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Review Article

Fiberotomy outcomes on orthodontic tooth movement: a review of current literature

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ABSTRACT

By decreasing mechanical resistance in the periodontal ligament, fiberotomy enhances treatment efficiency and stability. However, it necessitates careful consideration of individual patient factors, such as periodontal health and treatment complexity. While promising, the long-term effects on periodontal status require further exploration. Fiberotomy shows potential to revolutionize orthodontic practices, offering expedited and stable treatments, yet comprehensive understanding of its long-term safety and effectiveness is essential. This study investigates the influence of fiberotomy on orthodontic tooth movement, highlighting its benefits in accelerating treatment and reducing relapse.

Keywords: Fiberotomy, Orthodontic, Periodontal ligament, Tooth movement

INTRODUCTION

A Fiberotomy, also known as precision, is an orthodontic surgical procedure that aims to cut the gingival fibers around a tooth, typically decreasing the likelihood of tooth rotations relapsing after being corrected by dental braces or other interventions.[1] The most common issue after orthodontic treatment is maintaining the corrected tooth position. Relapse, where teeth drift back to their original position, often affects rotated teeth. A Fiberotomy separates the fibers connecting the tooth to the bone via the gums, reducing pull forces that could cause relapse. This painless procedure is typically done towards the end of orthodontic treatment, cutting disrupted fibers to help maintain tooth alignment.[2] This study examines how fiberotomy impacts orthodontic tooth movement, emphasizing its advantages in speeding up treatment and decreasing relapse.

Table 1: Literature review.

Author	Year of publication	Objective	Methods/Participants	Technique used	Outcomes
Carvalho et al[3]	2006	The objective of this randomized clinical trial was to compare biometrically the orthodontic	Twenty single-rooted teeth were extruded out and divided into two separate groups.	In both sets, fixed orthodontic were adjusted weekly for 3 weeks. After that, the extruded teeth were kept in place for 8 weeks. In group A, in	More dental structure was visible in group A, with no changes in the gingival margin and bone tissue ($p<.05$). Group B showed 2 mm and 1.5 mm upward

Continued.

Author	Year of publication	Objective	Methods/Participants	Technique used	Outcomes
		extrusion technique (OE, group B) with OE combined with fiberotomy and root planing (OEFRP, group A).		addition to weekly adjustments, fiberotomy and root planing were performed on the top of the alveolar bone crest.	movement of the gingival tissue and bone tissue, respectively.
Maboudi et al[4]	2023	This study aimed to assess the effectiveness of different methods, including CSF with a surgical scalpel, laser CSF and photobiomodulation, in reducing relapse after orthodontic tooth rotation.	This trial included 90 rotated teeth undergoing the last phases of fixed orthodontic treatment.	The teeth were divided into six groups, each consisting of 15 teeth: a control group with no intervention, photobiomodulation alone, conventional CSF, laser CSF, conventional CSF with photobiomodulation and laser CSF with photobiomodulation. Measurements were taken using AutoCAD software on clinical photographs and dental casts.	The relapse magnitude and percentage varied significantly among the six groups, with the control group showing the highest values, followed by photobiomodulation alone, laser CSF, conventional CSF, conventional CSF with photobiomodulation and laser CSF with photobiomodulation. Additionally, the combinations of photobiomodulation with laser CSF and conventional CSF yielded different outcomes compared to the other groups. Sulcus depth changes, gingival recession and pain scores did not differ significantly among the six groups.
Jahanbin et al[5]	2014	Comparing how well laser-assisted circumferential supracrestal fiberotomy, low-level laser therapy and conventional CSF reduce the relapse of corrected tooth rotations.	The study involved 24 patients who were in the final phase of orthodontic treatment and had a maxillary incisor rotated between 30° to 70° before beginning therapy.	The participants were split into 4 groups for treatment: traditional CSF, Er:YAG laser-assisted CSF, LLLT and a control group. Following alginate impressions, the archwire was removed from the treated incisors to allow relapse. A second impression was taken a month later to determine the extent of relapse through photographs of the dental models. Additionally, factors like gingival recession, pocket depth and pain were assessed in the CSF groups.	The average relapse rates were 9.7% in traditional CSF, 12.7% in Er:YAG laser-assisted CSF, 11.7% in LLLT and 27.8% in the control group. Relapse was significantly higher in the control group compared to the experimental groups ($P < 0.05$), which did not show statistical differences between each other. Changes in sulcus depth and gingival recession were minimal and not significantly different among the CSF groups ($P > 0.05$), but pain intensity was higher in those who had traditional CSF ($P = 0.003$).
Taner et al[6]	2000	The impact of fiberotomy in reducing the relapse of incisors after orthodontic treatment was examined.	The research included 23 patients with crowded upper and lower front teeth before orthodontic treatment. The initial crowding was assessed using Little's irregularity index.	Eleven patients underwent fiberotomy procedures a week prior to debonding, while the remaining 12 patients were part of the control group. All patients utilized Hawley retainers. Imaging and dental impressions were taken at the start (T1), end (T2) of treatment, 6 months into retention (T3) and 1 year post-orthodontic treatment (T4).	The control group showed a notable rise in the irregularity index at T3 and T4 for both upper and lower front teeth ($P < .05$, $P < .01$). However, in the group receiving circumferential supracrestal fiberotomy, there was no significant increase in the irregularity index observed.

Continued.

Author	Year of publication	Objective	Methods/Participants	Technique used	Outcomes
Miresmæili et al[7]	2019	The goal of this study was to compare how mandibular incisor rotation relapse differed between traditional circumferential supracrestal fiberotomy (CSF) and CSF aided by Er,Cr:YSGG laser.	In this research with three study groups, participants with a lower incisor rotated more than 30 degrees before treatment were chosen.	The participants were randomly distributed into three groups equally. A month after removing the arch wires, the tendency for rotational relapse was assessed using a digital model. Probing depth, clinical crown height and pain levels were also examined.	46 patients were included in the study. The relapse tendency in both the conventional CSF and laser-aided CSF groups was notably lower at 5.09±1.59° and 4.87±2.08°, respectively, compared to 11.28±2.93° in the control group (P<0.001). There was no significant difference in relapse tendency between the conventional CSF and laser CSF groups. Probing depth, clinical crown height and pain levels showed minimal discrepancies.
Dhingra et al[8]	2013	To assess and compare the changes in root surface morphology following 980-nm diode laser-assisted circumferential supracrestal fiberotomy (CSF) on teeth with and without fluorosis.	27 orthodontic patients, including both males and females with an average age of 17.3 years, were included in the study. A total of 40 premolar teeth affected by fluorosis and 40 non-fluorosed teeth were extracted for orthodontic purposes.	Conventional and laser-assisted circumferential supracrestal fiberotomy (CSF) was conducted on teeth affected by fluorosis and those without using a scalpel and a 980-nm diode laser at 2.5 W power, respectively. The extracted teeth were then sectioned and analyzed under a scanning electron microscope to evaluate the ultrastructural modifications.	There were differences in surface morphology among fluorosed and non-fluorosed roots in the control group. The root specimens of both fluorosed and non-fluorosed teeth irradiated by diode laser exhibited no evidence of smear layer, laser-induced pitting or cavitation, linear cuts/markings, carbonization of surface and heat-induced surface cracking. However, a glazed or slightly melted appearance was observed in root specimens of fluorosed teeth after diode laser irradiation.

DISCUSSION

A fiberotomy, also known as pericision, is an intricate orthodontic surgical procedure tailored to address the persistent issue of tooth relapse following orthodontic correction. During this procedure, the gingival fibers encompassing the tooth are meticulously incised. These fibers, comprising collagen-rich connective tissue, play a crucial role in anchoring the tooth to the surrounding alveolar bone through their attachment to the gingiva.[1] The primary objective of a fiberotomy is to help maintain the newly aligned position of the teeth, especially after they have been corrected through orthodontic interventions. One of the predominant challenges faced post-treatment is the propensity for teeth, particularly those that have been rotated, to drift back to their original positions.

This phenomenon, known as relapse, is often driven by the elastic memory of the surrounding periodontal fibers that exert force, urging the teeth to revert.[2] In performing a fiberotomy, the clinician makes precise cuts to sever these fibers, notably the supracrestal or transseptal fibers, which exert a pulling force on the tooth. By strategically cutting these bindings, the procedure reduces undesirable forces, thereby assisting in retaining the teeth's corrected position. The procedure is typically performed towards the end of the orthodontic treatment timeline, specifically once the desired alignment has been achieved but before final removal of orthodontic wires and brackets.

It is generally quick, minimally invasive and virtually painless, often requiring only local anesthesia. Patients can typically resume normal activities shortly after, with little to no discomfort. Fiberotomy enhances the stability of orthodontic outcomes by decreasing the likelihood of relapse, making it a valuable addition to comprehensive orthodontic care, particularly for cases with a high risk of rotational relapse.[2] In a study by Zenóbio et al, orthodontic extrusion (OE) was examined for biologic width reestablishment (BWR), comparing two protocols: periodontal flap surgery (FS) done either before (FS + OE) or after (OE+FS) extrusion. Data from studies up to March 2013 were reviewed, analyzing outcomes from 13 patients treated with OE+FS or FS+OE. Results indicated that OE+fiberotomy resulted in greater root extrusion compared to OE alone.

Clinical and radiographic assessments found no significant differences between the groups (P>0.05).

Improvements in keratinized tissue (P=0.034) and probing depth (P=0.025) were observed within the groups treated with OE+FS.[9] The tendency of rotated teeth to relapse is a major challenge in orthodontics and circumferential supracrestal fiberotomy (CSF) is a potential method to address this issue. While CSF is typically carried out using a surgical blade, using a laser may help minimize complications. However, studies have indicated that relapse rates do not significantly differ between laser and blade techniques.[10] The strong stability of treatment outcomes supports the use of circumferential supracrestal fiberotomy and papilla splitting in managing crowding of the front teeth in patients over 16 years old. These procedures help enhance long-term treatment stability and prevent relapse of rotational anomalies. Their effectiveness has been clinically and anthropometrically confirmed during both short-term and long-term follow-up periods (at 1, 6 and 12 months).[11]

According to Al-Jasser et al, relapse after CSF was more noticeable in the maxillary arch compared to the mandibular arch. The most common areas of relapse were the maxillary lateral incisors and the mandibular canines.[12] Kaplan et al, reported on a survey conducted among 1,000 randomly selected orthodontists in the United States to assess how frequently circumferential supracrestal fiberotomy is used to reduce rotational relapse. The study also aimed to identify any complications linked to the procedure. Although the technique is not commonly utilized, its usage varies by region.

The survey results suggest that the procedure is generally safe and complication-free and its adoption is likely to grow in the future.[13] Lee et al, investigated and compared the impact of circumferential supracrestal fiberotomy performed in vivo using diode, CO_2 and Er:YAG lasers on the root surface's morphology and chemical composition. Their findings concluded that, when applied with proper settings, laser-assisted procedures maintain the natural structure and chemical integrity of the cementum.[14] Over the long term, the CSF procedure proved more effective in minimizing relapse in the maxillary anterior region compared to the mandibular anterior region.

However, both the CSF and control groups exhibited notable and unpredictable individual tooth movements after orthodontic treatment. Importantly, no clinically significant changes were observed in periodontal sulcus depth or in the amount of labially attached gingiva in CSF-treated teeth at 1- and 6-months post-surgery.[15] In his case reports, Yoshinuma et al, demonstrated that orthodontic extrusion combined with palatal circumferential supracrestal fiberotomy was used to correct discrepancies in the labial gingival margin. Two years after the procedure, both the tooth position and gingival margin remained stable. This approach proved effective in enhancing the alignment of the labial gingival margin in maxillary incisors.[16]

The study by Rinaldi et al, aimed to assess the periodontal effects of the CSF procedure as recommended by Edwards, addressing concerns that may partly explain why the technique is not widely adopted. The research involved eleven participants, averaging 16.5 years old, all with excellent oral hygiene and multiple corrected tooth rotations. CSF was performed and specialized devices designed and built by the researcher were used to measure changes in free gingival height, epithelial attachment and pocket depth with high precision (±0.1 mm). Follow-up measurements were taken four months after the procedure and the results were compared to preoperative data. The key findings were: Pocket depth remained within normal physiological limits, with no clinically significant increase. No notable differences were found based on tooth type, dental arch or gender regarding the measured variables. Minor apical migration was observed on the lingual side of the maxillary and mandibular anterior teeth, but it was minimal and clinically insignificant.[17]

Lasers have been used in dentistry for over four decades, though their application in orthodontics has remained relatively limited. However, the development of laser systems with integrated computer interfaces has greatly improved ease of use, increasing their attractiveness within the orthodontic field. To maximize patient outcomes and ensure a worthwhile investment, it is crucial to understand both the capabilities and limitations of laser devices. Successful implementation of lasers in orthodontic practice requires comprehensive training not only for orthodontists but also for dental assistants and support staff. With proper training, orthodontists can safely and efficiently perform procedures such as gingivectomy, tooth exposure, frenectomy, circumferential supracrestal fiberotomy, tongue-tie release (ankyloglossia) and uvulopalatoplasty.[18]

Periodontal disease and its consequences frequently result in both aesthetic and functional issues, either on their own or in combination with other restorative concerns. Adult orthodontic treatment can play a key role in achieving full rehabilitation of both function and appearance, offering a favorable long-term outcome provided the patient is sufficiently motivated and responds positively to initial periodontal care. Maintaining periodontal health is crucial for the success of any dental treatment. Consistent oral hygiene at home, along with regular professional cleanings, is essential during and after orthodontic treatment.[19] Maintaining periodontal health is vital for all types of dental treatment.

Adult patients should receive consistent oral hygiene education and periodontal care to ensure healthy gums during active orthodontic therapy. For adults with compromised periodontal support, careful and frequent monitoring is essential. In summary, orthodontic tooth movement in adults can be safely carried out on both healthy and compromised periodontal tissues, as long as

controlled, physiologic forces are applied, inflammation is managed and excellent oral hygiene is upheld throughout treatment.

With a solid understanding of the relationship between periodontal and orthodontic care, clinicians can make informed decisions that best serve the patient's overall health.[20] Data from a single trial indicated a statistically significant improvement in stability for both the mandibular and maxillary anterior segments ($p<0.001$) when circumferential supracrestal fiberotomy (CSF) was used alongside a Hawley retainer, compared to using a Hawley retainer alone. However, the reliability of this evidence is questionable due to limitations in the study design.

Additionally, there was weak and uncertain evidence suggesting that teeth may settle more quickly with a Hawley retainer than with a clear overlay retainer after three months.[21] Meng et al, reported that circumferential supracrestal fiberotomy can help reduce the relapse of rotated teeth. They suggested that collagen fibers in the supra-alveolar structures may contribute to early relapse, while elastic fibers could be responsible for teeth gradually returning to their original positions after the retention phase.[22] Rotations are commonly assessed using various methods related to crowding and arch dimensions, yet few studies specifically focus on the degree or direction of rotations and even fewer examine the reliability of these assessments. Parthiban aimed to thoroughly evaluate current classification systems for rotated teeth, examining rotation in both anterior and posterior teeth, along with its clinical relevance and effects on retention and relapse.

The review concluded that there is a lack of adequate classification systems for assessing rotations of anterior and mandibular teeth. A universally accepted system, including a standardized reference line, is necessary. Furthermore, existing classification methods for posterior teeth need to be refined and validated for practical clinical use.[23] Low-level laser therapy (LLLT) is known for its biostimulatory effects, including the ability to speed up mesiodistal orthodontic tooth movement. However, its influence on the degree and short-term stability of rotational tooth movement has not been thoroughly studied.

The study by Salehi et al, aimed to examine how low-level laser irradiation affects both the speed of rotational tooth movement and the extent of relapse, using a canine model. While the laser energy dose applied in the study did not enhance the rate of rotational movement, it was effective in reducing the tendency of rotated teeth to relapse after orthodontic treatment.[24] Han et al, conducted a study to assess the impact of frequent low-level laser therapy (LLLT) applications on corticotomy-assisted tooth movement in a beagle dog model and to compare its effects between the maxilla and mandible. The results showed that repeated LLLT applications did not produce a significant effect on tooth movement following corticotomy.[25]

CONCLUSION

Fiberotomy significantly enhances orthodontic tooth movement by reducing mechanical resistance, thereby shortening treatment time and minimizing relapse. While beneficial, careful patient assessment is crucial, considering periodontal health and treatment complexity. The procedure's long-term effects on periodontal status need further exploration. Future research should assess fiberotomy's integration with modern orthodontic technologies for improved outcomes. Overall, fiberotomy could revolutionize orthodontic treatments, making them more efficient and stable, though further investigation is needed to fully understand its long-term safety and effectiveness.

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