RESEARCH PAPER

Effect of osteotomy technique selection on intraoperative time and surgeon comfort ability in Post cleft anterior maxillary distraction

Khaled Ibrahim Barakat[1], Ayman Magdy Aly[1], Diaa El Saied[1*]

1. Oral and Maxillofacial Surgery, Faculty of Dentistry, Minia University, Minia

Received: 04th June, 2026; Revised: 05th July, 2026; Accepted: 16th July, 2026; Available Online: 28th July, 2026

ABSTRACT

Background: Anterior maxillary distraction (AMD) is an established treatment modality for correcting maxillary hypoplasia in patients with cleft lip and palate. The osteotomy technique may influence surgical efficiency, postoperative morbidity, and healing outcomes. This study aimed to compare piezoelectric and conventional bone saw osteotomy techniques during AMD in patients with post-cleft maxillary hypoplasia.

Methods: This prospective comparative split-mouth study was conducted on 20 patients with unilateral cleft lip and palate-associated maxillary hypoplasia. During AMD, piezoelectric osteotomy was performed on the right side and conventional bone saw osteotomy on the left side. Operative time was evaluated.

Results: Piezoelectric osteotomy demonstrated significantly shorter operative time compared with the conventional saw (4.39 ± 0.52 vs. 4.92 ± 0.40 min; $p = 0.003$).

Conclusions: Piezoelectric osteotomy provided superior intraoperative performance and reduced postoperative morbidity while achieving bone healing comparable to that of conventional saw osteotomy. It represents a safe and effective alternative for AMD in post-cleft maxillary hypoplasia.

Keywords: Anterior maxillary distraction; Maxillary hypoplasia; Cleft palate; Piezoelectric surgery; Osteotomy.

How to cite this article: Barakat K.I, Aly A.M, El Saied D, Effect of osteotomy technique selection on intraoperative time and surgeon comfort ability in Post cleft anterior maxillary distraction. 2026;16(72s): 373-376. DOI: 10.25258/ijddt.16.72s.43

Source of support: None

Conflict of interest: None

INTRODUCTION

It has been clearly documented in the literature that in approximately 25 to 47% of patients with cleft lip and palate, orthodontics alone might not be able to address the issue of maxillary hypoplasia and that these patients require surgical intervention to achieve the desirable esthetic and functional results. This can be accomplished with the help of orthognathic surgery or distraction osteogenesis or a combination of these procedures [1]. Le-Fort I osteotomy is widely used for this purpose, but poor maxillary and alveolar bone growth and palatal scarring lead to difficulty in maxillary advancement greater than 6 mm. Prominent relapses have been documented in cleft lip and palate patients receiving conventional maxillary advancement, especially in those with large maxillary movements [2]. Studies focused on anterior maxillary distraction using palatal distractor have demonstrated stable long-term results with negligible relapse, as well as improved if not unhampered speech outcomes [3].

Therefore, this study aimed to compare between two maxillary osteotomy techniques (bone saw versus piezoelectric) used for advancement of post cleft hypoplastic maxilla using anterior maxillary distraction osteogenesis.

PATIENTS AND METHODS

Study design and setting

This comparative split-mouth study that included 20 patients complaining from post cleft maxillary hypoplasia. Patients were enrolled from the out-patient clinic of Oral and Maxillofacial Surgery Department in the Faculty of Dentistry – Minia University. The study was conducted after approval of Research Ethics Committee of Minia University, Egypt. Informed written consent was obtained from all patients prior to enrolment.

Inclusion criteria were patients with hypoplastic maxilla secondary to unilateral cleft lip and palate, aged 13–25 years with erupted premolars, irrespective of gender or required advancement; those who had undergone alveolar cleft bone grafting at least 6 months before distraction (if not previously performed), were in good general health, maintained good oral hygiene, provided written informed consent, understood the study procedures, agreed to follow-up visits, and demonstrated compliance. Exclusion criteria were chronic smokers; patients with uncontrolled diabetes mellitus, heart disease, renal failure, or osteoporosis; those who had received chemotherapy or radiotherapy; pregnant or lactating women; and patients with persistent palatal fistula.

Distractor Design and Fabrication

A customized tooth-borne palatal distractor was fabricated using a Hyrax screw (Forestadent Co., Pforzheim, Germany). The screw arms were soldered to orthodontic bands with the screw oriented perpendicular to the transverse plane and parallel to the sagittal plane to achieve anteroposterior distraction. Fig.1

**Author for Correspondence: Diaa_e_mostafa@mu.edu.eg*

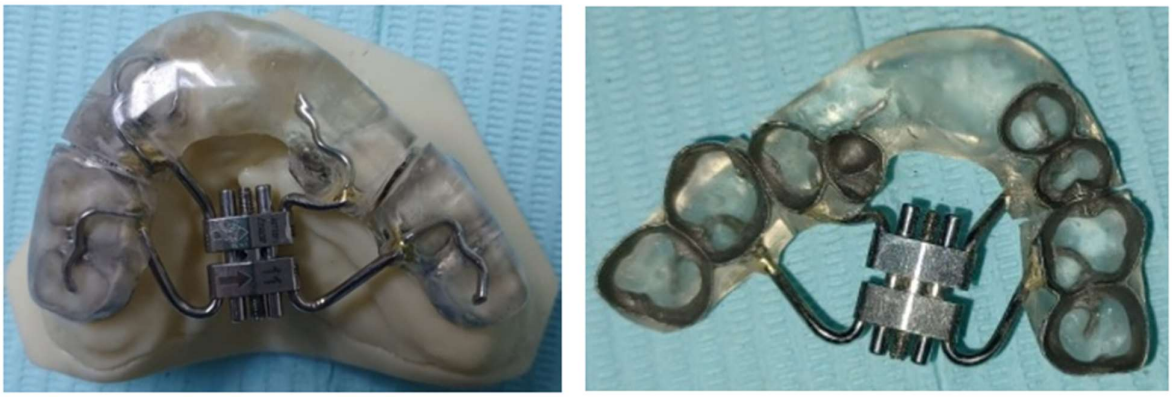

Fig.1 custom made tooth borne palatal distractor

Surgical Procedure

A maxillary vestibular incision extending from the first molar to the contralateral first molar was made, followed by elevation of a full-thickness mucoperiosteal flap.Fig.2. Horizontal and vertical interdental osteotomies were performed to mobilize the anterior maxillary segment Fig. 3, followed by lateral nasal and septal osteotomies. The distractor was activated intraoperatively to verify complete osteotomy and symmetrical movement before wound closure with 3-0 Vicryl sutures. Using a split-mouth design, osteotomy was performed with a piezoelectric device (Guilin Woodpecker Medical Instrument Co., LTD. China) on the right side (Group 1) and a bone saw (AI DENTAL Dental Ltd., China) Fig. 3 on the left side (Group 2). Outcomes compared between both techniques regarding surgeon satisfaction using a 5-point Likert scale [4].

Fig.2 incision and flap reflection

Fig. 3 osteotomy using saw

Distraction Protocol

Following a latency period of 5–7 days, distraction was initiated by activating the screw by a rate of 1 mm daily. The distractor was retained for 8–10 weeks to allow consolidation.

RESULTS

The study population consisted of 20 patients presenting with maxillary hypoplasia following cleft palate repair. All patients underwent anterior maxillary distraction osteogenesis using a split-mouth design to compare two osteotomy techniques: a piezoelectric device (right side) and a conventional bone saw (left side). The assessment

*Author for Correspondence: Diaa_e_mostafa@mu.edu.eg

focused on intraoperative efficiency and safety (osteotomy time and surgeon comfortability).

The piezoelectric osteotomy technique was significantly faster than the conventional saw (4.39 vs. 4.92 minutes, p = 0.003). **Table 1**

Table 1: Intraoperative surgical outcomes between the studied groups.

Variable	Piezoelectric (Right) (n=10)	Conventional Saw (Left) (n=10)	P-value
Osteotomy Time (min)	4.39 ± 0.52	4.92 ± 0.40	**0.003**

Data was presented as Mean ± SD or n (%), Statistically significant P value when ≤ 0.05,

Surgeon comfortability heavily favored the piezoelectric device, with 75.0% reporting "Satisfied" or "Very Satisfied," whereas 50.0% reported "Unsatisfied" or "Very Unsatisfied" with the conventional saw (P.value= 0.049). **Table 2**

Table 2: surgeon comfortability during osteotomy

Surgeon Comfortability, n (%)	piezoelectric	conventional saw	P-value
Very Unsatisfied	0 (0.0%)	3 (15.0%)	
Unsatisfied	0 (0.0%)	7 (35.0%)	
Neutral	5 (25.0%)	9 (45.0%)	*0.049
Satisfied	5 (25.0%)	1 (5.0%)	
Very Satisfied	10 (50.0%)	0 (0.0%)	

**Formal ordinal statistical testing was Wilcoxon rank.*

DISCUSSION

Distraction osteogenesis allows gradual advancement of bone while simultaneously stretching the surrounding soft tissues, which may reduce relapse compared with conventional advancement. However, conventional maxillary distraction may still fail to provide adequate alveolar bone for orthodontic tooth alignment[5]. Moreover, previous reports indicated that the risk of velopharyngeal dysfunction after maxillary distraction may be comparable to that after conventional advancement, possibly due to movement of the posterior maxillary segment after pterygomaxillary disjunction[6,7]. Anterior maxillary distraction using a palatal distractor has emerged as a more localized technique that advances the anterior maxillary segment, improves facial balance and occlusion, and may preserve speech and velopharyngeal function. Tooth-borne palatal distractors have traditionally been used for transverse maxillary expansion, particularly in cleft cases, but their use in the anteroposterior direction has also been supported experimentally and clinically for advancement of the anterior maxilla[8,9]. The use of tooth-borne palatal distractor was confirmed feasible in dogs to distract the anterior maxilla forward and generate new bone and palatal mucosa, also the use of a palatal distractor in the anteroposterior direction to advance a retruded maxilla after an alveolar osteotomy in a noncleft patient has been reported [10,11].

In the current study, piezoelectric osteotomy demonstrated superior intraoperative performance compared with the conventional bone saw, evidenced by significantly shorter osteotomy time. the cavitation effect improves surgical visibility by removing blood and debris from the operative field, facilitating better control during osteotomy [12,13].

Consistent with these findings, Köhnke et al. [14] reported significantly shorter osteotomy duration with piezoelectric surgery compared with conventional osteotomy (17 ± 6 vs. 25 ± 9 minutes, P < 0.001) in a randomized split-mouth study of bilateral sagittal split osteotomies. Several studies and reviews have further supported the advantages of piezoelectric osteotomy. Cascino et al. [15] found comparable operative times between piezosurgery and saw techniques but reported reduced analgesic requirements, less swelling, earlier discharge, and improved neurosensory recovery with piezosurgery.

In contrast, Raj et al. [12] reported longer osteotomy duration and greater postoperative swelling with piezosurgery despite faster neurosensory recovery. Similarly, Al-Delayme[16] found that piezoelectric osteotomy required significantly longer operative time than conventional rotary surgery (P < 0.001), although it resulted in less pain, swelling, and trismus postoperatively [16]. These discrepancies may be explained by differences in surgical procedures, bone characteristics, device types, and operator experience.

piezoelectric intraoperatively is better compared with saw, with more surgeon comfortability. Cutting action of piezoelectric is more clean, cavitation effect improves visibility which removes debris from site of osteotomy

[12,13]. Piezoelectric cutting work appears to improve surgical experience and in delicate regions [14].

Study showed reduced intraoperative blood loss contributing to a cleaner surgical field and improved surgeon comfort[17]. Cavitation effect facilitates cutting especially in scarred post-cleft tissues [11,12]. Another study revealed less soft tissue trauma and better work with piezoelectric[12].
Similar study resulted in better outcomes in ultrasonic cuttings[13].

Other study found that no difference between osteotomy with saw or with piezosurgery in wisdom tooth removal[14].

CONCLUSIONS

Piezoelectric osteotomy was associated with superior intraoperative and early postoperative outcomes compared with the conventional bone saw during anterior maxillary distraction for post-cleft maxillary hypoplasia. It achieved a shorter osteotomy time, indicating that piezoelectric osteotomy improves surgical safety, surgeon comfortability and patient morbidity

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