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CONVENTIONAL BUR ALVEOLOPLASTY VERSUS CONSERVATIVE SUBPERIOSTEAL PIEZOSURGICAL ALVEOLOPLASTY – A COMPARATIVE STUDY

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ABSTRACT:

Background: Alveoloplasty is a term for pre-prosthetic surgical procedure following the extractions, that involves smoothening of rough alveolar bone on the edentulous area or trimming of bulbous tuberosities, which creates deep undercuts. In this study, conventional alveoloplasty technique involving crestal and releasing incision followed by mucoperiosteal flap elevation and bone contouring with round bur was compared with subperiosteal tunneling and piezoelectric bony contouring with piezo tips with respect to various parameters such as time for the procedure, healing of soft tissues, post-operative pain, and other post-operative complications. Material and Methods: The study comprised 16 edentulous patients having bilateral requirements of alveoloplasty on the alveolar ridge in the same jaw. Alveoloplasty was performed by round bur no.8 size on one side. In the same sitting the alveoloplasty on the contralateral side of the arch was done by US4 & US5 piezosurgical tips through the subperiosteal tunnel technique. Results: The post-operative sequelae such as pain, healing, and time were significantly high in the conventional group and swelling was equal in both groups. Conclusion: Piezosurgery unit is available in most of maxillofacial surgical setups. Wherever indicated tunneling technique with piezosurgery should be kept as an option for alveoloplasty.

Keywords: Alveoloplasty; Pre-prosthetic Surgery; Piezosurgery; Alveolar Ridge Recontouring; Bony Prominences.

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INTRODUCTION

In 1976, Michael and Barsoum used a variety of surgical procedures, such as

1) straightforward extractions without additional surgery, to measure the amount and duration of postoperative bone resorption and ridge shape alterations in patients wearing immediate dentures.
2) Labial cortical alveolectomy and extractions
3) Extracciones con el alveolectomy intraseptal de Dean

The phrase "primary alveoloplasty" refers to the trimming and removal of the labiobuccal alveolar bone, as well as some interdental and interradicular bone, which is done at the time of tooth extraction. Secondary alveoloplasty refers to bone correction surgery performed on the edentulous ridge for irregularity following the start of extraction socket healing. The crestal incision with or without releasing incisions and reflection of a full thickness mucoperiosteal flap are necessary for the secondary alveoloplasty technique. Massive saline irrigation is used to eradicate gross bone imperfections.

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reflection of a full thickness mucoperiosteal flap are necessary for the secondary alveoloplasty technique. Massive saline irrigation is used to eradicate gross bone imperfections. When doing radical alveoloplasty, the alveolar ridge with teeth or the edentulous ridge may both receive the considerable excision of alveolar bone. The radical alveoloplasty entails removing the teeth and doing the bone excision. Depending on the severity of the irregularity in the bone, a rongeur, bone file, handpiece with bur, or a mallet and osteotome are the most used devices for alveoloplasty.

Piezoelectric bone surgery is a sophisticated technique that uses ultrasonic microvibrations to precisely cut bone while causing little to no soft tissue damage. By altering ultrasound technology, an Italian oral surgeon named Tomaso Vercellotti developed piezo surgery in 1988 to get beyond the restrictions of traditional instrumentation in bone surgery. The piezo unit operates between 25 and 29 kHz, with microvibration amplitudes between 60 and 200 mm/s. When this frequency is used, soft tissues are not damaged. Oral and maxillofacial surgeons use piezoelectric devices in their clinical work for procedures like sinus lift, bone graft harvesting, osteogenic distraction, orthognathic surgery, periodontal surgery, inferior alveolar nerve decompression, cyst removal, exposure of impacted canines, dental extraction, and removal of impacted teeth. Selective cutting is the piezoelectric device's most novel feature. Piezosurgery may cut soft tissues including arteries, nerves, and mucosa but not mineralized tissues like bones. It works by the ability of some crystals and ceramics to deform when an electric current is delivered through them, which causes microvibrations at an ultrasonic frequency. Following ultrasonic surgery, bone structure preservation, which reflects osteosynthesis levels, promotes quicker recovery. This device's special ability to cause micro-coagulation due to the "cavitation effect" results in a surgical field devoid of blood. The constant swirling motion of a fluid caused by a tiny vibrating insert that favours a mechanical action of debris removal creates the micro-streaming. When used properly, the cavitation phenomenon—which is brought on by the implosion of gas bullae into blood arteries during osteotomy—produces a significant hemostatic impact to enhance intra-operative visibility. Piezo surgery has unusual cavitation and microstreaming phenomena. The development of piezoelectric bone surgery was primarily guided by two essential ideas in the field of bone microsurgery. The first is minimally invasive surgery, where enhanced tissue repair results in significantly lower postoperative pain and swelling compared to older procedures, eventually lowering patient suffering. Surgical predictability is the second idea that boosts therapeutic effectiveness. Controlling the instrument easily results in less bleeding and more accurate cutting, which ultimately results in superior tissue healing.

In order to create the subperiosteal flap that might serve as a pocket for graft materials during the partially blind subperiosteal tunnelling technique, it is necessary to be patient and perform careful surgical manoeuvres. Despite the fact that this bone augmentation prevents a direct view of the ridge that is lacking, it has the benefit of reducing postoperative problems such bleeding, discomfort, bone loss, and recovery time. In order to augment the underdeveloped alveolar ridge, the authors used a minimally invasive access technique called subperiosteal tunnelling. Using a periosteal elevator, they prepared a subperiosteal cavity. A variety of bone graft material was then placed inside the tunnel. To access the bone spicule and execute alveoloplasty using a contrangled piezo blade, a similar approach is performed. This less invasive sutureless procedure has the benefit of a quicker recovery and less postoperative pain. In this study, subperiosteal tunnelling and piezoelectric bony contouring with piezo tips were compared with conventional alveoloplasty technique, which involves crestal and releasing incision followed by mucoperiosteal flap elevation and bone contouring with surgical round bur, with respect to various parameters, including time for procedure, healing of soft tissues, post-operative pain, and other post-operative complications.

Materials and Methods

The study comprised of 16 edentulous patients having bilateral requirements of alveoloplasty on the alveolar ridge in the same jaw. Alveoloplasty was performed by round bur no.8 size on one side. In the same sitting the alveoloplasty on the contralateral side of the arch was done by US4 & US5 piezosurgical tips through the subperiosteal tunnel technique. Post-operative swelling & pain were evaluated on 1st , 3rd and 7th post operative day. Healing was assessed using Landry et al index on the 3 rd & 7 th post operative day. Time was calculated from start of incision to the end of the procedure. Other complications were also noted.

Inclusion criteria

- Patients with bilateral requirements of alveoloplasty having similar clinical presentation.
- Under ASA grade I & ASA grade II
- Patients who agree to come for regular follow-up.

Exclusion criteria

- Patients with pacemaker or any other implantable electronic devices.
- Patients with history of an allergy to Local Anesthesia and to any medication that were to be prescribed.
- Non co-operative patients.
- Patients not willing to give consent for the study.

Both the surgical procedures, conventional bur alveoloplasty and alveoloplasty using piezosurgery were performed in the same surgical session. Patients were alternatively allocated to the following 2 groups :

Group A – Conventional site of arch where alveoloplasty was done by round bur size of no.8.

Group B – Piezosurgical site of arch where alveoloplasty was done by US4 & US5 piezosurgery tips. (Surgic Touch Woodpecker Piezo Bone Surgery)

Surgical Procedure

The patient underwent oral antibiotic prophylaxis with 1-gram amoxicillin or 1-gram erythromycin (for patients allergic to penicillin) 1 hour before surgery.

Before beginning with the surgical procedure, the oral cavity was rinsed thoroughly with 0.2% chlorhexidine gluconate mouthwash for 10 seconds. Standard painting and draping of the patient was done. The procedure was performed under local anesthesia. (2% lignocaine hydrochloride with 1:80,000 adrenaline)

For Group A : Once the complete anaesthesia of the planned surgical area was achieved, crestal and releasing incisions were given using scalpel no.3, with 15 no. blade and full thickness flap was reflected. Bony contouring was done by round bur no. 8 under copious irrigation. The area was curetted and irrigated with sterile 0.9% saline solution post-surgically. The flap was approximated and secured with nonresorbable suture (3-0 silk suture).

For Group B: A stab incision was placed mesial or distal to the irregular bone required for alveoloplasty, with 15 no. blade. A small sized tip of periosteal elevator was passed underneath the stab incision, and subperiosteal tunneling was done until the prominent bony region was reached. The piezo tip (US4/US5) was inserted through the subperiosteal tunnel up to the bony spicule. The bony contouring was done carefully in a unidirectional motion of piezo tip. The motion was continued until the uniformity of the ridge was reached and was determined by digital palpation. No sutures were given. The surgical procedure was timed from start of incision to the end of the procedure. Both the surgical procedures, conventional bur alveoloplasty and alveoloplasty using piezosurgery were performed in the same surgical session.

Results

Both the groups were statistically analyzed for following parameters and data was analyzed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$.

Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Since the data was following Normal distribution parametric test were used for the data analysis. Inferential statistics to find out the difference within the group done by REPEATED MEASURES OF ANOVA followed by TUKEY'S HSD POST HOC TEST. Between group comparison was done using Independent t test and Paired t test.

1. Post-operative pain comparision.

A. Intergroup Comparison

i. 1 ST day post-operatively, the mean pain score was for Group A was 3.75 and for Group B was 2.5, showing statistically significant results (P value 0.0001).

ii. 3 rd day post-operatively, the mean pain score for Group A was 2.56 and for Group B was 1.43, showing statistically significant results (P value 0.0001).

iii. 7 th day post-operatively, the mean pain score for Group A was 1.06 and for Group B was 0.68, showing statistically significant results (P value 0.0001). It was concluded that post-operative pain in Group B was less as compared to Group A.

B. Intra-group Comparison

1. For Group A

I. 1st day vs 3rd day post-operative pain showing statistically significant results (P value 0.0001).

II. 1st day vs 7th day post-operative pain showing statistically significant results (P value 0.0001).

III. 3rd day vs 7th day post-operative pain shows statistically significant results (P value 0.0001).

2. For Group B

I. 1st vs 3rd post-operative pain shows statistically significant results (P value 0.0001).
II. 1st vs 3rd post-operative pain shows statistically significant results (P value 0.0001).
III. 3rd vs 7th post-operative pain showing nonstatistically significant results. (P value 0.003). It may be concluded that there is gradual reduction in pain in both the groups.

2. Comparision of Swelling

A. Inter-group Comparison

I. Pre-operative measurements for Group A was 12.17 and for Group B was 12.20 shows statistically nonsignificant results in both groups (P value 0.88).

II. 1 st post-operative swelling measurements for Group A was 12.70 and for Group B was 12.54 shows statistically non-significant results in both groups (P value 0.79).

III. 3 rd post-operative swelling measurements for Group A was 13.23 and for Group B was 13.07 shows statistically non-significant results in both groups (P value 0.54).

IV. 7 th post-operative swelling measurements for Group A was 12.24 and for Group B was 12.27 shows statistically non-significant results in both groups (P value 0.88).

B. Intra-group Comparison

1. For Group A The intragroup comparative analysis for group A regarding swelling showed non-significant results statistically.

2. For Group B The intragroup comparative analysis for group B regarding swelling showed non-significant results statistically.

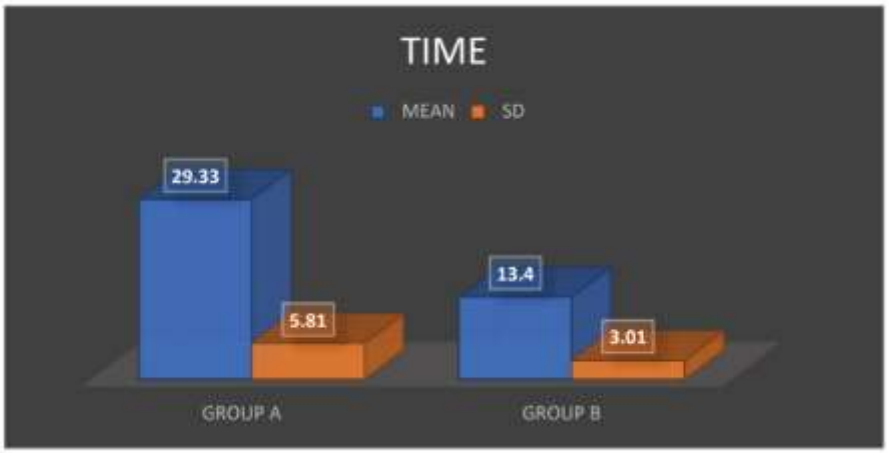
3. Comparison of Healing

Statistical analysis showed that mean healing score in group A is 3.31 , 4.43 on 3rd & 7th post operative day respectively and in group B is 3.68, 4.48 on 3rd & 7th post operative day respectively. Statistical analysis of mean healing was done using paired t test (within the group) test and reported a significant difference within both the groups ($P<0.05$). Between group analysis was done using independent t test and significant result was observed at 7th day ($p<0.05$).

It was concluded that both clinically and statistically significant piezosurgery quadrants had improved tissue healing when compared to quadrants operated using conventional methods. The substantial amount of osteoblasts and osteocytes that survive enhances the speed and effectiveness of bone repair, and the soft tissue that is spared heals wounds more quickly.

4. Comparison of Time

Statistical analysis showed that the duration of surgery is less in group B as compared to group A and proven to be statistically significant. The mean time for group A is 29.33 mins with standard deviation of 5.81 whereas in group B it is 13.4 mins with standard deviation of 3.01. In this study for conventional group full thickness flap was reflected and then alveoloplasty was performed thereafter suturing was done. So, time taken was more as compared to piezosurgical group where alveoloplasty was done through the subperiosteal tunnel technique and no suture was given. The piezoelectric unit has a built-in irrigation system, so less instrumentation is needed and manual irrigation is not necessary. This system maintains a clean field of vision during the surgery and shortens the intraoperative period.



Discussion

Clinicians often perform tooth extractions for a variety of reasons, including root fractures, periapical pathology, extensive decay, periodontal disease, or trauma. Despite employing gentle techniques for tooth removal, the natural process of bone resorption, both vertically and horizontally, unavoidably occurs.

Bony spicules and undercuts are formed on the ridges following extraction which causes pain and hinders in the rehabilitation of oral cavity. Various pre-prosthetic surgeries are performed to correct these defects such as ridge correction, ridge extension and ridge augmentation. One commonly employed technique for ridge correction is alveoloplasty, which involves reducing or eliminating the labiobuccal alveolar bone, along with some interdental and interradicular bone. Alveoloplasty, utilizing a rounger and bone file, has been a well-established method for over a century. However, drawbacks such as inadequate or excessive bone removal, suboptimal reshaping, potential harm to adjacent soft tissues, and prolonged surgical duration have been associated with this approach. Pre-prosthetic surgery entails the preparation of a patient's oral cavity to facilitate the insertion of a denture or prosthesis. In order to attain the utmost comfort for certain patients prior to the placement of a partial or complete denture, minor oral surgical procedures may be necessary. Among pre-prosthetic surgical interventions, alveolectomy or alveoloplasty is the most frequently employed technique. The introduction of interseptal alveoloplasty by Sir O. T. Dean marked a transformative shift in alveoloplasty practices. Dean advocated for an approach that emphasizes preserving the labial cortex while sacrificing the interradicular medullary bone to achieve an optimal alveolar ridge shape. Particularly well-suited for immediate dentures, Dean's interseptal alveoloplasty holds significant advantages.

Obwegeser proposed a variant of Dean's procedure in 1966 for cases of extensive premaxillary protrusion, in which both the palatal and labial cortices were broken and repositioned. Piezosurgery, a technology rooted in the piezoelectric effect discovered by Jean and Marie Curie in 1880, functions on the principle that certain ceramics and crystals undergo deformation when subjected to an electric current. This deformation leads to ultrasonic frequency oscillations. These oscillations are then amplified and transmitted to a vibrating tip. When this tip is gently applied to bone tissue, it induces a cavitation phenomenon, resulting in a cutting effect that solely affects mineralized tissue. The linear vibrations of the tips exhibit a horizontal range of 60 to 200 micrometers and a vertical motion of 20 to 60 micrometers. The ultrasonic tip maintains a controlled vibration speed of 60 to 200 mm/sec, specifically designed to selectively cut mineralized tissue while preserving adjacent soft tissues from damage. Frequencies surpassing 50 kHz are exclusively capable of cutting neurovascular and other soft tissues. Additionally, the vibration amplitude is adjustable within the range of 30 to 60 micrometers.
According to a prospective study by Waite and Cherala, the authors stated that tight closure over a large bony socket or defect does not facilitate drainage and oral hygiene. Suturing may create a one-way valve that allows food debris to enter the socket but not easily escape which may lead to local infection, inflammation, edema, clot necrosis, alveolar osteitis, and pain. A small flap left open without suturing may facilitate drainage, improve hygiene, and reduce the risk of pain associated with alveolar osteitis. Hence, we performed a sutureless alveoloplasty technique in this study.

Piezosurgery unit is available in most of the maxillofacial surgical setups. Wherever indicated tunneling technique should be considered as a viable option for alveoloplasty.
This innovative approach warrants encouragement among surgeons for its adoption in alveoloplasty procedures, supplanting conventional methods.

Conclusion :
Piezosurgery unit is available in most of the maxillofacial surgical setups. Wherever indicated tunneling technique with piezosurgery should be kept as an option for alveoloplasty. It's a novel technique and surgeons must be encouraged for its use in alveoloplasty over conventional methods.
Conflict of interest All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.
Ethical Approval All procedures performed in studies involving human participants were in accordance with ethical standards of the institutional and/ or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.
Informed Consent Informed consent was obtained from all individuals participants included in the study. Patients signed informed consent regarding publishing their data and photographs

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