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Incidence of periodontal attachment loss over 5 years among older South Australians

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Abstract

Objectives: This study described the 5-year incidence of periodontal attachment loss (ALOSS) among older Australians.

Material and method: Clinical examination data were obtained at baseline and 5 years from participants in a cohort study of South Australians aged 60+. Periodontal measurements (gingival recession, GR; probing depth, PD) were made for each tooth at 3 sites. An incident case of ALOSS was identified as an individual having 2+ sites with 3+ mm ALOSS.

Results: Some 342 (42.7%) of the 801 individuals examined at baseline were re-examined after 5 years, contributing longitudinal data from a total of 15,522 sites (6102 in the maxilla and 9420 in the mandible). Most sites showed no change in either GR or PD. Using a threshold of 3+ mm for change, ALOSS occurred at 2.3% of mesiobuccal sites, 2.5% of buccal sites, and 3.4% of distolingual sites. Distolingual sites on molars showed the highest progression rates. The major component of ALOSS was increased GR. Overall, only 10.1% of the observed ALOSS was contributed by increases in PD. Nearly two-thirds of the sites that experienced ALOSS had <3 mm of ALOSS at baseline. The weighted 5-year incidence estimate for ALOSS was 43.2% ($N = 145$), and was higher among diabetics or those who had lost 1+ teeth since baseline. Smoking was not a significant predictor.

Conclusion: The rates and patterns of ALOSS among older South Australians are largely similar to those recently reported for North Carolinians. Most ALOSS in older people manifests as increases in GR, rather than PD. Diabetics should be targeted for intensive primary and secondary prevention of periodontal disease.

Key words: cohort study; incidence; periodontal disease

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Longitudinal observational research is the sole approach that permits elucidation of (a) a disease's natural history, and (b) those characteristics and behaviours that are associated with a greater risk of disease development and progression. Until recently, there had been few published reports from longitudinal studies of periodontal disease among population-based samples. The influential study of male Sri Lankan tea labourers by Löe et al. (1986) challenged the notion that all people and all periodontal sites were universally susceptible, and was the first to address the issue of defining an incident case. Ismail et al. (1990) reported on changes in periodontal attachment level over a 28-year period in 165 people resident in Tecumseh, Michigan. Some 87.9% of persons had incident attachment loss (ALOSS) of 3 mm or more, with 13.4% of sites having lost 3+ mm. The identified risk factors for progression were age, smoking, and the presence of mobile teeth at baseline. Haffajee et al. (1991) reported on the 12-month periodontal disease incidence in a Japanese population-based sample of 271 individuals aged between 20 and 79 years of age at baseline. Over one-quarter (27.3%) experienced ALOSS of 3+ mm at 1+ sites, with ALOSS predicted by a greater extent of sites with plaque, bleeding on probing (BOP), or clinical attachment level (CAL) at baseline. These earlier incidence studies were somewhat diverse in characteristics such as their follow-up periods, analytical approaches, and key findings.

Since the mid-1990s, a number of reports have been published from studies of periodontal disease incidence in older people. Without exception, these come from the Piedmont 65+ Dental Study (a cohort study of adults aged 65 or more) and report: the 18-month incidence of ALOSS (Brown et al.

1994); patterns and predictors of ALOSS over 18 and 36 months (Beck et al. 1994); the incidence of new and progressing lesions (Beck et al. 1995); patterns and predictors of ALOSS during three observation intervals (0–18, 19–36 and 37–60 months) over a 5-year period (Beck et al. 1997); and the aetiologic modelling of ALOSS using an incidence density approach with five sequential examinations (Elter et al. 1999). Fifty-four percent of the Piedmont cohort experienced ALOSS during the 5 years, and it was found that, while previous ALOSS predicted subsequent ALOSS at the *person* level, the majority of *sites* that experienced ALOSS had not previously undergone it. This is consistent with the notion that although periodontitis risk is invested at the person level, individual site characteristics determine site-level patterns of tissue destruction within the mouth. Predictors of ALOSS by 18 months were, for whites, the presence of the bacteria *Porphyromonas gingivalis (P. gingivalis).* in plaque, medical care in the previous 6 months, feeling depressed, or smoking cigarettes regularly; for blacks, they were the presence of *P. gingivalis* or *P. intermedia*, no dental visit in the previous 3 years, not flossing regularly, or reporting a worsening of memory.

While the Piedmont study reports have contributed a substantial amount to understanding of the natural history and antecedents of periodontal loss of attachment in that age group, it is important to obtain descriptive information from elsewhere, as the reported disease patterns may be unique to that population and setting. The aim of this study was to describe the occurrence of periodontal ALOSS over 5 years in a population-based sample of older South Australians.

Methods

The South Australian Dental Longitudinal Study (SADLS) is a prospective cohort study of people aged 60 or more and who reside in Adelaide or Mount Gambier, South Australia. The sampling strategy and data on baseline periodontal status have been previously described (Slade & Spencer 1995). Dental examinations at baseline (1991) and 5 years (1996) were conducted using calibrated dental examiners. For the periodontal assessment, all teeth present in the mouth were assessed, with measurements of gingival recession (GR) and probing depth (PD) being made with the manual NIDR (National Institute of Dental Research) periodontal probe at three sites per tooth (mesiobuccal, midbuccal, and distolingual). Measurements were rounded down to the nearest whole millimetre at the time of data recording. Measurements were excluded when the cemento-enamel junction (CEJ) could not be visualised or when pockets could not be probed (such as when large amounts of calculus were present). Recession measurements were recorded as positive when recession was present; where the gingival margin was located more than 1 mm coronally to the CEJ, a negative value for GR was recorded.

Medication data were collected at the time of the dental examination at both baseline and 5 years: participants were asked to bring the containers for all medications that they had taken in the previous 2 weeks. Medication data analysis was facilitated by allocating a five-digit numeric code to each preparation (Thomson 1997). The 20 most prevalent medication categories were examined. For each, a participant's exposure to any medication was assumed to have been continuous throughout the follow-up period if it was taken at *both* baseline and 5 years.

At baseline, a participant was categorised as a current smoker if he or she answered affirmatively the question ''Do you smoke cigarettes?'', and ''ever-smokers'' were defined as those who answered affirmatively the question ''Have you ever smoked regularly?''. Exposure-level information such as the number of pack-years was not collected.

Information on participants' usual dental visiting pattern at baseline was collected with the question ''Would you say that you visit the dentist on a regular basis, or do you go only when you are in discomfort or when you need something fixed?''. Those who chose the ''regular basis'' option were categorised as having a ''routine'' dental visiting pattern, with the remainder designated ''episodic'' users of dental services.

Description of analysis

The CAL for each site was computed by summing GR and PD in the unit-record data sets of periodontal data from the baseline and 5-year SADLS examinations. After the data sets were merged, ALOSS for each site was computed by subtracting baseline CAL from the follow-up CAL. We also computed the ''extent'' of incidence ALOSS, modifying the method for calculating the extent in cross-sectional studies described by Carlos et al. (1986). Specifically, we calculated the extent of incident ALOSS as the number of sites with incident ALOSS of 3+ mm divided by the total number of sites measured at both time points.

The data were weighted to adjust for different probabilities of participant selection that were created through the stratified sampling scheme. Unit-record weights were computed by dividing the stratum-specific sample size (obtained from all records in the State Electoral Database) by the number of participants in the corresponding stratum. This was further divided by the quotient of the total population divided by the total sample size. It was considered that any error arising from not adjusting the variances to allow for the stratified sampling scheme would have been minor. We assumed that the design effects would be close to unity, and hence made no adjustment of standard errors.

After the computation of univariate statistics, bivariate associations were tested for significance using the χ^2 test for categorical dependent variables, the independent samples *t*-test for continuous dependent variables that met the normality criterion, or the Mann–Whitney *U*-test for continuous dependent variables that did not.

Reliability of measurements

Interexaminer reliability was determined by examining the intraclass correlation coefficients for replicate measurements made by the four examiners on 28 participants at baseline. Data were pooled for all pairwise combinations of four examiners, yielding 1145 periodontal sites, each measured twice. Intraclass correlation coefficients for the periodontal measurements were 0.46 for mean PD, 0.92 for mean GR, and 0.84 for mean CAL. Of the 1145 replicated pairs of measurements, 97.8% were within plus or minus 2 mm, meaning that only 2.2% of replicated pairs differed by 3+ mm. Thus, for this analysis, 3+ mm was chosen as the threshold of ALOSS that was indicative of true change.

Results

At baseline, 801 individuals were examined periodontally, and 342 (42.7%) of these were re-examined after 5 years. Data are presented in Table 1 on the characteristics of those who were lost to follow-up and those who were not. Those who had been lost to follow-up tended to be older and have more missing teeth, and proportionately fewer reported incomes of AU$21,000 or more. Proportionately fewer of those lost to follow-up made regular dental visits, or brushed their teeth once or more per day, and a higher proportion of those lost to follow-up had 1 or more sites with 6+ mm CAL, 3+ mm of GR, or 6+ mm of PD. They also reported more chronic medical conditions and took more medications, but there was no difference in the proportion of smokers in each group.

Unless otherwise specified, all subsequent site-level analyses refer to the individuals who were examined on both occasions; data are weighted estimates and represent 336 individuals.

At baseline, the total number of sites examined was 16,794, comprising a mean 50.0 sites (SD 22.4; range 6–94) per person. At the 5-year follow-up, the total number of sites examined was 15,562, comprising a mean 46.3 sites (SD 22.2; range 3–92) per person. Longitudinal ALOSS data were available from 15,167 sites (5885 in the maxilla and 9282 in the mandible). The remaining sites were excluded from analysis because of tooth/site coding discrepancies.

Progression and "reversal" of disease

Data on the person-level incidence and extent (that is, the mean percentage of sites showing ALOSS) of disease progression and reversal are presented in Table 2 using three case definition thresholds. One or more sites with ALOSS of 3+ mm were observed in 58.6% of the sample (and 652 sites in total), while 43.2% of the sample had 2 or more sites with 3+ mm of ALOSS. Apparent attachment gains of 3 mm or more were seen in 26.2% of participants (involving a total of 120 sites). For each case definition threshold, the number of people and sites with progression exceeded those with reversals. Subsequent analyses used 3+ mm as the threshold for change.

Table 1. Baseline characteristics of dentate individuals who were examined at 5 years compared with those who were lost to follow-up (unweighted data)

	Lost to follow-up	Examined
Total number	459	342
Sociodemographic characteristics		
% living in Adelaide	64.0	58.5
% female	38.7	41.9
mean age (SD)*	72 (8)	69 (6)
% income of $21,000 or more*	23.6	30.9
% educated past age 16	34.3	34.6
Dental characteristics		
% regular dental visitors*	38.2	45.6
% who brush teeth at least once/day*	57.1	67.3
% who floss teeth at least once/week	46.8	48.8
mean number of missing teeth (SD)*	16.1 (7.5)	15.0 (7.4)
% wearing partial denture	41.0	42.1
Periodontal disease		
Prevalence		
% with 1+ sites with 6+ mm CAL*	18.7	18.4
% with 1+ sites with 3+ mm GR*	78.9	72.2
% with 1+ sites with 6+ mm PD*	15.7	10.8
Extent		
mean% of sites with 2+ mm CAL* (SD)	82.3 (17.0)	77.1 (17.4)
mean% of sites with 3+ mm CAL* (SD)	51.3 (28.3)	41.5 (26.2)
mean% of sites with 4+ mm CAL* (SD)	31.0 (27.6)	22.3 (22.5)
mean% of sites with 5+ mm CAL* (SD)	17.0 (22.7)	10.3 (15.5)
mean% of sites with 6+ mm CAL* (SD)	9.5 (17.9)	4.8 (9.5)
Severity		
mean PD (SD)*	1.9 (0.5)	1.8 (0.4)
mean CAL (SD)*	3.0 (1.3)	2.6 (0.9)
General health		
% who currently smoke	12.3	9.9
mean no of medications taken (SD)*	1.8 (2.0)	1.1 (1.4)
mean no of chronic medical conditions (SD)	2.5 (1.5)	1.9 (1.3)

*$p < 0.05$.

Table 2. Prevalence and extent of periodontal attachment loss (ALOSS) progression and reversal, using 3 thresholds (weighted data)

Case definition threshold	Number of people (%)	Total number of affected sites	Extent among entire sample (SD; range)	Extent among those affected (SD; range)
Progression				
1+ sites with ALOSS of 3+mm	197 (58.6)	652	5.5 (9.3; 0.0–66.7)	9.4 (10.6; 1.2–66.7)
1+ sites with ALOSS of 4+mm	93 (27.7)	175	1.6 (5.0; 0.0–46.7)	5.7 (8.1; 1.2–46.7)
1+ sites with ALOSS of 5+mm	19 (5.7)	42	0.5 (3.2; 0.0–33.3)	8.7 (10.7; 1.3–33.3)
2+ sites with ALOSS of 3+mm	145 (43.2)			
2+ sites with ALOSS of 4+mm	38 (11.3)			
2+ sites with ALOSS of 5+mm	8 (2.4)			
Reversal				
1+ sites with ALOSS < -3 mm	88 (26.2)	120	0.9 (2.1; 0.0–21.4)	3.6 (2.8; 1.1–21.4)
1+ sites with ALOSS < -4 mm	23 (6.8)	28	0.3 (1.4; 0.0–14.3)	4.4 (3.2; 1.3–14.3)
1+ sites with ALOSS < -5 mm	4 (1.2)	5	0.1 (0.4; 0.0–7.7)	3.4 (2.8; 1.1–7.7)
2+ sites with ALOSS < -3 mm	23 (6.8)			
2+ sites with ALOSS < -4 mm	5 (1.5)			
2+ sites with ALOSS < -5 mm	1 (0.3)			

Data on the site-level changes by contributory component are presented in Table 3. Most sites showed no change in either GR or PD: where GR is concerned, 2.4% of sites progressed, and 0.2% showed reversals. For PD, 0.4% of sites progressed, and 0.5% showed reversals. It should be noted that the number of sites with 3+ mm increase in CAL (652 sites) was greater than the sum of sites with 3+ mm increase in GR or PD. This came about because a given site could meet the 3+ mm ALOSS criterion, while experiencing increases in GR and PD that were both below the 3 mm threshold.

An increase in GR was observed at 1.7% of mesiobuccal sites, 2.1% of mesial sites, and 3.4% of distolingual sites. PD increased at 0.2% of mesiobuccal sites, 0.5% of mesial sites, and 0.3% of distolingual sites. ALOSS occurred at 1.9% of mesiobuccal sites, 2.5% of buccal sites, and 3.7% of distolingual sites.

Comparison of the baseline and follow-up CAL status of sites (Table 4) shows that 62.5% of sites had <3 mm CAL at baseline and did not develop new disease. Just under one-third of sites (33.2%) showed evidence of past CAL at baseline but did not progress during the next 5 years. Of the 652 sites that experienced 3+ mm of ALOSS, almost two-thirds (423 sites) had <3 mm CAL at baseline.

Table 3. Number of sites showing change, by contributory component (using 3+mm as the criterion for change; weighted data)

	Number of sites	Range per person	Percentage of all sites
Gingival recession			
reversed	33	0–3	0.2
no change	14,785	1–91	97.4
progressed	365	0–12	2.4
all sites	15,183	0–91	100.0
Probing depth			
reversed	83	0–6	0.5
no change	15,061	3–91	99.1
progressed	53	0–6	0.4
all sites	15,197	0–91	100.0
Attachment level			
reversed	121	0–8	0.8
no change	14,394	1–91	94.9
progressed	652	0–12	4.3
all sites	15,167	0–91	100.0

Table 4. Number of sites showing new or progressing attachment loss (weighted data)

	Follow-up status		
	Δ CAL <3 mm	Δ CAL $\geqslant 3$ mm	row totals
Baseline status			
CAL <3 mm	9479 (62.5%)	423 (2.8%)	9902
CAL $\geqslant 3$ mm	5036 (33.2%)	229 (1.5%)	5265
column totals	14,515	652	15,167

Table 5. Number of sites (and rates) showing incidence attachment loss (ALOSS) by jaw, tooth type, and measurement site (weighted data)

	No. of sites	Rate (% of sites with ALOSS)
Maxilla		
Molars		
mesiobuccal	536	3.9
midbuccal	525	1.8
distolingual	519	7.2
Premolars		
mesiobuccal	411	1.7
midbuccal	416	0.6
distolingual	404	3.3
Incisors and canines		
mesiobuccal	1027	1.1
midbuccal	1030	0.2
distolingual	1017	0.8
Mandible		
Molars		
mesiobuccal	555	5.2
midbuccal	552	2.4
distolingual	433	6.2
Premolars		
mesiobuccal	829	1.7
midbuccal	829	4.3
distolingual	822	3.8
Incisors and canines		
mesiobuccal	1777	2.6
midbuccal	1792	1.9
distolingual	1693	3.7

Distribution and nature of attachment loss

The number of (and rates for) sites showing ALOSS by jaw, tooth type, and measurement site are presented in Table 5. The percentage of mandibular sites showing ALOSS was greater than that observed at maxillary sites (1.9% and 3.1% of sites, respectively; $\chi^2 = 21.45$, 2 df, $p<0.001$). The highest rate of progression for ALOSS was for distolingual sites on maxillary molars, where 7.2% of sites showed positive change, followed closely by mesiobuccal and distolingual sites. Buccal and distolingual sites on mandibular premolars also showed relatively high rates of progression. The major contributor in either jaw was increased GR. Overall, 17.7% of the observed ALOSS in maxillary sites was contributed by sites showing progression in PD, while the equivalent estimate for mandibular sites was 7.4%. For both jaws combined, 10.1% of the

observed ALOSS was contributed by sites showing increases in PD.

Person-level incidence of disease

Employing the previously used case definition of 2 or more sites with ALOSS of 3+ mm gave a weighted 5-year incidence estimate of 43.2% (145 individuals), equivalent to an average (life table) estimated incidence rate of 10.7% per year. Associations between ALOSS and sociodemographic characteristics and putative risk factors are presented in Table 6. People who had fewer than 15 missing teeth at baseline had a significantly higher incidence of ALOSS than people with 15+ missing teeth. The incidence of ALOSS was significantly greater among people who experienced tooth loss in the 5-year period than among those who did not. Other oral health or sociodemographic characteristics (or smoking) were not associated with ALOSS. Although not shown in Table 6, all 6 diabetics in the sample (identified as those who were taking hypoglycaemic medications at both baseline and 5 years) were incident cases. No other medical conditions and no medications were associated with disease incidence.

Table 6. Bivariate associations between periodontal disease incidence and sociodemographic characteristics, and putative predictors (weighted data)

	No. of participants	% with 2+ sites with 3+mm ALOSS	*p* value
Sociodemographic characteristics			
Sex			
male	177	43.5	0.89
female	159	42.8	
Age group at baseline			
60–69	235	43.0	0.92
70+	101	43.6	
Place of residence			
Mt Gambier	14	42.9	0.97
Adelaide	323	43.3	
Education			
left school before age 16	210	46.2	0.17
left school after age 16	127	38.6	
Oral health and self-care			
Toothbrushing			
brush 1+ times daily	242	40.5	0.11
brush less frequently	94	50.0	
Flossing			
floss regularly	168	42.9	0.91
floss infrequently/never	168	43.5	
Dental visiting pattern			
episodic	164	42.1	0.70
routine	172	44.2	
Missing teeth at baseline			
<15 teeth missing	179	48.0	0.05
15+ teeth missing	157	37.6	
Loss of teeth since baseline			
0 teeth lost	220	38.6	0.02
1+ teeth lost	116	51.7	
Smoking status			
Ever smoked regularly?			
yes	149	45.0	0.47
no	183	41.0	
Smoker at baseline?			
yes	40	32.5	0.15
no	296	44.6	

Discussion

Over the course of 5 years, 43% of participants in this prospective cohort study of community-dwelling older people were incident cases of ALOSS (defined as two or more sites with ALOSS of 3+ mm). There were high rates of ALOSS among the few diabetics in the study and those who had lost one or more teeth during the observation period. The bulk of incident ALOSS came from increases in GR, although there were differences by jaw, tooth type, and site.

In any longitudinal epidemiological study, the loss of participants from the cohort over time can lead to the non-representativeness of the study sample, irrespective of how meticulously the baseline sample was drawn. This has occurred in the current study: those remaining at 5 years were younger, less highly medicated, and reported better dental self-care and service-use patterns than those lost to follow-up. While there was no difference between people lost and those retained with respect to the prevalence of 6+ mm CAL, there were minor differences in the prevalence of the contributing components (GR and PD). Moreover, at the tooth level, it is possible that there may also have been ALOSS missed because of teeth that were not measured at follow-up (whether because of tooth loss or other reasons), further affecting the generalisability of the study's findings. At least 1 tooth was lost to follow-up by 176 (52.4%) of the participants who were periodontally examined at baseline and 5 years, and a mean 2.9 (SD, 2.2; range 1–13) teeth per person were affected in this way. Data on the periodontal characteristics of the teeth that were and were not measured at follow-up are presented in Table 7. In 16 of the 32 tooth types, the mean CAL at baseline was significantly greater among the ''lost'' teeth than among those retained, and this pattern was more apparent among molars and lower incisors. In only one tooth type (upper left first molars) was the mean baseline CAL greater among those that were measured on both occasions. These findings suggest that a proportion of the teeth that were not measured at follow-up did indeed have more severe periodontal disease, and that the current study's findings should therefore be regarded as under-estimates of the actual periodontal disease progression that occurred in the cohort. Thus, generalisation from the findings should be made with a fair degree of caution, particularly when comparing the study's estimates and associations with those from other studies.

The above considerations notwithstanding, because this report of periodontal disease incidence in older people is, to date, the only one from outside the Piedmont study, it is worth determining the extent to which the latter study's conclusions are supported or contradicted by our findings. Generally, there

Table 7. Number of each tooth measured at baseline and follow-up, and mean CAL associated with teeth measured and not measured at follow-up (weighted data)

Quadrant, tooth	No. measured at baseline	No. not measured at follow-up	Mean CAL[a] (SD)	
			teeth measured at both times	teeth measured at baseline only
Upper right				
18	79	15	2.3 (1.1)	3.8 (2.0)*
17	147	9	2.8 (1.2)	2.4 (0.9)
16	83	14	3.3 (1.4)	2.8 (1.5)
15	119	12	2.6 (1.2)	3.7 (2.2)*
14	132	17	2.4 (1.1)	2.8 (1.9)
13	199	15	2.1 (1.0)	3.3 (2.1)*
12	191	24	2.0 (1.0)	2.2 (0.9)
11	193	26	2.0 (1.0)	1.8 (0.6)
Upper left				
28	76	24	2.4 (0.9)	3.1 (1.3)**
27	139	13	2.7 (1.2)	4.1 (1.5)*
26	91	4	2.9 (1.2)	1.7 (0.1)**
25	104	19	2.5 (1.2)	3.4 (1.6)*
24	137	33	2.5 (1.2)	2.5 (1.0)
23	207	21	2.1 (0.8)	2.1 (0.5)
22	182	20	1.9 (0.8)	2.0 (1.7)
21	189	27	2.0 (1.1)	2.1 (1.2)
Lower left				
38	99	15	2.1 (0.8)	3.3 (1.7)*
37	157	29	2.4 (0.8)	3.0 (1.4)*
36	91	20	2.5 (0.7)	2.1 (0.8)**
35	189	13	2.5 (1.1)	2.8 (1.3)
34	261	12	2.4 (0.9)	3.8 (2.2)*
33	307	8	2.1 (1.0)	4.2 (2.0)*
32	300	16	2.0 (1.2)	3.7 (1.9)*
31	300	9	2.2 (1.2)	5.2 (3.4)*
Lower right				
48	86	9	2.4 (0.9)	2.7 (1.1)
47	151	16	2.4 (0.9)	2.9 (1.2)**
46	80	16	2.6 (0.7)	3.1 (1.5)
45	181	17	2.6 (1.2)	3.2 (1.5)
44	258	14	2.5 (1.0)	2.7 (1.0)
43	319	5	2.2 (1.0)	3.2 (1.5)**
42	310	7	2.3 (1.3)	2.7 (1.3)
41	298	11	2.3 (1.2)	4.8 (2.8)*

[a]Calculated for each tooth as the mean CAL over the three sites measured.
*$p<0.01$. **$p<0.05$.

were more similarities than differences, despite the discrepancy in the number of sites measured (whereby the Piedmont study examined the mesiobuccal and midbuccal sites on each tooth, and the SADLS study examined the distolingual site as well). An initial comparison suggests that the current study's 5-year incidence estimate of 43% was somewhat lower than the 56% reported by Beck et al. (1997) for the North Carolina sample. However, the 5-year incidence of ALOSS among the 114 whites examined in the Piedmont study was 37% (95% CI 28, 46), which is not significantly different from the SADLS population that (if classified using US racial group categories) was almost entirely white. The current study's finding that the majority of sites showing ALOSS had <3 mm CAL at baseline also confirms the Piedmont findings (Beck et al. 1995), and underlines the need for clinicians to emphasise the need for monitoring and prevention at all sites in a patient's mouth, rather than just the diseased sites.

Where the constituents of ALOSS are concerned, the two studies' findings were also broadly similar, with both finding that, on average, the bulk of ALOSS manifested as increases in GR rather than PD. This suggests that, as folk wisdom would have it, older people do indeed get ''longer in the tooth''. Nonetheless, it is important to remember that such a change fundamentally reflects an apical migration of the periodontal attachment and a lessening of support for the affected tooth. Hence, this should be viewed as a pathological change, rather than simply as an age-related phenomenon. In this study, 4.3% of sites lost 3+ mm of attachment that, in a tooth with (say) an 18 mm root, represents one-sixth of its length in just 5 years, at least at that site. The degree to which such a change compromises the longer-term retention of a tooth is presently unclear, and perhaps a focus for longitudinal periodontal research could be to develop methods to determine the overall loss of support for dental units at the whole-tooth level.

Given the consistency of previous studies' findings on cigarette smoking and periodontal disease (Gelskey 1999), it was notable that cigarette smokers in the current study did not have a higher incidence of ALOSS. Although not reported above, the mean number of sites at baseline among smokers and non-smokers did not differ in that respect (46.2 and 49.5, respectively; $p>0.05$), suggesting that a lack of association with smoking is not an artefact of variation in the number of sites at risk. In an analysis of the Piedmont data that distinguished between new lesions and the progression of existing lesions, Beck et al. (1995) found that smoking was a risk factor not for new lesions but for lesions that progressed. The current analysis did not make that distinction, and this may account for the absence of an association with smoking, given that the majority of ALOSS was observed at sites that were not diseased at baseline. Finally, it may also be that most of the periodontal damage inflicted by smoking manifests earlier in the life course as suggested by Hashim et al. (2001), and both the teeth and the individuals who have survived to old age may not be as susceptible to the detrimental effects of smoking than those succumbing earlier, suggesting that a ''healthy survivor'' effect may be operating.

There are several clinical implications from this study. First, periodontal ALOSS is active among a sizeable minority of older people, and a comprehensive periodontal examination should be part of any clinical dental consultation. Follow-up periodontal monitoring should not just be limited to previously diseased sites but should include all sites. Second, diabetics should be the focus of intensive periodontal maintenance therapy and preventive effort, particularly given the increase in the prevalence of Type 2

diabetes in industrialised countries (Health Funding Authority 2000). Third, while smoking did not emerge as a risk factor for periodontitis in this group of older people, the weight of evidence from other studies means that smokers should clearly also be the target of intensive primary and secondary preventive efforts.

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