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Localized Aggressive Periodontitis Treatment Response in Primary and Permanent Dentitions

SHERIN. N. MERCHANT*, ANDREA. VOVK*, DANNY. KALASH*, NICOLE HOVENCAMP*, IKRAMUDDIN. AUKHIL*, PETER HARRISON*, EDWARD ZAPERT†, JOHN BIDWELL†, PHYLLIS VARNADO‡, and LUCIANA. M. SHADDOX*.§

*Department of Periodontology, College of Dentistry, University of Florida Gainesville, FL

†Department of Health, Leon County, Tallahassee, FL

‡Department of Health, Duval County, Jacksonville, FL

§Department of Oral Biology, College of Dentistry, University of Florida

Abstract

Background—The comparative treatment response of children and young adults with localized aggressive periodontitis (LAP) affecting primary and permanent dentition is unknown. The objective of this study was to evaluate the influence of non-surgical periodontal therapy with adjunctive systemic antibiotics on the clinical outcome of children/young adults with primary versus permanent dentition affected by LAP.

Methods—A cohort of 97 African-American participants between the ages of 5–21 (30M; 66F; 22 primary and 75 permanent dentition affected), diagnosed with LAP were included. Patients presented with no significant medical history. All patients underwent periodontal therapy, which consisted of full mouth mechanical debridement at baseline, 3, 6, and 12 month appointments. Additionally, all patients were prescribed a one-week regimen of systemic antibiotics at the initial appointment. Clinical parameters were analyzed, including probing depth (PD), clinical attachment levels (CAL), bleeding on probing (BOP) and percentage of visible plaque.

Results—Overall, periodontal therapy was found to be effective in improving the clinical outcomes of both primary and permanent dentitions. Although baseline CAL were similar between the groups, the reductions in mean CAL at 3, 6 and 12 months as well as reduction in % Plaque at 3 months were significantly greater in primary dentition as compared to permanent dentition.

Conclusions—Non-surgical therapy with systemic antibiotics is effective for LAP in both primary and permanent dentitions. A greater reduction in CAL in LAP of primary dentition may suggest that younger children may carry a greater propensity for positive treatment outcomes and healing potential as compared to children/young adults with permanent dentition.

Corresponding Author: Luciana M. Shaddox, DDS, MS, Ph.D., Department of Periodontology, University of Florida College of Dentistry, P.O. Box 100434, Gainesville, FL 32610-0434, Phone: 352-273-8368, Fax: 352-273-6192, lshaddox@dental.ufl.edu.

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Keywords

Adolescent; aggressive periodontitis; root planing

INTRODUCTION

Localized Aggressive Periodontitis (LAP) is a rare form of inflammatory periodontal disease characterized by a rapid rate of progression, dramatic attachment and bone loss, on very specific teeth (first molars and incisors), and an early age of onset^{1,2}. The disease in younger children and adolescents in North America appear to be most prevalent in African-American populations (2.6 %) followed by Hispanics and Whites (0.5% and 0.06% respectively)³. Prior studies have indicated that there is a greater prevalence of the disease in underdeveloped nations (>5%) in comparison to developed ones (3 %) ^{4, 5}. Aggressive periodontitis may affect the primary dentition, a condition previously classified as localized pre-pubertal periodontitis (LPP) or permanent dentition, previously classified as localized juvenile periodontitis (LJP)¹. Clinical characteristics of localized aggressive periodontitis in these two dentitions are very similar: abundant calculus is infrequent; tissues do not look very inflamed upon clinical observation, and bone loss patterns are vertical or “U” shaped. However, it seems like the disease in primary dentition tends to be more localized to molars whereas the disease in permanent dentition can be detected solely at first molars or solely at incisors, or both 1st molars and incisors.

Proper treatment of primary dentition requires early and accurate disease diagnosis⁶. There is limited research regarding clinical treatment of primary dentition affected by LAP, and these studies are limited to case reports⁷⁻⁹. In addition, improper or delayed diagnosis may often occur due to a lack of awareness about this disease along with improper methods of diagnosis in pediatric populations. This can result in improper treatment choices, premature tooth loss and possible negative outcomes for permanent dentition⁶. As observed in clinical settings, early stages of LAP may be go undetected¹⁰ and only be diagnosed at more advanced stages when severe bone loss is observed radiographically, due to lack of probing at initial examination of younger individuals. Diagnosis at later stages may reduce treatment options, and necessitate treatment such as bone grafts or extractions followed by implants, which may be unaffordable for the most vulnerable populations.

Currently, there are no long-term clinical trials assessing different therapies for the treatment of aggressive periodontitis in primary dentition, and whether outcomes may be influenced by different dentitions affected or patient age¹. Information about response to treatment for pre-pubertal periodontitis patients comes mostly from case studies and thus is limited in scope⁷⁻¹⁰ and only a few studies have evaluated early onset periodontitis compared to other forms of periodontitis. For instance, in a study comparing immune response of localized pre-pubertal periodontitis to chronic periodontitis, LPP patients exhibited greater number of lymphocytes, particularly B cells, when compared to adults with periodontitis¹¹. Another study showed that severity of gingivitis may increase with age, possibly due to changes in plaque levels, bacterial composition, hormonal changes, inflammatory response, and tooth eruption or exfoliation, although there is still no evidence that different levels of marginal

inflammation will affect progression to periodontitis in older individuals¹². Thus, whether these differences, such as age and related growth changes in immune response, affect treatment outcomes in LAP patients is so far unknown.

While there is evidence that supports a favorable clinical outcome in treating permanent dentition of LAP patients with mechanical and antibiotic therapy^{13–17}, there are very few studies on the clinical response of primary dentition with similar therapy^{7, 14}. Additionally, no known studies have attempted to compare the clinical response of primary and permanent dentition using conventional therapy in patients with LAP. The purpose of this study is to evaluate the influence of non-surgical periodontal therapy with adjunctive systemic antibiotics on the clinical outcome of localized aggressive periodontitis (LAP) when comparing primary versus permanent dentition.

MATERIALS AND METHODS

Participant Population

This study is part of a clinical trial (NCT01330719). The data analysis presented in this study has not been published before and is aimed to evaluate LAP patient response to treatment according to patient dentition. All data collected were obtained under the protocol approved by the Institutional Review Board (IRB) at the University of Florida (Gainesville, USA). All participants/their legal representative signed an informed consent in order to be included in the study. Participants with suspected diagnosis of LAP were referred to us by the dentists in each of the different clinical settings: Leon County Health Department, Tallahassee, Florida, the Duval County Health Department in Jacksonville, FL and the University of Florida, Gainesville, FL, from Dec 2006 to November 2012. Participants were then recruited to this study if they met the following inclusion criteria: patient age between 5 and 25 years old, African-American origin, a confirmed diagnosis of LAP^{2, 18}, defined as having at least 2 teeth (incisor and/or first molar: in permanent or primary dentition) with probing greater than 5mm displaying bleeding on probing, attachment level 2mm, and bone loss detected through radiographic examination. Exclusion criteria included patients having taken antibiotics within 3 months prior to the study, smokers, pregnant/lactating women, or current diagnosis of any significant systemic condition with a potential to influence periodontal diseases (examples: diabetes, neutropenia, AIDS, Down-syndrome, hypophosphatasia).

Clinical Measurements

All patients underwent a preliminary dental history examination. All participants were tested with the following periodontal clinical parameters during the initial visit: (1) probing depth (PD), (2) bleeding on probing (BoP), (3) clinical attachment level (CAL) and (4) visible plaque (P). Gingival margin (GMP) was measured as a negative number if margin was coronal to the cementum-enamel junction (CEJ) and clinical attachment levels were calculated by adding probing depth and GMP (thus, CAL=0 for gingival/pseudo pockets). Partially erupted teeth were not probed. Measurements were executed by calibrated examiners (LS, PH) and the use of a 15mm periodontal probe^{**} at 6 sites per tooth (mesial-buccal, buccal, distal-buccal, mesial-lingual, lingual and distal-lingual), rounded to the

nearest millimeter, and recorded with a periodontal software program^{††}. All clinical parameters were recorded at baseline, 3, 6, and 12 months after treatment. Calibration of examiners was achieved when 80% of duplicate measures of PD and CAL were within 1mm.

Periodontal Treatment

At baseline, patients received a full mouth supra/sub debridement with an ultrasonic scaler^{‡‡}, scaling and root planning (SRP) in PD>4mm with hand instruments, as needed, and were placed on a systemic antibiotic regimen: amoxicillin 500mg and metronidazole 250mg three times a day for 7 days, as published previously^{14–16, 19–22}. Antibiotic dosage adjustments were made for patients weighing less than 40kg, according to package instructions. Local anesthesia was administered as needed. All mechanical treatment was attempted to be completed in the initial visit. If this was not possible (rare occurrence), the antibiotic regimen was started at the second visit, when treatment was completed. Compliance and possible side effects were monitored via a written antibiotic log, verbally with patients/parents, and the medication bottles were checked for remaining pills at the first follow up visit after treatment. Patients considered non-compliant with their antibiotic regimen were eliminated from this analysis. At 3, 6, and 12 months appointments all patients underwent supra/sub full mouth debridement with ultrasonic scaler. SRP of PD >4mm was performed whenever needed. Through oral hygiene instructions and oral hygiene tools were provided to all patients at all timepoints. An electric toothbrush^{§§} was also provided to each patient at baseline.

Statistical Analysis

Means of PD and CAL were calculated for sites with PD>4mm with concomitant CAL 2mm (affected sites). In addition, the % of pockets with PD>4mm and % affected sites, % bleeding sites and % sites with visible plaque were computed for each patient at each timepoint. Every effort was made to contact patients to re-schedule missed appointments in a proper timeframe. All available data were entered in the analysis, including patients with 1–2 missed timepoints. Statistical analysis was completed using a software program^{***}. One-way ANOVA was used to evaluate the reductions in all clinical parameters for primary and permanent dentitions among baseline, 3, 6 and 12 month timepoints. Non-parametric analysis (Kruskal-Wallis test) was used when data was not normally distributed and Dunns's multiple comparisons test was used when differences among timepoints were identified. Paired t-tests were used to assess the differences among reductions of clinical parameters between primary and permanent dentitions. Power calculations were performed using a statistical software^{†††} and it was determined that a sample size of 15 per group would provide >80% power to allow detection of difference of minimum of 1mm in CAL with a standard deviation of 0.9mm.

**UNC-15, Hu-Friedly, Chicago IL.

††Florida Probe, Gainesville, FL.

‡‡Cavitron Jet Plus, DENTSPLY, York, PA.

§§Oral B Vitality Precision Clean, Henry Schein, Gainesville, FL.

***GraphPad Prism V.5.0, GraphPad Software, La Jolla, CA.

†††Sigma Plot 11, Systat Software Inc, San Jose, CA

RESULTS

Ninety-seven patients were included in the final analysis of this study, which comprised of 30 males and 67 Females): 22 with primary dentition affected (12 females and 10 males), and 75 with permanent dentition affected (55 females and 20 males). See figure 1 for a diagram of all patients recruited, excluded and numbers of completed timepoints. The mean age of patients in the primary dentition category was 8.818 $\pm$ 0.4036 years and 16.05 $\pm$ 0.3308 years for permanent dentition ($p < 0.05$, table 1). All other parameters at baseline for both groups are presented on Table 1. Most teeth affected in both permanent and primary dentitions were 1st molars, with just a few cases of incisors affected in the permanent dentition. Patients either had primary or permanent dentition affected by LAP. No patient had both dentitions affected simultaneously. All patients included in the analysis were compliant with antibiotics.

Overall there was significant reduction ($P < 0.05$) in mean PD and CAL at all timepoints in both primary and permanent dentition (Fig. 2A–D). In primary dentition, there was a significant reduction in % sites with PD > 4 mm at 3 and 12 months (Fig. 2E). In permanent dentition, this reduction was present at 3, 6, and 12 months (Fig. 2F). There was no significant change in % BoP at any timepoint for primary dentition, whereas significant reduction at the 6 months timepoint for permanent dentition was present (Fig. 2H). Table 2 (Appendix) presents means for all clinical parameters at each timepoint for both groups.

Regarding comparisons between primary and permanent dentitions, primary dentition patients presented greater reductions in CAL at 3, 6 and 12 months and greater plaque reduction at 3 months, whereas permanent dentition presented greater reduction in BOP at 3 months (Figs 3B and D, respectively). No significant differences were present for other parameters between groups (Fig 3A–D). At 12 months after treatment, only 9 patients remained with primary teeth affected by LAP, whereas 13 patients that initially had LAP affected primary teeth, now presented only permanent teeth (normal exfoliation/eruption process), which were no longer affected by LAP. Correlations between baseline mean PD and number of affected sites were run against CAL reductions at 3, 6 and 12 months within each group and no significant correlations were detected.

DISCUSSION

The detection and treatment of periodontitis in children and young adults at an early age, prior to severe disease progression is desirable not only for better prognosis and treatment response but also for the prevention of early tooth loss and possibly disease occurrence in the permanent dentition at a later timepoint. This is the first study to compare the responses of treatment between primary and permanent dentitions affected by LAP, where we showed that primary dentition showed greater reduction for mean CAL possibly suggesting a different healing response and a difference in maturation of the immune system in younger populations, although specifics of these differences are not yet clear.

A previous study showed that age-related response to treatment may be associated to inflammatory cell response, hormonal changes, morphological changes, tooth eruption,

shedding, and bacterial composition of dental plaque¹². For instance, increased levels of hormones from prepuberty to puberty stages have been correlated with an increase in gingival inflammation and proportions of specific periodontal pathogens, such as *P. intermedia* and *P. nigrescens*²⁴. These hormonal and/or microbial changes in different age groups could be playing a role in the response to treatment. Although the present study did not assess hormonal levels in these patients, there was a clear difference in age between the two groups and thus, the influence of hormonal changes and a difference in host response to specific plaque in these individuals cannot be ruled out. In fact, a study on the gingival inflammatory reaction in children of different ages, showed that with no significant difference in baseline plaque accumulation there was a higher tendency for children of older ages (14–16 years old) to develop gingivitis compared to children of younger ages (4–6 years old)²⁵. These results indicate that the gingiva may react differently to plaque resulting in greater inflammatory response with age. In a previous study²⁶, a hyper-inflammatory response to LPS in children and young adults with LAP has been reported and in our recent preliminary results, we have demonstrated that children/young adults with permanent dentition affected by LAP have a greater inflammatory response to LPS compared to children with primary dentition affected by LAP²⁷. Thus, it is possible that different host immune response to LPS at different ages could be influencing the response to treatment observed here.

The present study also shows differences in BOP and plaque between the two dentitions, where permanent dentition presented higher reductions in BOP at 3 and 12 months and the primary dentition showed greater reduction of plaque at 3 months. Although the presence of BOP has been reported as a good marker for predicting the progression of chronic periodontitis²⁸, this parameter, as well as presence of plaque, are not reliable indicators/predictors of LAP, as these are whole mouth parameters and may be more indicative of a gingivitis state rather than a localized periodontitis state. Therefore, it is difficult to draw conclusions on the differences in BOP and plaque between groups observed here. However, we cannot rule out that the greater initial reduction in plaque observed in the primary dentition initially could have positively influenced the greater initial CAL reductions in this group, although this plaque difference was not present after 3 months.

For patients experiencing aggressive periodontitis, the most efficient method of therapy seems to be mechanical removal of bacteria and calculus through scaling and root planing with ultrasonic debridement or hand instruments coupled by immediate prescription of systemic antibiotics, although there seems to be no consensus on specific antibiotic regimens or the impact of antibiotic resistance with a single regimen^{14, 22, 29–33}. Our results showed that mechanical debridement combined with a single regimen of antibiotics resulted in overall reduction in mean PD, and mean CAL regardless of the dentition affected with LAP. Unfortunately, there is no evidence that supports that LAP diagnosis and treatment in primary dentition will prevent re-occurrence of the disease in permanent dentition. According to previous studies^{12, 34, 35}, LAP in primary dentition does not always progress into LAP in permanent dentition. A study conducted by Bimstein, in 2003⁷ illustrated that in 9 children diagnosed and treated (mechanical debridement along with systemic antibiotics) for periodontitis in the primary dentition, only one case was suspected to

develop the disease in permanent dentition, on a 7-year follow up. The present study in fact shows that 12 patients that initially presented LAP disease in primary dentition did not present any disease when permanent dentition erupted (at least at a timepoint 12 months post treatment). Although it is not yet known that lack of treatment of the disease in primary dentition will result in lack of disease in permanent dentition, in order to prevent disease occurrence in permanent dentition, the current recommendation is to diagnose early and treat disease in the primary dentition ^{1, 7, 36}.

A possible limitation in this study is the smaller sample size of patients diagnosed with LAP in primary dentition, some loss in follow up (mostly due to inability to contact patients despite numerous attempts), and the lack of determination of hormonal values of the participants to provide us with insight into a possible hormonal influence on the different CAL reductions observed between the two different dentitions. In addition, the role of the immune response between the two affected dentitions needs to be further elucidated. Given the low prevalence of aggressive periodontitis among patients diagnosed with LAP in primary dentition, which can be as low as 0.06%, ¹, it is difficult to gather large populations with this disease and this may be the reason why there are so few studies addressing LAP in primary dentition. However, this study reports a greater reduction in CAL in primary dentition affected by LAP, which may suggest that younger children may carry a greater propensity for positive treatment outcomes and healing potential compared to children/young adults with permanent dentition, and thus strongly supports the idea of prevention of LAP disease at young ages.

CONCLUSION

In conclusion, treatment of LAP with systemic antibiotics and full mouth mechanical debridement was effective in reducing clinical parameters of localized aggressive periodontitis affecting both primary and permanent dentitions in African-American participants. However, patients with LAP in primary dentition presented greater attachment level gain compared to patients with LAP in permanent dentition.

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Figure 1.
Diagram of study indicating number of patients included/excluded and attrition.

Figure 2.

Figures (A–J) illustrate clinical parameters over time for compliant patients from baseline to 12 months post-treatment. (A) Mean PD, in primary dentition. (B) Mean PD, permanent dentition. (C) Mean CAL, primary dentition. (D) Mean CAL, permanent dentition. (E) Percent sites with PD >4mm, primary dentition. (F) Percent sites with PD >4mm, permanent dentition. (G) Percent BoP, primary dentition. (H) Percent BoP, permanent dentition. (I) Percent plaque, primary dentition. (J) Percent plaque, permanent dentition. Bars depict significant reductions from baseline timepoints by Kruskal-Wallis test with Dunn's multiple comparisons (*p<.05, **p<.01, ***p<.0001).

Figure 3.

Data compares reduction levels in all clinical parameters between groups (primary dentition in white bars and permanent dentition in shaded bars) at each timepoint. (A) Mean PD (B) Mean CAL. (C) Percent PD > 4mm. (D) Percent BOP (E) Percent plaque. Significant decrease in reductions between groups are illustrated with horizontal lines, inter-quartile range (box), 5th–95th percentiles (whiskers), at 3 months, 6 months and 12 months after treatment. P values: ***<0.0001; **<0.005; *<0.05 Unpaired T-test.

Table 1

Baseline values of clinical parameters and demographics for patients with primary and permanent dentition

	primary dentition	permanent dentition
gender	10M/12F	20M/55F
Age	8.82±0.4*	16.05±0.33
#affected sites	12.77±2.63	18.56±2.14
% affected sites	9.50±0.11	11.36±1.40
# Teeth affected	6.6±4.37	8.9±5.6
# Total teeth	23.53±3.03	27.81±2.24
Mean PD	4.84±0.13*	5.52±0.11
Mean CAL	3.42±0.32	3.16±0.17
# PD > 4mm	14.86±2.64*	28.13±2.32
% PD > 4mm	10.73±1.93*	17.01±1.46
% BOP	13.36±1.87	16.60±1.50
% Plaque	57.14±5.98*	39.30±2.91

Values represented by means plus or minus standard error.

* Significantly different than permanent dentition (p < 0.05).

Table 2

(appendix). Mean clinical parameters at each timepoint for both dentitions.

PRIMARY DENTITION				
	Baseline	3 Month	6 Month	12 Month
# PD>4mm	16.93 ± 12.90	3.10 ± 2.77**	5.10 ± 4.58	4.46 ± 4.25*
%PD>4mm	12.07 ± 9.21	2.30 ± 1.89**	3.60 ± 3.17	3.08 ± 2.99**
%BoP	15.60 ± 11.02	8.90 ± 4.93	12.10 ± 9.67	7.85 ± 4.39
%Plaque	54.17 ± 25.57	25.50 ± 17.43**	35.30 ± 25.91	38.85 ± 13.22
Mean PD	4.84 ± 0.65	3.00 ± 0.81***	2.85 ± 0.84***	2.59 ± 1.15***
Mean CAL	3.47 ± 1.44	0.32 ± 0.34***	0.51 ± 0.56***	0.43 ± 0.64***
# Aff Sites	14.34 ± 12.49	1.10 ± 1.20***	2.50 ± 3.78**	1.62 ± 2.66***
% Aff Sites	10.46 ± 8.92	0.77 ± 0.82***	1.78 ± 2.62**	1.10 ± 1.82***

PERMENENT DENTITION				
	Baseline	3 Month	6 Month	12 Month
# PD>4mm	29.08 ± 19.27	15.86 ± 17.13***	13.63 ± 9.54***	16.08 ± 16.71***
%PD>4mm	17.20 ± 11.28	9.78 ± 10.33***	8.09 ± 5.46***	9.84 ± 10.39***
%BoP	17.52 ± 12.20	12.20 ± 9.07	10.39 ± 8.96*	13.86 ± 16.25
%Plaque	38.13 ± 22.71	27.02 ± 17.77	30.57 ± 23.63*	29.54 ± 15.17
Mean PD	5.47 ± 0.80	3.71 ± 1.01***	3.82 ± 0.86***	3.65 ± 0.90***
Mean CAL	3.10 ± 1.34	1.45 ± 1.40***	1.60 ± 1.67***	1.26 ± 1.56***
# Aff Sites	19.11 ± 16.02	7.96 ± 8.61***	7.19 ± 6.30***	7.58 ± 8.89***
% Aff Sites	11.66 ± 10.46	4.89 ± 5.36***	4.23 ± 3.64***	4.58 ± 5.47***

* denotes significance compared to baseline: P<0.05;

** p<0.01;

*** P<0.0001