

Clinical course of chronic periodontitis

II. Incidence, characteristics and time of occurrence of the initial periodontal lesion

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Heitz-Mayfield LJA, Schätzle M, Löe H, Bürgin W, Ånerud Å, Boysen H, Lang NP: Clinical course of chronic periodontitis. II. Incidence, characteristics and time of occurrence of the initial periodontal lesion. J Clin Periodontol 2003; 30: 902–908. © Blackwell Munksgaard, 2003.

Abstract

Aim: The purpose of this study was to assess the initiation and progression of periodontal disease during adult life.

Materials and Methods: In a 26-year longitudinal investigation of the initiation and progression of chronic periodontitis that started in 1969 and included 565 men of Norwegian middle class, 223 who had participated in some, but not all, intermediate examinations presented at the last survey in 1995. Fifty-four individuals were available for examination in all seven surveys.

Results: Covering the age range from 16 to 60 years, the study showed that at 16 years of age, 5% of the participants had initial loss of periodontal attachment (ILA ≥ 2 mm) at one or more sites. Both the subject incidence and the site incidence increased with time, and by 32 years of age, all individuals had one or more sites with loss of attachment. As age progressed, new lesions affected sites, so that as these men approached 60 years of age approximately 50% of all available sites had ILA.

An assessment of the intraoral distribution of the first periodontal lesion showed that, regardless of age, molars and bicuspids were most often affected. At and before the age of 40 years, the majority of ILA was found in buccal surfaces in the form of gingival recession. By 50 years, however, a greater proportion of sites presented with attachment loss attributed to pocket formation or a combination of pocket formation and gingival recession. As individuals neared 60 years of age, approximately half of the interproximal areas in posterior teeth had these lesions.

Conclusion: This investigation has shown that, in a well-maintained population who practises oral home care and has regular check-ups, the incidence of incipient periodontal destruction increases with age, the highest rate occurs between 50 and 60 years, and gingival recession is the predominant lesion before 40 years, while periodontal pocketing is the principal mode of destruction between 50 and 60 years of age.

Key words: initial attachment loss; early periodontal lesion; longitudinal studies; incidence; periodontal disease

Accepted for publication 2 January 2003

A knowledge of the transition from health to disease and the progression of the disease through various stages of severity are important in the development of effective strategies of prevention and treatment. During the last 50 years, the prevailing clinical concept of the pathogenesis of the early lesion in chronic periodontitis included (1) the formation and maturation of the supra-gingival plaque and the develop-

ment of gingivitis, (2) the extension of the bacterial plaque and the chronic inflammatory process into the subgingival area and the initial destruction of the connective tissue attachment of the teeth, and (3) the apical extension of the junctional epithelium and the formation of the periodontal pocket and loss of alveolar bone.

While the clinical features of the role of the bacterial plaque and the timing of

the development of chronic gingivitis are reasonably well understood, the sequence of events, incidence, pattern and timing of the initial periodontal lesion are less well defined.

Cross-sectional epidemiological studies from many countries have shown that gingivitis is common in the primary and permanent dentitions of children (Kinane 2000), and affects most adults (Brown & Löe 2000). Although loss of

attachment is rarely found in children, it seems to start some time during the late teens (Hugoson & Jordan 1982, Løe et al. 1986, Bhat 1991, Brown & Løe 2000). Most young individuals between 20 and 30 years of age have one or more sites with attachment loss (Ånerud et al. 1983), expressed as gingival recession, pocket formation or a combination thereof.

The purpose of the present analysis was to examine the initiation and progression of periodontal disease during a man's adult life, in order to evaluate the time of occurrence, incidence and distribution pattern of the early periodontal lesion.

Materials and Method

The investigation started in Oslo (Norway) in 1969, and consisted of 565 healthy males between 16 and 34 years of age. The older birth cohorts (born between 1934 and 1948) were non-dental University students and young faculty members randomly chosen from the census files of the Central Bureau of Statistics, while the younger birth cohorts (born in 1950 and 1952) were recruited from three high schools (gymnasium) selected by the City Board of Education. They were all raised in Oslo, which since the 1930s had provided systematic dental care for all children from the age of 4 years until 16 years. All participants reported that subsequent to the release from public programs, they continued to see their private dentist on a regular basis. Thus, these study groups represented a population who had experienced professional dental care during their entire life, and reported to brush their teeth daily. The cohort was re-examined in 1971, 1973, 1975, 1981, 1988 and 1995 (Fig. 1), covering a total length of 26 years of follow-up. For detailed information on the study design, demography and baseline data, see Løe et al. (1978).

Throughout the study, the same two examiners, both well-trained and experienced periodontists (Å.Å. and H.B.), scored the clinical indices. Loss of attachment was measured using a periodontal probe with a point diameter of 0.6 mm, and graded at 1, 2, 3, 4, 5, 7, 9 and 11 mm. The same probes were used at all examinations, and a periodontal pocket was assigned when loss of attachment minus gingival recession equaled 3 mm or more. Efforts were

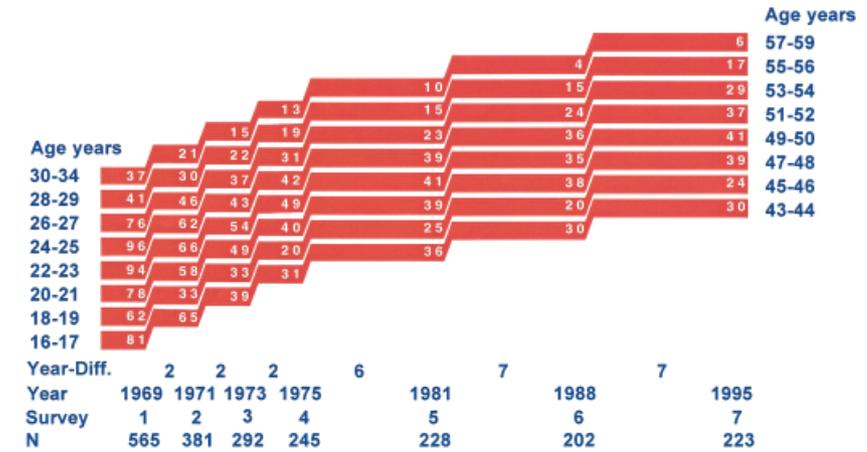


Fig. 1. Norwegian age cohorts at baseline and subsequent re-examinations. N: number of participating individuals at each survey; S: survey number; Y: year of survey; Year Diff: number of years between surveys.

made to standardize the measuring force (0.2–0.3 N) throughout the study.

Intra-examiner reproducibility for each index was tested at baseline and repeated during the study. The clinical examination of the periodontal tissues included measurements and scoring of various indices on the surfaces of all teeth, except third molars. One examiner always scored the periodontal situation (gingival index (GI) and loss of attachment) and the other scored for local exogenous factors (PII, CI). The data for each examination were computerized and updated on an ongoing basis.

Parameters analyzed for the purposes of this report included plaque index (PII) (Silness & Løe 1964), GI (Løe & Silness 1963) and loss of attachment (Glavind & Løe 1967). In surveys 1–4, mesial and buccal surfaces were examined, while in surveys 5–7, four surfaces of each tooth were scored. In surveys 3–7, gingival recession was also recorded.

No preventive or therapeutic measures were undertaken during the examinations. However, the cohort members reported seeing a private dentist on a regular basis. The investigators made special efforts to avoid any interference of habits or home-care practices pertaining to the oral health-care status of the individuals, except in a few situations when overt dental problems called for an appointment with a private dentist.

The study was approved by the University of Oslo, Faculty of Odontology, Ethics Committee, and written consent was obtained from all subjects.

Data Analysis

In the data analysis, three subsets of individuals were considered:

Subset 1: Individuals included in the study that were available for examination at one or more surveys: the All Valid Observation (AVO) group; N = 565.

Subset 2: Individuals present in the First and Last (F&L) surveys; N = 223.

Subset 3: Individuals present In All the Surveys (IAS); N = 54.

In order to gain true longitudinal information, subset 3, i.e. IAS, was analyzed using the SAS software package (SAS Institute Inc., Cary, NC, USA). Mesial and buccal sites were consistently scored throughout the study, and these sites were therefore chosen for evaluation.

Initial loss of attachment (ILA) was defined as the first attachment loss of 2 mm or more as measured from the cemento-enamel junction.

The age of individuals having ILA at one or more sites, and at ≥10%, ≥20%, ≥50% of sites, was analyzed within each subset. The frequency distribution of ILA at different surfaces of different teeth was evaluated over time.

Results

An evaluation of the incidence, characteristics, distribution and the time of occurrence of the initial periodontal lesion showed no significant difference between the three subsets as based on AVO, participation in F&L surveys or

participation in IAS, indicating that the loss to follow-up had no significant impact on the data to be analyzed.

Five percent of the individuals had an ILA of 2 mm or more in one or more sites at the age of 16 years. The incidence increased somewhat during the twenties, and by the age of 32 years all men had an ILA at one or more sites (Fig. 2). Fig. 2 also shows that at the age of 48 years, all individuals had an ILA at least in 10% of all available sites, and that at 56 years, more than 20% of the sites were affected.

Until 25–30 years of age, ILA was essentially confined to buccal surfaces of molars and bicusps of both jaws, while very few anterior teeth and interproximal surfaces in general were involved (Fig. 3, Table 1). Interproximal ILA increased to some extent during the thirties and forties, but most of the initial lesions were still found in the buccal surfaces. As the men neared 50 years of age, interproximal ILA increased significantly in all groups of teeth (Table 1). At 55 years, ILA had occurred in 50–100% of all buccal and interproximal aspects of posterior teeth, and 40–70% of the available sites in the anterior teeth.

At 20 years, almost all ILA was due to gingival recession. Actually, out of 107 sites with $ILA \geq 2$ mm, only two sites showed pocket formation (Fig. 4a). Similarly, at 30 years, the vast majority of sites were characterized by gingival recession (Fig. 4b). At 40 years, still less than 10% of the sites had pockets measuring 3 mm or more (Fig. 4c). At 55 years, however, approximately one-third of the sites with ILA had lost attachment due to pocket formation (Fig. 4d). With increasing age, increas-

ing proportions of sites with ILA were attributed to pocket formation or combinations of pocketing and gingival recession. As the men approached 60 years of age, almost all buccal surfaces and the majority of interproximal areas had ILA in the form of gingival recession, pocket formation or combinations of the two.

Discussion

When the longitudinal investigation started in Oslo in 1969, the main purpose was to study the initiation and progression of chronic periodontitis during major portions of the adult life of a randomized population of healthy, well-educated men of middle class, who had a lifelong experience with state-of-the-art professional and personal oral health care.

It was expected that in such a group the clinical course of the disease would transpire in a subtle mode, and that the age distribution and clinical methods chosen would allow for the assessment of the earliest signs of the transition from periodontal health to disease. Both have been borne out by this and previous publications (Ånerud et al. 1979, 1983).

Incidence

In the current analysis, a difference of 2 mm or more from a previous recording of zero periodontal attachment loss was chosen to represent ILA. Although rarely seen, any ILA of this magnitude did occasionally occur during adolescence, became more frequent among young adults in their twenties, and at 32

years of age all individuals had developed one or more sites with ILA.

Since no other longitudinal study covering the incidence of ILA over the life span has been made, it is difficult to compare directly the subject incidence rates of ILA of this publication with those of other and comparable groups. However, relatively recent reports on the prevalence of attachment loss in adolescence indicate that ILA occurred in 3–5% of 16-year-old European Caucasians (Van der Velden et al. 1989, Clerehugh et al. 1990, Källestål & Mattson 1990). While these subject prevalence rates coincide quite well before 20 years of age, the site prevalence of ILA was much higher in the US (Miller et al. 1987) and in England (Clerehugh et al. 1990) than in the Norwegian group.

The current study has shown that the number of affected sites continued to grow with age, and that between 40 and 50 years, 10% of all available sites had ILA. As the men approached 60 years, more than 20% of all sites were affected. Indeed, in approximately 75% of these men, 50% of the sites, or some 60–65 sites, had ILA, indicating that in this middle-class population with a history of lifelong oral health care, the fastest increase in the incidence of new periodontal lesions occurred between 50 and 60 years of age.

The incidence of chronic periodontitis during adult life has not been studied before; and the finding that the incidence rate escalates as the individuals reach 60 years could lend evidence to the notion that aging is a factor in the scope of destructive periodontal disease in the elderly (Avlund et al. 2001). It should be noted, however, that at present no information exists relative to incidence rates beyond 60 years. Also, it is worth remembering that as these individuals neared 60 years, half of the available tooth sites were still healthy.

Pattern and types of lesions

Before 30 years of age, most ILA in this population group occurred in buccal surfaces of posterior teeth. Very few anterior teeth and interdental areas were affected. Interdental ILA increased somewhat between 30 and 40 years of age, but the large increment in new interdental lesions occurred before and after 50 years, when most posterior teeth and some half of the anterior teeth

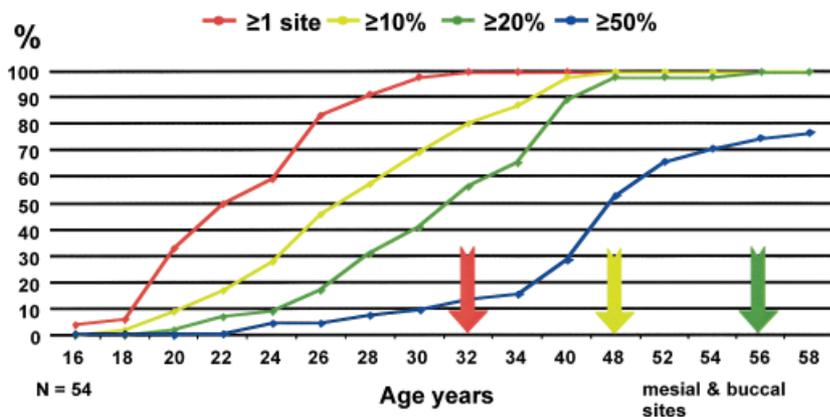


Fig. 2. Age at which initial attachment loss occurred at ≥ 1 site, $\geq 10\%$, $\geq 20\%$, $\geq 50\%$ of sites in the subset IAS.

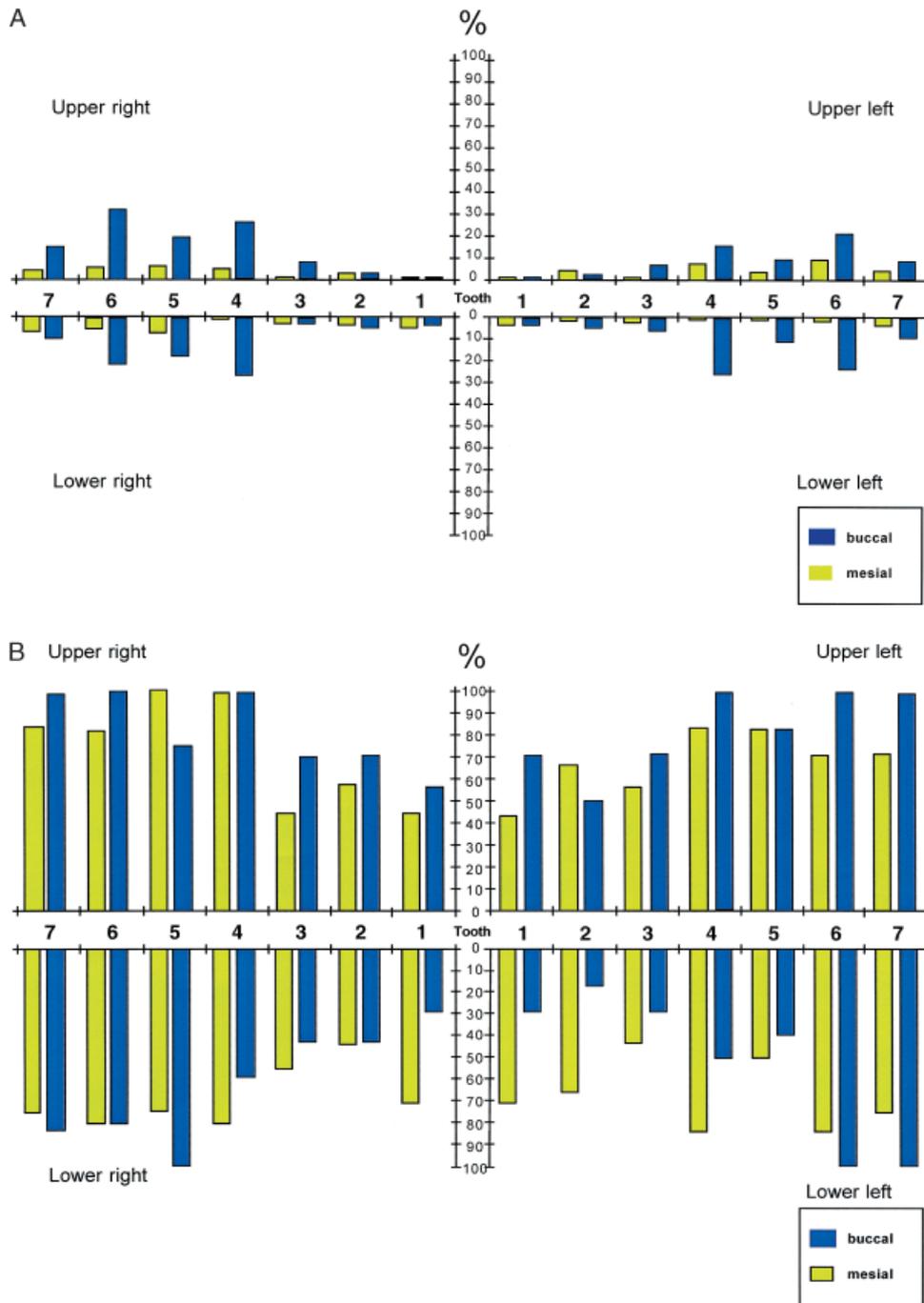


Fig. 3. Frequency of sites with loss of attachment (a) ≥ 2 mm at age < 25 years and (b) ≥ 2 mm at age ≥ 55 years.

exhibited an interdental attachment loss of 2 mm or more.

Below the age of 30 years, the vast majority of sites with attachment loss were characterized by gingival recession. A pocket formation of 3 mm or more, typically rare and scattered before 40 years of age, increased significantly around the age of 50 years, and coincided with increased incidence of interdental lesions. As these men approached 60 years, almost all buccal surfaces and most

interdental areas developed periodontal lesions in the form of gingival recession, pocketing or combinations of the two.

Thus, this investigation has clearly shown that in a well-maintained population who practises oral home care and has regular check-ups, the initial reduction in the normal periodontal attachment is characterized by two pathogenic mechanisms: (1) recession of the gingiva and partial denudation of root surfaces, and (2) the formation of periodontal

pockets. In such populations, the first (gingival recession) is the dominating type of incipient lesion during the first 40–50 years of life. The second (pocketing) starts in earnest around the age of 50 years, and increases in incidence towards 60 years of age.

In a previous publication (L oe et al. 1992), we documented that the development of gingival recession and the denudation of the root surfaces could not be explained by toothbrushing or

Table 1. Distribution of initial loss by age, tooth type and site

Age	Tooth type								
	incisor				canine				
	m	b	d	l	m	b	d	l	
	20	1.8	3.8	—	—	0.8	5.9	—	—
30	6.7	4.6	—	—	5.8	9.5	—	—	
40	30.9	17.0	15.6	22.6	22.4	14.7	12.5	12.5	
55	27.3	10.3	22.4	33.6	26.9	20.0	12.9	29.5	
	premolar				molar				
	m	b	d	l	m	b	d	l	
	20	1.9	13.9	—	—	2.7	13.1	—	—
	30	11.3	17.5	—	—	13.2	13.2	—	—
40	30.1	31.9	14.3	10.0	38.7	37.2	23.5	13.3	
55	41.0	17.3	24.4	28.7	30.7	20.9	17.9	31.1	

m = mesial; b = buccal; d = distal; l = lingual.

Sites changing from health to initial loss of attachment expressed as a percentage of sites present at a certain age within a certain tooth group and site category.

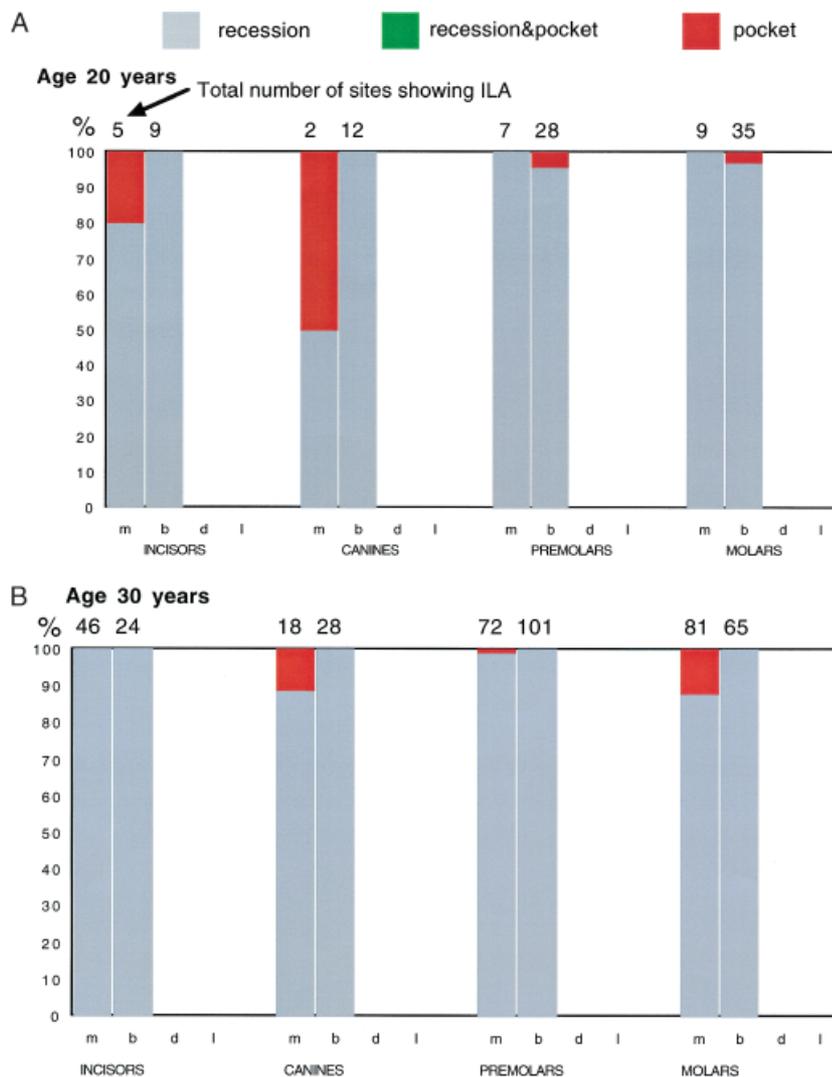


Fig. 4. (a–d) Proportion of sites with initial loss of attachment described as recession, pocket formation or a combination of recession and pocket formation at ages 20, 30, 40 and 55 years.

other mechanical oral-hygiene practices, and that recession of the gingiva is associated with both good and bad oral hygiene, presence and absence of calculus, occurrence and non-existence of faulty restorations, as well as the prevalence and severity of gingivitis and periodontitis. Such equivocation suggested that the causes and mechanisms of the development of gingival recession are more complex than is generally believed.

The present analysis did not throw new light on these issues, but the findings underscore the role of gingival recession in the early pathogenesis of chronic periodontitis and the loss of periodontal support. The formation of the pathological periodontal pocket as the incipient lesion in periodontal disease occurred after 40 years of age, and represented the principal mode of initial periodontal destruction as the incidence of attachment loss increases as the individuals were nearing 60 years of age. The extent to which each of these mechanisms contributes to the progression of the lesion is currently being examined.

Zusammenfassung

Der klinische Verlauf chronischer Parodontitis: II. Inzidenz, Charakteristika und Zeit des Auftretens initialer parodontaler Läsionen

Zielsetzung: Untersuchung von Beginn und Fortschreiten chronischer Parodontitis in einer über 26 Jahre laufenden longitudinalen Studie.

Material und Methoden: Die Untersuchung begann 1969 und umfasste 565 Norwegische Männer der Mittelklasse, von denen 223, die an manchen, aber nicht allen Zwischenuntersuchungen teilgenommen hatten, sich zur Abschlussuntersuchung 1995 vorstellten. 54 Personen waren für alle 7 Untersuchungen verfügbar.

Ergebnisse: Die Studie, die ein Altersspektrum von 16 bis 60 Jahren umfasste, zeigte, dass mit 16 Jahren 5% der Teilnehmer an einer oder mehreren Stellen initialen Attachmentverlust (ILA ≥ 2 mm) aufwiesen. Die Inzidenz sowohl auf Personen- wie auch auf Stellenebene nahmen mit der Zeit zu und im Alter von 32 Jahren hatten alle Personen an einer oder mehreren Stellen Attachmentverlust. Mit zunehmendem Alter kamen neue Läsionen hinzu, so dass mit etwa 60 Jahren etwa 50% aller vorhandenen Stellen initialen Attachmentverlust aufwiesen. Eine Betrachtung der intraoralen Verteilung der ersten parodontalen Läsionen zeigte, dass unabhängig vom Alter Molaren und Prämolaren am häufigsten betroffen waren. Bis zum 40. Lebensjahr einschließlich fand sich die Mehrheit der Stellen mit IAL bukkal in Form von Rezessionen. Mit dem 50. Lebensjahr allerdings wies ein größerer Anteil der Stellen Attachmentverlust mit Taschenbildung oder

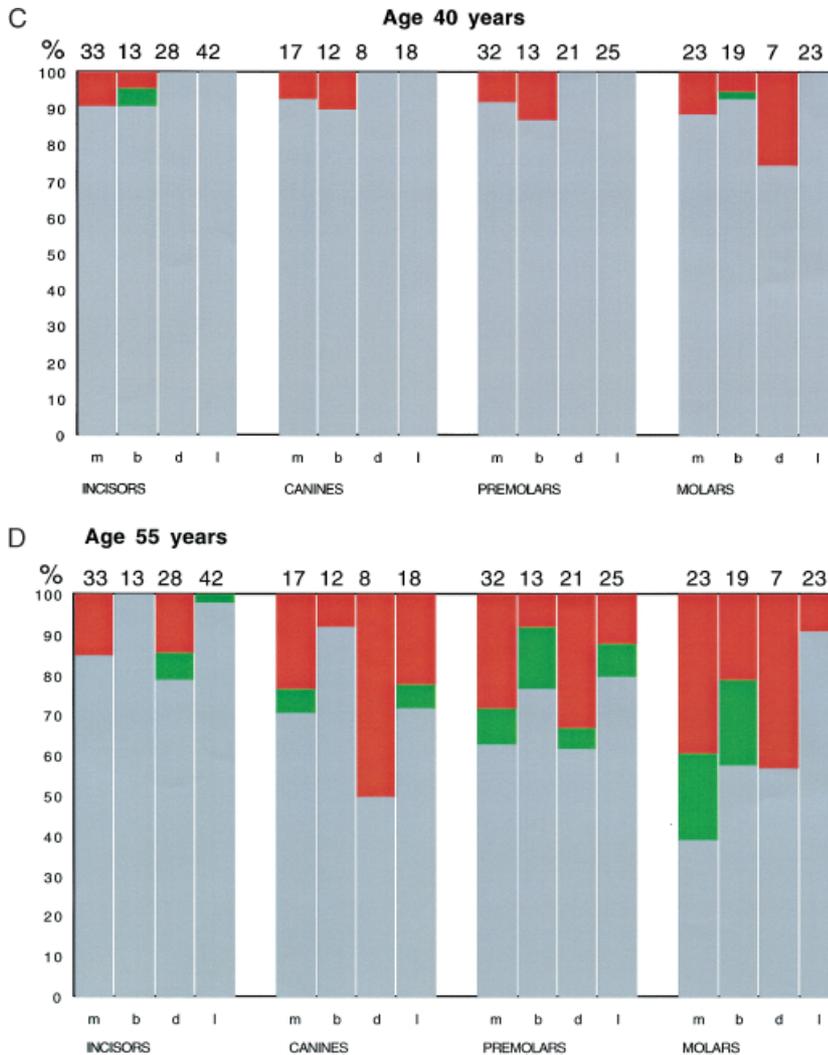


Fig. 4. Continued.

einer Kombination von Taschenbildung und Rezession auf. Bei Personen, die sich dem 60. Lebensjahr näherten, wiesen etwa die Hälfte der approximalen Bereiche der Seitenzähne diese Läsionen auf.

Schlussfolgerung: Diese Untersuchung hat gezeigt, dass in einer gut betreuten Population, die häusliche Mundhygiene betreibt und regelmäßige Kontrollen wahrnimmt, die Inzidenz beginnender parodontaler Zerstörung mit dem Alter zunimmt und ihre höchste Rate zwischen 50 und 60 Jahren erreicht. Rezessionen sind die vorherrschende Läsion vor dem 40. Lebensjahr, während Taschenbildung die vorherrschende Art der Zerstörung zwischen dem 50. und 60. Lebensjahr ist.

Résumé

L'évolution clinique de la parodontite chronique: II. Incidence, caractéristiques et date d'apparence de la lésion parodontale initiale
Au cours d'une recherche longitudinale sur une

période de 26 ans concernant l'initiation et la progression de la parodontite chronique, recherche qui débuta en 1969 et qui concerna 565 norvégiens issus de la classe moyenne et de sexe masculin, 223 sujets participèrent à quelques examens intermédiaires, mais pas à tous, se sont présentés au dernier bilan en 1995. 54 individus ont été disponibles pour les 7 bilans.

Les sujets avaient entre 16 et 60 ans. L'étude montre qu'à l'âge de 16 ans, 5% des participants avaient une perte d'attache initiale (ILA ≥ 2 mm) sur un ou plusieurs sites. L'incidence relative au sujet et aussi l'incidence relative au site augmentaient au cours du temps. Et vers 32 ans, tous les individus avaient un ou plusieurs sites présentant une perte d'attache. En même temps que l'âge augmentait, de nouvelles lésions affectaient les sites de sorte que, lorsque ces hommes atteignaient la soixantaine, pratiquement 50% des sites disponibles présentaient une perte d'attache initiale.

Un examen de la distribution intra-orale de la première lésion parodontale a montré qu'indépendamment de l'âge, les molaires et prémo-

laires étaient le plus souvent touchées. Jusqu'à 40 ans, la majorité des pertes d'attache initiales se rencontraient sur les surfaces vestibulaires sous la forme de récessions gingivales. Vers la cinquantaine, cependant, une proportion plus importante de sites était atteinte de perte d'attache due à la formation de poches ou à une combinaison de formation de poche et de récession. Comme les individus approchaient de la soixantaine, environ la moitié des zones interproximales des dents postérieures présentait ces lésions. Cette recherche a montré que dans une population bien maintenue capable de manoeuvres d'hygiène orale et régulièrement suivie, l'incidence de destruction parodontale débutante augmente avec l'âge, le taux le plus important apparaissant entre 50 et 60 ans, et que la récession gingivale est la lésion prépondérante avant 40 ans, alors qu'entre 50 et 60 ans, la formation de poche devient le principal mode de destruction.

References

- Ånerud, Å., Løe, H., Boysen, H. & Martyn, S. (1979) The natural history of periodontal disease in man. Changes in gingival health and oral hygiene before 40 years of age. *Journal of Periodontal Research* **14**, 526–540.
- Ånerud, K. E., Robertson, P. B., Løe, H., Ånerud, L. A., Boysen, H. M. R. & Patters, M. R. (1983) Periodontal disease in three young adult populations. *Journal of Periodontal Research* **18**, 655–668.
- Avlund, K., Holm-Pedersen, P. & Schroll, M. (2001) Functional ability and oral health among older people: a longitudinal study from age 75 to 80. *Journal of American Geriatric Society* **49**, 954–962.
- Bhat, M. (1991) Periodontal health of 14–17-year-old US schoolchildren. *Journal of Public Health Dentistry* **51**, 5–11.
- Brown, L. J. & Løe, H. (2000) Prevalence, extent, severity and progression of periodontal disease. *Periodontology* **2**, 57–71.
- Clerhugh, V., Lennon, M. A. & Worthington, H. V. (1990) 5-year results of a longitudinal study of early periodontitis in 14- to 19-year old adolescents. *Journal of Clinical Periodontology* **17**, 702–708.
- Glavind, L. & Løe, H. (1967) Errors in the clinical assessment of periodontal destruction. *Journal of Periodontal Research* **14**, 526–540.
- Hugoson, A. & Jordan, T. (1982) Frequency distribution of individuals aged 20–70 years according to severity of periodontal disease. *Community Dentistry and Oral Epidemiology* **10**, 187–192.
- Källestål, C. & Matsson, L. (1990) Periodontal conditions in a group of Swedish adolescents (II) Analysis of data. *Journal of Clinical Periodontology* **17**, 609–612.
- Kinane, D. F. (2000) Periodontal disease in children and adolescents: introduction and classification. *Periodontology* **26**, 7–15.
- Løe, H., Ånerud, Å., Boysen, H. & Morrison, E. (1986) Natural history of periodontal disease

- in man. Rapid, moderate and no loss of attachment in Sri Lankan laborers 14 to 46 years of age. *Journal of Clinical Periodontology* **13**, 431–445.
- Löe, H., Ånerud, Å., Boysen, H. & Smith, M. (1978) The natural history of periodontal disease in man. Study design and baseline data. *Journal of Periodontal Research* **13**, 550–562.
- Löe, H., Ånerud, Å. & Boysen, H. (1992) The natural history of periodontal disease in man: prevalence, severity and extent of gingival recession. *Journal of Periodontology* **63**, 489–495.
- Löe, H. & Silness, J. (1964) Periodontal disease in pregnancy. Prevalence and severity. *Acta Odontologica Scandinavica* **21**, 533–551.
- Miller, A. J., Brunelle, J. A., Carlos, J. P., Brown, L. J. & Löe, H. (1987) *National Institute of Dental Research. Oral Health in United States Adults. National Findings. The National Survey of Oral Health in U.S. Employed Adults and Seniors: 1985–1986.* NIH Publication No. 87-2868, August 1987, US Department of Health and Human Services, Bethesda, Maryland.
- Silness, J. & Löe, H. (1963) Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontologica Scandinavica* **22**, 121–135.
- Van der Velden, U., Abbas, F., Van Steenberg, T. J., De Zoete, O. J., Hesse, M., De Ruyter, C., De Laat, V. H. & De Graaff, J. den. (1989) Prevalence of periodontal breakdown in adolescents and presence of *Actinobacillus actinomycetemcomitans* in subjects with attachment loss. *Journal of Periodontology* **60**, 604–610.

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