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# Methodological Proposal to Assess Gingival Thickness in Children

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**Fig 1** Marginal tissue recession due to bacterial inflammation and tooth malposition.

However, probing may be challenging in children. More convenient tests may be advantageous to identify the patients and teeth at risk of gingival recession, which is always difficult to treat in children. A whitening of the attached gingiva with coronal labial traction could be related to its low resistance under tension. The visibility of capillaries located in the chorion could also reasonably suggest a thin gingiva.

The objective of this study was to assess the utility of two non-invasive tests for evaluating gingival thickness in young patients: the whitening of the attached gingiva with coronal labial traction (GW test) and the visibility of the gingival blood supply (BS test). These were compared with the probing test (reference test).

## MATERIAL AND METHODS

### Study Population

This study targeted a convenience sample of 73 children and adolescents up to 16 years old who volunteered and consented to participate, recruited on the basis of their attendance at the Paediatric Dentistry Unit of Mondor-Chenevier Hospital Complex. Ethical approval was granted by the departmental ethics committee of Albert Chenevier Hospital. The principal investigator explained consent and withdrawal procedures to the parents and children, and attained their consent through signing an informed consent form, prior to the clinical observation.

Patients with any pathology, genetic or chronic disease, regular medication, tobacco/alcohol/other substance addiction as well as wearers of orthodontic appliances or uncooperative children were excluded. Exclusion criteria were gingival sites with periodontal disease (gingivitis, periodontal recession), gingival melanin pigmentation, fixed dental prostheses (stainless steel crown), active cervical decay, cervical restoration, structural abnormality, malposition or tooth in eruption (less than 3 mm of clinical crown).

### Data Collection

According to Cuny-Houchmand et al,<sup>5</sup> different biotypes can co-exist in a mouth, depending on the position, the shape, and the arch (maxillary or mandibular). The gingiva of both arches were evaluated, with at least one anterior and one posterior tooth. In addition, in an effort to limit the number of studied teeth and reduce the observation time for these young patients, especially in hard-to-reach areas, the second primary molar or second premolar (or the permanent molars) were not selected. Canines, which are between anterior and posterior sites and erupt late, were also not selected. Thus, for each patient and criterion, the maxillary and mandibular labial gingiva examined was next to the primary and/or permanent central and lateral incisors, and primary and/or permanent first primary molars and/or first premolars.

The following three clinical gingival thickness tests were performed by one experienced examiner, in random order:

- Probing test (reference): the visibility of the probe tip through the gingival margin while probing the sulcus at the midface of the tooth evaluated was recorded. If the outline of the underlying probe could be seen through the gingiva due to transparency, it was categorised as thin (Fig 2a); if not, it was categorised as thick (Fig 2b). The probes used were sterile, disposable and individually packaged.
- GW test: the whitening of the attached gingiva with coronal labial traction was recorded. If whitened, the gingiva was categorised as thin (Fig 3a); if not, it was categorised as thick (3b).
- BS test: the visibility of the gingival blood supply was recorded. When visible, the gingiva was categorised as thin (Fig 4a); if not, it was categorised as thick (Fig 4b).

### Statistical Analysis

To compare the results with GW and BS tests to those with the probing test, Fisher's exact test was performed. The sensitivity and specificity from GW and BS tests and also the odds ratio from the probing test were calculated to determine their respective correlations. All the tests and calculations were performed with Excel (Microsoft) and Open Epi (Open Source), with an alpha risk of 5%.

## RESULTS

### Study Population

Of the 73 original patients, 2 were excluded due to systemic disease, and 2 because of their uncooperative behaviour during clinical examination. A total of 69 patients (32 girls and 37 boys) fulfilled all the inclusion criteria study. The average age was  $8.6 \pm 2.9$  years (minimum 1, maximum 16). The gingiva of 750 teeth (269 primary and 481 permanent) were examined; 258 were excluded due to melanic pigmentation (129), inflammation (50), caries (31), eruption (24), probing impossible (16), malposition (4), stainless steel crown (3), gingival recession (1). Thus, 492 observations of the gingivae were included in 69 children.

**Fig 2a** The probe tip is visible through the gingival margin: the gingiva is categorised as thin (patient A).



**Fig 2b** The probe tip is not visible through the gingival margin: the gingiva is categorised as thick (patient B).



**Fig 3a** The attached gingiva is whitened with coronal labial traction, compared to without traction in Figs 2a or 4a (patient A).



**Fig 3b** The attached gingiva is not whitened with coronal labial traction, compared to without traction in Figs 2b or 4b (patient B).



**Fig 4a** The gingival blood supply is visible (patient A).



**Fig 4b** The gingival blood supply is not visible (patient B).



### Thickness of Gingiva and Validity of the Different Tests

Table 1 presents the percentage (and number) of teeth where the probe was visible (or not), the attached gingiva whitened (or not) and the blood supply was visible (or not), for each type of tooth (primary, permanent, and all teeth). It also indicates sensitivity (Se), specificity (Spe), positive/negative predictive values (PPV/NPV), odds ratio (OR) and confidence interval (CI) of the GW and BS tests compared to the probing test.

Tables 2 to 5 present the percentage (and number) of teeth where the probe was visible, the attached gingiva whitened and the blood supply was visible for the maxillary (primary and permanent) incisors, the maxillary primary first molars and first premolars, the mandibular (primary and permanent) incisors, and finally the mandibular primary first molars and first premolars.

According to the probing test (Table 1), 39.0% of the studied population had a thin gingiva (i.e. the probe was visible through the gingival margin). Furthermore, the percentage of thin gingiva was higher in the permanent (49.3%) than the primary dentition (15.3%).

Regarding the results for all teeth, the respective percentages of teeth where the attached gingiva whitened (25.0%) and where the blood supply was visible (10.8%) were significantly different from the percentage of teeth where the probe was visible (39.9%). Thus, the GW and BS tests reported different proportions of thick and thin gingiva, compared to the probing test.

The sensitivity for the GW and BS tests was 37% and 19%, respectively, when compared to the probing test, but specificity was 84% and 96%, respectively. The odds ratios were 3.05 (CI 5% = [1.89;4.92]) and 5.98 (CI 5% = [2.74;13.03]), respectively.

However, concerning the primary teeth (Table 1), the maxillary permanent incisors (Table 2) and the mandibular first premolars (Table 5), the percentage of teeth where the attached gingiva whitened was not significantly different from the percentage of teeth where the probe was visible. Thus, GW test and probing test reported similar proportions of thick and thin gingiva.

## DISCUSSION

### Gingival Thickness in Children

To our knowledge, no previous studies have explored gingival thickness and biotype of young patients. According to the probing test, 39.0% of the studied population has a thin gingiva, with a statistically significantly higher percentage for permanent teeth. These results corroborate those of De Rouck et al<sup>6</sup> and Kan et al,<sup>12</sup> which reported 37% and 50%, respectively, of thin gingiva in adults on the central maxillary permanent incisor.

The fact that the gingiva was thinner on the permanent teeth could be explained by several factors: the tongue pul-

**Table 1 Percentage (and number) of teeth where the probe was visible (or not), the attached gingiva whitened (or not) and the blood supply was visible (or not), and the sensitivity (Se), specificity (Spe), positive/negative predictive values (PPV/NPV), odds ratio (OR) and confidence interval of the two latter tests compared to the probing test**

	Visibility of the periodontal probe		Whitening of the attached gingiva		Visibility of the gingival blood supply	
	Probe visible	Probe not visible	Whitening	No whitening	Blood supply visible	Blood supply not visible
Total of teeth (TT)	39.0% <sup>A</sup> (153)	61.0% (239)	25.0% <sup>B</sup> (102)	75.0% (306)	10.8% <sup>C</sup> (44)	89.2% (364)
Primary teeth (pt)	15.3% <sup>D</sup> (18)	84.7% (100)	15.7% <sup>D</sup> (19)	84.3% (102)	2.5% <sup>E</sup> (3)	97.5% (118)
Permanent teeth (PT)	49.3% <sup>F</sup> (135)	50.7% (139)	28.9% <sup>G</sup> (83)	71.1% (204)	14.3% <sup>H</sup> (41)	85.7% (246)
Se / Spe for TT	-		37% / 84%		19% / 96%	
Se / Spe for pt	-		44% / 89%		11% / 99%	
PPV / NPV for PT	-		60% / 67%		76% / 65%	
OR; CI 5% for TT	-		3.05; CI 5% = [1.89;4.92]		5.98; CI 5% = [2.74;13.03]	
OR; CI 5% for pt	-		6.47 ; CI 5% = [2.11;19.86]		12.4; CI 5% = [1.06 ;144.54]	
OR; CI 5% for PT	-		2.29; CI 5% = [.,32;3.96]		4.1; CI 5% = [1.79;9.38]	
Same superscript letters in the same row indicate no statistically significant differences (p < 0.05).						

**Table 2 Percentage (and number) of maxillary (primary and permanent) incisors where the probe was visible, the attached gingiva whitened and the blood supply was visible**

	Visibility of the periodontal probe		Whitening of the attached gingiva		Visibility of the gingival blood supply	
	Probe visible		Whitening		Blood supply visible	
Primary incisors	28.6% <sup>A</sup> (6/21)		36.4% <sup>A</sup> (8/22)		0.0% <sup>B</sup> (0/22)	
Permanent incisors	33.6% <sup>C</sup> (37/110)		26.4% <sup>C</sup> (29/110)		5.5% <sup>D</sup> (6/110)	
Total	32.8% <sup>E</sup> (43/131)		28.0% <sup>E</sup> (37/132)		4.6% <sup>F</sup> (6/132)	
Same superscript letters in the same row indicate no statistically significant differences (p < 0.05).						

sion (in the anterior mandibular area),<sup>3</sup> the higher buccolingual tooth diameter of permanent teeth<sup>15</sup> and the growth of the underlying alveolar process.<sup>21</sup> According to O'Meyer,<sup>21</sup> the latter is stronger in the maxillary posterior and mandibular anterior areas, which would lead to thinner gingivae in these areas. Our results corroborate this idea: the thickness of the gums in the maxillary arch was 5% thinner in the anterior area vs 27.5% thinner in the posterior area for permanent vs primary teeth. In contrast, in the mandible, the thickness of the gingivae is 56.6% thinner in the anterior area vs 29.5% thinner in the posterior area for permanent vs primary teeth.

The substantial percentage of patients with thin gingivae emphasise the importance of diagnosing the gingival bio-type, both in adults and children.

#### Assessment of Gingival Thickness

For all teeth, the percentages of thin gingivae according to the GW and BS tests were significantly different from that obtained with the probing test. If the probing test is considered as the most reliable test for assessing gingival thickness, the widespread use of GW and BS tests alone as screening tests should not be recommended, because of their poor sensitivity

**Table 3 Percentage (and number) of maxillary primary first molars and first premolars where the probe was visible, the attached gingiva whitened and the blood supply was visible**

	Visibility of the periodontal probe	Whitening of the attached gingiva	Visibility of the gingival blood supply
	Probe visible	Whitening	Blood supply visible
Primary first molar	11.8% <sup>A</sup> (4/34)	0.0% <sup>A</sup> (0/36)	0.0% <sup>A</sup> (0/36)
Premolar	39.3% <sup>B</sup> (11/28)	14.3% <sup>B</sup> (4/28)	0.0% <sup>C</sup> (0/28)
Total	24.2% <sup>D</sup> (15/62)	6.3% <sup>E</sup> (4/64)	0.0% <sup>F</sup> (0/64)

Same superscript letters in the same horizontal line indicate no statistically significant differences values ( $p < 0.05$ ).

**Table 4 Percentage (and number) of mandibular (primary and permanent) incisors where the probe was visible, the attached gingiva whitened and the blood supply was visible**

	Visibility of the periodontal probe	Whitening of the attached gingiva	Visibility of the gingival blood supply
	Probe visible	Whitening	Blood supply visible
Primary incisors	12.5% <sup>A</sup> (2/16)	31.3% <sup>A</sup> (5/16)	12.5% <sup>A</sup> (2/16)
Permanent incisors	69.1% <sup>B</sup> (76/110)	31.7% <sup>C</sup> (39/123)	26.8% <sup>D</sup> (33/123)
Total	61.9% <sup>E</sup> (78/126)	31.6% <sup>F</sup> (44/139)	25.2% <sup>G</sup> (35/139)

Same superscript letters in the same horizontal line indicate no statistically significant differences ( $p < 0.05$ ).

**Table 5 Percentage (and number) of mandibular primary first molars and first premolars where the probe was visible, the attached gingiva whitened and the blood supply was visible**

	Visibility of the periodontal probe	Whitening of the attached gingiva	Visibility of the gingival blood supply
	Probe visible	Whitening	Blood supply visible
Primary first molar	12.8% <sup>A</sup> (6/47)	12.8% <sup>A</sup> (6/47)	2.1% <sup>A</sup> (1/47)
Premolar	42.3% <sup>B</sup> (11/26)	42.3% <sup>B</sup> (11/26)	7.7% <sup>C</sup> (2/26)
Total	23.3% <sup>D</sup> (17/73)	23.3% <sup>D</sup> (17/73)	4.1% <sup>E</sup> (3/73)

Same superscript letters in the same horizontal line indicate no statistically significant differences ( $p < 0.05$ ).

(37% and 19%, resp.). However, they presented high specificity (84% and 96%, resp.) and would also be of particular interest in two situations: when probing is not possible (with uncooperative children or when the sulcus is hard to penetrate) or to confirm the probing test. In fact, if the attached gingiva is whitened or if the blood supply is visible, the probe visibility is highly probable (VPP respectively of 60% and 76%, resp., odds ratio 3.05 and 5.98, resp.).

Nevertheless, for primary teeth, the percentages of thin gingiva yielded by the GW and probing tests were not significantly different. Thus, the GW test is comparable to the

probing test. This result is particularly interesting because the probing test can be more difficult to perform in young children. The sensitivity of 44% ameliorates these results. The GW test is also comparable with the probing test in some other areas in permanent dentition: in maxillary incisors and first mandibular premolars.

It is relevant to point out that, in any case, the advantage of GW and BS tests is that they directly evaluate the thickness of the attached gingiva, whereas the probing test considers only the marginal gingiva and extrapolates its thickness to the whole gingiva.

## Clinical Impact

The clinical exam in children should systematically include gingival thickness assessment, in order to identify patients at risk for periodontal problems, analogous to caries risk assessment. Because there already seemed to be a noticeable physiological thinning of the gingiva from primary to permanent dentition, the transition between dentitions is a critical period which should be closely supervised.

Furthermore, any trauma, such as inappropriate tooth-brushing or orthodontic treatment,<sup>10</sup> may hasten the process. Candidates for orthodontic treatment should also be carefully monitored, especially to prevent marginal tissue recession. Moreover, practitioners should adapt their advice on brushing techniques,<sup>19</sup> frequency of check-ups, and the increased risks of smoking habits<sup>9</sup> and piercing.<sup>24</sup> They should inform patients with thin gingiva about avoiding electric toothbrushes, preferring a soft manual toothbrush and avoiding circular movements.<sup>23</sup> These preventive measures on the gingiva will also ensure the effective protection of the underlying periodontal structures.

It would also be pertinent to carry out more studies on gingival thickness assessment in children and adolescents from representative groups of patients, to obtain more data on the prevalence of the various gingival biotypes.

## CONCLUSION

A substantial part of the studied population has a thin gingiva. The percentage of thin gingiva in primary dentition was higher than in permanent dentition. Thus, a full examination of the gingival biotype in children and adolescents should be recommended to detect early patients at risk, monitor them and guide their dental treatment if necessary.

The gingival evaluation should incorporate an easy, reproducible and sensitive method for distinguishing between thin and thick gingivae. The percentages of thin gingivae according to GW and BS tests were significantly different from the probing test results, except for primary teeth, maxillary permanent incisors and mandibular first premolars, where the GW test exhibited comparable percentages.

However, the GW and BS tests are significantly correlated to the probing test, with a high specificity. Within the limits of the present study, it can be concluded that gingival whitening with coronal labial traction or blood supply visibility could be used for first-line diagnosis of thin gingiva. If they are negative, probe tip visibility through the gingival margin can be examined.

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