# Frontal Tomography of Articulating Temporomandibular Joint Surfaces

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***A new technique orienting frontal tomographs of the TMJ in two planes to image the primary working surfaces of the joint.***

The ongoing concern of the dental profession with temporomandibular joint (TMJ) pathology is evidenced by the plethora of publications and continuing education courses in the past decade.

Many practitioners consider a radiographic evaluation of the bony structures of the joint an important aid in the diagnosis of TMJ problems. A variety of radiographic techniques have been employed with varying success, but all have serious limitations. Dense bony obstructions and the complex shapes of the condyle and fossa in all three dimensions make it difficult to obtain sufficient information in a two-dimensional image.

Conventional transcranial projections are relatively easy to produce, but they visualize only a very limited part of the joint that does not include the surfaces most commonly involved in pathology.

Cross-sectional lateral tomography can show the entire joint, but only with multiple exposures and complex equipment to produce images with less than ideal sharpness.

Few techniques for making frontal tomographs of the TMJ have been described in the literature.

Rozencweig (1975) keeps the condyles in a centric occlusion position and adjusts the machine so the plane of focus passes through the condyle perpendicular to the Frankfort horizontal plane. This images the superior surface of the head of the condylar process (Fig. 1). The dense bone of the articular eminence, root of the zygoma and floor of the orbit are sufficiently close to the plane of this radiographic cut through the long axis of the condyle that the image is somewhat obscured even with narrow tomographic sectioning.

Monfort (1978) suggested having the mouth wide open to get a clearer image of the condyle as it rests below the articular eminence. Unfortunately, as he points out, rotating the mandible open results in a radiograph showing a more posterosuperior surface even farther from the primary articulating area.

A technique to yield frontal tomographs of the anterosuperior surface of the mandibular condyle without the obscuring effect of the articular eminence has not been found in the literature.

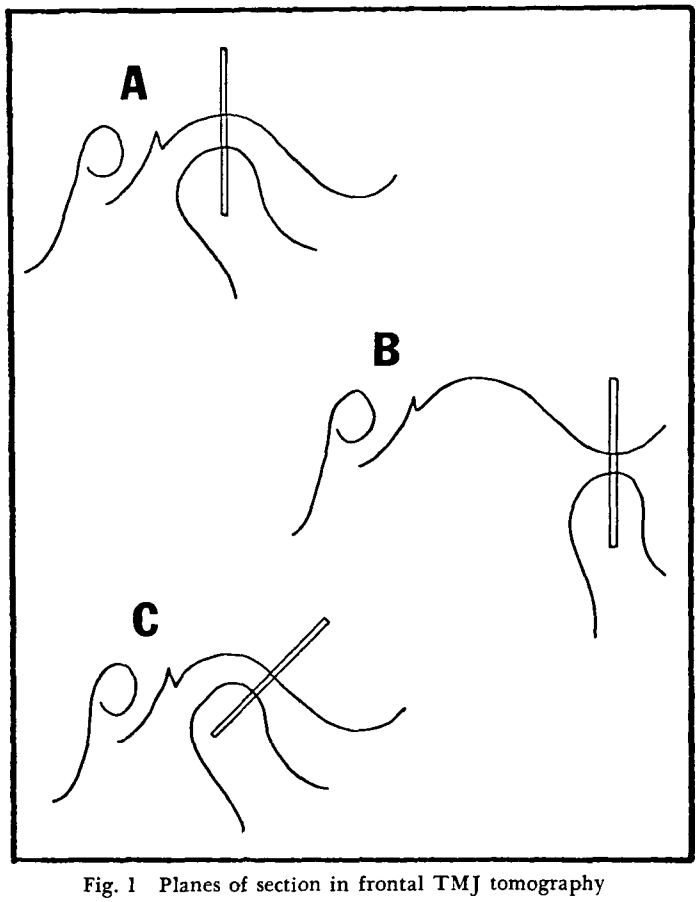


Fig. 1 Planes of section in frontal TMJ tomography
A. Rozencweig's method
B. Monfort's method
C. New method discussed in this paper

The purpose of this study was to develop such a technique and test it on dry skulls. This should produce precise frontal (transverse) tomographs of the TMJ showing the stress-bearing anterosuperior surface of the condyle from pole to pole with the condyle seated in the glenoid fossa. This is where pathologic changes are often first encountered.

Possible clinical advantages of such a technique would include the ability to examine this entire stress-bearing area of the condyle and its relation to the fossa on one film. Advantages of tomographic diffusion of obscuring images would be retained, and radiation exposure would be less than required for multiple lateral tomographs.

## Design of the Study

The following criteria were established for the proposed technique:

1) The patient's head should be turned so that the major axis of the condyle is perpendicular to the x-ray beam and parallel to the film. This correcting horizontal angulation should provide the sharpest image of the articulating surfaces from medial to lateral condyle pole.

2) The patient's head should be tilted up so that the central ray of the x-ray beam is tangent to the articular surfaces.

3) There must be a means to determine the linear distance of the condyle from the zero reference plane of the machine to establish an accurate plane of tomographic cut.

Input data was determined from tracings of initial orientation radiographs. Conventional postero-anterior and submental-vertex cephalometric radiographs were used to determine the location and orientation of the condyle. A lateral TMJ tomograph corrected as described by Beckwith *et al* (1980) was used to determine the angulation of the articulating surfaces to the Frankfort horizontal plane.

Tomographs were exposed with a horizontal linear motion at the standard cephalometric five-foot (152.4cm) distance from target to earpost axis, with 14cm from midline to film.

Three dry skulls were used for test exposures. Medial and lateral condyle poles were marked with short ends of ball clasp wires bent in different configurations so that each could be identified in the various radiographs. The markers were fixed to the bone with utility wax. The mandibles were then rearticulated in the best-fit, centric occlusion position as dictated by the teeth, and stabilized with interdental wiring and soft beeswax between condyle heads and the fossae. Metal markers were also placed on the orbital rims at anatomic orbitale.

Each skull was first placed in the cephalostat for a submental-vertex (sM-V) radiograph with the earrods oriented parallel to the film and with the Frankfort plane vertical.

Beckwith *et al*'s (1980) method was then used to calculate machine settings for aligning lateral tomographs through the center of each condyle, with the skull turned to produce a section perpendicular to the condyle axis.

A conventional postero-anterior radiograph of each skull was also exposed.

Lines were drawn tangent to the primary functional joint surfaces on tracings of the TMJ made from the lateral tomographs (Fig. 2), and the angle with Frankfort plane measured. Aslanides (1980) had found the Frankfort plane as seen in such an oriented lateral tomograph to be within 0.5°

of the Frankfort plane seen in a lateral cephalometric film.

A protractor with plastic arms pivoted around a central point was fastened over each of the earrods and used to measure the tipping of each skull up to the angle measured for the articular surfaces. This aligned the articular surfaces so they were grazed by the x-ray beam.

Cephalostat and skull were then rotated to match the horizontal condyle angle determined from the sM-V film, and the depth calculated accordingly.

Additional films for qualitative analysis and orientation of the condyle in space included conventional lateral and postero-anterior cephalometric and tomographic exposures. In all, 12 trials were run for the quantitative test of the technique, and 12 frontal TMJ tomographs were made on the three skulls for qualitative study.

## Results and Discussion

Student's "t" test was used to compare the differences between the calculated condyle positions and the actual positions shown in the cephalometric films. No statistically significant differences were found.

One skull among the dental school collection illustrated the diagnostic advantage of this technique especially well. Pathological bony changes were noted on the anterosuperior surface of the right condyle, and tomographs were made using all of the techniques mentioned.

Rozencweig's method (Fig. 3A) yielded an image in which the surface of the condyle could not be adequately visualized.

Monfort's method (Fig. 3B) showed a clear image of the condyle, but with no indication of the pathology.

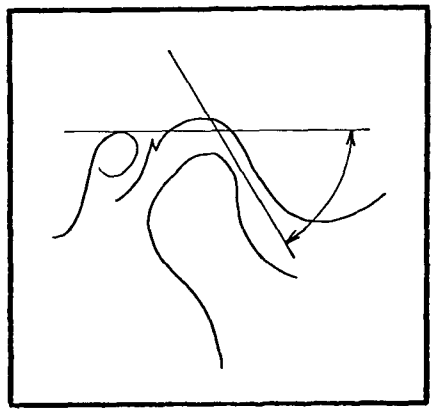

Fig. 2 Tangent to primary articulating surfaces on a lateral tomograph

Using the technique outlined in this paper, the pathologic bony change was readily apparent (Fig. 3C). Had this subject been a living patient with TMJ dysfunction signs or symptoms, only the view of the anterosuperior condyle surface would have yielded positive diagnostic information.

This technique has thus far been applied to only one human subject, but as a logical refinement of accepted procedures it involves no untried methods. The soft tissues in a living subject cause lower image contrast than is seen in a dry skull, increasing the importance of this enhancement of the condyle image.

It has been found that a medium tomographic section thickness provides the best results in practical application.

## Summary and Conclusions

A variety of radiographic techniques to overcome the limitations imposed by the complex and dense bony anatomy of the TMJ area have been developed and reported over the years.

Body section tomography can produce images of the internal hard tis-

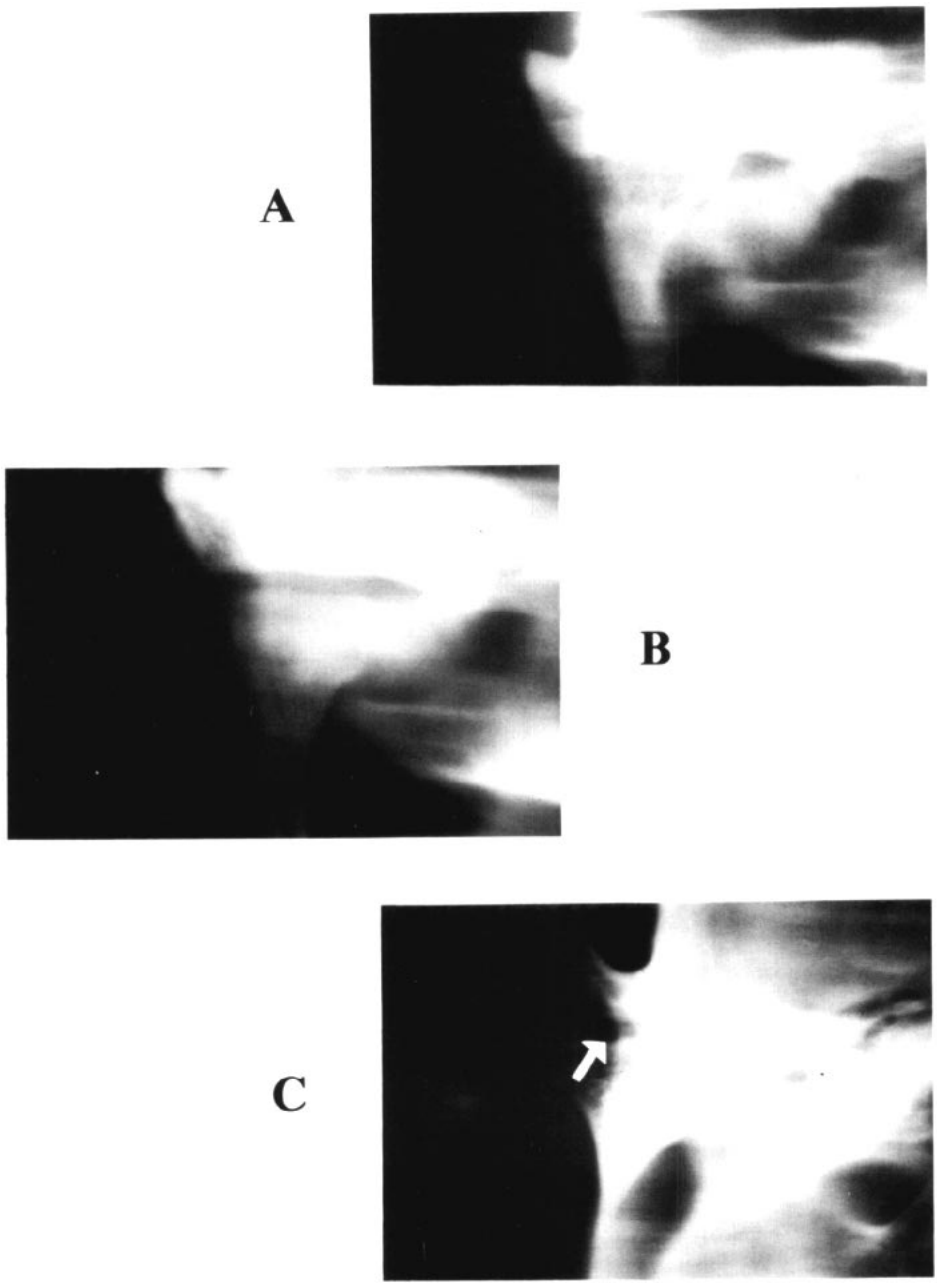


Fig. 3 Tomographs of the right condyle of a dry skull with visible bony changes on the anterosuperior surface.

A. Rozencweig's method
B. Monfort's method
C. New method discussed in this paper

sues of the joint with much less interference from superimposing structures. Multiple lateral tomographs of the joint can provide useful diagnostic radiographic coverage, but the many exposures require relatively large accumulated radiation exposure.

Frontal TMJ tomography offers one alternative, visualizing the entire anterosuperior surface of the condyle from medial to lateral pole on one film. Existing frontal tomographic methods provide a view of the superior surface, but not of the important anterior articulating surfaces.

This project has developed and tested a technique for angulating frontal tomographs of the temporomandibular joint on two axes to visualize the articulating anterosuperior surface of the condyle and posterior slope of the articular eminence.

## References

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