Comparison of three radiographic methods in screening of temporomandibular joint involvement in patients with psoriatic arthritis

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Fifty-three randomly selected subjects with psoriatic arthritis (PA) were examined radiographically by means of orthopantomography, transcranial radiography, and transmaxillary radiography. Two examiners graded the radiographic signs of flattening, osteophytes, erosion, and sclerosis. The findings obtained were then compared, to determine the best technique for screening of temporomandibular joint (TMJ) bone changes. Together the techniques showed definite (24%) and possible (6%) changes suggesting TMJ involvement in 31 (30%) of 106 joints. In all projections radiographic signs suggesting TMJ involvement were most frequent in the condyle. Erosion in the condyle was the most frequent finding. Agreement with regard to definite changes in the condyle was found in only one-third to half of the cases. It is concluded that in radiography of the TMJ in subjects with PA a combination of radiographic techniques should be used to obtain maximum information. However, orthopantomography is well suited for screening of TMJ involvement in subjects with PA. □ *Orthopantomography; psoriatic arthritis; temporomandibular joint disease; transcranial radiography; transmaxillary radiography*

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Conventional techniques such as transcranial radiography, transmaxillary radiography, and panoramic radiography are recommended for use in screening examinations of temporomandibular joint (TMJ) abnormalities (1). When a screening radiograph shows a possible abnormality, it should be complemented with other conventional projections, including tomography (2, 3). More recently, computerized tomography and magnetic resonance imaging have been used to demonstrate abnormalities of not only the disc but also the bone (4–6). However, these advanced methods are seldom available to practicing dentists.

Some studies of autopsy and craniomandibular disorder patient material have compared the diagnostic information obtained by using different projections (7–11), but none of them have dealt with psoriatic arthritis (PA). In three previous studies (12–14) subjective, clinical, and radiographic features of craniomandibular disorders in patients with PA have been described. Thirty-one per cent of 110 PA patients and 13% of 100 controls had radiographic changes in the condyle of the TMJ as obtained by orthopantomography (14).

The aim of the present study was to compare three radiographic techniques—orthopantomography, transcranial radiography, and transmaxillary radiography—in the examination of the TMJ, to 1) determine the best technique for screening for TMJ involvement in subjects with PA, and 2) to ascertain whether any sign is best found by using a particular technique.

Patients and methods

Fifty-three subjects (31 men and 22 women) with PA were selected at random, regardless of TMJ symptoms, for examination of both TMJs by orthopantomography, transcranial radiography, and transmaxillary radiogra-

phy. The patients were selected from a psoriatic arthritis group ($n = 110$) described earlier (12). The diagnosis of PA had previously been confirmed radiographically in 86% of the patients (medical histories). Their mean age was 51 years (range, 27–70 years). Four transcranial and seven transmaxillary radiographs were technically not satisfactory. Thus a total of 106 TMJs were evaluated from orthopantomographs, 102 from transcranial radiographs, and 99 from transmaxillary radiographs. For ethical reasons no control patients were included.

Orthopantomography

Subjects were radiographed with the mouth maximally opened when using orthopantomography (2, 15) (OP 3, Palomex, Vantaa, Finland). The radiographic beam intersected the TMJ region in the oblique projection owing to the axis of rotation in the TMJ region. Exposure data were 65 to 73 kV, 35 to 40 mA, and 15 sec (Trimax film, 3M).

Transcranial radiography

Transcranial radiography (oblique lateral transcranial projection) (16) was performed with Princeps radiographic equipment (CGR, France). A standardized technique was used; the subject was seated with the sagittal plane vertically and the Frankfort plane horizontally and with the teeth in intercuspal position. The central ray was angled 25° cranially and 13° dorsally in relation to the line connecting the right and left condyles, and perpendicularly towards the film. Exposure data were 73 to 75 kV and 68 to 70 mA. A cassette (Min-R, Kodak) with one film (MR1, Kodak) and one screen (Min-R, Kodak) was used.

Transmaxillary radiography

The same equipment as in transcranial radiography was used in transmaxillary radiography (oblique infraorbital projection) (17). In this projection the central ray was directed 10° cranially in relation to the occlusal plane and just inferior to the infraorbital foramen through the maxillary sinus towards the condyle of the opposite side. A free-handed technique was used, and the subject was seated with the sagittal plane vertically, the Frankfort plane horizontally, and the mouth maximally opened. The film position was perpendicular to the central ray. Exposure data were the same as for transcranial radiography.

Interpretation

All the films obtained by the same technique were read together by two examiners independently. The radiographs were read in random order and without knowledge of the history and the results of clinical examination of the subject (12, 13).

Radiographic signs in the condyle of the TMJ—flattening, osteophyte, erosion, and sclerosis—were methodologically used for comparison of the information obtained by the different techniques. The highest score for any one sign was used for each individual condyle. The condyles were graded as follows: 0 = no change; 1 = possible change; and 2 = definite change. The condyles of

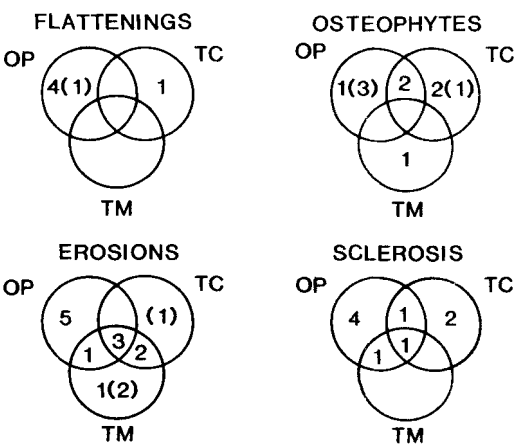
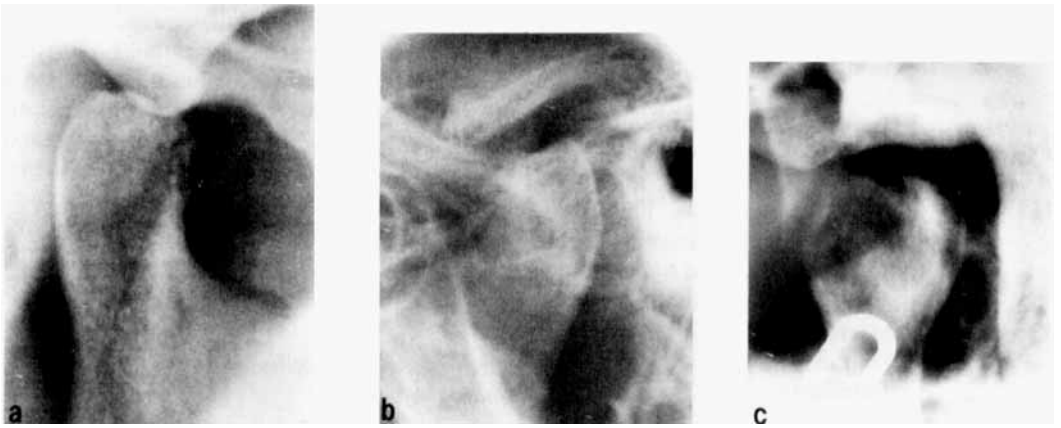


Fig. 1. Summary of radiographic signs found by orthopantomography (OP), transcranial radiography (TC), and transmaxillary radiography (TM). Figures within unobstructed areas of a circle denote the number of changes found exclusively with the technique represented by the circle. The figures within overlapping circle areas denote the number of changes observed in radiographs taken by the respective techniques. Figures outside parentheses denote definite changes, and those inside parentheses possible changes.



each subject were evaluated separately. In addition, the temporal component of the TMJ in the transcranial and transmaxillary radiographs was analyzed by means of the same interpretation criteria. In case of disagreement in interpretation, the radiographs were reviewed by both examiners in common to achieve a final diagnosis.

Statistics

The significance of differences was analyzed with the chi-square test.

Results

Twenty-two subjects (42%) had definite ($n = 25$) or possible ($n = 6$) changes in 31 TMJs in at least 1 projection. Fifteen changes were in the right and 16 in the left joints. Twenty-one subjects had definite ($n = 25$) or possible ($n = 5$) changes in 30 condyles. With regard to the condyles, orthopantomography showed a definite or possible change in 21% (22 of 106), transcranial radiography in 14% (14 of 102), and transmaxillary radiography in 12% (12 of 99) (NS).

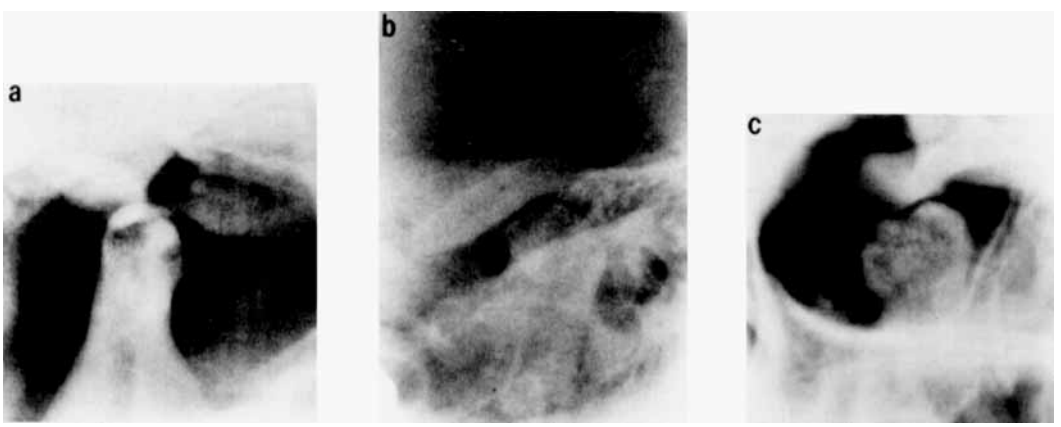


Fig. 3. Cortical sclerosis of the condyle found simultaneously in a) an orthopantomograph, b) a transcranial radiograph, and c) a transmaxillary radiograph.

Radiographic signs in the condyle

Fig. 1 shows the comparison of orthopantomography, transcranial radiography, and transmaxillary radiography in detecting flattenings, osteophytes, erosions, and sclerosis in the condyle. Erosion was the most frequent finding in all projections. There was no statistically significant difference between the three techniques with regard to detection of the single signs in the condyle. Only in three cases was erosion (Fig. 2) and in one case sclerosis (Fig. 3) found in all three projections simultaneously.

Orthopantomography and transcranial radiography

Table 1 shows the comparison between orthopantomography and transcranial radiography with regard to condyles. A total of 102 condyles were evaluated, because 4 transcranial radiographs were not technically satisfactory. The orthopantomograph showed a definite change in one of these. With regard to definite changes, agreement between orthopantomography and transcranial radiography was found in 39% of the condyles.

Orthopantomography and transmaxillary radiography

Table 2 shows the comparison between orthopantomography and transmaxillary radiography with regard to condyles. Ninety-nine condyles were evaluated, because seven transmaxillary radiographs were not

Table 1. Comparison of orthopantomography and transcranial radiography in detecting abnormal signs in the mandibular condyles of 52 subjects with psoriatic arthritis*

	Transcranial radiography			
Orthopantomography	No change	Possible change	Definite change	Total joints
No change	76	1	4	81
Possible change	3	0	0	3
Definite change	9	2	7	18
Total joints	88	3	11	102

* Chi-square (df = 1) = 1.97; p = NS. For statistical analysis the categories possible change and no change were pooled.

Table 2. Comparison of orthopantomography and transmaxillary radiography in detecting abnormal signs in the mandibular condyles of 50 subjects with psoriatic arthritis*

	Transmaxillary radiography			
Orthopantomography	No change	Possible change	Definite change	Total joints
No change	78	1	1	80
Possible change	3	0	0	3
Definite change	6	1	9	16
Total joints	87	2	10	99

* Chi-square (df = 1) = 2.24; p = NS. For statistical analysis the categories possible change and no change were pooled.

technically satisfactory. In three of these the orthopantomographs showed definite changes. With regard to definite changes, agreement between orthopantomography and transmaxillary radiography was found in 56% of the condyles.

Transcranial and transmaxillary radiography

Table 3 shows the comparison between transcranial and transmaxillary radiography with regard to condyles. Since 4 transcranial and 7 transmaxillary radiographs were technically not satisfactory, 95 condyles were evaluated. One condyle technically not satisfactory in transcranial radiography showed a possible change in the transmaxillary radiograph. With regard to definite changes, agreement between transcranial radiography and transmaxillary radiography was found in 56% of the condyles.

Temporal component

Transcranial and transmaxillary radiography together showed nine definite and four possible abnormal temporal components of the TMJ. Of these, three definitely and one possibly affected joints showed no abnormal signs in the condyles at orthopantomography. Orthopantomography showed 10 definite and 3 possible changes of the condyles, whereas transcranial and transmaxillary radiography showed no change in the respective temporal components.

Discussion

The subjects were selected at random from among 110 PA patients. All subjects had a medical diagnosis of PA in accordance with the criteria of Moll & Wright (18). The PA group has earlier been considered representative of the PA subjects in Finland (12).

In screening radiography one must consider not only the relation between the information obtained from an examination and the resulting radiation dose but also the availability and ease with which the procedure can be performed. Of the three techniques used in the present study, orthopantomography is routinely used at the Department of Dental Radiology, University of Helsinki. It is an easy procedure to perform and is available to most dental practitioners in Finland. The advantage of orthopantomography in clinical practice is that both the TMJs and the jaws can be radiographed at one exposure.

Since the temporal component of the TMJ is poorly imaged by orthopantomography, only the condyles were evaluated (19). Rohlin et al. (20) have shown that in tomographic images radiographic signs are as frequent in the condyle as in the temporal component. In the present study radio-

Table 3. Comparison of transcranial and transmaxillary radiography in detecting abnormal signs in the mandibular condyles of 49 subjects with psoriatic arthritis*

	Transmaxillary radiography			
Transcranial radiography	No change	Possible change	Definite change	Total joints
No change	77	2	2	81
Possible change	2	0	1	3
Definite change	5	0	6	11
Total joints	84	2	9	95

* Chi-square (df = 1) = 1.59; p = NS. For statistical analysis the categories possible change and no change were pooled.

graphic signs were most frequent in the condyle in all projections. Only one possible radiographic sign in the TMJ in a transcranial radiograph was exclusively found in the temporal component. Moreover, in a recent study of the macroscopic and microscopic appearance of radiographic signs in the TMJ, Åkerman et al. (21) concluded that radiographic signs suggesting joint disease are more reliable when found in the condyle than in the temporal component. Hence, in the screening of TMJ diseases it might be reasonable to concentrate on the condyle.

Transcranial radiography with its many variants is the projection most frequently used in radiography of the TMJ. To avoid distortion and thus to obtain more information, an individualized technique has been suggested (22). According to Yale et al. (23), however, the vertical condylar angle should also be identified, to minimize distortion. In the present study a standardized technique was used in transcranial radiography, because the aim was to find one single technique suitable for the screening of TMJ bone changes. Further, as the individualized examination requires a mento-vertical projection, it increases the radiation dose to the subject.

It has been suggested that transmaxillary radiography is of greater diagnostic importance than transcranial radiography (24). It has been shown, however, that apart from erosions of the condyle, transcranial radiography gives more information than transmaxillary radiography (10, 25). In the present study no statistically significant difference between the three methods was found with regard to erosion or any other sign.

Of the conventional radiographic techniques, sagittal tomography is regarded as superior to other conventional techniques for disclosing osseous abnormalities of the TMJ (8, 9, 20). However, tomography should also be combined with other projections (3, 8, 9). Furthermore, the tomographic image may give false-positive signs because of blurring (3). More recently, computerized tomography and magnetic resonance imaging have been used in the diagnosis of TMJ disease (4–6). Avrahami et al. (26) described three male patients with a clinical diagnosis of PA of the TMJ in whom computerized tomography demonstrated changes of the condyle and glenoid fossa, whereas panoramic radiography showed changes only in one condyle, and conventional radiography showed changes in none.

On the basis of earlier studies, flattening, osteophytes, erosion, and sclerosis are classical radiographic signs of TMJ involvement (5, 22, 27). They were methodologically used for comparison of the information yielded by the different techniques. Erosion, the most frequent finding (definite in 23% of the subjects), is regarded as the most typical radiographic sign of inflammation in a joint in PA (14, 28, 29). However, secondary osteoarthrosis, a healing process after inflammatory attack (30), produces changes such as flattening, sclerosis, and osteophytes.

Orthopantomography showed more definite or possible changes in the condyle of the TMJ than did either transcranial or transmaxillary radiography, but the differences were not statistically significant. Orthopantomographic findings have agreed well with those of other conventional techniques in studies of subjects with severe TMJ involvement by inflammatory arthritis (7, 11). Further, Larheim (11) found definite signs in the condyles of subjects with TMJ involvement equally often by orthopantomography and by conventional tomography. Both methods were superior to transcranial radiography. In fact, orthopantomography is an oblique lateral tomographic method (19).

In the present study comparison of the three different techniques found agreement with regard to condyles with definite changes in only one-third to half of the cases. Further, no technique was superior to another in revealing any one sign. Thus all three techniques seem to have serious limitations in diagnosing bony changes in the condyles of the TMJ in subjects with PA. The present results confirm earlier findings that more than one projection should be used for diagnosis of abnormalities of the TMJ, since many changes are unique to the particular technique used (3, 8–11). However, if only

one technique is available for screening of TMJ involvement, orthopantomography is the method of choice.

References

1. Phillips RW, Hamilton IA, Jendresen MD, McHorris WH, Schallhorn RG. Report of the committee on scientific investigation of the American Academy of Restorative Dentistry. J Prosthet Dent 1985;53:844–70.
2. Paatero YV. Orthoradial jaw pantomography. Ann Med Int Fenn 1959;48(suppl 28):222–7.
3. Klein IE, Blatterfein L, Miglino JC. Comparison of the fidelity of radiographs of mandibular condyles made by different techniques. J Prosthet Dent 1970;24:419–52.
4. Helms CA, Richardson ML, Moon KL, Ware WH. Nuclear magnetic resonance imaging of the temporomandibular joint: preliminary observations. J Craniomandib Pract 1984;2:219–24.
5. Christiansen EL, Thompson JR, Kopp SFO, Hasso AN, Hinshaw DB Jr. Radiographic signs of temporomandibular joint disease: an investigation utilizing X-ray computed tomography. Dentomaxillofac Radiol 1985;14:83–92.
6. Manzione JV, Katzberg RW, Tallents RH, et al. Magnetic resonance imaging of the temporomandibular joint. JADA 1986;113:398–402.
7. Blair SG, Chalmers IM. Radiology of the temporomandibular joint. A comparison of circular tomography with orthopantomography and lateral transcranio-oblique radiography. J Dent 1972;1:69–76.
8. Petersson A. Radiography of the temporomandibular joint. A comparison of information obtained from different radiographic techniques [Thesis]. Lund: University of Lund, 1976.
9. Bean LR, Omnell K-Å, Öberg T. Comparison between radiologic observations and macroscopic tissue changes in temporomandibular joints. Dentomaxillofac Radiol 1977;6:90–106.
10. Hansson L-G, Petersson A. Radiography of the temporomandibular joint using the transpharyngeal projection. A comparison study of information obtained with different radiographic techniques. Dentomaxillofac Radiol 1978;7:69–78.
11. Larheim TA. Comparison between three radiographic techniques for examination of the temporomandibular joints in juvenile rheumatoid arthritis. Acta Radiol Diagn 1981;22:195–201.
12. Könönen M. Subjective symptoms from the stomatognathic system in patients with psoriatic arthritis. Acta Odontol Scand 1986;44:377–83.
13. Könönen M. Clinical signs of craniomandibular disorders in patients with psoriatic arthritis. Scand J Dent Res 1987;95:340-6.
14. Könönen M. Radiographic changes in the condyle of the temporomandibular joint in psoriatic arthritis. Acta Radiol Diagn 1987;28:185–8.
15. Paatero YV. Clinical orthopantomograms. Suom Hammaslaak Toim 1960;56:408–18.
16. Lindblom G. Technique for roentgen-photographic registration of the different condyle positions in the temporomandibular joint. Dent Cosmos 1936;78:1227–35.
17. Tveito L. Kjeveleddet i nytt röntgenologisk perspektiv. Odontol Tidskr 1969;77:437–45.
18. Moll JHM, Wright V. Psoriatic arthritis. Semin Arthritis Rheum 1973;3:55–78.
19. Uotila E. Temporomandibular joint in adult rheumatoid arthritis. A clinical and roentgenologic study. Acta Odontol Scand 1964;22(suppl 39):1–91.
20. Rohlin M, Åkerman S, Kopp S. Tomography as an aid to detect macroscopic changes of the temporomandibular joint. An autopsy study of the aged. Acta Odontol Scand 1986;44:131–40.
21. Åkerman S, Kopp S, Rohlin M. Macroscopic and microscopic appearance of radiologic findings in temporomandibular joints from elderly individuals. An autopsy study. Int J Oral Maxillofac Surg 1988; 17:58–63.
22. Omnell K-Å, Petersson A. Radiography of the temporomandibular joint utilizing oblique lateral transcranial projections. Odontol Rev 1976;27:77–92.
23. Yale SH, Allison BD, Hauptfuehrer JD. An epidemiological assessment of mandibular condyle morphology. Oral Surg 1966;21:169–77.
24. McCabe JB, Keller SE, Moffett BC. A new radiographic technique for diagnosing temporomandibular disorders [Abstract 30]. J Dent Res 1959; 38:663.
25. Petersson A, Nanthaviroj S. Radiography of the temporomandibular joint utilizing the transmaxillary projection. Dentomaxillofac Radiol 1975;4: 76–83.
26. Avrahami E, Garti A, Weiss-Peretz J, Yaron M. Computerized tomographic findings in the temporomandibular joint in patients with psoriatic arthritis. J Rheumatol 1986;13:1096–8.
27. Toller PA. Osteoarthrosis of the mandibular condyle. Br Dent J 1973;134:223–31.
28. Avila R, Pugh DG, Slocumb CH, Winkelman RK. Psoriatic arthritis: A roentgenologic study. Radiology 1960;75:691–702.
29. Lundberg M, Ericson S. Changes in the temporomandibular joint in psoriasis arthropathica. Acta Derm Venereol 1967;47:354–8.
30. Ogus H. Degenerative disease of the temporomandibular joint in young persons. Br J Oral Surg 1979;17:17–26.

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