A clinical study of the width of attached gingiva in the deciduous, mixed and permanent dentitions

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Abstract

A certain width of attached gingiva is required to maintain gingival health. The purpose of this study was to examine the dimensional changes in the width of attached gingiva and the depth of gingival sulcus among the deciduous, mixed and permanent dentitions and establish baseline information on the width of attached gingiva in Korean children.

Eighty-eight children aged 4 to 14, who visited the Department of Pediatric Dentistry at Samsung Medical Center, were selected and divided into 3 groups according to the periods of dentition: deciduous, mixed and permanent dentitions. The width of keratinized gingiva and the depth of gingival sulcus were measured in each group with a periodontal probe and the width of attached gingiva was determined.

The width of attached gingiva in maxillary and mandibular first molars increased significantly with age after eruption in the permanent dentition ($p<0.05$). The sulcus depth significantly increased in newly erupted permanent teeth with narrower width of attached gingiva ($p<0.05$) in all of the experimented teeth with the exception of the mandibular central incisor during the transition period. The results suggest that the mean width of attached gingiva does not increase steadily from the deciduous to the permanent dentition.

Key words : Width of attached gingiva, Gingival sulcus depth

I. INTRODUCTION

Presence of attached gingiva (AG) is essential for maintenance of gingival health and prevention of recession. Adequate width of AG can better withstand gingival inflammation, trauma from toothbrushing, muscle pulls and forces from orthodontic movement[1,2]. However, the adequate width remains indefinite and the necessity of surgical interventions of increasing attached gingiva, especially in children, continues to be controversial[3-5]. This controversy is inevitable with the indefinite knowledge regarding the dimensional changes of AG from the deciduous to the permanent dentition.

Several studies have indicated that there is a tendency for the width of AG to increase with age[6-12]. According to Bowers[6], the mean width of AG increased from deciduous to adult dentition. Saario et al.[11] also showed a significant increase over permanent incisors and first molars of 6 to 12-year-old children and stated that an inadequate width of AG in the mixed dentition is a transi-

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tory physiologic phenomenon which will correct itself with continuous eruption of the permanent teeth.

On the other hand, Tenenbaum and Tenenbaum[13] did not observe an increase of AG from the deciduous to permanent dentition. The AG of deciduous dentition was wider with a deeper sulcus depth in comparison to the permanent dentition. It was concluded that the steady decrease of sulcus depth at a rate proportional to the eruption of the permanent teeth resulted a concomitant increase of AG with age. Other studies have also concluded that the actual width of AG did not increase steadily with age[14-17].

The purpose of this study was to establish a baseline information on the width of facial/buccal AG in Korean children in the deciduous, mixed and permanent dentition and dimensional changes in the width of attached gingiva and the depth of gingival sulcus among the three periods of dentition.

Ⅱ. MATERIALS AND METHODS

Eighty-eight children (45 males and 43 females) between the ages of 4 and 14, who visited the Department of Pediatric dentistry at Samsung Medical Center, were selected for this study.

The selection criteria were as follows:

1. No clinical evidence of gingival and periodontal inflammation
2. No orthodontic treatment history or currently required
3. Absence of dental caries, restorations or fractures below gingival margin
4. Not more than one tooth missing in posterior or anterior segment
5. No medical history

The subjects were divided into 3 groups according to the periods of dentition: deciduous, mixed and permanent groups (Table 1). In order to compare the width of AG in fully erupted teeth, certain teeth were selected in each group for comparison. In Group 1 (deciduous dentition), deciduous central incisors and first molars in both maxilla and mandible were selected. In Group 2 (mixed dentition), permanent central incisors, deciduous first molars and permanent first molars were selected and in Group 3 (permanent dentition), permanent central incisors, first premolars and first molars were selected.

Table 1. Distribution of subjects by gender and dentition period

	Gender		No. of Children
	Male	Female	
Group 1	6	12	18
Group 2	16	14	30
Group 3	23	17	40

The width of keratinized gingiva was measured to the nearest 0.5 mm from the gingival margin to the mucogingival junction on the mid-facial aspect of the teeth, using a calibrated, flat periodontal probe (Goldman-Fox, Hu-Friedy). Mucogingival junction was delineated by jiggling the alveolar mucosa with a blunt instrument. The depth of the gingival sulcus was also measured to the nearest 0.5 mm with the same probe on the mid-facial aspect. The width of AG was calculated by subtracting the sulcus depth from the width of keratinized gingiva.

Statistical Analysis

The means and standard deviations were computed for the widths of AG and probing depths. The differences between the contralateral teeth within each group were statistically analyzed with the Wilcoxon-signed rank test. ANOVA was used to analyze the differences among the three dentition groups as well as the differences within each tooth by age.

Ⅲ. RESULTS

1. Attached gingiva dimensions by dentition periods

The mean width of AG between the contralateral teeth within each dentition group showed no significant difference. Thus, the data were pooled for analysis. The mean and standard deviation of the width of the AG in three dentition groups are shown in Table 2. Generally, AG over the maxillary teeth appeared to be wider than the corresponding mandibular teeth in all dentition periods. There was a statistically significant increase of AG in both maxillary and mandibular permanent first molars from mixed to permanent dentition. However, the other teeth did not show a significant change from deciduous to permanent dentition.

2. Sulcus depth dimensions by dentition periods

The mean and standard deviation of the sulcus depths in three dentition groups are shown in Table 3. There was a statistically significant increase of sulcus depth during the transition period in all of the

Table 2. Mean width and standard deviation (mm) of attached gingiva by tooth and dentition period

DECIDUOUS	Deciduous Central Incisor	Deciduous First Molar	
Maxilla	3.17 ± (0.90)	1.63 ± (0.81)	
Mandible	2.26 ± (0.81)	1.58 ± (0.76)	
MIXED	Central Incisor	Deciduous First Molar	First Molar
Maxilla	2.75 ± (1.00)	1.82 ± (0.99)	2.22 ± (1.13)
Mandible	1.77 ± (0.93)	1.29 ± (0.79)	1.34 ± (0.75)
PERMANENT	Central Incisor	First Premolar	First Molar
Maxilla	2.79 ± (0.98)	2.01 ± (0.87)	2.88 ± (1.45) *
Mandible	2.03 ± (1.02)	1.36 ± (0.78)	1.74 ± (0.81) *

* statistically significant ($p<0.05$)

Table 3. Mean and standard deviation (mm) of sulcus depth by tooth and dentition period

PRIMARY	Deciduous Central Incisor	Deciduous First Molar	
Maxilla	1.11 ± (0.44)	1.01 ± (0.34)	
Mandible	0.87 ± (0.45)	0.93 ± (0.35)	
MIXED	Central Incisor	Deciduous First Molar	First Molar
Maxilla	1.81 ± (0.73) *	0.94 ± (0.32)	1.67 ± (0.56)
Mandible	1.12 ± (0.34)	0.97 ± (0.36)	1.57 ± (0.41)
PERMANENT	Central Incisor	First Premolar	First Molar
Maxilla	1.49 ± (0.62)	1.27 ± (0.43) *	1.78 ± (0.63)
Mandible	1.09 ± (0.39)	1.19 ± (0.39) *	1.59 ± (0.50)

* statistically significant ($p<0.05$)

Table 4. *Mean width of attached gingiva (mm) and sulcus depth (mm) of maxillary deciduous central incisor to central incisor by age*

Age (years)	n	Attached gingiva	Sulcus depth
4	12	2.92 ±0.76	1.38 ± 0.38
5	12	3.38 ± 1.05	0.92 ± 0.19
6	12	3.21 ± 0.94	1.04 ± 0.58
7	12	2.75 ± 1.29	1.50 ± 0.67
8	24	2.48 ± 1.16	1.94 ± 0.77*
9	14	2.96 ± 0.66	1.93 ± 0.76
10	22	2.98 ± 0.70	1.75 ± 0.67
11	16	2.78 ± 1.08	1.63 ± 0.56
12	22	2.50 ± 1.05	1.57 ± 0.44
13	8	2.25 ± 1.22	1.69 ± 0.80
14	22	3.25 ± 0.72	1.07 ± 0.44*

* statistically significant ($p<0.05$)

Table 5. Mean width of attached gingiva (mm) and sulcus depth (mm) of maxillary deciduous first molar to first premolar by age

Age (years)	n	Attached gingiva	Sulcus depth
4	12	1.54 ± 0.62	1.04 ± 0.33
5	12	2.13 ± 1.05	1.13 ± 0.43
6	12	1.33 ± 0.49	0.88 ± 0.23
7	12	1.79 ± 1.01	1.00 ± 0.00
8	24	1.69 ± 0.91	0.98 ± 0.28
9	14	2.07 ± 1.12	0.71 ± 0.26
10	22	1.82 ± 0.93	1.18 ± 0.45
11	16	2.00 ± 1.03	1.34 ± 0.47
12	22	2.02 ± 0.96	1.34 ± 0.45
13	8	1.94 ± 0.94	1.56 ± 0.56
14	22	2.16 ± 0.62	1.05 ± 0.21

Table 6. Mean width of attached gingiva (mm) and sulcus depth (mm) of maxillary first molar by age

Age (years)	n	Attached gingiva	Sulcus depth
7	12	2.00 ±1.00	1.67 ± 0.54
8	24	2.19 ±1.11	1.75 ± 0.61
9	14	2.25 ±1.27	1.61 ± 0.53
10	22	2.16 ± 1.15	2.00 ± 0.87
11	16	3.41 ± 1.38	2.00 ± 0.58
12	22	2.98 ± 1.80	1.64 ± 0.47
13	8	2.56 ± 1.21	1.94 ± 0.32
14	22	3.09 ± 1.24	1.41 ± 0.48

Table 7. Mean width of attached gingiva (mm) and sulcus depth (mm) of mandibular deciduous central incisor to central incisor by age

Age (years)	n	Attached gingiva	Sulcus depth
4	12	1.92 ± 1.04	1.08 ± 0.47
5	12	2.46 ± 0.72	0.79 ± 0.58
6	12	2.42 ± 0.67	0.79 ± 0.26
7	12	1.63 ± 1.03	1.08 ± 0.19
8	24	1.29 ± 0.61	1.08 ± 0.43
9	14	2.54 ± 0.95	1.04 ± 0.13
10	22	1.93 ± 0.89	1.30 ± 0.43
11	16	1.84 ± 1.03	1.06 ± 0.40
12	22	1.98 ± 0.93	1.05 ± 0.15
13	8	2.44 ± 1.18	1.44 ± 0.32
14	22	2.16 ± 1.53	0.95 ± 0.43

examined teeth with the exception of the transition from mandibular deciduous central incisors to permanent central incisors. Also, there was no significant change of sulcus depth from mixed to permanent dentition in permanent molars.

3. Attached gingiva and sulcus depth dimensions by age and tooth type

The mean and standard deviation of the width of the AG and sulcus depth by tooth and age are depicted in Tables 3 to 8. There was a statistically sig-

Table 8. Mean width of attached gingiva (mm) and sulcus depth (mm) of mandibular deciduous first molar to first premolar by age

Age (years)	n	Attached gingiva	Sulcus depth
4	12	1.67 ± 0.49	0.92 ± 0.36
5	12	1.92 ± 0.93	0.96 ± 0.40
6	12	1.04 ± 0.50	0.96 ± 0.33
7	12	1.38 ± 1.11	0.96 ± 0.26
8	24	1.27 ± 0.77	0.96 ± 0.33
9	14	1.39 ± 0.84	0.86 ± 0.23
10	22	1.11 ± 0.58	1.27 ± 0.55
11	16	1.28 ± 0.93	1.28 ± 0.45
12	22	1.27 ± 0.72	1.20 ± 0.30
13	8	1.63 ± 0.95	1.31 ± 0.37
14	22	1.55 ± 0.79	0.98 ± 0.33

Table 9. Mean width of attached gingiva (mm) and sulcus depth (mm) of mandibular first molar by age

Age (years)	n	Attached gingiva	Sulcus depth
7	12	1.83 ± 0.81	1.21 ± 0.33
8	24	0.92 ± 0.64*	1.69 ± 0.36*
9	14	1.39 ± 0.74	1.54 ± 0.41
10	22	1.57 ± 0.44	1.91 ± 0.45
11	16	1.22 ± 0.89	1.66 ± 0.51
12	22	1.93 ± 0.64	1.64 ± 0.41
13	8	1.50 ± 0.85	1.69 ± 0.46
14	22	2.16 ± 0.81*	1.23 ± 0.40*

* statistically significant ($p<0.05$)

nificant increase of AG between age 8 and 14($p=0.0007$) with concomitant change of sulcus depth($p=0.0272$) for the mandibular permanent molar. Also, there was a significant change of sulcus depth for the maxillary central incisor between age 8 and 14($p=0.0102$).

Ⅳ. DISCUSSION

Although there was no steady increase of attached gingiva from the deciduous to the permanent dentition, as it was speculated in some studies, the findings of this study are in agreement with previous reports suggesting a gradual increase of attached gingiva within the permanent dentition period in correspondence to a reduction of sulcus depth. Under the circumstances of the selection criteria stipulated for this study, the permanent first molars demonstrated a significant increase of attached gingiva from the mixed to the permanent dentition. This increase was also accompanied by a significant reduction of sulcus depth between age 8 and 14 for the mandibular permanent molars.

The dimensional changes of the attached gingiva can be explained to be in relations to the decrease of sulcus depth at a rate proportional to the increase of the clinical crown height[18]. Tenenbaum and Tenenbaum also reported that the gradual decrease of sulcus depth results in an increase of attached gingiva to its adult width about 8 to 10 years after eruption[13]. This reduction of sulcus depth is attributed by a coronal shift of the cementoenamel junction level in absence of any retraction of the gingival margin and a coronal extension of the connective tissue apparatus[17,19]. Although it was not statistically significant, the central incisors and the first premolars also showed a general tendency towards an increase of attached gingiva with age.

However, the increase of attached gingiva in the maxillary permanent first molars was not accompanied by a concomitant decrease of sulcus depth. This can partly be explained by the differences in the ages of tooth eruption as well as the difficulty in accurately delineating the mucogingival junction in the maxillary teeth compared to the mandible. Further investigation with longitudinal studies may be more beneficial in determining this discrepancy of findings.

The adequate width of attached gingiva cannot be determined solely on its measurement values, especially during the transition period. Individual variances regarding oral hygiene factors as well as the possibility of its increase within the permanent dentition must be carefully considered before planning surgical interventions. The baseline information obtained in this study on the width of the attached gingiva and its dimensional changes during the mixed and permanent dentition periods may be helpful in determining children who are in need for mucogingival surgical procedures for adequate zone of attached gingiva.

Ⅴ. CONCLUSIONS

1. The mean width of attached gingiva did not show a significant increase from the deciduous to the permanent dentition.
2. The width of attached gingiva in maxillary and mandibular first molars increased significantly within the permanent dentition with age ($p<0.05$).
3. The width of attached gingiva was generally wider in the maxilla than in the mandible in all of the dentition periods.
4. There was a significant increase of sulcus depth in newly erupted permanent teeth with narrower width of attached gingiva ($p<0.05$).

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국문초록

성장기 아동의 연령에 따른 부착치은 폭경에 대한 연구

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건강한 치주조직을 유지하기 위해서는 적절한 폭경의 부착치은이 필요하다. 이러한 부착치은의 폭경은 연령에 따라서 변화한다는 보고가 있다. 그러나 그 정상치에 대한 보고는 저자들마다 차이를 보이며 또한 한국인에서의 정상 평균값에 대한 연구는 미흡한 실정이다. 본 연구의 목적은 악골의 발육 및 치아의 맹출과 관련하여 유치열기로부터 초기영구치열기까지의 부착치은의 폭경 및 치은열구 깊이의 변화 양상을 조사하고, 한국인 아동의 정상치를 구하는 것이다.

삼성서울병원 소아치과에 내원한 4세에서 14세 사이의 유치열기, 혼합치열기 및 영구치열기 아동 88명을 대상으로 유치열기(4~6세)에서는 유중절치와 제1유구치, 혼합치열기(7~10세)에서는 중절치, 제1유구치 및 제1대구치, 영구치열기(10~14세)에서는 중절치, 제1소구치 및 제1대구치에서 협측 부착치은의 폭경과 치은열구 깊이를 치주탐침으로 측정하여 비교하였다.

상하악 제1대구치 부착치은의 폭경은 치아맹출 후 연령에 따라서 증가하였다($p<0.05$). 하악유전치을 제외한 모든 실험 치아에서 맹출 직후 치은열구 깊이가 증가하는 것을 보였으며 부착치은의 폭경은 상대적으로 줄어들었다($p<0.05$). 이러한 결과는 부착치은의 폭경이 유치열기부터 영구치열까지 연령에 비례하여 일정하게 증가하지 않는다는 것을 의미한다.

주요어 : 부착치은 폭경, 치은열구 깊이