

TITLE PAGE

TITLE: Need for Interdental Brushing in 18-35 yrs adults with healthy periodontal condition:

An analytical cross-sectional study

AUTHORS

Florence Carrouel,^{†‡} Denis Bourgeois,* Juan Carlos Llodra,^{†§} Julie Santamaria,[†] Manuel Bravo,[§]
and Stéphane Viennot*

INSTITUTIONS

*EA4129, University Lyon1, France

[†]Faculty of Odontology, University Lyon1, France

[‡]Team «Evo-Devo of Vertebrate Dentition», IGFL, UMR5242

[§] Faculty of Odontology, University of Granada, Spain

CORRESPONDENCE

D. Bourgeois, University Lyon 1, 11 rue Paradin 69372 F. Lyon

Tel.: +33 4 78 77 86 84; Email: denis.bourgeois@univ-lyon1.fr

Email can be published

COUNT:

Number of words: ; Number of figures: ; Number of tables: ; Number of references:

RUNNING TITLE: Need for interdental brushing in adults

ONE SENTENCE SUMMARY: 92.3% interdental sites can be cleaned through interdental brushes in adults with healthy periodontal condition

Journal of Periodontology

ABSTRACT

Background: To evaluate the need for daily interdental cleaning during routine practice in adults free of caries and periodontal diseases.

Methods: In this epidemiological analytical cross-sectional study, ninety-nine subjects were selected following screening. All the subjects' interproximal spaces were evaluated using a colorimetric probe and then, the corresponding brush was introduced in the interproximal space and the presence of bleeding was observed. The statistical unit was the interdental space.

Results: 2408 sites out of 2608 can be used for interdental brushing (92.3%). In anterior sites the diameter of interdental brushes used is smaller than diameter of interdental brushes used in posterior sites. The prevalence of bleeding is higher in posterior sites. Globally, 8 out of 10 sites need interdental brushes with smaller diameters. The adjusted ORs indicate a significant association with zone (about double risk of bleeding, i.e., an OR=1.9, in posterior sites) and with IDB diameter (an inverse relationship between diameter and bleeding).

Conclusion: Most interdental sites can be cleaned through such interdental brushes. Even in healthy people, interdental hygiene requirements are very high.

KEYWORDS

Interdental brushes, interdental cleaning, gingival bleeding, oral prophylaxis

INTRODUCTION

Mechanical cleaning is crucial to control and/or disrupt of biofilm, the common pillar of the prevention of oral condition^{1,2}. If the use of toothbrush is recommended to remove dental plaque at lingual, occlusal and buccal surfaces^{3,4} whatever the technique and /or the toothbrush used, it is not efficient to disrupt biofilm in interdental spaces⁵. Interdental brush (IDB) currently represents the primary and most effective methods available for interproximal cleaning as compared with brushing alone or the combination use of tooth brushing and dental floss⁶. The interproximal spaces are the most difficult to access for oral hygiene^{7,8}, especially in healthy and physiological oral environment, which have a smaller and calibrated diameter⁹. On the other hand, if the technique and the type of IDB is incorrect, the interdental cleaning can induce potential gingival injury. Composed of a soft nylon filaments twisted into a fine stainless steel wire, IDBs were until recently of diameters and shapes adapted to interdental spaces to contribute to help reduce periodontal disease, enroll in the initial phase and promote maintenance after treatment.

The effective cleaning in daily practice of interdental spaces is a challenge¹⁰. There is a need for a more comprehensive and a rigorous assessment to ensure the subject is able to perform optimal biofilm disruption. IDBs are specially designed for cleaning between the teeth according to **access** diameter for interdental space. New generations of IDBs have the ability to penetrate into the interdental space, whatever space, and then to fill it completely. Although interdental cleaning is an integral component of daily plaque control, greater understanding is required of the interdental space. Limited data exist on the needs of interdental cleaning especially in adults with healthy oral conditions.

The aim of this study is to evaluate the need for daily interdental cleaning in young adults free of periodontal diseases.

MATERIALS AND METHODS

This was an epidemiological analytical cross-sectional study.

Study population

Recruitment and examination of the subjects was performed at the University School of Dental Medicine, Lyon, France. The local ethics committee approved the protocol and the informed consent of the subjects was collected. The criteria for inclusion were: dental students at the University of Lyon, healthy from periodontal condition (pockets less than 2 mm), declaring at least two tooth brushings per day, with no clinically significant dental anomalies or prosthetic restoration, no interproximal caries and accepting the study terms of reference. The following were excluded: subjects at risk of infection or major haemorrhage, and those with immunosuppression, diabetes, haemophilia, those taking anti-platelet or anti-coagulant agents and/or those with a history of periodontal illness or treatment, and subjects undergoing a course of dental or orthodontic treatment. Ninety-nine subjects were selected following screening and three were rejected. The final study sample of sites with enough space for the IDB comprised 2408 sites. After considering a design effect (i.e., the sites are clustered within the patients) of 5.0 (estimated from the first 20 studied patients) in estimating bleeding percentage this sample size is larger than that required ($n=384 \times 5.0 = 1920$) to estimate the proportion of bleeding with a precision of 5%, considering a priori the worst of possibilities ($p=0.5$).

Internal validity

The study involved two examiners who were trained beforehand in the use of the IAP CURAPROX[®] probe. A procedure manual was developed and distributed to the study examiners in advance of the training session. A PowerPoint[®] presentation was used for training. A gold standard examiner (DB), specialist in epidemiology and with vast experience in periodontal screening, led calibration stages. The two examiners obtained a minimum kappa value of 0.86 compared to the gold standard examiner (excellent agreement according to Landis scale)¹¹.

Classification of Access Diameter for Interdental Space

The IDBs used are from the CPS range of CURAPROX[®]. This pack comprises 5 cylindrical IDBs with the following characteristics:

- A colour code related to the size of the brush
- An access diameter defined by the gauge of the CURAL[®] wire core used for stiffening the IDB
- An effective cleaning diameter defined by the length of the synthetic bristles covering the working part of the device.

The characteristics of the IDBs are resumed in table 1.

Colour code	Blue (B)	Red (R)	Pink (P)	Yellow (Y)	Green (G)
Access diameter (mm)	0.6	0.7	0.8	0.9	1.1
Effective cleaning diameter (mm)	2.2	2.5	3.2	4.0	5.0

Technical reference

Calibration of the interdental diameter is made by means of the IAP CURAPROX[®] calibrating probe. The procedure consists in introducing the IAP CURAPROX[®] probe into the vestibular interdental space, inserting it fully, and then noting the colour emerging from the interdental space on the vestibular side. This corresponds to the colour code of the IDB most suitable for the space in question.

Clinical examination

All the subjects' interproximal spaces were evaluated using the colorimetric probe. The pressure used to place the probe tip at the base of the interdental sites was approximately 50 N/cm² (0.20 gram force). Then, the corresponding brush was introduced in the interproximal space and the presence of bleeding was observed. The statistical unit was the interdental space. 2408 sites were retained in the study out of 2970 potential sites. This difference is linked to the absence of teeth, interproximal spaces too small or presence of diastema.

Analysis

The analysis was carried out at global level including all interdental sites, and considering the five categories of interdental score as an ordinal scale (from 1 to 5). Secondly, by location of sites: anterior (up to distal of second incisor) and posterior (from distal of canine to distal of second molar). At site level, the analysis was carried out with SUDAAN 7.0 (RTI, RTP, NC) to account for clustering (multiple sites within the mouth) in p-value and standard errors calculations. At patient level, we used SPSS 15.0 (SPSS Inc., Chicago, IL).

RESULTS

The sample consisted of 99 subjects (44 females and 24 smokers) with a mean age of 22 ± 2.7 year-old. Table 2 presents mean distribution of the interproximal sites according to the diameter of IDB.

	n	IDB diameter (mm.)				
		0.6	0.7	0.8	0.9	1.1
All	99	8.78±5.18	10.83±4.56	3.39±3.47	0.83±1.42	0.49±1.66
Sex						
Male	55	8.27±5.07	10.80±4.50	3.74±3.52	0.98±1.51	0.60±2.01
Female	44	9.41±5.31	10.86±4.68	2.95±3.38	0.64±1.30	0.36±1.06
<i>p</i> -value		0.280	0.944	0.260	0.229	0.510
Tobacco						
No	75	9.03±5.29	10.83±4.35	3.11±3.15	0.79±1.33	0.37±0.98
Yes	24	8.00±4.86	10.83±5.26	4.29±4.27	0.96±1.71	0.87±2.89
<i>p</i> -value		0.594	0.991	0.142	0.615	0.195
Patient's periodontal risk						
Low (<30% bleeding sites)	39	7.85±4.74	10.74±4.87	4.18±3.82	1.10±1.82	0.67±1.32
High (≥30% bleeding sites)	60	9.38±5.40	10.88±4.39	2.88±3.14	0.65±1.07	0.38±1.84
<i>p</i> -value		0.147	0.877	0.065	0.118	0.587

Table 2. Distribution (mean ± sd) of the interproximal sites according to diameter of interproximal brush in 99 patients

Of the total of 24 sites, a mean of 8.78 sites required an IDB of 0.6 mm and 10.83 sites needed an IDB of 0.7 mm. No statistically significant differences were found for sexy, tobacco or baseline periodontal risk, for any of the diameters of the brush.

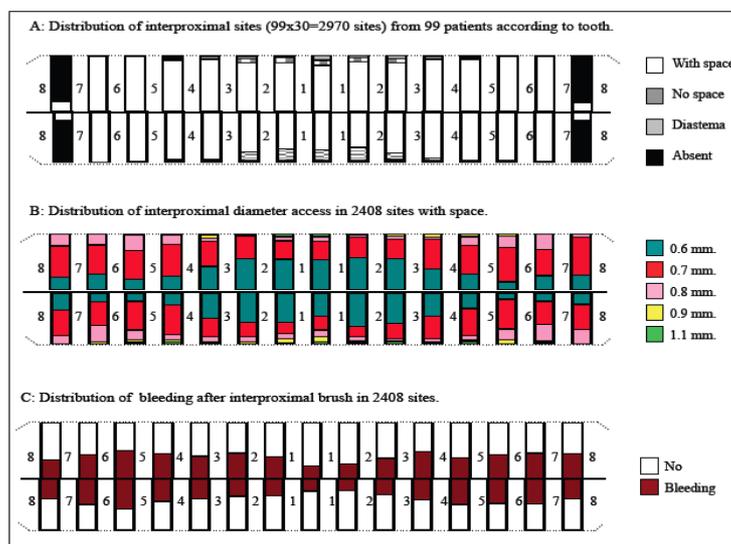


Fig. 1: Distribution of characteristics in interproximal sites (30/patient), denoted in bars corresponding to 99 patients. Note that teeth are numbered.

Figure 1 shows distribution of characteristics in interproximal sites denoted in bars corresponding to 99 patients. We can observe that most absent sites focus in the third molars (Fig. 1A). 2608 sites were present out of 2970 potential sites. This difference is linked to the absence of teeth (362 sites, predominantly third molars). Interproximal space is too small for introducing IDB in 153 sites and diastema is present in 47 sites. So, in the study 2408 sites out of 2608 can be used for IDB (92.3%).

In anterior sites the diameter of interdental brushes used is smaller than diameter of interdental brushes used in posterior sites (Fig. 1B). Finally, we found a higher prevalence of bleeding in posterior sites compare to the bleeding prevalence in anterior sites (Fig. 1C).

Globally, 8 out of 10 sites need interdental brushes with smaller diameters (diameter of 0.6-0.7 mm). In anterior location, brush of 0.6 mm is need in about 56% of the sites and it becomes the most common brush. In posterior location, brush of 0.7 mm is need in about 51% of the sites. The distribution of interdental brushes in anterior sites and posterior sites is statically different ($p < 0.001$). The prevalence of bleeding is higher in posterior than anterior sites, globally and for the majority of brushes sizes, as can be seen in Table 3 where the 95%-Cis do not overlap.

Table 3. IDB and bleeding in sites with space (n=2408). Data from 99 patients

IDB	All (n=2408)		Anterior (n=812)		Posterior (n=1596)	
	Brush ^a n (%)	Bleeding % (95%-CI) ^b	Brush n (%)	Bleeding % (95%-CI)	Brush n (%)	Bleeding % (95%-CI)
All	2408 (100)	40 (35-45)	812 (100)	31 (26-37)	1596 (100)	45 (39-50)
Brush diameter						
1 (0.6 mm.)	869 (36.1)	41 (35-47)	453 (55.8)	36 (29-43)	416 (26.1)	46 (39-54)
2 (0.7 mm.)	1072 (44.5)	43 (36-49)	253 (31.2)	31 (24-39)	819 (51.3)	46 (39-53)
3 (0.8 mm.)	336 (14.0)	39 (31-48)	53 (6.5)	15 (4-26)	283 (17.7)	44 (35-53)
4 (0.9 mm.)	82 (3.4)	24 (12-37)	32 (3.9)	6 (0-15)	50 (3.1)	36 (20-52)
5 (1.1 mm.)	49 (2.0)	14 (4-24)	21 (2.6)	5 (0-11)	28 (1.8)	21 (5-38)

a: The comparison of brush distribution between anterior and posterior teeth is $p < 0.001$ with CROSSTAB procedure in SUDAAN.

b: 95%-Confidence Intervals corrected for complex sampling (multiple sites within the mouth), with the DESCRIPT procedure in SUDAAN.

Furthermore, an inversely relationship between brush diameter and bleeding prevalence is found.

Table 4 shows distribution of the different interdental brushes according to principal studied variables.

Table 4. Distribution of interproximal sites (n=2408^a) from 99 patients according to patient's variables

	n	Brush diameter (mm.) (%↔)					p-value ^b
		0.6	0.7	0.8	0.9	1.1	
Sex							0.161
Female	1066	38.8	44.8	12.2	2.6	1.5	
Male	1342	33.9	44.3	15.4	4.0	2.5	
Tobacco							0.205
Yes	599	32.1	43.4	17.2	3.8	3.5	
No	1809	37.4	44.9	12.9	3.3	1.5	
Patient's periodontal risk							0.061
Low (<30% bleeding sites)	957	32.0	43.8	17.0	4.5	2.7	
High (≥30% bleeding sites)	1451	38.8	45.0	11.9	2.7	1.6	

a: Interproximal sites with enough space to introduce the IDB (interdental brush).

b: With DESCRIPT procedure in SUDAAN 7.0 to adjust for clustering (multiple sites within the patient).

Sex ($p= 0.16$) and tobacco ($p=0.20$) have no influence in the distribution of interproximal brushes diameter. However, a lower prevalence of larger brush diameter is observed at the sites of subjects classified as high periodontal risk ($p=0.06$).

Table 5 presents the univariate and multivariate associations of studied variables with interproximal bleeding after IDB as dependent variable.

Variable	n	Bleeding	Univariate	Multivariate
		% (95%-CI)	OR ^b (95%-CI)	OR (95%-CI)
Sex			$P=0.252$	$P=0.313$
Female	1066	44 (36-51)	1.3 (0.8-1.9)	1.2 (0.8-1.9)
Male	1342	38 (31-44)	1.0	1.0
Tobacco			$P=0.769$	$P=0.870$
Yes	599	39 (31-47)	0.9 (0.6-1.4)	1.0 (0.6-1.5)
No	1809	41 (35-47)	1.0	1.0
Zone			$P<0.001$	$P<0.001$
Posterior	1596	45 (39-51)	1.8 (1.4-2.3)	1.9 (1.5-2.4)
Anterior	812	31 (26-37)	1.0	1.0
IDB diameter			$P=0.002$	$P=0.003$
1 (0.6 mm.)	869	41 (35-47)	4.2 (1.8-9.5)	4.4 (1.9-10.0)
2 (0.7 mm.)	1072	43 (36-49)	4.4 (1.9-10.2)	3.9 (1.7-9.0)
3 (0.8 mm.)	336	39 (31-48)	3.9 (1.8-8.5)	3.3 (1.5-7.2)
4 (0.9 mm.)	82	24 (12-37)	1.9 (0.7-5.4)	1.9 (0.7-5.1)
5 (1.1 mm.)	49	14 (5-24)	1.0	1.0

a: Univariate and multivariate (forcing all variables) associations with P-values and 95% CI estimated with LOGISTIC PROC in SUDAAN 7.0, to account for clustering (multiple sites -408- within patients -99-).

b: Odds ratio

It should be noted that crude (univariate effects) and adjusted (multivariate effects) ORs are very similar, indicating that confounding effects are low in this sample, at least for the studied variables. The adjusted ORs indicate a significant association with zone (about double risk of bleeding, i.e., an OR=1.9, in posterior sites) and with IDB diameter - an inverse relationship between diameter and bleeding-. In this sample, sex and tobacco were not significantly associated with bleeding.

DISCUSSION

The subjects in this study were homogenous, including only 18-35 years old adults and healthy periodontal subjects, with a high level of standard mechanical toothbrushing. In line with the aim of this study, the criteria for inclusion chosen are logical according to it. The choice of healthy young adults is to place the study in a preventive sense: reduce the risk of the occurrence of periodontal disease and/or reduce the severity in short or medium term. The need for IDB in periodontal patients has been extensively described previously⁵. However, the current literature is less clear on the relevance of IDB in healthy subjects.

Regarding sampling method, several discussion points are important. First, the analysis is mainly carried out including all interdental sites, using SUDAAN program, that allows and adjustment of p-values and standard errors due to clustering (multiple sites within the mouth), Second, a convenience sampling has been chosen because has described in Material and methods section this study is cross-sectional, without any intention to extrapolate these results to any specific reference population.

The internal validity of the study has been guaranteed through a calibration process. The two examiners who participated in data collection have been previously trained in a workshop calibration. A third member of the team, expert in dental public health with WHO and international experience in periodontal epidemiology, has acted as the gold standard. The clinical dependent variable used in this study is bleeding. However, the reproducibility of the diagnosis of bleeding has been widely discussed in the literature¹².

An interesting discussion is to associate bleeding with the need for periodontal care in the medium and long term. The reduction of gingivitis in the general population results in more than merely the cosmetic improvement following the reduction of the gingival bleeding. There is overwhelming evidence that gingivitis is linked to periodontitis, and the elimination of gingivitis will result in the reduction of attachment loss in the majority of the population¹³. Therefore, the overall reduction of gingivitis is a good way to improve oral health. The absolute magnitude could be enormous or modest. At this stage no scientific evidence can quantify this magnitude.

Many studies shown that people prefer IDBs to floss because it's easier to use, providing there is sufficient space between teeth^{5,14}. XX. Furthermore, it's well established than the IDBs are more effective to remove plaque than floss^{5,14}. A recently study mentioned the use of interdental brushes in case of small embrasures¹⁵. Until now, the IDBs were adapted to interdental spaces of patients affected by periodontal disease but not to healthy interdental spaces.

Nevertheless, our study shows that in a young adult population, IDBs from CPS range of CURAPROX© can penetrate in 94% of interdental spaces. The remaining 6% can use the floss. Thus, if this cleaning technique is recommended, it should be accompanied by dental floss in those very narrow interdental spaces. The brushes used in this study were able to penetrate the majority of healthy interdental spaces. This shows that this is only a problem of access to the interdental space and not other reasons that would limit the use of IDB in healthy subjects.

Results in this study allow us to postulate that interdental bleeding represent a very prevalent problem. If in our particular sample, with periodontal healthy and young patients, with high level of standard mechanical toothbrushing, 40.4% of sites present bleeding after IDB. The prevalence of bleeding is higher in posterior than anterior sites, indicating the worst access to accurate interdental hygiene in posterior sections of the mouth. Clearly it is necessary to make a greater effort from the educational point of view to achieve better control of bacterial plaque, especially in less accessible areas.

Another interesting aspect of the results is the inverse relationship between bleeding and diameter of the interdental brush. It is probably due to the greater resistance to penetration of the interdental brush space. It could be hypothesized a higher prevalence in general population. Furthermore, this figure is still more conservative. Looking at the inversal relation between IDB diameter and bleeding, one could argue a higher prevalence of gingivitis in those interproximal spaces with no space to introduce any IDB. Gingivitis caused by plaque bacteria are the most common gingival reached. It can occur at any age (children and adults)^{16,17}. Indeed an inflammatory condition of the gums is one of the warning signs of gingivitis, and its installation can in certain cases eventually drift into periodontitis¹⁸. There is a lack of early diagnosis of gingivitis by general practitioners who are more focused on the diagnosis of caries or loss of attachment. In healthy subjects it is evident that efforts must focus on early diagnosis and prevention of gingival and periodontal process.

Interproximal plaque accumulation may favor the occurrence of proximal caries, and thus its disorganization allows the prevention of caries in the same way XX. The lack of interdental spacing is considered to be associated with the increased accumulation of plaque and higher susceptibility

of interproximal surfaces to caries¹⁹. So the IDB could have a relevant preventive role²⁰. An IDB with an adapted diameter can be considered as a preventive factor in the disruption of the biofilm. The interdental brushes from the CPS range of CURAPROX© have an access diameter defined by the thickness of the wire core serving as reinforcement, and this access diameter is correlated to a cleaning efficiency diameter which varies from 2.2 mm to 5.0 mm, defined by the length of the synthetic bristles covering the working part of the device. Associating them with the initial use of a dedicated IAP Curaprox type-calibrating probe minimizes the risk of bias in the interpretation of the efficiency diameter. Given these scale characteristics, the CIP was developed as a clinician assessment scale, including 5 items, corresponding to access diameter (mm) and consequently the effective cleaning diameter of interdental brushes. It is important to intercept the beginnings of periodontal disease at an early age. Therefore, the introduction of a correct interdental hygiene in all subjects should be considered as educational priority.

CONCLUSION

This original study has highlighted the high need and necessity of introducing the interdental brushing, provided that the choice of the IDB and technique are correct in individual prophylaxis in young adults. A reflection must be conducted on the terms and frequency of use as well as it was done for the use of the toothbrush. Recent concepts biofilm disruption are arguments in favor of the integration of brushes into daily practice and their generalizations as periodontal lesions prevention tools. This may appear as an innovative measure to address the gap observed between the progress made by the populations of the industrialized countries, which generally have similar dental brushing two times a day, and finding mixed in terms of gingivitis, periodontitis. Further studies are needed to see if prophylaxis model can be generalized to the childhood and adolescence in order to contribute also to reducing interproximal caries.

CONFLICT OF INTEREST

The authors confirm that this article content as no conflict of interest.

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