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Comparative Evaluation of Laser and Traditional Frenectomy Techniques: An Analysis of Clinical Case Series

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Abstract: ***The frenum is a mucous membrane fold that attaches the lip and the cheek to the alveolar mucosa, the gingiva, and the underlying periosteum. Consequences of an abnormal frenal attachment include gingival recession, decreased vestibular depth, decreased range of lip movement, and involvement of interdental papilla, causing a diastema. In addition to this, the maxillary frenum may present aesthetic problems or compromise the orthodontic result in midline diastema cases, thus causing a recurrence after the treatment. The management of such an aberrant frenum is accomplished by performing a frenectomy. The present article is a compilation of a brief overview of various frenectomy techniques, like Miller's technique, V-Y plasty, Z-plasty and frenectomy by using a scalpel along with the comparison with the laser technique. A series of clinical cases of frenectomy which were approached by various techniques have been reported.***

Keywords: Frenum, Frenectomy, Diode laser

1. Introduction

Originating from the Latin term "fraenum," the frenum is an anatomic structure composed of a mucous membrane membranous fold, connective tissue, and occasionally muscle fibers. Stabilizing the tongue and upper and lower lips is the main purpose of this frenum. When the aberrant frenum is too closely connected to the gingival margin, gingival recession may result. Moreover, the presence of it is also one of the aetiological factors for the persistence of a midline diastema affecting the aesthetics. It also results in relapse of orthodontic treatment, interference with retention of the denture and compromised gingival health because of poor plaque control [1] for which the focus on the frenum has become most essential. [2]

Diagnosis of the aberrant frenum attachment:
The abnormal frenum are detected visually by applying tension over the frenum to see the movement of the papillary tip or the blanching which is produced due to ischemia in the region, called as a blanching test or tension test. The frenum is considered pathogenic if it is particularly wide; there is no visible zone of connected gingiva along the midline, or the interdental papilla moves when the frenum is expanded. The management of such aberrant frenum can be treated by Frenectomy Procedure which is defined as complete elimination of the frenum and its attachments.

Classification: The labial frenal attachments have been classified as mucosal, gingival, papillary, and papilla penetrating, by Placek et al (1974) based on the attachment location. [3]

Indications for Frenectomy: An abnormal frenum generates stress on the gingival margin and causes midline diastema. It also facilitates orthodontic therapy without recurrence, thereby improving overall oral hygiene by eliminating the frenum. Since abnormal frenum causes gingival recession, frenectomy is indicated.

Contraindications to Frenectomy: In the Ugly Duckling Stage, the space can be a typical growth feature during the primary and mixed dentition and is usually closed by the time the maxillary canines emerge. The frenum is normally large and thick in young children, but it becomes thinner and narrower as they grow older. In such cases, frenectomy is not recommended.

The techniques which were employed were:
- Conventional (Classical) frenectomy
- Miller's technique
- V-Y Plasty
- Z Plasty
- Frenectomy by laser

2. Clinical Cases

Classical Frenectomy: Kruger (1964) and Archer (1961) [4] introduced the classical technique. The type II frenal attachment of Placek is the subject of this case. [Fig. 1A]. After administering anesthesia to the affected area, the frenum was engaged using a hemostat that was pushed into the vestibule's depth [Fig. 1B]. Incisions were then made on the hemostat's upper and lower surfaces until it was free. The hemostat-containing triangular section of the frenum was excised. A blunt dissection was done on the bone to relieve the fibrous attachment [Fig.1C]. Simple interrupted sutures with 3-0 mersilk sutures were used to stitch the borders of the diamond-shaped incision. The area was covered with a periodontal pack. The pack and the sutures were removed 1 week post-operatively. [Fig.1D]

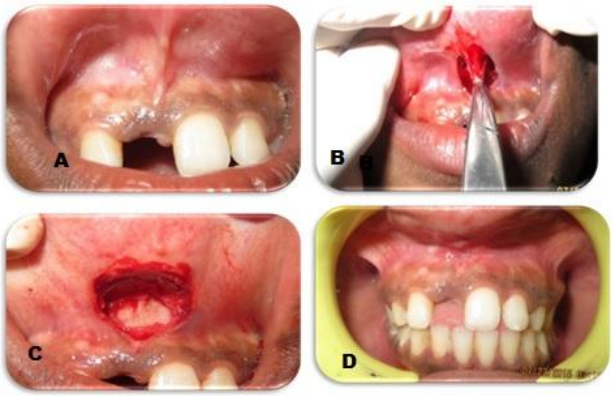

Figure 1: (A) Showing pre-operative view of high labial frenum. (B) Frenum was engaged using a hemostat (C) Surgical field after severing muscle attachment (D) 1-week post-operative view.

Miller's Technique

The Miller's technique was advocated by Miller PD in 1985. [5] This particular case is Placeks type III frenal attachment [Fig.2A] which was treated with the following surgical procedure after the area was anaesthetized. The frenum was removed, revealing the labial alveolar bone in the midline. The mesial side of the lateral incisor was incised vertically and parallelly. [Fig.2B]. A horizontal incision linking the coronal ends of the two vertical incisions was performed in the connected gingiva, 1-2 mm apical to the gingival sulcus [Fig.2C]. Flap was raised, mobilised mesially and sutured to obtain primary closure across the midline [Fig.2D]. After 1 week, the periodontal dressing was removed and healing was satisfactory.

Figure 2: (A) Showing pre-operative view Type III frenal attachment. (B) Vertical parallel incision on the mesial side of lateral incisor (C) Horizontal incision connecting the coronal ends of the two vertical incisions (D) Flap was raised and sutured.

Z Plasty [6] A case of Placek's type IV frenal attachment [Fig.3A] was operated by using the Z-plasty technique. The length of the frenum was incised with the scalpel and at each end incisions were made in equal length to that of the band. By using fine tissue forceps, with care not to damage the apices of the flaps, a Z plasty incision was placed [Fig.3B]. Double rotation flaps were produced as a result. The resulting flaps were mobilized and translated through ninety degrees to seal the horizontal incisions that were made vertically [Fig.3C]. 3-0 mersilk suture was placed [Fig.3D]. After 1 week, the dressing was removed, and the healing was found to be uneventful, with no hypertrophic scar formation and tension at the frenum area. And subsequently, the patient was recalled after 1 month for follow- up.

Figure 3: (A) Showing pre-operative view Type IV frenal attachment. (B) Z plasty incision was placed (C) Showing transposition of flap (D) Interrupted suture placed

V-Y Plasty [7] V-Y plasty can be used for lengthening the localized area, like the broad frenum in the premolar-molar area. This technique was employed in a case of Placeks type III frenal attachment [Fig.4A]. A V-shaped incision was performed on the underside of the frenal attachment after the area had been anesthetized [Fig.4B]. The frenum was relocated at an apical position and the V- shaped incision was converted into a Y, while it was sutured with 3-0 mersilk suture [Fig.4C]. After 1 month of follow-up [Fig.4D], the frenal attachment was found to be relocated at an apical position, with an uneventful healing.

Figure 4: (A) Showing pre-operative view Type III frenal attachment. (B)V shaped incision placed (C) Suture placed in V -Y figure (D) 1 Week post-operative view.

Laser:

With partial ankyloglossia, the patient was evaluated for lingual frenectomy, which was scheduled to be performed using a diode laser (Fig.5A). After administering anesthesia to the surgical site, a 3-0 silk suture (traction suture) was inserted through the tongue's midline. A Diode laser was used for the frenectomy procedure (Fig.5B). The frenum was released from the apex to its base. At the operative site, no suturing was required. Following surgery, the patient was

provided topical anesthetic ointment, antibacterial prophylaxis, and analgesics for pain management.

It was recommended to practice tongue movement actively. Initially white soft scab was formed in the surgical site (Fig.5C). Complete healing was seen approximately within 5 weeks. There was a significant increase in tongue mobility and speech articulation & phonation was improved. Follow up was done at 6 months post-surgery and showed no relapse (Fig.5D).

Figure 5: (A) Showing pre-operative lingual frenal attachment. (B) Usage of diode laser (C) Post-operative view showing scab formation (D) Follow up at 6 months.

3. Discussion

Frenum is said to be pathogenic when it is unusually wide or there is no apparent zone of attached gingiva along the midline. A diastema and gingival recession could result from an untreated ectopic frenum. Excessive movement of the upper lip can also negatively impact the healing of wounds and the development of soft tissues, thereby jeopardizing the results of traditional frenectomy procedures. There are a number of surgical procedures available that can be used to remove or realign an ectopic frenum; each has pros and cons of its own.

In a classic frenectomy, part of the papilla must be eliminated if the frenum has penetrated it, and this approach can cause significant aesthetic problems for the patient. [2] It was advocated in the midline diastema cases with an aberrant frenum to ensure the removal of the muscle fibres which were supposedly connecting the orbicularis oris with the palatine papilla. [1] Advantage for this particular technique is that it's easy to perform. But the main disadvantages are formation of Scar tissue. In contrast, Miller's method has two unique benefits. The advantages of this procedure over conventional ones are twofold: first, there is no visible scarring after healing since a continuous strip of gingiva forms across the midline; second, there is no damage to the interdental papilla because the trans-septal fibers are not damaged during surgery. It is therefore most appropriate for preventing a recurrence in orthodontics.

For a thick and wide variety of hypertrophic frenum with a low insertion and a short vestibule, Z-plasty was determined to be the best option. The vestibule's vertical extension and the fibrous band's removal were both accomplished. Similarly, the primary drawback of the V-Y Plasty procedure is that, in the case of a thick, hypertrophied frenum, it does not yield adequate cosmetic outcomes.

Modern frenectomy techniques have evolved to avoid scarring and promote healing through the use of lasers and soft tissue grafts. Compared to a cold scalpel, surgical laser treatment has the following advantages: a bloodless surgical field; no suturing is required because healing occurs subsequent to the intended healing; and less severe or nonexistent postoperative discomfort and edema. The coagulation of protein at the wound surface, which functions as a biological dressing and seals the terminals of the sensory neurons, may be the cause of decreased pain perception. [8] Using a scalpel caused more discomfort, which could be related to the surgical site becoming more involved, which could result in more blood loss, a bigger incision, and the need for suturing. Because of the accumulation of food and plaque, sutures may cause discomfort following surgery. In the scalpel group [9], a higher quantity of analgesics is consequently needed. Compared to the scalpel group, there was reduced intraoperative bleeding in the laser group. This finding aligns with the research conducted by Patel and colleagues, who observed notably reduced intraoperative hemorrhage during laser-assisted frenectomy. [10] The reduced bleeding near the ablated tissue borders may be the consequence of soft-tissue proteins coagulating at high temperatures during tissue ablation.

Three months after surgery, there was no discernible difference in the healing outcome of two groups. According to Fisher et al., the laser wound healed more slowly than the conventional wound. This was due to the fact that the laser causes less harm to the surrounding tissue, less collagen formation, delayed and more uneven epithelial regeneration. [11] Nevertheless, compared to scalpel approach, several additional researches revealed that laser treatment promotes faster wound healing and results in less scar tissue. [12] Neev et al. found that following laser soft-tissue procedures, there is less collagen remodeling, which leads to quicker healing and less visible scar tissue. [13]

4. Conclusion

However, the generally used method that is still in use for frenectomy is the classical technique, even with all of the variations that have been presented. The traditional method leaves a scar and a longitudinal surgical incision that may cause periodontal issues and an unsightly appearance, requiring additional adjustments. Out of all the frenectomy techniques used in this case series, the laser technique had the most benefit. The accompanying drawbacks, however, are increased expenses and the requirement for operator expertise.

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