Longitudinal changes in craniomandibular dysfunction in an elderly population in northern Sweden

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Longitudinal changes and cohort differences in craniomandibular dysfunction (CMD) were studied in a 79-year-old cohort ($n = 65$) and in 70-year-old cohorts in 1981 ($n = 62$) and 1990 ($n = 60$) by means of interview and clinical examination. Although the frequency of reported CMD symptoms decreased, many clinical signs of CMD increased during the 9-year observation period. Women reported more symptoms and showed more signs of CMD than men, and a great many of the clinical signs registered in 1981 still persisted in 1990. The 70-year-old cohort studied in 1990 showed a lower frequency of reported symptoms of CMD and of temporomandibular joint pain on palpation and a higher frequency of muscle pain and mandibular deviation than the 70-year-olds examined in 1981. □ *Epidemiology; functional disturbances, oral; temporomandibular joint syndrome*

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In 1987 the average life expectancy was 74.2 years for men and 80.2 years for women in Sweden; it is expected to be 75.4 and 81.7 years, respectively, by the turn of the century (1). This means that essential human organs are expected to function for longer in more people than ever before, and it is therefore most important in due course to support specific functions in the aging body with adequate measures.

Craniomandibular dysfunction (CMD) in adult and elderly people has been studied as part of consecutive series (2) and in industrial workers (3, 4). The prevalence of CMD in adult and elderly people living in different parts of Sweden has also been reported in cross-sectional epidemiologic studies (5–9).

In a 6-year longitudinal study of consecutive patients (10) it was reported that temporomandibular arthropathy symptoms lasted a mean of 5.5 years, during which all temporomandibular joint (TMJ) symptoms, except crepitation, improved. Longitudinal studies of CMD in representative population samples of the elderly are rare. However, in a recent longitudinal study of elderly people in Gothenburg (11) it was reported that symptoms and signs of CMD tended to decrease with increasing age. The pattern of medical diseases is known to differ between the southern and northern parts of Sweden. No longitudinal study of CMD symptoms and signs in elderly people in northern Sweden has been published.

Thus the aim of the present paper was to study the effect of gender and increasing age and observation time on the subjective symptoms and observed clinical signs of CMD in an elderly population in northern Sweden. A further aim was to study the long-term persistence of individual clinical signs of CMD. The investigation includes both cross-sectional and longitudinal observations and is one part of a gerontologic and geriatric population study (U70) in the city of Umeå (12).

Materials and methods

Sample selection

In 1981 there were 82,143 inhabitants in

Umeå (statistical data from the local authorities), of whom about 16,000 were living in the central city district (parish 1). The following procedure was used to obtain a representative sample of the city population: the total number of men and women in the age groups chosen was divided by the estimated number of people needed. The result of this calculation was that every third 70-year-old man and woman, all 79-year-old men, and every second 79-year-old woman was to be drawn in consecutive order from the national population register. A sample of 37 men and 37 women, all 70 years old, and 41 men and 41 women, all 79 years old, in all 156 persons, was collected. In total, 127 subjects (81.4%), 32 men and 30 women from the 70-year-olds and 35 men and 30 women from the 79-year-olds, agreed to participate. The sample from 1981 was re-examined in 1984, 1987, and in 1990. Both the earlier participants and the non-responders were offered the opportunity to participate. In 1990 a new 70-year-old cohort of 35 men and 35 women was selected and examined in the same manner as the cohorts examined in 1981. Of this new sample, a total of 92.3% (32 men and 28 women) participated.

Seventy-one of the 127 subjects examined in 1981 participated in the 1990 investigation. Of these subjects 61 (32 people from the 70-year-old and 29 people from the 79-year-old cohort chosen in 1981) attended all 4 investigations from 1981 to 1990, and these people were used to study individual changes in the TMJs and jaw muscles during the 9-year observation period.

The responders and non-responders in the original samples from 1981 have been compared on the basis of register data and found not to differ with regard to age, marital status, income, and inpatient care occasions or days in 1980 (12).

Survey procedures

CMD symptoms and signs were registered by means of a clinical examination and an interview. Both the interview and the clinical examination of each patient were performed by the same dentist. In 1981 the study was performed by one examiner (G. Nordström), who participated in all four investigations. In 1984 and in 1990 he was assisted by one and in 1987 by two colleagues who, like him, were working as teachers and clinicians at the Department of Prosthetic Dentistry at the University in Umeå. To confirm definitions and calibrate clinical examination methods, 20 of the subjects were examined simultaneously by G. Nordström and each of the assisting dentists at the start of each of the investigations.

The clinical examination started with a simultaneous bilateral palpation of the temporomandibular joints. Palpation was undertaken at rest and during opening and closing movements with the patient sitting in an upright position. The joints were palpated laterally and posteriorly via the auditory meatus, to reveal irregularities on opening and closing and to register clicking or crepitation (without a stethoscope) in accordance with whether single (a distinct cracking, snapping sound) or multiple (grinding, scraping) sounds were found. Any locking or luxation during this examination was recorded. Deviation or irregular opening was recorded when the mandibular midline deviated more than 2 mm during the opening movement, as evaluated by the naked eye.

The anterior and posterior portions and the insertion of the temporal muscle in the coronoid process, the superficial and the deep portions of the masseter muscle, and the region of the lateral pterygoid muscle were palpated bilaterally. Tenderness or pain in the joints and muscles on palpation was registered only when a palpebral or guarding reflex was produced.

Maximal mouth-opening capacity was measured to the nearest millimeter with a plastic ruler as the distance between the superior incision and its horizontally marked projection on the buccal surface of the lower jaw incisors. It was also measured in people with removable dentures if the dentures could be kept properly in situ. Only some general sociomedical questions were asked before the clinical examinations, mainly to establish good communication and cooperation with the subject. The wording of the questions was identical throughout the 9-year study, and the interview followed fixed

Table 1. The percentage distribution of symptoms of craniomandibular dysfunction and chewing problems in 1981 and 1990. In 1990 a new 70-year-old cohort was also drawn and investigated using the same methods as in 1981

	Men			Women		
Study year	1990	1981–90	1981–90	1990	1981–90	1981–90
Age cohort	70	70–79	79–88	70	70–79	79–88
Clenching or grinding teeth	12.5	18.8–0.0	22.9–0.0	17.9	23.3–20.0	20.0–5.9
Head, face, or neck pain	12.5	31.3–6.7	28.6–0.0	10.7*	50.0*–32.0	30.0–5.9
Headache	9.4	9.4–6.7	8.6–0.0	14.3	33.3–20.0	20.0–11.8
TMJ† luxation or locking	3.1	9.4–6.7	8.6–0.0	7.1	6.7–0.0	16.7–0.0
Problems swallowing	6.3	15.6–0.0	8.6–0.0	10.7	10.0–8.0	16.7–5.9
Chewing problems	28.1	21.9–33.3	20.0–35.7	21.4	13.3–20.0	40.0–41.2
No. of subjects	32	32–15	35–14	28	30–25	30–17

* The 95% confidence intervals do not overlap, also indicating a difference in the underlying population.

† TMJ = temporomandibular joint.

forms. The question forms and all clinical procedures had been tried out in a pilot study. Functional dental status was described using the Eichner index (13).

Statistical methods

The answers to questions about current pain from the head, face, and neck region, TMJ locking or luxation, headache, chewing and swallowing problems, clenching or grinding behavior, and mandibular deviation were either given a value of 0 = no finding or 1 = finding. The clinical findings of TMJ clicking, crepitation, and muscle pain were given the value 0 = no finding, 1 = unilateral finding, and 2 = bilateral finding. The three main groups from the Eichner index were given the values 1, 2, or 3, representing groups A, B, and C, respectively. In the medical interview the subjects were also asked whether they felt healthy = 0 or ill = 1. Men were denominated by the figure 1 and women by 2, and age was used with the nominal value. The four study years, 1981, 1984, 1987, and 1990 were given the values 1, 2, 3, and 4, respectively. The question about the presence of TMJ luxation or locking was only asked in the 1981 and 1990 investigations. The clinical examinations of the jaw muscles were performed in the 1981, 1987, and 1990 investigations. The other CMD variables were examined in all four investigations. The means and proportions in two populations were regarded as different when there was no overlapping between the 95% confidence intervals (95% CI) (14). The data were aggregated to principal components, and component scores were then used in multiple regression models. The p values calculated for the regression coefficients were tested with Post-Hoc tests. The Systat statistical program for the Macintosh computer (15) was used for the calculations. Sex, age, and observation time were used as explanatory variables in the multiple regression models.

Results

Reported symptoms

Table 1 shows reported oral dysfunction, symptoms of CMD, and swallowing and chewing problems. There was a general tendency for the frequency of reported symptoms to decrease during the 9-year period. This tendency was stronger in the older age group. About 20% of the 79-year-olds reported clenching or grinding teeth in 1981, compared with only a few per cent of the 88-year-old women and none of the 88-year-old

Table 2. The percentage distribution of clicking and crepitating sounds and of mandibular deviation in the 70- and 79-year-old cohorts examined in 1981 and in those who could be re-examined in 1990. A new cohort of 70-year-olds was also examined in the 1990 study

	Men			Women		
Study year	1990	1981–90	1981–90	1990	1981–90	1981–90
Age cohort	70	70–79	79–88	70	70–79	79–88
Clicking sound	28.1	25.0–33.3	28.6–21.4	35.7	25.0–34.0	26.7–29.4
Crepitating sound	17.2	20.3–33.3	11.4–14.3	28.6	26.7–34.0	36.7–47.1
Mandibular deviation	71.9*	43.8*–66.6	37.1–42.9	82.1*	50.0*–76.0	46.7–70.6
No. of joints	64	64–30	70–28	56	60–50	60–34

* 95% confidence interval also indicates a difference in the underlying 70-year-old population.

men in 1990. Luxation or locking of the TMJ was reported by 8.6% and 16.7% of the 79-year-old men and women, respectively, in 1981 and by none of the 88-year-olds 9 years later.

The multiple regression analysis of principal components showed that reported bruxism ($p \leq 0.05$) and TMJ luxation or locking ($p \leq 0.05$) decreased with time during the 9-year period. In general, women reported more pain than men, and the regression analysis showed that headache was statistically significantly more common among women ($p \leq 0.001$). The 88-year-old men reported no CMD symptoms at all in 1990. It should, however, be mentioned that the 'Don't know' alternative answer in the older cohort increased almost as much as the decrease in reported symptoms. A decrease in reports of pain from head, face, and neck ($p \leq 0.001$) and of headache ($p \leq 0.05$) was found with increasing age.

Chewing problems increased in frequency in the course of time in all four cohorts, and the multiple regression analysis showed a statistically significant increase in reported chewing problems with increasing age ($p < 0.05$).

Comparisons between the 'old' 70-year-old cohort examined in 1981 and the 'new' 70-year-old cohort studied in 1990 showed in general a lower frequency of reported symptoms in the new cohorts. Pain in the face, the neck, or the back of the head was much less common in the new 70-year-old cohort, and a calculation of the 95% CI showed that this difference could also be expected in the underlying 70-year-old population of women ($p < 0.05$).

Clinical signs

The prevalence and longitudinal changes in clicking and crepitating sounds and in mandibular deviation are shown in Table 2. The frequency of crepitating sounds increased in all four cohorts during the 9-year period, and 88-year-old women showed the highest frequency of crepitating joints in 1990. The regression analysis showed that women had more crepitating sounds than men ($p \leq 0.001$). The new 70-year-old cohorts showed similar frequencies of joint sounds as the old cohort examined in 1981.

The frequency of mandibular deviation increased strongly during the 9-year period. The regression analysis showed that this increase was statistically significant ($p \leq 0.001$). The new 70-year-old cohorts also showed a much higher frequency of deviation than the old cohorts, and the 95% CI indicated that this difference could be expected in the 70-year-old population of women in Umeå ($p \leq 0.05$).

Pain on palpation of the masseter, the temporalis, and the pterygoideus lateralis muscles was a common finding, and the frequency of muscle pain increased during

Table 3. The percentage distribution of muscle pain on palpation of the masseter, the temporalis, and the pterygoideus lateralis muscles in the 70- and 79-year-old cohorts examined in 1981 and in those who could be re-examined in 1990. A new cohort of 70-year-olds was also examined in the 1990 study. The frequencies only account for those subjects in whom a palpebral or guarding reflex was produced as a pain reaction on palpation

		Men			Women		
Muscle	Study year Age cohort	1990 70	1981–90 70–79	1981–90 79–88	1990 70	1981–90 70–79	1981–90 79–88
M. masseter		9.4	6.3–30.0	14.3–10.7	25.0	16.7–28.0	16.7–32.4
M. temporalis		28.1	18.8–53.3	30.0–64.3	37.5	40.0–52.0	45.0–67.6
M. pterygoideus lateralis		40.6	29.7–53.3	34.3–53.6	57.1	38.3–50.0	56.7–70.6
No. of muscles		64	64–30	70–28	56	60–50	60–34

the 9-year observation period among both men and women (Table 3). In general, the masseter muscle showed the lowest and the pterygoideus lateralis muscle the highest frequency of muscle pain on palpation. This general picture was the same among the new 70-year-old cohort in 1990. The multiple regression analysis showed that muscle pain was commoner among women ($p \leq 0.01$) and increased with age ($p \leq 0.05$) and time ($p \leq 0.05$).

TMJ pain on palpation was much more uncommon than muscle pain and other CMD signs, and pain on palpation of the mandibular joints also decreased in frequency from 5% in 1981 to 2% in 1990 for the total sample. In 1981, 6% of the joints in the 70-year-olds showed a pain reaction, and in the new 70-year-old cohort examined in 1990 no painful TMJs were found.

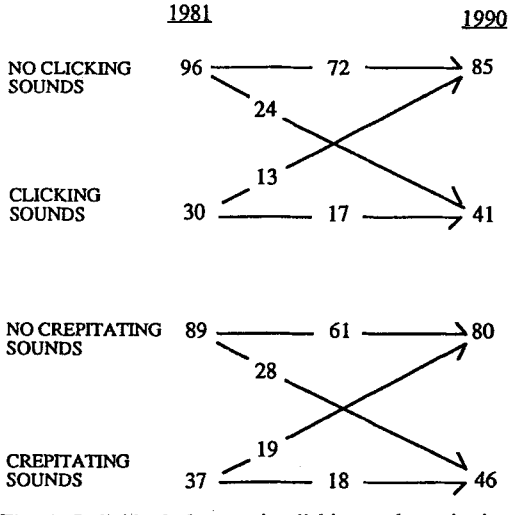

Fig. 1. Individual changes in clicking and crepitating sounds, joint by joint, in the temporomandibular joints examined in 1981 which could be re-examined in 1990.

Individual changes

In 1981 clicking sounds were registered in 30 of the 126 joints (23.8%) re-examined in 1990 (Fig. 1). Seventeen of the clicking joints (56.7%) were still clicking in 1990, and, in addition, 24 joints not clicking in 1981 were registered for clicking sounds in 1990. Thus altogether 32.5% of the joints were clicking in 1990. The frequency of crepitating joints increased from 29.4% in 1981 to 36.5% 9 years later (Fig. 1). Nine of the 28 new crepitating joints in 1990 (32%) had previously been registered for clicking sounds in 1981.

In 1981 mandibular deviation was registered in 29 of 61 persons (47.5%) (Fig. 2). At the follow-up in 1990, 24 of those subjects (82.8%) still deviated to the same side, and 5 now deviated to the opposite side. Moreover, 11 subjects who did not deviate in 1981 deviated to the left and 4 to the right in 1990. Thus altogether 72.1% deviated in 1990. In 1981, 72.4%, and in 1990, 65.9% of the deviating mandibles deviated to the left.

The maximal opening capacity showed a

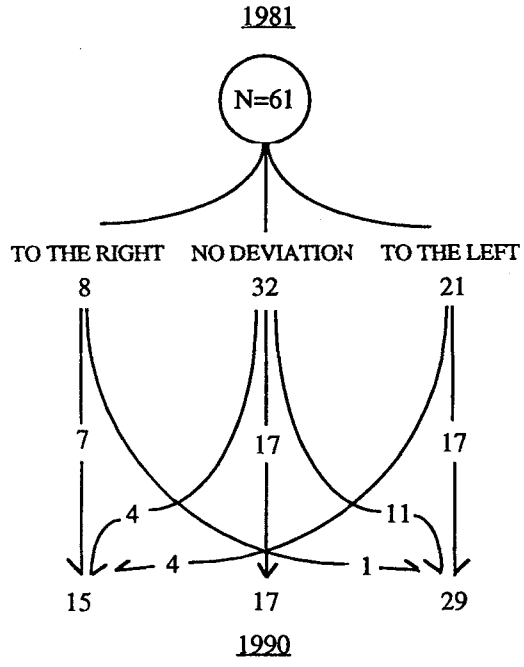

Fig. 2. Individual changes in mandibular deviation in the 61 subjects examined in 1981 who could be re-examined in 1990.

mean decrease of 1.3 mm in men (range, 35–66 mm) and of 0.9 mm in women (range, 35–58 mm) during the 9-year observation time. In 1981, 12.1% (eight subjects), and in 1990, 13.6% (nine subjects) had a maximal opening <40 mm. Four of eight subjects with a maximal opening capacity <40 mm in 1981 also had an opening <40 mm in 1990, and the other four had improved to just above 40 mm in 1990.

Changes in muscle pain in the masseter (122 separate muscles), the temporalis (122 separate muscles), and the pterygoideus lateralis muscles (119 separate muscles) could be evaluated in 61 persons examined in 1981 and in 1990. More than 80% of the muscles painful in 1981 were still painful in 1990, and 42% of the muscles without pain in 1981 had become painful in 1990. Sixty-three per cent of the muscles had the same status in 1981 and 1990. Only 4% of the muscles had become 'better' during the observation period.

Fifteen of 66 people (22.7%) interviewed in both 1981 and 1990 reported chewing problems in 1981. Ten of the 15 subjects still had chewing problems 9 years later. A correlation between Eichner index (13) and chewing problems showed that 30.6% of Eichner group C (those without supporting zones, mainly complete denture wearers) in 1981 and 44.7% of group C in 1990 reported problems in chewing food.

A multiple regression model with reported chewing problems as the dependent variable and the various CMD symptoms and signs shown in Table 2, plus subjective medical health and Eichner index used as explanatory variables, was performed. A worse dental status defined by the Eichner index (standard regression coefficient = 0.24; $p \leq 0.001$), muscle pain (std reg coeff = 0.22; $p \leq 0.01$), and a poor subjective medical health (std reg coeff = 0.13; $p \leq 0.05$) were estimated to be the most important variables in explaining chewing problems.

Discussion

At the start of the study in 1981 the samples were validated and judged to be age- and gender-stratified representative samples from the city population in Umeå (12). All five examiners had been working together as clinical teachers in the Department of Prosthetic Dentistry, Faculty of Odontology, University of Umeå, and one examiner (G. Nordström) participated in all four studies and calibrated the other examiners. In a recent review of the reliability and validity of methods used to register temporomandibular disorders it was concluded that 'traditional clinical measurements of muscle palpation and mandibular range of motion can be achieved with acceptable reliabilities' and that 'reliabilities may be improved by retraining experienced examiners' (16). Thus, the results in this study should be reasonably reliable, as the examiners had the same clinical training, and the calibration method used was satisfactory.

A retrospective comparison of the results from the 1981 study showed no statistically significant differences in the variables used in

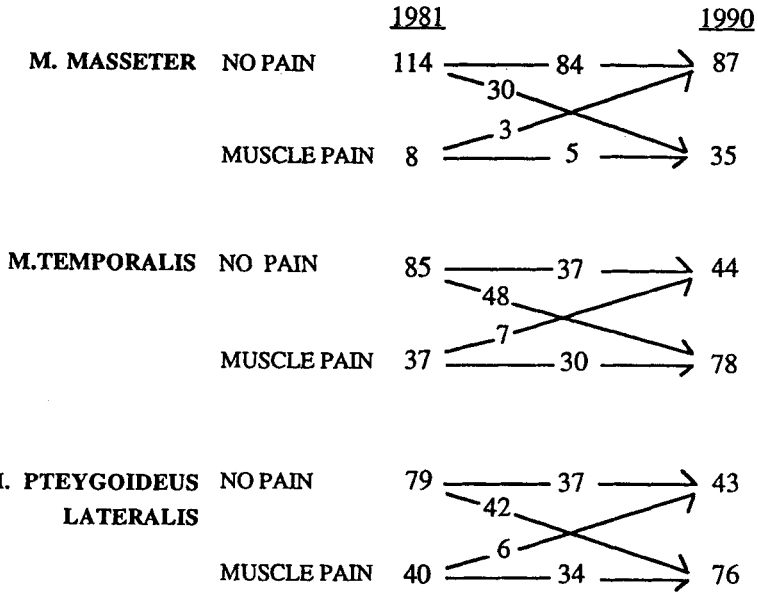

Fig. 3. Individual changes in pain, muscle by muscle, in the muscles examined in 1981 which could be re-examined in 1990.

the regression analysis between the persons who could be followed up throughout the whole 9-year period and the persons who were later registered as dropouts. The question 'Do you feel well' showed the greatest difference (12.4%) between the responders and the dropouts, as 31.8% of the responders and 44.2% of the dropouts, in 1981, answered they were not feeling healthy. It seems normal that the answer 'Not feeling well' would be overrepresented in the dropout group, as the main part of this group had died by 1990. Subjective health problems increased during the longitudinal study, and in 1990, 93.9% reported such problems. A poor medical health might influence the different symptoms and signs of CMD and was also one of the predictors for chewing problems in the regression analysis in 1990.

In general, reported symptoms, apart from chewing problems, decreased and clinical findings increased during the 9-year observation period. A similar discrepancy between symptoms and signs has been reported in Norwegian (17) and Swedish cross-sectional studies (7, 8) in elderly populations but was not found in studies in the younger populations (18, 19).

The discrepancy between CMD symptoms and signs in elderly people could be explained by the increasing presence of other, more disabling, painful, or frightening medical symptoms and diseases that leave little room for worries about CMD conditions. For instance, the 79-year-olds increased their mean drug intake from 2.5 to 5.2 drugs during the 9-year study, and the proportion of subjects regularly taking drugs increased from 82% at 79 years to 95% at 88 years of age (20). The use of analgesics increased with age, and paracetamol was the commonest preparation used by 25–30% of the 88-year-olds. However, this explanation for the decreasing reports of CMD problems does not fit in with the high and increasing prevalence of reported chewing problems. Use of analgesics, diseases, and age-related changes in the nervous system might decrease pain sensitivity in the elderly. This probably does not influence chewing problems but might reduce the frequency of reported symptoms and clinical signs. In contradiction to this, the regression analysis showed that muscle pain on palpation increased with age and time, which does not correspond to a lower sensitivity, an increased use of analgesics, or the decrease in reported symptoms.

An impaired dental status as estimated by the Eichner index, muscle pain, and the feeling of illness were the most important background factors in explaining chewing problems. Increasing chewing problems is an important finding, as subjective chewing problems in the 1981 study had been found to be the strongest single background factor for explaining the variation in energy intake, associated with a low intake of most nutrients, minerals, and vitamins (21).

Joint sounds can be examined by the use of a stethoscope, and with this method Hansson & Nilner (3) found a prevalence of 65% in workers in a shipyard. The other way is to 'listen with the fingers', giving prevalence figures between 29% and 37% in elderly populations (5, 7, 21). Helöe & Helöe (17) concluded that CMD tended to increase with age and was evenly distributed between sexes, but women were more likely to report symptoms of CMD. Österberg & Carlsson (7) reported that all CMD signs except deviation showed higher frequencies among women. In an epidemiologic cross-sectional investigation of 65-year-old people living in the county of Västerbotten, where Umeå is the largest city, Agerberg & Bergenholtz (9) reported that crepitation was observed more often in women and increased with age and that jaw muscles were more frequently tender to palpation in women.

There are both similarities and differences between the results in this paper and the findings reported by Österberg et al. (11) in the longitudinal population study in Gothenburg. Reported symptoms decreased in both studies and in both sexes, and the decrease was greater among men. Clinical signs of severe CMD were rare in both studies. Another similar result is the stable situation in and the mean values for maximal mouth opening. However, in the present paper most clinical signs of CMD increased during the 9-year observation period, whereas the conclusion in the Gothenburg study was that there is no increased risk of CMD with aging. There are differences in the methods used in the two studies. For instance, the present paper does not use the Helkimo classification (22) and also uses another method for the statistical analysis. The sample in Umeå had a higher mean age. The difference in approach, analysis, and material could explain most differences in and interpretation of the results.

Individual changes

About half of the joints with clicking/crepitating sounds in 1981 were still registered for clicking/crepitation in 1990. It has been stated (23, 24) that clicking may indicate a possible development into degenerative joint diseases such as osteoarthrosis and thus is tranformed into a crepitating sound. One-third of the new crepitating joints in 1990 had been registered for clicking sounds in 1981.

The preponderance of leftward deviations is in agreement with the findings by Gross & Gale (2) in an investigation of 1000 patients in a general dental practice. Deviation to the left has been reported previously in investigations of young persons (19, 25) and has been suggested to be the result of the greater number of right-handed people with stronger right-side lateral pterygoid muscles. It has also been proposed that left-sided deviation is the result of having the examiner seated on the patient's right, which would make the patient turn his head to the right and thus activate the infrahyoid muscles on his left side (26). However, in the present study all clinical examinations of CMD signs were performed with the patient in the upright position with the examiner standing in front, and TMJs were examined simultaneously on both sides. Deviation was recorded in the same examining sequence as the palpation of the TMJ. This might increase and improve sensitivity and reliability but could also increase the risk of overregistration. No previous records were at hand when the follow-ups were performed.

The present paper describes longitudinal changes in CMD status among our presumptively elderly patients. It shows the discrepancy between symptoms and signs of CMD and the persistent and increasing character of many clinical CMD signs. The high and increasing frequency of chewing problems associated with an impaired dental status emphasizes the importance of improv-

ing dental status while the elderly patient still can adapt to a new situation and then continuously support the oral function for life.

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