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Impact of Brushing Technique on Cervical Abrasion and Tooth Loss

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Abstract: **Objective:** This study aimed to investigate the association between improper brushing technique, particularly horizontal brushing in right-handed individuals, and its impact on cervical abrasion and tooth loss. **Methods:** A questionnaire-based cross-sectional study was conducted among 400 right-handed participants aged 18–65 years. Data on oral hygiene behavior were collected through a structured questionnaire. Clinical examination assessed cervical abrasion at premolar and canine teeth. Chi- square tests were used to explore associations between behavioral variables and oral health outcomes. An independent t-test compared mean abrasion between maxillary and mandibular arches. **Results:** Horizontal brushing with excessive force was prevalent. Chi-square analysis revealed significant associations between brushing duration and technique ($p < 0.001$), toothbrush type and brushing force ($p < 0.001$). Tooth 45 (mandibular right second premolar) exhibited the highest mean abrasion (1.67). Although the mandibular arch showed higher average abrasion than the maxillary arch, the difference was not statistically significant. **Conclusion:** Improper brushing technique and forceful habits are significant risk factors for cervical abrasion and non-carious tooth loss, with mandibular premolars in right-handed individuals being most vulnerable. These findings highlight the urgent need for targeted oral health education programs that emphasize correct brushing methods, force regulation, and preventive strategies to reduce long-term tooth damage and preserve oral health.

Key Words: Cervical Abrasion, Horizontal Brushing, Tooth Loss, Brushing Technique, Mandibular Premolars, Oral Hygiene Behavior

INTRODUCTION

Cervical abrasion is a prevalent form of non-carious cervical lesion (NCCL), characterized by the progressive loss of tooth structure near the cementoenamel junction (CEJ). This condition is predominantly linked to mechanical actions, notably improper tooth brushing. Investigating the effects of various brushing techniques and tools is essential to formulate evidence-based preventive strategies.

Dentin hypersensitivity (DH) is a commonly encountered and challenging dental condition that often affects individuals between 20 and 50 years of age [1]. The widely accepted hydrodynamic theory suggests that thermal, mechanical, chemical, or osmotic stimuli cause fluid shifts within exposed dentinal tubules, leading to nerve activation and sharp, short-lasting pain. Accurate diagnosis relies on both visual inspection and standardized tactile or air-blast stimuli [1].

Anatomical and histological attributes of the cervical area, including thinning enamel near the CEJ, make this region more susceptible to damage. Cervical abrasion typically begins as a shallow, horizontal groove on the buccal or labial surface and presents a polished, shiny surface with tactile sensitivity upon examination [2].

Cervical abrasion is defined as a pathological process driven by repeated exposure to mechanical forces, including those from abrasive toothpaste or foreign objects habitually placed near the teeth. This condition, along with attrition and erosion, is classified under NCCLs and is often associated with discomfort, sensitivity, or pulp involvement [3]. It arises from multiple contributing factors, including forceful brushing, abrasive dentifrices, and to a lesser extent, chemical erosion and occlusal stress (abfraction) [3].

Although the process typically unfolds gradually, it stimulates protective responses such as the formation of secondary and tertiary dentin or sclerotic dentin. If left unmanaged, cervical abrasion can lead to plaque accumulation, tooth sensitivity, pulpal inflammation, or periodontal deterioration. Clinical management focuses on alleviating symptoms, restoring tooth structure, and addressing associated soft tissue complications [4].

The progression of cervical abrasion can be accelerated by a combination of biological, chemical, and behavioral influences, with cementum and dentin being especially vulnerable. The lesions often present as wedge-shaped or V-shaped defects accompanied by gingival recession [5].

Mechanical brushing habits—especially those involving vigorous technique or abrasive toothpaste—are recognized as primary contributors to abrasion. These lesions are more commonly seen in the incisor, canine, and premolar regions compared to molars [6].

Toothbrushing remains the cornerstone of personal oral hygiene; however, inappropriate techniques have been implicated in adverse outcomes like cervical abrasion. Factors such as excessive brushing force, hard-bristled brushes, and high-abrasive toothpastes are well- established risks.

Although the condition affects individuals across age groups, improper oral hygiene behavior remains the most significant modifiable risk factor. Studies evaluating optimal brushing frequency, duration, and technique have shown mixed results, highlighting the need for more precise recommendations. Additionally, the role of chemical factors—such as dietary acids and toothpaste abrasiveness—requires further clarification.

Brushing force is one of the most scrutinized factors. While gentle brushing with soft-bristled toothbrushes is generally advised, there is ongoing debate regarding their effectiveness compared to harder bristles. The use of manual versus powered toothbrushes also remains contentious—some studies favor pressure-sensitive powered brushes for reducing damage, whereas others caution against the potential effects of oscillatory movement on dental tissues.

Furthermore, brushing technique is critical. Popular methods such as the Bass, Stillman, and Fones techniques differ in bristle angulation, motion, and applied force. Their influence on the development of cervical abrasion, especially in individuals with root exposure or gingival recession, warrants deeper exploration.

This review aims to consolidate current findings regarding the association between toothbrushing and cervical abrasion. Specifically, it addresses the following objectives:

- To assess the effects of various brushing techniques on the occurrence and severity of cervical abrasion
- To evaluate the influence of brushing force, bristle hardness, and dentifrice abrasivity
- To compare the impact of manual and powered toothbrushes on cervical wear
- To explore the synergistic effects of mechanical and chemical factors
- To provide evidence-based preventive guidelines for minimizing toothbrush-induced cervical abrasion

A robust understanding of these elements is vital for clinicians, researchers, and public health stakeholders in crafting oral hygiene practices that balance effective plaque control with the preservation of dental hard tissues.

Cervical abrasion is a non-carious lesion typically caused by mechanical wear at the cervical region of teeth, often due to faulty brushing habits. Repeated horizontal strokes with excessive force are major contributors [1–4]. When left unchecked, abrasion may lead to dentin hypersensitivity [7-9], aesthetic concerns, and eventual tooth structure loss [10-11].

Tooth loss unrelated to decay or periodontal disease—termed non-decay tooth loss—can result from chronic mechanical trauma such as aggressive brushing or bruxism [12–14]. This study focuses on the impact of brushing technique and associated behaviors in right-handed individuals, who may apply more force and experience less dexterity on the contralateral mandibular arch.

METHODS

Study Design and Sample

A cross-sectional observational study was conducted among 400 right-handed participants aged 18–65 years. Ethical approval was obtained prior to data collection.

Data Collection

Participants completed a validated questionnaire capturing:

- Brushing technique, frequency, and duration
- Type of toothbrush and toothpaste
- Awareness of enamel wear
- History of tooth loss unrelated to decay
- Use of oral hygiene tools and dental visits

Clinical examination focused on assessing cervical abrasion on selected teeth (canines and premolars). Tooth numbers 13–15, 23–25, 33–35, and 43–45 were scored using a standardized abrasion index [1,2].

Statistical Analysis

- **Descriptive statistics:** Summarized demographics and behaviors.
- **Chi-square tests:** Assessed associations between variable pairs.
- **Independent t-tests:** Compared abrasion means between arches.
- **Significance level:** $p < 0.05$. SPSS v26.0 was used.

RESULTS

Demographics

- **Age**: Mean = 35.42 ± 10.75 years

- **Gender**: Predominantly male
- **Education**: Mostly secondary/tertiary

Oral Hygiene Behaviors

- **Brushing:** Mostly once or twice daily, ~2 minutes
- **Toothbrush:** Predominantly manual; moderate force used
- 68% used horizontal brushing technique

Statistical Findings

- **Brushing duration × technique** : $\chi^2 = 143.52$, $p < 0.001$
- **Toothbrush type × force**: $\chi^2 = 63.24$, $p < 0.001$
- **Clenching × non-decay tooth loss**: $\chi^2 = 4.63$, $p = 0.031$
- **Education × awareness**: $\chi^2 = 14.89$, $p = 0.00058$

Tooth Abrasion Rankings

- Tooth 45 (mand. right 2nd premolar): 1.67
- Tooth 44: 1.64
- Tooth 43/13: 1.53
- Maxillary average: 1.493
- Mandibular average: 1.553
- $t = -0.475$, $p = 0.635 \rightarrow$ NS

DISCUSSION

Non-carious cervical lesions (NCCLs) represent a prevalent category of dental wear, commonly observed across diverse populations. These lesions encompass abrasion, abfraction, and erosion. Abrasion results from mechanical forces unrelated to normal physiological actions such as mastication. The most frequent cause is improper use of toothbrushes and abrasive dentifrices, leading to wedge-shaped defects on exposed root surfaces [3,4]. Abfraction is attributed to flexural stress from occlusal loading, whereas erosion involves the chemical dissolution of enamel and dentin in the absence of bacterial activity [4].

Cervical abrasion specifically results from external mechanical forces that repeatedly contact the tooth surface. Common contributing factors include aggressive brushing, the use of hard-bristled toothbrushes, and abrasive toothpaste [3,15]. Erosive agents that soften tooth structures further predispose them to mechanical damage [5].

One major limitation in effectively diagnosing and managing cervical abrasion is the lack of standardized clinical assessment tools. Several classification systems exist—such as those proposed by Eccles, Smith and Knight, and Lussi—but their variability reduces comparability across studies. A more recent method, the Cervical Abrasion Index of Treatment Needs (CAITN) probe, was introduced to provide consistent lesion depth measurements and assist in treatment planning [1,2,15].

The prevalence of cervical abrasion varies depending on demographic and behavioral factors. Studies indicate a higher occurrence in older individuals and a notable link with brushing behaviors, particularly technique and bristle hardness [4]. While no consistent gender differences have been reported, the condition is commonly seen in posterior and maxillary teeth [3,4].

Adoption of standard indices like CAITN can help unify prevalence data and support evidence- based decision-making [2].

From a management perspective, goals include halting lesion progression, reducing hypersensitivity, preventing pulpal damage, and improving aesthetics [8,15-16]. Patient education plays a critical role in prevention, including guidance on appropriate brushing force, brush type, and toothpaste selection [5,11]. For cases requiring restorative treatment, materials such as resin-modified glass ionomer cements (RMGICs) and composite resins are commonly used [9]. RMGICs, in particular, have shown greater retention in some cases, offering advantages in managing cervical lesions [9].

This review highlights the significant role of tooth brushing behaviors in the development of cervical abrasion. Horizontal brushing—especially when performed with excessive force—is consistently associated with greater tooth surface loss at the cervical margin [4,17]. In contrast, the modified Bass technique, which employs angled, gentle vibratory strokes, is protective and less likely to cause trauma [11,9].

Electric toothbrushes equipped with pressure sensors are a promising preventive tool, as they regulate force and are particularly helpful for individuals with limited manual dexterity or aggressive habits [9]. Brushing frequency and duration also influence abrasion risk; more than twice-daily brushing or prolonged brushing sessions amplify cumulative stress [4,17].

Encouraging patients to limit brushing sessions to two minutes and apply gentle pressure is essential for reducing damage [16,18].

The studies reviewed showed considerable variation in methodology, follow-up period, and sample size, which limits the generalizability of findings. To improve the quality of evidence, future research should implement standardized diagnostic tools and extend follow-up durations. It is also critical to study the combined influence of toothpaste abrasivity, brushing methods, and toothbrush types [20,13].

A toothbrush was successfully developed using a natural composite filament made from neem fiber, neem powder, and PLA. Analysis of its functional groups, crystalline structure, and morphology revealed that the neem-infused bristles help reduce oral diseases and improve teeth whitening. FTIR results showed peaks linked to cellulose, carbohydrates, and nimbin—an active compound known for its oral health benefits. The high amorphous content (89%) suggests reduced crystallinity, supporting the natural antibacterial properties of neem. This eco-friendly toothbrush blends modern dental care with neem's natural antimicrobial effects, offering promising benefits for oral health and sustainability [20].

Toothbrush may be a well-known tool in oral care. Familiarity of youngsters with this device is vital. Effective

tooth brushing aids in the management of cavity and periodontitis. Dentists and Dental assistants need adequate information about children's oral hygiene to teach them and their parents. Also tooth brushing twice daily under parent's supervision is suggested [21].

The oldest toothbrushing method was described in 1913 by Fones and is suggested mainly for youngsters . The Bass technique places emphasis on the removal of plaque from above and slightly below the gingival margin . Bass had been changed to the Modified Bass where the bristle position and predominantly horizontal brush movements within the Bass method are retained, but vertical and sweeping motions to make circles are added . The Stillman technique is analogous to the Bass technique .The vertical motions of the Stillman technique could also be combined with the Bass, as prescribed for the Modified Bass .Charters suggested angling the comb head at 45° coronaly to the margin instead of apically. Vibratory and slight rotary movement is then applied before moving to the subsequent group of teeth. An abnormal frenum may be an additive factor to plaque accumulation and may cause inhibition to proper tooth brushing . The Scrub technique is the most simple technique, with the toothbrush held parallel to the gingiva and horizontal motions to scrub the gingival crevice in an ordered fashion . There are some modification techniques such as Hirschfeld's technique which is a modification of the Fone's technique where the circular motion is smaller and concentrated over the gingival crevice. Frequency and duration of brushing are usually included with recommendations concerning the tactic of toothbrushing for children[22]

Modified Bass technique emerged as the most commonly recommended brushing method for patients aged 13 to 17 years. Oral hygiene instructions should be tailored to align with a child's developmental level and motor coordination. It is important to account for differences in brushing ability, particularly among younger children [21].

Fones technique emerged as the most commonly recommended brushing method by dentists for children aged 6 to 12 years, regardless of gender. The Modified Bass technique was the next most preferred. Ensuring proper oral hygiene during the mixed dentition stage is crucial and demands ongoing reinforcement [22].

Participants who regularly used ultrasonic toothbrushes showed a noticeable reduction in oral and salivary bacterial counts compared to those in the control group. However, proper guidance and monitoring are essential for individuals using ultrasonic toothbrushes [23].

She indicated that toothbrushes used by individuals with gingivitis had higher levels of bacterial contamination compared to those used by individuals with healthy gums. The most commonly identified microorganisms were Staphylococcus aureus and Streptococcus mutans. Toothbrushes play a significant role in the transmission of microorganisms, potentially increasing the risk of infection. Therefore, it is essential for dentists to take an active role in educating patients about the proper selection, storage, hygiene, and timely replacement of toothbrushes [24].

A toothbrush is a principle instrument that helps in maintaining proper hygiene and oral care.Based on the different bristle diameters the tooth brushes have been categorized as soft (0.2mm), medium (0.3mm) and hard (0.4mm). Choosing the right toothbrush plays an important role in maintaining oral hygiene . Apart from choosing the right toothbrush, proper usage of the toothbrush should also be taken into consideration, as improper brushing may lead to the soft and hard tissues of the teeth . This may lead to conditions such like abrasion .Abrasion is the process in which the enamel erodes due to the force applied on teeth ,improper brushing can also be caused for abrasion. Toothbrushes with different functions have been developed for oral health management.The factors that influence the surface roughness of teeth are the brushing methods, frequency, duration of brushing ,bristle diameter,shape, force of brushing direction of brushing ,number of bristles per tuft and its management[25]

Electric toothbrushes may be less effective for blind children due to their limited tactile feedback, which makes it challenging for them to feel the pressure and identify the areas being cleaned. This can hinder effective brushing techniques and result in inadequate plaque removal. Additionally, the complexity of electric toothbrushes- often relying on visual cues and features like timers and sensors- creates difficulties for blind children in establishing consistent routines and gaining confidence in their use. Caregivers and healthcare providers play a crucial role in supporting the unique needs of blind children by developing tailored oral care solutions, including the use of manual brushes and adaptive tools such as Braille instructions. [26]

Toothbrushing Technique and Cervical Abrasion

Several patterns emerged from the literature:

- **Force and Frequency**: High brushing force, regardless of brushing frequency, is a major contributor to cervical lesions. Although frequent brushing may elevate risk, excessive pressure appears to be the dominant factor [4,10].
- **Toothbrush Type**: Hard-bristled brushes are linked to increased cervical wear compared to soft-bristled ones [3,4].
- **Toothpaste Abrasivity**: Use of abrasive dentifrices exacerbates wear, especially when combined with poor brushing technique [18,19].

Confounding Variables and Study Limitations

Confounding factors such as age, gingival recession, tooth anatomy, and genetic predisposition complicate the evaluation of cervical abrasion [4,5]. Furthermore, inconsistencies in diagnostic criteria and study design limit the strength of conclusions, underscoring the need for uniform research protocols [7,19].

Implications for Clinical Practice

Based on these findings, clinicians should prioritize the following:

- Encourage the use of soft-bristled toothbrushes [4]
- Educate patients on gentle brushing techniques [5,18]
- Recommend toothpaste with moderate abrasivity for long-term use [18,19]

Limitations and Future Directions

The primary limitation lies in the heterogeneity of included studies. Many relied on self-reported data regarding brushing behavior, which may introduce recall bias. Controlled clinical trials with objective measurement tools are essential to establish definitive causal links. Future studies should aim to integrate standardized protocols for both brushing technique assessment and lesion classification [6,13,16].

CONCLUSIONS

Tooth brushing is critical for oral hygiene, but improper technique—especially excessive force, hard-bristled brushes, or abrasive toothpaste—can lead to cervical abrasion [3,4,18]. Educational interventions promoting soft bristles and gentler methods should be widely adopted [5,18].

Innovations in toothbrush technology and formulation of less abrasive toothpaste may further reduce the prevalence of this condition [16,12].

Moving forward, comprehensive clinical trials and consistent evaluation metrics are needed to better understand the connection between oral hygiene habits and cervical abrasion [7,16]. By enhancing patient education and refining preventive tools, dental professionals can help reduce the impact of improper brushing practices and promote long-term oral health [12,16].

Improper brushing technique is a significant contributor to cervical abrasion and tooth loss in right-handed individuals. Education on force control and technique adjustment should be integrated into preventive dental care.

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