical osteotomies were done to yield a cortico- cancellous block and to expose the cancellous marrow.

Bone gouges were used in a rotating rest manner to remove large particles of cancellous marrows, then bone curetteswere used to harvest the remaining cancellous marrow which is stored in a solution consisting of 0.9% Sodium Chloride isotonic solution in addition to Gentamicin antibiotic.

The Cortico-cancellous block was the scrapped using a disposable bone scrapper for removal of the cancellous partto facilitate the use of the cortex above the cancellous graft in the cleft area.

The cancellous bone was placed and compressed in a plastic syringe to calculate the total volume of bone and to aidin the handling and placement of the graft into the recipient alveolar cleft site.

In the group of patients operated from 2018 , fat from the subcutaneous tissue at the incision margin was dissected freely to be placed in the recipient site above the graft composed of cancellous part filling the defect and cortex covering the defect and fixated with self-drilling mini screws as a barrier membrane before the closure of the mucoperiosteal flaps.

Drilling of holes:

Drilling of bur holes in the available bone bordering the recipient site was done using surgical round burs (size 2-3)and irrigation using 0.9% Sodium Chloride isotonic solution to accelerate healing and graft incorporation (RegionalAcceleratory Phenomenon) which is an important step Before the insertion of the graft in the donor site.

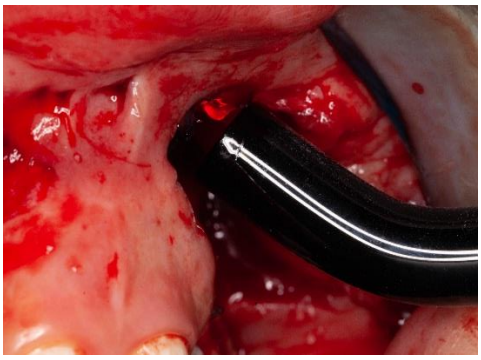
Laser application:

- Laser application to the recipient site to enhance vascularization to the bone before graft placement
- Laser Irradiation was done by diode laser 660nm (Sirolase Blue, Dentsply Sirona). The therapy light guide tip was used for laser delivery with a laser beam diameter of 8mm with an irradiation area (spot size) of 0.5cm2
- The following laser parameters and setting were used: power (100mW), irradiation time (20 sec), energy (2J), energy density (4 J/cm2), in contact mode.

Graft placement:

Packing of the cancellous graft into the prepared alveolar clefts sites against the reconstructed nasal floor was doneuntil slight overfilling was accomplished.

The cortex was then placed as an on lay graft and fixed in the bone adjacent to the cleft site by 1-2 self-drillingscrews (2.0mm diameter and 5-7mm length). Then the fat graft was placed over the bone graft.Laser application over the cancellous bone to enhance osteogenesis and promote cellular proliferation during the inflammatory phase.



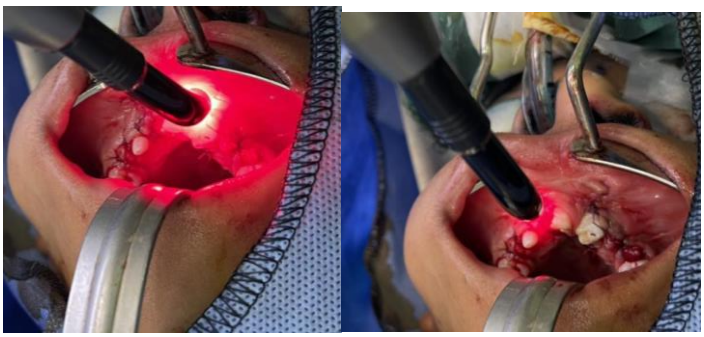
Donor site closure:

1. Hemostasis was achieved by cauterization and local hemostaticmeasures as bone wax and/or gel foam packing.
2. Closure of the muscular layer by 4-0 Braided Polyglycolic Acidsutures followed by suturing the fascial and subcutaneous layers.
3. Finally, skin closure was achieved by 5-0 blue Poly-Propylene sutureon a cutting needle in subcuticular manner.

Recipient site closure:

The gingival mucoperiosteal flaps were sutured in advanced position medially tocover the graft using 4-0 – 5-0 Braided Polyglycolic Acid2 suture on a round needle in an interrupted manner.

Laser application with the same radiation protocol after closure of the recipient site to enhance early soft tissue healing and minimize postoperative complications (fistula, edema, dehiscence and pain).



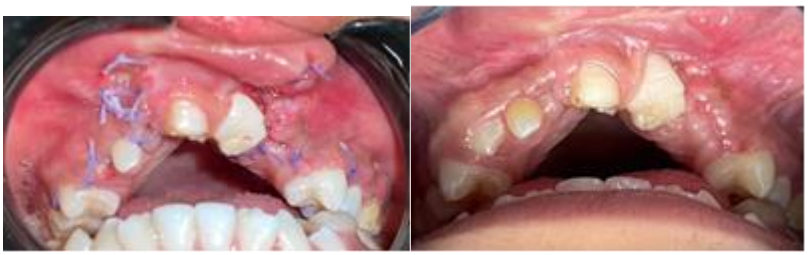
Statistical analysis:

Categorical and ordinal data were presented as frequency and percentage values. Categorical data were analyzed using Fisher's exact and McNemar's tests for inter and intragroup comparisons respectively. Ordinal data were analyzed using Mann-Whitney U test. Inter-observer reliability analysis was done using weighted Kappa coefficient. The significance level was set at $p \leq 0.05$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows. [(11)]

III. Result

Clinical examination:

1. At the recipient site: , Soft tissue healing was optimum ranging between very Good and excellent (**Tissue color:** 25% of gingiva reddish Pink – **Response to palpation:** No bleeding - **Incision margin:** No connective tissue exposure & No granulation tissue), mostly related to meticulous LLLT application with frequent observation on 24hr ,48hr, 72 hr. post-operatively and oral hygiene instructions. Soft tissue assessed according to clinical healing index by Landry et el. [(12)]. Wound healing was optimum within one week and sutures were removed 1 week post-operatively.



2 days postoperative

1 week postoperatively

Radiographic Assessment:

According to Bergland scale:

According to CBCT, reading was measured from the nasal floor which is the basal level, coronally was the interdental bone this was the height of the formed bone, width was the mesiodistal measurement between roots of the teeth (mid-level Interdentally) and the depth was the Bucco palatal dimension at the mid-level ofthe formed bone. The bone level followed low level laser therapy application was type II according to Bergland scale which These measurements were done by two examiners with a Pearson's correlation coefficient of 0.968 which shows thatthere was a moderate and acceptable agreement between the examiners.

IV. Conclusion

Photobiomodulation (LLLT) is an adjunctive therapy can be used in alveolar cleft grafting Surgeries to enhance the success rate through assessment of soft tissue healing clinically and sufficient formation and bone fill in 2D.

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