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Assessment of Various Tooth Brushing Techniques and its Association with Dental Plaque

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ABSTRACT

Dental plaque and poor oral hygiene are well-known risk factors for gingivitis, periodontitis, and other dental diseases. Using a manual toothbrush to remove plaque mechanically is essential for maintaining good oral hygiene every day and avoiding dental problems. Consequently, different toothbrushes are assessed to evaluate their effectiveness in plaque removal. **Objective:** To find the association between types of tooth brushing techniques and dental plaque in school children. **Methods:** A cross-sectional study was conducted in schoolchildren aged 15-18 years and convenience sampling was used to get data from the sample size of 211. Utilizing SPSS version 26.0, the data were examined to determine frequencies and percentages. The chi-square test was utilized to investigate potential associations of plaque with brushing techniques. **Results:** It showed that 58.3% of the children were male, while 41.7% were female. A majority (76.8%) used toothpaste, 59.2% brushed once daily, a smaller group brushed thrice a day (10%) and 45% have never visited a dentist. The Modified Bass technique proved the most effective, with 42.2% showing no plaque. The vertical and combined techniques showed moderate plaque levels, highlighting the significant impact of the brushing technique on plaque accumulation, as shown by the p-value of <0.001. **Conclusion:** The study revealed that the Modified Bass technique had the highest rate of reducing plaque, while horizontal brushing showed the greatest plaque buildup.

INTRODUCTION

Dental plaque is a soft, non-mineralized bacterial deposit that adheres to tooth surfaces and cannot be removed by water alone. Mechanical methods like brushing and flossing are required, with brushing being the most effective approach [1]. High dental disease rates in children result from host factors, microorganisms, parental behavior, and poor hygiene [2]. Tooth brushing is a widely recommended contemporary practice and serves as the main method for maintaining oral hygiene [3]. Dental plaque, a microbial biofilm on tooth surfaces, is a key cause of periodontal diseases like gingivitis and periodontitis. Plaque buildup near the gingival margin triggers inflammation, which worsens as the biofilm matures but resolves completely when the biofilm is removed [4]. The effective plaque removal relies on both the type and technique of toothbrushing. Over the past 20 to 30 years, various brushing techniques have been recommended, including the Bass, Stillman, Charters, horizontal, Fones, and roll methods [5].Brushing techniques vary in brush movements (horizontal, vertical, circular) and bristle alignment with the gingiva and tooth surfaces, affecting removal of plaque [6]. There is no agreement among dental professionals and companies on manual toothbrushing techniques. Brushing twice daily with fluoride toothpaste

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for two minutes is essential, yet manual brushing often leaves plaque, particularly on lingual surfaces. Bristle splaying and wear from prolonged use reduce plaque removal efficiency, increase gingivitis risk, and may damage teeth and gums, making timely toothbrush replacement crucial for effective oral hygiene. Studies examine plaque removal effectiveness by toothbrush type, technique, and frequency [7]. Studies have explored how plaque removal differs by toothbrush type, technique, and brushing frequency. While dental professionals recommend brushing for at least two minutes twice daily, guidelines from associations are limited, and actual brushing times often range from 30 to 60 seconds [8]. Modern dentifrices, available as pastes or gels, support tooth brushing and deliver agents that help prevent calculus, reduce plaque, protect against cavities, whiten teeth, and relieve sensitivity in exposed roots. Mild abrasives and detergents assist in plaque removal, though the abrasives may cause damage to exposed root surfaces [9]. Effective plaque control depends on proper hygiene tools, training, and motivation, highlighting the importance of tooth brushing in children's oral health.

The study aimed to find the relationship between various brushing methods and plaque buildup in school children.

METHODS

A cross-sectional study was conducted involving school children, carried out during the 10/1/24 to 10/7/24. The Lahore Medical and Dental College's Ethical Review Board granted ethical approval (LMDC/FD/65/24). The Open Epi calculator version 3.01 was calculated to be 200, using a 5% margin of error, a confidence interval of 95%, and a prevalence of 15.3% on Open Epi [10]. However, the 211 sample size was calculated due to missing data and dropouts. The data were collected by using convenience sampling technique. The consent form outlined the objectives, procedures, assurances of confidentiality, and dedication to scientific integrity. Participants were invited to inquire or seek clarification regarding any section of the consent form. They were also made aware of their rights to refuse or withdraw from the study at any time. A pilot survey was conducted on 10 students to validate the questionnaire before the beginning of the study. The study included healthy, cooperative school children aged 15-18 in both sexes, without mental and physical disabilities. Children with orthodontic or prosthodontic appliances, caries, periodontal issues, or any chemical agents for preventing plaque or oral infections were excluded. Information was gathered on age, gender, school type, tooth cleaning material, dentist visits, toothbrush types, and brushing techniques. Written consent was obtained from parents. The oral examinations were performed in natural daylight using a mouth mirror and a dental explorer to assess the Plaque visually. Plaque levels were assessed using the Silness and Loe plaque index (1964), with scores ranging from 0 to 3: Excellent (0), Good (0.1–0.9), Moderate (1–1.9), and Poor (2–3). The distobuccal, buccal, mesiobuccal, and lingual surfaces of six selected teeth (16, 12, 24, 36, 32, 44) were examined to calculate plaque scores. The plaque index (PI) was determined as the average of the area scores. Plaque was measured on four surfaces (distal, facial, mesial, and lingual) of the cervical portion of the teeth using an explorer. Scoring criteria were as follows: 0 indicated no plaque, 1 denoted plaque detectable by a probe but not visible, 2 represented moderate plaque visible to the naked eye, and 3 indicated an abundance of soft plaque [11]. Data analysis was conducted with SPSS version 26.0, where descriptive statistics, including percentages and frequencies, were calculated. A chi-square test assessed the relationship between tooth-brushing techniques and plaque index. A significance level (p-value) of ≤ 0.05 was deemed statistically significant.

RESULTS

It showed that the majority of the children were male (58.3%) and aged 17-18 (72.5%). Toothpaste was the most used as a cleaning material (76.8%). Over half (54.5%) had visited a dentist (Table 1).

Table 1: Showing the Demographic Information of the School Children(n:211)

Variables		Frequency (%)
Gender of Children	Male	123 (58.3)
	Female	88 (41.7)
Age	15-16	58 (27.5)
	17-18	153 (72.5)
Tooth Cleaning Material Used	Toothpaste	162 (76.8)
	Powder	37 (17.5)
	Nothing	12 (5.7)
Frequency of Brushing	Once a Day	125 (59.2)
	Twice a Day	57 (27)
	Thrice a Day	21 (10)
	None	8 (3.8)
Dental Visit	Yes	115 (54.5)
	No	96 (45.5)
Frequency of Dental Visit	Every 3 Months	26 (12.3)
	Whenever Needed	90 (42.7)
	Never	95 (45)

The Modified Bass technique shows the highest percentage (54.5%) of "No plaque" cases, while horizontal brushing has the most cases with abundant plaque (56.7%). P-value (<0.001) indicates a significant difference in plaque outcomes among the techniques, favoring modified bass (Table 2).

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Table 2: Association between Types of Tooth Brushing and Plaque Index

Plaque Index	Brushing technique				P-Value
	Modified Bass	Horizontal	Vertical	Combined	
0= No Plaque	18	5	8	2	>0.001
	54.5%	15.2%	24.2%	6.1%	
1= Plaque on Free Gingival Margin	11	18	12	15	
	19.6%	32.2%	21.4%	26.8%	
2= Moderate Plaque	7	24	11	12	
	13.0%	44.4%	20.4%	22.2 %	
3= Abundance of Soft Matter	6	34	11	9	
	10%	56.7%	18.3%	15.0%	

DISCUSSION

According to present study, 58.3% of the children were male. Most participants (76.8%) used toothpaste for cleaning, while 59.2% brushed once a day. Additionally, 54.5% reported visiting the dentist, and 45% had never visited one. Regarding dental visits, 12.3% went every three months, 42.7% visited when needed, and 45% never visited. In research on tooth brushing habits, Davidovich *et al.*, found that most kids (63.5%) used manual toothbrushes, 36.3% used electric toothbrushes that could be recharged, and 72% of kids brushed their teeth twice a day [12]. According to the study, over 60% of participants visited the dentist less frequently than every two years, with 22.7% never going, and only 9% attending regular checkups. Regarding dental hygiene behaviors, 53% brushed twice daily, while the use of mouth rinse (11%) and interdental cleaning was infrequent, occurring in only 3% of the participants [13]. Current study's findings showed that the Modified Bass approach was the most successful in lowering plaque, with 42.2% of participants showing no plaque. In contrast, the horizontal brushing technique resulted in 44% of children having abundant plaque. An earlier study reported that the forty-six orthodontic patients compared modified Bass and Charter's techniques, showing similar plaque removal effectiveness across all tooth surfaces as present results [14]. On the contrary, the study showed that the most commonly used brushing technique among children was the combined method (42.9%), followed by the horizontal technique (32.6%), the circular method (15.2%), and the least used was the vertical technique (9.3%) [10]. In a study with participants aged 12.161±0.493 years, both Group A and B showed good plaque scores, with the Bass method being significantly more effective in plaque reduction compared to other techniques ($p<0.001$) [15]. Previous studies revealed significant differences in brushing techniques recommended for adults and youngsters. The Bass and its modified version were typically advised for adults, while the Scrub and Fones techniques were more common for youngsters. The Modified Bass procedure proved superior in removing plaque, especially on lingual and buccal sites [16]. The American Academy of Pediatric Dentistry guidelines clearly explained that plaque buildup was strongly linked to the caries in young children and was important for assessing risk, particularly in preschoolers [12]. Another study demonstrated that the effectively optimized tooth brushing technique reduced dental diseases. It also found that toothbrush type significantly facilitated plaque removal, while brushing frequency was key in preventing oral diseases.[17]. Moreover, it was observed that 15- to 16-year-olds had lower plaque levels, indicating improvements in oral hygiene compared to the 11- to 12-year-old group [18]. Therefore, manual toothbrushes effectively remove dental plaque, although, mastering effective tooth brushing requires practice and professional training. Previous research on disseminating training through mass media showed unsatisfactory outcomes due to a lack of repetition and reinforcement [19]. Parents and teachers can promote behavior change by delivering dental health education through methods and media tailored to the child's developmental stage, ensuring effective and age-appropriate learning[20].

CONCLUSIONS

The majority of children were using toothpaste for oral hygiene and it was revealed that the Modified Bass approach was the most successful in keeping teeth free of plaque and 54.5% of children showed no plaque (P-value < 0.001 while the horizontal technique had the poorest outcomes (56.7% with abundant plaque). These findings highlight the need for school-based oral health education, parental guidance on effective techniques like the Modified Bass method, and improved access to dental care.

Authors Contribution

Conceptualization: SLSS
Methodology: SLSS
Formal Analysis: SLSS, AH, ZK
Writing Review and Editing: AH, RS

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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