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A cross-sectional study to correlate oral hygiene habit among orthodontic patients with their clinical findings and periodontal treatment need

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Abstract

Background Orthodontic treatment requires good oral hygiene for successful completion of treatment. As protocol, patients are usually given instructions for oral hygiene and diet at the start of treatment, however, they are not fully followed. Different methods are employed in order to increase patient compliance including digital means, however, these are not possible in teaching hospitals with high burden of patient care and limited resources. The present study aims to correlate the patient reported behavior with their clinical findings and treatment need. This will enable us to identify potential sources of motivation which will be incorporated in daily practice and enable us to improve methods to enhance patient's behavior.

Method A cross-sectional study was conducted in the orthodontic department of a semi-government teaching hospital from August to October 2023 using a modified questionnaire. The clinical examination was done using a Community Periodontal Index for Treatment Need-C (CPITN-C) probe. The diagnosis of presenting clinical conditions and treatment need was done using Community Periodontal Index for Treatment Need (CPITN) and Gingival Bleeding Index (BI). Data collected was analyzed for frequencies and correlation was done using Spearman Correlation Coefficient. P-value ≤ 0.05 was taken as statistically significant.

Result The sample size consisted of 110 patients of which 60% were entitled to receive treatment. The predominant age group was 15–20 years (39.1%). Approximately 70% patients were in code 1 for CPITN and GI and in need of oral hygiene instructions. Overall patients' showed good level of awareness, however, they were not compliant in behavior.

Conclusion Although patients showed a good level of awareness towards oral hygiene practices, there was a lack of compliance in following them. Patients were more concerned for being affected by dental caries due to poor oral hygiene than its effect on overall treatment outcome.

Keywords Oral hygiene, CPITN, Gingival indices, Orthodontics

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Background

Bracket systems are potential stagnation zones in the oral cavity, which increase the build-up of supra-gingival plaque. [1] They are also known to alter the biofilm which results in increased risk of caries and periodontal disease in these patients. To avoid these outcomes, two factors are essential: clear and robust oral hygiene instructions, and good patient compliance.

Studies have shown that the digital modalities such as Instagram or teledentistry are becoming more popular than traditional method of chairside instructions however studies have shown comparable results [2, 3]. A randomized clinical trial found that patients who followed orthodontic instructions via social media were more likely to have improved oral hygiene. [4] This is also controversial as search engines in these platforms can generate algorithms which may divert patients to unverified educational material and cause misconceptions among patients. [5] Another trial used teledentistry as means for patient education on oral hygiene status. The study followed patients in their initial three visits and found it to be an effective method. [6] This is debatable as patients usually have high motivation levels at the commencement of treatment. Other methods to increase patient compliance are through weekly reminders, however, this is not possible in teaching hospitals due to large number of reporting patients. [7]

Hence, this brings us to the present research which aims to determine the effectiveness of the oral hygiene instructions being delivered to the patients undergoing orthodontic treatment. Patient reported behavior was correlated with clinical findings of plaque and gingival condition and with ensuing treatment need.

Materials and methods

It was a cross sectional study conducted on the orthodontic department of a semi-government teaching hospital. The ethical clearance was obtained from the institutional ethical review committee (FF/FUCD/632/ERC/41). The duration of the study was from August 2023 till October 2023.

The sample size was calculated using WHO calculator. The estimated population proportion was 60% who used a soft toothbrush at a confidence level of 80% with a relative precision of 10%, the total sample size calculated was 110. [8]

Patients who reported to the department with full mouth bond-up of braces and undergone treatment for six months or more were included in the research after taking their consent. Patients with craniofacial anomalies or syndromes, communication or learning disabilities, and, having history of gingival and periodontal disease or undergone treatment for infections through antibiotic

therapy in the last three months were not taken into consideration.

Upon obtaining informed consent, participants completed a verified questionnaire which had been modified from a previous study. [8] The initial questionnaire consisted of 15 questions. Face validation was done by an experienced orthodontist. The content validation was done using Cronbach's Alpha. The value obtained for 15 questions was 0.621 which was further analysed for item analysis. The final questionnaire had 12 questions with a reliability score of 0.747. The questionnaire was prepared on Google Forms.

The questionnaire was comprised of two parts. The first part focused on demographic data of the participants. The main survey, consisted of questions regarding the subject's knowledge of oral hygiene maintenance associated with their orthodontic treatment. In an effort to ensure that the subjects clearly understood what was being asked, the questions were read out to them by the investigators, who explained any ambiguities that arose. The investigators filled in the questionnaire on the subject's behalf on their own mobile devices after ensuring the subject clearly understood what was being asked. Investigators were briefed about how to explain the questions to the subjects to avoid as much discrepancy as possible in the subjects understanding. Additionally, the investigators were asked to fill the form in real time to avoid any biases affecting the data collected.

The clinical examination of the subjects was done by measurement of the following metrics; CPITN index and Gingival Bleeding Index (BI) given by Silness and Loe. The treatment need was assessed using the CPITN index with slight modification in Score 3 and 4 which were taken together due to similarity in clinical procedure i.e. periodontal surgeries to remove infected tissue along with scaling and oral hygiene instructions. The investigators measured and documented these values into the forms to avoid any biases affecting the data, as done in the previous section. The measurement was done using a standard WHO probe. A set of 14 probes was used to collect all the data. Eight Internees in the orthodontic department who were familiar with the probe and had undergone formal training in its use as part of their undergraduate curriculum and internship were recruited for data collection. Standardization was done before commencing the procedure to determine reliability and ICC of 0.76 was obtained. Hence, there was good agreement among the examiners.

The six-point probing technique was employed in all individuals. This included probing of all first molars, one upper central incisor and one lower central incisor. The lower central incisor was selected in the contralateral quadrant to the upper incisor that was probed. The probe was inserted along three points on the lingual/

palatal and buccal/facial surfaces of the selected teeth. The points chosen where the mesial and distal line angles as well as the central most point of each surface. The pocket depths were measured and bleeding on probing was assessed. Furthermore, visible changes of the gingival tissues were also assessed and documented. The subjects were then assessed for treatment need by the examiner and informed.

All patients were verbally given oral hygiene instructions (OHI) and dietary advice in their bonding appointments by their treating doctors. They comprise

postgraduate residents who are working under supervision of the faculty and the faculty themselves.

Data analysis

The data collected was analysed using SPSS version 23.0. The descriptive statistics of the sample along with their answers were assessed for frequency. The correlation of the patients' responses with clinical findings and treatment need was done using Spearman Correlation Coefficient.

Results

The sample size consisted of 46 males (41.8%) and 58 females (52.7%) with 6 patients (5.5%) preferring not to disclose their identity, as shown in Table 1. The sample size consisted predominantly of patients in the 15–25 years age group (39.1%) followed by 20–25 years (38.2%). 60% of the sample consisted of 'beneficiary' patients (entitled to receive treatment at nominal cost). The highest level of education received was 'Undergraduate' (40%).

Table 2 shows the frequencies of patients' responses on oral hygiene treatment. 97.3% of the patients stated that they had received OHI at the start of treatment. Instructions were mostly given verbally (71.8%). Nearly half of the patients (48.2%) had 'always' received reinforcement of instructions at every visit. Interdental brush was commonly used by the patients (79.1%). While all patients had been given dietary instructions (94.5%), 50% of the patients reported following them. While 48.2% patients had been instructed about brushing technique, 40% could not recall. All patients agreed that hygiene is important for successful treatment outcome (96.4%) and that positive results will be achieved with good oral hygiene (86.4%). 88.2% of the patients were of the opinion that poor oral hygiene during orthodontic treatment caused dental cavities and 59.1% said that it effected 'treatment efficacy'.

The patient's responses were correlated with their clinical findings, as shown in Table 3. Overall, a positive correlation was obtained for reported behaviour and clinical examinations and this was statistically significant. This shows that although the subjects were answering positively for following oral hygiene practices, their oral hygiene was mostly poor. A statistically significant and negative correlation was obtained for 'Consequence of poor oral hygiene: dental cavities' with GI ($r = -0.236$, p -value = 0.013*). Thus, patients had little awareness that poor oral hygiene caused dental cavities.

Table 4 shows the correlation of reported behaviour with treatment needed after clinical examination. A negative correlation was obtained for 'treatment needed (OHI with scaling)'. This shows that while patients reported positively for level of awareness, most of them needed scaling and this was statistically significant. A highly

Table 1 Descriptive statistics of the Sample

Gender	Frequency	Percent
Male	46	41.8
Female	58	52.7
Prefer not to say	6	5.5
Age	Frequency	Percent
10–15 years	15	13.6
15–20 years	43	39.1
20–25 years	42	38.2
25–30 years	7	6.4
above 30 years	3	2.7
Entitlement Status	Frequency	Percent
Beneficiary	66	60.0
Private	32	29.1
Panel	12	10.9
Educational Status	Frequency	Percent
Primary	12	10.9
Secondary/Matric	16	14.5
Higher secondary/Intermediate	31	28.2
Undergraduate	44	40.0
Post graduate	7	6.4
CPITN Score	Frequency	Percent
0	14	12.7
1	77	70
2	19	17.3
Gingival Bleeding Index	Frequency	Percent
0	14	12.7
1	76	69.1
2	20	18.2
Treatment Need	Frequency	Percent
No treatment need	15	13.6
OHI	77	70
OHI with scaling and polishing	22	20
OHI with scaling and polishing and surgery	1	0.9

Table 2 Patients' responses on oral hygiene practices during orthodontic treatment

Variable		Fre- quen- cy (n)	Per- cent- age (%)
Did you receive additional guidance regarding oral hygiene maintenance at the beginning of orthodontic treatment?	Yes	107	97.3
	Can't recall	3	2.7
If yes, how did you receive it?	Via demonstrations	14	12.7
	Visual illustrations (videos)	16	14.5
	Verbally	79	71.8
	Via brochures, pamphlets, charts	1	0.9
Have you received oral hygiene reinforcement at every dental visit?	Always	53	48.2
	Sometimes	39	35.5
	Rarely	16	14.5
	Never	2	1.8
Have you incorporated additional oral hygiene measures after receiving orthodontic treatment?	Interdental brush	87	79.1
	Mouth washes	51	46.4
	Flossing	18	16.4
	Saline rinses	4	3.6
Have you been instructed about dietary precautions after receiving orthodontic treatment?	Yes	104	94.5
	No	2	1.8
	Can't recall	4	3.6
Do you avoid consumption of sticky foods?	Always	49	44.5
	Sometimes	55	50.0
	Rarely	6	5.5
	Irregular	12	10.9
Have you been instructed about brushing techniques?	Yes	53	48.2
	No	13	11.8
	Can't recall	44	40.0
Is good oral hygiene maintenance important while undergoing orthodontic treatment?	Yes	106	96.4
	No	1	0.9
	I don't know	3	2.7
Does good oral hygiene maintenance affect orthodontic treatment outcome?	Yes	106	96.4
	I don't know	4	3.6
If yes, how do you think maintaining good oral hygiene is going to affect your treatment outcome?	Positively	95	86.4
	I don't know	15	13.6
Consequences of not maintaining good oral hygiene during the course of orthodontic treatment (multiple options can be chosen)	Gum swelling	15	13.6
	Gum bleeding	33	30.0
	Dental cavities	97	88.2
	Treatment efficacy	65	59.1
	Treatment failure	45	40.9

N=110

statistically significant and inverse correlation was seen for patients who reported that they had received dietary instructions and yet need surgical procedures such as gingivectomy along with OHI and scaling ($r = -0.406$, $p\text{-value} < 0.001^{***}$). Patients who avoided sticky foods ($r = 0.381$, $p\text{-value} < 0.001^{***}$) and had received instructions

on brushing techniques ($r = 0.393$, $p\text{-value} < 0.001^{***}$) showed a highly statistically significant and positive correlation with 'no treatment need'.

Discussion

The oral hygiene status of orthodontic patients has been extensively studied in different populations world-wide. However, few studies have been conducted in Pakistan which correlate patient-reported behaviour with periodontal treatment need and clinical findings.

A study conducted by Ali et al. [9] found that visual aids were more effective than verbal instructions for educating patients in oral hygiene practices. In the present study, 71.8% patients reported they had received their instructions verbally. A positive correlation was obtained between verbal instructions and CPITN ($r = 0.338$) and BI ($r = 0.343$) scores which was highly statistically significant ($p\text{-value} < 0.001^{***}$). Plaque accumulation was noted in approximately 70% of the patients but the score of CPITN and BI was '1'. This score states that there is bleeding on probing along with mild inflammation which does not require any clinical intervention (TN, OHI with scaling; $r = -0.203$, $p\text{-value} = 0.034$). Thus we state that admittedly visual aids are effective, verbal instructions can be equally relevant.

48.2% patients reported "always" receiving reinforcement of oral hygiene habits while 35.5% patients' stated that they "sometimes" received them. This correlated strongly with CPITN ($r = 0.445$, $p\text{-value} < 0.001$) and moderately with BI ($r = 0.396$, $p\text{-value} < 0.001$) showing that there was mild inflammation. Although patients received brushing instructions at the first appointment (97.3%), but due to lack of reinforcement at subsequent appointments, the oral status of the patients deteriorated. A moderate correlation was seen with treatment need as patients either did not need treatment ($r = 0.314$, $p\text{-value} = 0.001^*$) or required OHI with scaling ($r = -0.365$, $p\text{-value} < 0.001^{***}$). The oral microbiome of orthodontic patient changes with the incorporation of appliances due to increased tendency of plaque stagnation sites and the presence of residual composite. [10] Other reasons could include patient burnout from lengthy treatment which transiently affects their behaviour. However, this was not measured in this study.

A statistically significant and positive correlation was obtained for reported 'additional oral hygiene measures: mouthwash' with CPITN ($r = 0.244$, $p\text{-value} = 0.01$) and BI ($r = 0.256$, $p\text{-value} = 0.007$). Although patients preferred to use mouthwashes over mechanical means to maintain oral hygiene, this is not advised as it is not effective on mature biofilms. On the contrary, evidence shows that it may lead to ecological changes in microbiota along with formation of resistant strains. [11] This may be the cause of increased plaque accumulation. In contrast, nearly 80%

Table 3 Correlation of patients' responses with clinical findings

Variables	CPITN score		BI	
	r	p-value	r	p-value
Did you receive additional guidance regarding oral hygiene maintenance at the beginning of orthodontic treatment?	0.193	0.043*	0.188	0.049*
If yes, how did you receive it?	0.338	< 0.001***	0.343	< 0.001***
Have you received oral hygiene reinforcement at every dental visit?	0.445	< 0.001***	0.396	< 0.001***
Additional oral hygiene measures: Interdental Brush	0.159	0.096	0.106	0.269
Additional oral hygiene measures: Mouthwashes	0.244	0.01*	0.256	0.007*
Additional oral hygiene measures: Flossing	0.034	0.727	0.086	0.374
Additional oral hygiene measures: Saline rinses	-0.072	0.454	-0.068	0.482
Have you been instructed about dietary precautions after receiving orthodontic treatment? (<i>Instructions for dietary precautions</i>)	0.202	0.035*	0.119	0.214
Do you avoid consumption of sticky foods? (<i>Avoiding sticky food consumption</i>)	0.466	< 0.001***	0.410	< 0.001***
Have you been instructed about brushing technique? (<i>Instructions for brushing technique</i>)	0.452	< 0.001***	0.429	< 0.001***
Is good oral hygiene maintenance important while undergoing orthodontic treatment? (<i>Importance of good oral hygiene while undergoing orthodontic treatment</i>)	0.073	0.449	0.068	0.477
Does good oral hygiene maintenance affect orthodontic treatment outcome? (<i>Effect of oral hygiene on orthodontic treatment</i>)	0.254	0.007**	0.248	0.009*
If yes, how do you think maintaining good oral hygiene is going to affect your treatment outcome? (<i>Good oral hygiene and treatment outcome</i>)	0.408	< 0.001***	0.298	0.002*
Consequences of poor oral hygiene on orthodontic treatment: <i>Gum swelling</i>	0.177	0.064	0.132	0.168
Consequences of poor oral hygiene on orthodontic treatment: <i>Gum bleeding</i>	0.056	0.56	0.067	0.488
Consequences of poor oral hygiene on orthodontic treatment: <i>Dental cavities</i>	-0.183	0.055	-0.236	0.013*
Consequences of poor oral hygiene on orthodontic treatment: <i>Treatment efficacy</i>	0.240	0.012*	0.189	0.048*
Consequences of poor oral hygiene on orthodontic treatment: <i>Treatment Failure</i>	0.171	0.074	0.079	0.409

N = 110

Spearman Correlation

p - value < 0.05*, ≤ 0.001**, < 0.001 ***

CPITN- Community periodontal index for treatment need, BI- bleeding index

of the patients who resorted to the use of 'interdental toothbrush' did not require treatment (r- 0.204, p-value 0.032). Hence, we emphasize on mechanical removal of plaque more than chemical.

The present study asked patients whether they had received instructions on brushing technique. While 48.2% patients said "yes", 40% "could not recall". Although patients had mild inflammation, as seen by strong and positive correlation with CPITN (r- 0.452, p-value- < 0.001***), it was weakly correlated with TN (OHI with scaling) (r- -0.285, p-value -0.003). The technique of brushing taught was not taken into consideration, however, previous studies state that orthodontic patients prefer horizontal brushing due to convenience. [12] Also, there is no consensus on which brushing technique is most effective on plaque removal. While, the modified Bass technique is preferred as it removes plaque from the gingival margin, it is difficult to master, which it makes it unfavorable to orthodontic patients. [13]

While 94.5% of the patients claimed to have received dietary instructions, 50% stated that they "sometimes" avoided consumption of sticky food. The correlation of dietary habits with CPITN (r- 0.446) and BI (r- 0.410) was strong and statistically significant (p-value- < 0.001***).

Thus patients' showed awareness, however, they were not compliant as it was affecting their oral health to the extent that they required scaling for intervention (r- -0.305, p-value 0.001**). Brushing in itself cannot assure control of plaque levels as according to the present research, education of diet and dietary habits are also important for good oral hygiene. This has been reiterated in previous studies where reinforcement of oral hygiene and regular visits for scaling result in effective plaque control. [14] However, in other studies where patients reported brushing their teeth twice daily, and consumed sugary beverages, oral hygiene was found satisfactory. [15] This is relevant to the current study setting as majority of our patients were beneficiary. The current setting is a semi-government teaching hospital where the families of retired military soldiers are entitled to receive either free or low cost treatment. This includes prophylaxis until the age of 18 years for boys and for girls, till they are married. These patients are mostly from lower socioeconomic status with rural backgrounds. A meta-analysis by Knorst et al. [16] found that low socioeconomic status is linked with poor oral health related quality of life. Thus, patients did show awareness for good oral health, they were not motivated to maintain it. This creates a hurdle

Table 4 Correlation of patients' responses with treatment need

Variables	Treatment needed (Not needed)		Treatment needed (OHI)		Treatment needed (OHI with Scaling)		Treatment needed (OHI with scaling and surgery)	
	r	p-value	r	p-value	r	p-value	r	p-value
Did you receive additional guidance regarding oral hygiene maintenance at the beginning of orthodontic treatment?	0.067	0.49	0.012	0.9	-0.195	0.041*	0.016	0.868
If yes, how did you receive it?	0.285	0.003*	-0.082	0.393	-0.203	0.034*	-0.055	0.566
Have you received oral hygiene reinforcement at every dental visit?	0.314	0.001*	0.079	0.41	-0.365	<0.001***	-0.148	0.123
Additional oral hygiene measures: Interdental Brush	0.204	0.032*	-0.093	0.336	-0.078	0.417	-0.186	0.051
Additional oral hygiene measures: Mouthwashes	0.162	0.091	-0.028	0.773	-0.191	0.045*	-0.089	0.355
Additional oral hygiene measures: Flossing	0.111	0.25	-0.086	0.373	0.025	0.799	0.217	0.023*
Additional oral hygiene measures: Saline rinses	-0.077	0.423	0.021	0.826	0.024	0.801	-0.019	0.847
Instructions for dietary precautions	0.095	0.321	0.105	0.276	-0.18	0.06	-0.406	<0.001***
Avoiding sticky food consumption	0.381	<0.001***	-0.043	0.653	-0.305	0.001**	-0.073	0.448
Instructions for brushing technique	0.393	<0.001***	-0.009	0.923	-0.285	0.003**	-0.11	0.254
Importance of good oral hygiene while undergoing orthodontic treatment	0.077	0.423	-0.02	0.834	-0.025	0.792	0.019	0.847
Effect of oral hygiene on orthodontic treatment	0.077	0.423	0.191	0.046*	-0.267	0.005**	0.019	0.847
Good oral hygiene and treatment outcome	0.158	0.099	0.26	0.006*	-0.464	0.001**	-0.241	0.011*
Consequences of poor oral hygiene on orthodontic treatment: Gum swelling	0.151	0.116	-0.029	0.764	0	1	-0.038	0.693
Consequences of poor oral hygiene on orthodontic treatment: Gum bleeding	0.029	0.764	0.126	0.191	-0.129	0.179	-0.063	0.515
Consequences of poor oral hygiene on orthodontic treatment: Dental cavities	-0.183	0.056	0.068	0.483	0.113	0.241	0.035	0.716
Consequences of poor oral hygiene on orthodontic treatment: Treatment efficacy	0.007	0.939	0.222	0.02	-0.324	<0.001***	-0.115	0.231
Consequences of poor oral hygiene on orthodontic treatment: Treatment Failure	0.154	0.108	0.02	0.834	-0.092	0.337	-0.08	0.408

N – 110

Spearman Correlation

p-value <0.05*, ≤0.001**, <0.001***

OHI- oral hygiene instructions

for the clinicians and in order to overcome it, it is recommended to incorporate periodontal check-ups at 3–6 month intervals, as part of treatment procedure to help the patients maintain good oral hygiene status.

Patients showed general awareness, that good oral hygiene effects treatment outcome, and that if they maintained their oral hygiene then their treatment result will be impacted. However, with this knowledge, there was a strong correlation with CPITN ($r = 0.408$, $p\text{-value} < 0.001^{***}$) indicating that hygiene was not maintained and this led to the need for scaling procedure ($r = -0.464$, $p\text{-value} = 0.001^{**}$). Majority of the patients' responses were that "dental caries" (88.2%) occurs due to poor oral hygiene and this did not correlate with their clinical findings and treatment need. On the other hand, respondents who thought that the "treatment efficacy" (59.1%) would be effected, showed a weak yet statistically significant correlation with CPITN ($r = 0.240$, $p\text{-value} = 0.012$) and moderate for TN (OHI with scaling, $r = -0.324$,

$p\text{-value} < 0.001^{***}$). A meta-analysis conducted by Siddiqui et al. [17] found that nearly 60% of the population in Pakistan is effected by dental caries with a prevalence of 55.445% in the province of Punjab. The sample consisted predominantly of patients from low income groups who had a dental fear of being affected by carious teeth. These have been recognized as potential factors for dental fear, hence, patients were more encouraged to practice meticulous oral hygiene. [18] As they cannot visualize the outcome of their treatment, unlike the clinicians, this did not motivate their behavior towards positive brushing habits.

The limitations of the present research are that even though the patients were fairly educated, the forms were digitally filled by the doctor asking questions from them. This required that the questions be communicated to them and in such situations, people usually try to answer the best and most appropriate choice. This can create bias in the overall result, however, we correlated with the

clinical findings and treatment need in order to determine the exact behaviour of the sample.

Conclusions

Although the patients were fairly educated about oral hygiene habits, they were not implementing them in their daily routine. It is imperative that prophylactic procedures be incorporated as part of their treatment plan in order to maintain the oral health of patients. Other than that, clinicians should adopt a method of informing their progress in every visit and practice positive reinforcement towards good oral hygiene. Brushing instructions should be intermittently repeated and patients should be asked to bring their brushes so that they can be taught how to properly use them. It is imperative that patients are kept informed of potential cariogenic activity and timely intervention be advised. However, there are no adverse effects of using the element of fear, when needed, to promote good oral hygiene habits among patients.

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Author contributions

MM conceptualised the research, designed the methodology and collected the data. MM, DM and RA collected the data. RA wrote the abstract, DM and TAS wrote the original draft. TAS and HAM conducted formal analysis and reviewed and edited the manuscript. TAS supervised the project. RN reviewed the manuscript.

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None to declare.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate

Ethical clearance was obtained from the ethical review committee of Foundation University College of Dentistry and Hospital, Foundation University Islamabad (FF/FUCD/632/ERC/41). Informed consent was obtained from the study participants.

Consent for publication

Not applicable.

Clinical trial number

Not Applicable.

Competing interests

The authors declare no competing interests.

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