



Comparative Efficacy of Ceramic Burs and Scalpels in Gingivectomy Procedures for Orthodontic Patients: A Case Series

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Abstract

Background: Orthodontic treatment often leads to gingival hyperplasia, which may complicate oral hygiene and necessitate surgical interventions such as gingivectomy. This study compared the efficacy of ceramic burs versus scalpels in gingivectomy procedures for orthodontic patients, focusing on periodontal outcomes and pain.

Methods: This case series describes six orthodontic patients with gingival hyperplasia. The patients were between 15-25 years and were non-smokers. They underwent gingivectomy using two methods: ceramic burs (NTI® Soft Tissue Trimmers) and traditional scalpels. Preoperative oral hygiene instructions were given, and intraoral photographs were obtained. Clinical measurements included the plaque index (PI), gingival index (GI), and bleeding index (BI). Bleeding, pain (using a visual analog scale), and periodontal indices were assessed at several time points postoperatively.

Results: Both groups showed significant improvements in gingival hyperplasia, PI, and mean GI. However, the ceramic bur group experienced lower postoperative pain compared to the scalpel group. One patient in the scalpel group required analgesics for pain management. The results highlighted the effective management of gingival hyperplasia with both methods but with a potential advantage in pain management for the ceramic bur group.

Conclusion: This study indicated that both ceramic burs and scalpels are effective for gingivectomy in orthodontic patients. Ceramic burs might offer a less painful alternative, although both methods effectively manage gingival hyperplasia. Further studies with a larger sample size and longer follow-ups are required to confirm the present findings and potentially recommend ceramic burs as a preferred method for gingivectomy.

Keywords: Gingival Hyperplasia, Gingivectomy, Orthodontics

Background

Fixed orthodontic treatment is often associated with pathological changes in periodontal tissues (1). Presence of fixed orthodontic appliances can increase plaque accumulation, complicate oral hygiene, and cause a shift in the microbial ecosystem towards periopathogenic oral biofilms (2). Clinical studies have repeatedly reported the progression of chronic periodontal inflammation,

clinical attachment loss, and gingival hyperplasia in orthodontic patients (3, 4). Changes in passive eruption that occur following orthodontic treatment have also been linked to gingival hyperplasia (5). Gingival hyperplasia is one of the most common soft tissue problems associated with fixed orthodontic treatment, with a reported prevalence rate of 15% (6, 7).

Gingival hyperplasia can cause difficulties in oral hygiene maintenance, cause esthetic and



functional problems, and compromise orthodontic tooth movement (6). Proper oral hygiene is the first line of treatment for management of gingival hyperplasia. However, patient cooperation is often insufficient in this process (8). The use of mouthwashes is another adjunctive method, which also depends on patient compliance. Nonsurgical methods are not always effective, especially when gingival hyperplasia is extensive and the patient's oral hygiene is mediocre (9). In such cases, surgical methods should be employed to remove excessive gingival tissue. In recent decades, special attention has been directed to laser therapy as a minimally invasive surgical method (10). Use of ceramic burs is another emerging minimally invasive method in soft tissue surgery. Ceramic burs are easy to use and associated with minimal bleeding and discomfort (11). The indications for using these burs include gingival contouring for esthetic purposes, contouring of enlarged gingiva, widening of the sulcus for fixed prosthesis impressions, and restoration of subgingival Class V cavities (12).

Controversy exists regarding the most effective method for gingivectomy. For instance, Guler et al. (12) emphasized on superior wound healing, faster recovery, and less discomfort of patients following the use of ceramic burs compared to traditional scalpels and diode lasers. On the other hand, AlMokadem et al. (13) found the CO₂ laser was the most effective method for gingivectomy; ceramic burs also showed optimal efficacy but had minimal depth of hemostasis. Such a controversy in the results underscores the complexity of determining the best approach for gingivectomy in orthodontic patients, as each method has its own advantages and limitations.

Considering the aforementioned controversy, a conclusive decision on the most effective method for gingivectomy remains elusive. Therefore, this study aimed to directly compare the effects of ceramic burs and the conventional scalpels by focusing on the differences in periodontal outcomes, pain, and patient discomfort.

Methods

Study Design

This case series included six orthodontic patients presenting with gingival hyperplasia. The aim was in-depth analysis of each case, providing unique insights into the outcomes of different gingivectomy techniques.

Patient Selection

Non-smoker patients between 15-25 years with

fixed orthodontic appliances and non-drug-induced gingival hyperplasia were selected. Patients under medications causing gingival hyperplasia, pregnant or lactating women, non-compliant patients, and those unwilling to participate were excluded.

Intervention

All patients underwent gingivectomy using two different methods:

Ceramic Bur Group: NTI® Soft Tissue Trimmers (Kerr, CA, USA) with a high-speed hand-piece and without coolant were used for incision and contouring of the gingiva in this group.

Scalpel Group: The conventional scalpel method was used for gingivectomy in this group using a #15 blade.

Preoperative Assessment

All patients received standardized oral hygiene instructions, including tooth brushing, flossing, and the use of suitable mouthwash preoperatively. Standardized close-up intraoral photographs were also obtained from the maxillary incisor region, preoperatively.

Clinical Measurements

Clinical measurements were made at four sites of each tooth (mesiobuccal, distobuccal, midbuccal, and palatal) for the plaque index (PI), gingival index (GI), and bleeding index (BI). The magnitude of vertical and horizontal gingival overgrowth was also measured using the Miller and Damn Index (14).

GI (15): Gingival health was evaluated using the following scale:

0: Normal gingiva

1: Mild inflammation (slight color change, slight edema, no bleeding on probing)

2: Moderate inflammation (redness, edema, glazing, or bleeding on probing)

3: Severe inflammation (marked redness and edema, spontaneous bleeding tendency, ulceration)

Gingival overgrowth index: The Miller and Damn's gingival overgrowth index was used. Measurement was done by a periodontal probe from the cemento-enamel junction to the free gingival margin, and classified as:

Grade 0: No overgrowth

Grade I: Not more than one-third of the clinical crown is covered

Grade II: Any part of the middle third of the crown is covered

Grade III: More than two-thirds of the crown is covered.

BI (16): It was evaluated postoperatively on days 7 and 14, using the following scale:

A: None

- B: Slight
- C: Moderate
- D: Severe

Gingivectomy Procedure **Ceramic Bur Group**

Preparation: Before the surgical procedure, each patient underwent a thorough oral examination, which included evaluation of the current state of gingival health and photography of the area to be treated for later comparison.

Local Anesthesia: Local anesthesia was administered in the area of gingivectomy to ensure patient comfort during the procedure.

NTI® Soft Tissue Trimmer (Kerr) ceramic burs were used at an optimal speed of 4000 rpm. This speed is crucial for achieving effective thermal coagulation, which helps in sealing of blood vessels and minimizing bleeding during the procedure (Fig. 1). The procedure was performed without irrigation to allow the instrument tip to generate the necessary heat. This heat production is the key to the thermal coagulation process, aiding in cauterization of the tissue while trimming.

Care was taken to exert minimal pressure and use the burs in a controlled, intermittent manner, as recommended by the manufacturer. This approach minimizes trauma to the gingival tissues, and enhances precision in contouring and removal of excess tissue.

Postoperative Care: Following gingivectomy, patients received standard postoperative care, which included instructions on oral hygiene, dietary recommendations, and use of prescribed mouth rinses to aid in the healing process.



Figure 1. Intraoral photograph of a patient after gingivectomy with a ceramic bur

Scalpel Group

Pre-surgical Protocol: The procedure was thoroughly explained to the patients, their thorough medical and dental history was taken, clinical examination of gingival and periodontal status was performed, and periodontal charting was conducted.

Surgical Procedure: The operative procedure included administration of local anesthesia,

marking of the gingiva for resection, and removal of hyperplastic tissues using a scalpel, followed by irrigation with saline. No periodontal packs were placed (Fig. 2).

Post-operative Care: Instructions to avoid brushing for a specified period, dietary restrictions, and use of antiseptic mouthwash were given to patients.

Postoperative Assessment

Patients were evaluated for bleeding, pain, and periodontal indices at specified intervals (immediately after surgery, and at 3, 7, and 14 days after surgery). Pain assessment included using a visual analog scale (VAS), and patients were provided with analgesics (Gelofen 400 mg; Daana, Iran) if needed. The patients were instructed to use Gelofen if needed (prn.) once every eight hours until their pain became manageable.



Figure 2. Intraoral photograph of a patient after gingivectomy with a scalpel

Statistical Analysis

Given the nature of a case series, descriptive statistics were used to analyze the outcomes. The focus was on individual patient responses to each method rather than a comparative statistical analysis typical of randomized clinical trials.

Ethical Considerations

The study protocol adhered to the ethical standards, and informed consent was obtained from all participants. The study received ethical approval from the ethical committee of Mashhad University of Medical Sciences, referenced by the approval number IR.MUMS.DENTISTRY.REC.1399.052. The intervention risks were minimized by close supervision by experienced periodontists.

Results

Six patients undergoing gingivectomy were evaluated in two groups of ceramic burs and surgical scalpels. The ceramic bur group included two females (ages 16 and 18 years) and one male (age 19 years). They exhibited varying degrees of gingival hyperplasia and plaque levels, preoperatively.

The scalpel group included three females (ages 16, 19, and 21 years), with similar variations in gingival conditions as the ceramic bur group.

Treatment Outcome

Ceramic Bur Group: Post-surgery, there was a notable reduction in BI from B to A within 3 days. Gingival overgrowth index showed significant improvement. The mean GI decreased within 2 weeks, indicating improved gingival health. PI remained the same or showed a slight reduction.

Scalpel Group: Similar to the ceramic bur group, these patients also experienced a reduction in BI post-surgery. There was a gradual decrease in gingival overgrowth, with certain areas like mesiobuccal and distobuccal showing persistent overgrowth of level

one. The PI had a descending trend, and the mean GI improved by the end of the observation period.

Regarding pain scores, one patient in the scalpel group reported a higher VAS pain score of five on the day of surgery, necessitating administration of one Gelofen for pain relief. None of the other patients in either the ceramic bur or the scalpel group reported VAS scores exceeding two on the day of surgery. Furthermore, at 2 days post-surgery, all patients in both groups exhibited pain levels not exceeding two, indicating a rapid decrease in discomfort following the initial surgical intervention.

The data of the ceramic bur group are presented in Table 1 and the data of the scalpel group are shown in Table 2.

Table 1. Summary of the results for patients in the ceramic bur group

Patient	Age (yrs.)	Sex	Time Point	VAS	BI	Overgrowth Index (MB/DB/P/MidB)	PI	Mean GI
1	18	Female	Pre-Surg.	N/A	N/A	DB of L3: 2, Others: 1	100%	2.0
			Surg.	2	B	N/A	N/A	N/A
			3 Days	1	A	Palatal of L3, L1, R3: 1	100%	1.8
			7 Days	N/A	A	Palatal of L3, L1, R3: 1	100%	1.3
			14 Days	N/A	A	MB of L1: 1	100%	1.5
2	19	Male	Pre-Surg.	N/A	N/A	DB of L3, R3: 2, Others: 1	100%	1.8
			Surg.	1	B/C	N/A	N/A	N/A
			3 Days	1	A	MB of R2, DB of R1: 1	75%	1.7
			7 Days	N/A	A	As 3 Days	75%	1.5
			14 Days	N/A	A	As 3 Days	67%	1.4
3	16	Female	Pre-Surg.	N/A	N/A	DB of R3: 2, Other: 1	93%	1.9
			Surg.	2	B	N/A	N/A	N/A
			3 Days	1	A	MB of R2, L1/L2, DB of R1: 1	93%	2.2
			7 Days	N/A	A	MB of R2, L1/L2, DB of R1: 1	75%	1.7
			14 Days	N/A	A	L1/L2, DB of R1: 1	63%	1.6

N/A—not applicable; Surg.—surgery; MB—mesiobuccal; DB—distobuccal; MidB—midbuccal; L1—left incisor; R3—right canine

Table 2. Summary of the results for patients in the scalpel group

Patient	Age (yrs.)	Sex	Time Point	VAS	BI	Overgrowth Index (MB/DB/P/MidB)	PI	Mean GI
1	19	Female	Pre-Surg.	N/A	N/A	MB/DB of 3s: 0, Others: 1	100%	2.0
			Surg.	2	B	N/A	N/A	N/A
			3 Days	1	A	DB of L1, MB of L2: 1	100%	1.8
			7 Days	N/A	A	MB of R2: 1	85%	1.2
			14 Days	N/A	A	MB of R3, L2: 1	85%	1.2
2	16	Female	Pre-Surg.	N/A	N/A	DB of R2, MidB of L3: 0	75%	1.7
			Surg.	5	B	N/A	N/A	N/A
			3 Days	3	A	MB of L1 & R1: 1	50%	1.7
			7 Days	N/A	A	MB of L1 & R1: 1	33%	1.2
			14 Days	N/A	A	MB of L1 & R1: 1	50%	1.3
3	21	Female	Pre-Surg.	N/A	N/A	MB & MidB of 3s: 0, Others: 1	93%	1.9
			Surg.	1	C	N/A	N/A	N/A
			3 Days	1	A	MB of R2, L1 & L2: 1	93%	2.2
			7 Days	N/A	A	Same as Day 3	75%	1.7
			14 Days	N/A	A	MB of L1 & R1: 1	63%	1.6

N/A—not applicable; Surg.—surgery; MB—mesiobuccal; DB—distobuccal; MidB—midbuccal; L1—left incisor; R3—right canine; R2.—2; Others.—1

Discussion

The present study compared the outcomes of gingivectomy using two different techniques: ceramic burs and scalpel. The results showed significant improvements in gingival hyperplasia, as well as in PI, and mean GI scores in both groups. Notably, the ceramic bur group experienced lower postoperative pain compared to the scalpel group. Additionally, only one patient in the scalpel group reported higher pain on the day of surgery, which was effectively managed. Overall, the study indicated that both methods were effective for gingivectomy, with the ceramic bur method demonstrating some potential advantages in pain management.

Gingival esthetics significantly affects the dental appearance, and concerns related to gummy smile or short clinical crowns are often rooted in gingival hyperplasia (17, 18). This hyperplasia can be due to various factors, including poor oral hygiene, trauma, medication intake, or systemic diseases (8). Gingivectomy, a surgical intervention aimed at resecting the overgrown tissue and recontouring of the gingiva, may be necessarily indicated when cause-related therapies such as scaling and root planing fail (19). Addressing the underlying causes is crucial initially to reduce inflammation and minimize the risk of postoperative recurrence. Inflamed tissues can increase bleeding during surgery, adversely affecting surgical visibility, and potentially leading to delayed healing and scarring.

The present study assessed the effectiveness of the traditional scalpel method and the ceramic bur technique for gingivectomy. Scalpel gingivectomy, while being a standard resective technique, may pose limitations in terms of postoperative discomfort. Conversely, various types of lasers have gained prominence for their surgical advantages, such as sterilizing the surgical field and reducing bleeding (20). These benefits lead to improved surgical accuracy and potentially faster epithelialization and healing times compared to the scalpel method (21, 22). Electrosurgery is another alternative, offering hemostasis advantages, particularly in pediatric patients due to faster operation time, although it has limitations in depth of tissue removal (23, 24).

The present findings align with the broader literature on periodontal surgery. The results revealed that both the ceramic bur and scalpel methods effectively managed gingival hyperplasia. The ceramic bur group showed a potential for less postoperative pain, resembling the advantages seen with laser techniques (25). This finding suggests that ceramic burs might be a viable alternative in gingivectomy, offering benefits

similar to lasers. This study indicated the need for evolving surgical techniques in periodontics, emphasizing on patient comfort and clinical efficacy.

Ceramic burs have emerged as a novel tool in dental surgery, particularly in gingivectomy (11). Their advantages are notable: they offer precise tissue removal while minimizing trauma to the adjacent areas. This precision is crucial in maintaining esthetics with respect to the gingival contour. Furthermore, ceramic burs can reduce the risk of postoperative complications, such as excessive bleeding or infection, due to their cleaner and more controlled incisions. Their design also allows for a smoother surface post-operation, which can enhance tissue healing and patient comfort. These benefits suggest that ceramic burs could offer a significant improvement over the traditional methods in terms of patient outcomes and surgical efficiency.

In the present study, the results of ceramic burs were comparable to those achieved with the traditional scalpel technique. Both methods effectively managed gingival hyperplasia, with the ceramic bur group demonstrating a potential for lower postoperative pain and faster healing (advantages that align with the inherent benefits of ceramic burs). Given these findings, coupled with the potential benefits of ceramic burs in terms of precision, reduced trauma, and enhanced healing, clinicians may consider ceramic burs as a recommended alternative for gingivectomy.

Limitations

1. Sample size and diversity: This study had a limited sample size and lacked diversity in patient demographics, which might affect the generalizability of the results.
2. Short-term follow-up: The follow-up period was short, limiting the ability to assess long-term outcomes and potential recurrence of gingival hyperplasia.
3. Subjective pain assessment: Pain was self-reported using a VAS, which is subjective and can vary significantly between individuals.

Suggestions for future research

1. Longer follow-up periods: Future studies should have longer follow-ups to assess the long-term efficacy and recurrence rates after gingivectomy with ceramic burs.
2. Larger and more diverse samples: Increasing the sample size and including a more diverse population of patients would enhance the reliability of the findings.
3. Comparative studies: Comparative studies on ceramic burs and other modern techniques like

lasers could provide deeper insights into the optimal surgical approach for gingivectomy.

4. Objective pain and healing metrics: Incorporating objective metrics for pain and healing and patient-reported outcomes could provide a more comprehensive assessment of postoperative recovery.

5. Randomized clinical trials: Conducting randomized clinical trials with rigorous study designs is essential before making definitive recommendations regarding using ceramic burs in gingivectomy.

Conclusion

Ceramic burs showed comparable outcomes to traditional scalpel gingivectomy in terms of postoperative pain. Moreover, considering the potential advantages of ceramic burs reported in previous studies, such as reduced bleeding and faster healing, they may offer a promising alternative for clinicians. However, further research with larger and more diverse samples, longer follow-up periods, and better designs are needed before definitive recommendations can be made regarding the widespread adoption of ceramic burs in gingivectomy procedures.

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Conflict of Interests

The authors have no conflict of interests to declare.

References

- Alfuriji S, Alhazmi N, Alhamlan N, Al-Ehaideb A, Alruwaithi M, Alkatheeri N, et al. The effect of orthodontic therapy on periodontal health: a review of the literature. *Int J Dent*. 2014;2014:585048. doi: 10.1155/2014/585048 PMID: 24991214
- Feu D. Orthodontic treatment of periodontal patients: challenges and solutions, from planning to retention. *Dental Press J Orthod*. 2020;25(6):79-116. doi: 10.1590/2177-6709.25.6.079-116.sar PMID: 33503129
- Morris JW, Campbell PM, Tadlock LP, Boley J, Buschang PH. Prevalence of gingival recession after orthodontic tooth movements. *Am J Orthod Dentofacial Orthop*. 2017;151(5):851-9. doi: 10.1016/j.ajodo.2016.09.027 PMID: 28457262
- Gebistorf M, Mijuskovic M, Pandis N, Fudalej PS, Katsaros C. Gingival recession in orthodontic patients 10 to 15 years posttreatment: A retrospective cohort study. *Am J Orthod Dentofacial Orthop*. 2018;153(5):645-55. doi: 10.1016/j.ajodo.2017.08.020 PMID: 29706212.
- Hakami Z. Is Orthodontic Treatment an Etiologic Factor for Altered Passive Eruption? A Clinical Study and Systematic Review. *Appl*. 2023; 13(14). doi:10.3390/app13148291
- Rathod AD, Jaiswal P. Gingival overgrowth during orthodontic treatment and its management. *Pan Afr Med J*. 2022;42:305. doi: 10.11604/pamj.2022.42.305.36600 PMID: 36425538
- Vincent-Bugnas S, Borsa L, Gruss A, Lupi L. Prioritization of predisposing factors of gingival hyperplasia during orthodontic treatment: the role of amount of biofilm. *BMC Oral Health*. 2021;21(1):84. doi: 10.1186/s12903-021-01433-2 PMID: 33627113
- Agrawal AA. Gingival enlargements: Differential diagnosis and review of literature. *World J Clin Cases*. 2015;3(9):779-88. doi: 10.12998/wjcc.v3.i9.779 PMID: 26380825
- Sandhu A, Jyoti D, Malhotra R, Phull T, Sidhu HS, Nayak S. Management of Chronic Inflammatory Gingival Enlargement: A Short Review and Case Report. *Cureus*. 2023;15(10):e46770. doi: 10.7759/cureus.46770 PMID: 37954790
- Maboudi A, Fekrazad R, Shiva A, Salehabadi N, Moosazadeh M, Ehsani H, et al. Gingivectomy with Diode Laser Versus the Conventional Scalpel Surgery and Nonsurgical Periodontal Therapy in Treatment of Orthodontic Treatment-Induced Gingival Enlargement: A Systematic Review. *Photobiomodul Photomed Laser Surg*. 2023;41(9):449-59. doi: 10.1089/photob.2023.0060 PMID: 37738371
- Negi R, Gupta R, Dahiya P, Kumar M, Bansal V, Kaur Samlok J. Ceramic soft tissue trimming bur: A new tool for gingival depigmentation. *J Oral Biol Craniofac Res*. 2019;9(1):14-8. doi: 10.1016/j.jobcr.2018.07.002 PMID: 30197858
- Guler B, Cagri Isler S, Uraz A, Bozkaya S, Deniz Cetiner F. The comparison of postoperative wound healing following different gingivectomy techniques: A randomized prospective clinical trial. *Annals of Medical Research*. 2021;26(3):0382-8.
- AlMokadem MMs, Elkhoully S, Abdelrahman AR, Nasr SS. Clinical Efficacy of Soft Tissue Trimmer versus conventional surgical excision of gingival hyperplasia on postoperative pain: A randomized clinical trial. *Advanced Dental Journal*. 2023;5(1):119-143. doi: 10.21608/adjc.2023.188180.1246
- Miller CS, Damm DD. Incidence of verapamil-induced gingival hyperplasia in a dental population. *J Periodontol*. 1992 May;63(5):453-6. doi: 10.1902/jop.1992.63.5.453.
- Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand*. 1963 Dec;21:533-51. doi: 10.3109/00016356309011240.
- Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J*. 1975 Dec;25(4):229-35.

17. Hunt O, Johnston C, Hepper P, Burden D, Stevenson M. The influence of maxillary gingival exposure on dental attractiveness ratings. *Eur J Orthod.* 2002;24(2):199-204. doi: 10.1093/ejo/24.2.199 PMID: 12001557
18. Negruțiu BM, Moldovan AF, Staniș CE, Pusta CTJ, Moca AE, Vaida LL, et al. The Influence of Gingival Exposure on Smile Attractiveness as Perceived by Dentists and Laypersons. *Medicina (Kaunas).* 2022;58(9): 1265. doi: 10.3390/medicina58091265 PMID: 36143942
19. Ozener HO, Kundak K, Sipahi NG, Yetis E, Dogan B. Different treatment approaches for the localized gingival overgrowths: Case series. *Eur J Dent.* 2018;12(2):311-316. doi: 10.4103/ejd.ejd_344_17 PMID: 29988262
20. Muralikrishna T, Kalakonda B, Gunupati S, Koppolu P. Laser-Assisted Periodontal Management of Drug-Induced Gingival Overgrowth under General Anesthesia: A Viable Option. *Case Reports in Dentistry.* 2013;2013:387453. doi: 10.1155/2013/387453 PMID: 23819068
21. Kazakova R, Tomov G, Vlahova A, Zlatev S, Dimitrova M, Kazakov S, et al. Assessment of Healing after Diode Laser Gingivectomy Prior to Prosthetic Procedures. *Applied Sciences.* 2023;13(9):5527. doi: 10.3390/app13095527
22. Kazakova RT, Tomov GT, Kissova CK, Vlahova AP, Zlatev SC, Bachurska SY. Histological Gingival Assessment after Conventional and Laser Gingivectomy. *Folia Med (Plovdiv).* 2018;60(4):610-616. doi: 10.2478/folmed-2018-0028 PMID: 31188758
23. Manivannan N, Ahathya RS, Rajaram PC. Scalpel versus electrosurgery: Comparison of gingival perfusion status using ultrasound Doppler flowmetry. *J Pharm Bioallied Sci.* 2013;5(Suppl 2):S154-9. doi: 10.4103/0975-7406.114317 PMID: 23956596
24. Xu D, Wang P, Liu H, Gu M. Efficacy of three surgical methods for gingivectomy of permanent anterior teeth with delayed tooth eruption in children. *Head Face Med.* 2022;18(1):23. doi: 10.1186/s13005-022-00328-z
25. Sobouti F, Rakhshan V, Chiniforush N, Khatami M. Effects of laser-assisted cosmetic smile lift gingivectomy on postoperative bleeding and pain in fixed orthodontic patients: a controlled clinical trial. *Prog Orthod.* 2014;15(1):66. doi: 10.1186/s40510-014-0066-5 PMID: 25487965.