

The Prescription of Diagnostic Images for Temporomandibular Joint Disorders

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The selection of the appropriate imaging modality for the diagnosis of various disorders of the temporomandibular joint (TMJ) can be difficult, due in part to recent development of imaging modalities. Practitioners responsible for the diagnosis and treatment of temporomandibular disorders may not be fully aware of the strengths and weakness of each modality; nor does the profession have the benefit of years of experience in the application of these new modalities. For those practitioners who are not intimately involved with diagnostic imaging of the TMJ, an available set of guidelines concerning the application of diagnostic imaging to disorders of the TMJ would be useful.

In the absence of clear research and long-term experience with new imaging modalities, the production of a set of guidelines is challenging and may ultimately be based on the various experiences of the authors. Also, there is a danger inherent in the formulation of guidelines. Guidelines may promote a cookbook-like approach, which lacks the judgment necessary for the prescription of imaging based on the merits of each specific case. The application of imaging to an individual patient should be based on the information provided by the clinical features and, in some cases, may be based on something as ethereal as a hunch. In this respect, diagnosis may be more an art than a science. However, the production of guidelines is a beginning point and can be helpful as long as these guidelines are never viewed as being infallible but, rather, are open to challenges. Changes should occur with further advances in knowledge, experience, and technology. To date, the most comprehensive document, which does not purport to be a set of guidelines but instead is a position paper, has been produced by the American Academy of Oral and Maxillofacial Radiology.¹ This document provides excellent information about the application of diagnostic imaging to various diseases and abnormalities of the TMJs.

There are many factors that should be considered in attempting to create a set of guidelines. The cost of each imaging modality and thus the total financial burden upon society and upon the individual patient should be considered. Is there a less expensive method that can provide the necessary information? The radiation dose may be a consideration, especially in situations where diagnostic imaging is being employed as a screening tool. Research findings indicating the sensitivity and specificity of a particular imaging modality should also be considered. However, these studies often fail to consider the practical overriding parameters, which

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include the quality of the images and the experience and knowledge of those who analyze the images. The guidelines must have a clear, clinical application. Lastly, the guidelines must be continually tested and challenged by considering the accuracy of differing imaging modalities and whether the findings were useful in both the development of treatment plans and in treatment outcomes.

Selection Criteria

With this article, I would like to take a different approach, one that assumes that the clinician does not know the true nature of the abnormality. In other words, imaging is required for a diagnosis to be made. It should be clear that much of the following is based on personal experience. The first step is the development of selection criteria for patients who require diagnostic imaging. A decision to proceed with imaging should be based on information obtained from the patient history and from clinical examination of the patient. The prescription of imaging should never be based on a general routine. Also, a contraindication is the perceived need to establish the absence of disease for medical-legal reasons, for instance, before orthodontic treatment is commenced. Attempts to obtain previous films of the joint should also be made.

Diagnostic imaging may be ordered for the staging of disease. For example, a diagnosis of osteoarthritis may be clear from the clinical information, but radiographs may be ordered, not to provide a diagnosis, but to establish the degree of joint involvement. This establishes a baseline, which is important for future studies to evaluate the success or failure of the treatment provided. Because of the extreme variation in the normal morphology of the TMJ, films of both left and right joints should always be taken to provide a comparison. There must be a reasonable anticipation that the information from the radiologic exam will aid in establishing an accurate diagnosis and that this information will influence the treatment plan for the patient.

More specifically, the selection criteria should include clinical evidence of the presence of disease within the joint. Examples of clinical information that suggest the presence of disease within the TMJ include:

- Soft tissue swelling over the lateral aspect of the joint
- Abnormal temperature or color of the skin over the joint
- Recent changes in mandibular function (eg, decreased opening or deviation on opening)
- Recent changes in the occlusion (eg, development of an anterior open bite)
- Severe, unrelenting pain within the joint
- Recent history of trauma to the joint or mandible
- Severe restriction in the movement of the mandible, which suggests ankylosis
- Unusual symptoms or pain, which suggest the presence of a giant cell reaction involving prosthetic joints

The presence of joint clicking by itself does not require diagnostic imaging. Because of the marked prevalence of disc displacement, it is possible that this may be considered a variation of normal and not a true abnormality of the joint. However, if joint clicking is accompanied by any of the above criteria, diagnostic imaging may be required. Also, when several modalities of treatment have been applied and fail, it would be reasonable to proceed with imaging to confirm the diagnosis.

Imaging Modalities

If one assumes that there is a need for diagnostic imaging, knowledge of the available imaging modalities is required before the prescription. For the purpose of simplification, the list of modalities available can be divided into those that can be used for the assessment of the hard tissues (bone components) and those for soft tissues (articular disc, bilaminar ligament, and surrounding muscles).

As noted below, arthrography or magnetic resonance imaging (MRI) can be applied to the evaluation of soft tissues. For the evaluation of hard tissues, imaging modalities include plain films, tomography, computed tomography (CT), and nuclear imaging (eg, most often technetium bone scan). Plain films include panoramic radiography, transcranial, transorbital, transmaxillary, and sometimes various skull views. In my opinion, the panoramic film should always be included in any survey of the TMJ. This film gives information that may be missed if the imaging is restricted to the area of the joint. For instance, the panoramic image may reveal abnormal morphology such as hyper- or hypoplasia of the joint and/or mandible, hyperplasia of the coronoid processes, or the presence of disease that may masquerade as temporomandibular disease. Examples would include inflammatory disease, such as periapical pathology (especially of mandibular molars) and the presence of neoplasia.

Imaging Protocol for Hard Tissues

What would be a reasonable initial protocol for the assessment of hard tissue abnormalities? The panoramic film by itself is not a good survey instrument because of the inherent distortion of the image of the joint. An initial survey should supplement the panoramic film with views of the joint from the lateral aspect and from the frontal aspect. Two viewing directions at right angles will provide enough information to permit a more 3-dimensional concept of the joint. If plain films are used alone, the lateral view would be provided by the transcranial film (unfortunately, this has considerable image distortion), and the frontal view would be provided by the transorbital or transmaxillary view. Therefore, this survey would include a panoramic film and transcranial (open and closed) and transorbital views. If available, tomography will provide a better initial survey because there is less image distortion. This survey would include a panoramic film and lateral and anteroposterior tomographs (corrected to the long axis of the condylar head). These 2 protocols can provide an adequate initial survey. If these images are of good quality and there is no evidence of disease, there may not be a need to continue with further imaging. However, if these images indicate the presence of an abnormality, further diagnostic images are likely required. The following sections list the criteria that indicate specific abnormalities and the types of images that should be used.

Neoplasia. If the initial images indicate the presence of disease, such as a neoplasm, then further imaging of the hard tissues may be required. General features that suggest the presence of a neoplasm include irregular enlargement of the condyle, bone destruction of the condyle or glenoid fossa, and soft tissue calcifications. The next imaging modality should be CT, to obtain better 3-dimensional information and bone detail and to increase tissue contrast (ability to differentiate different soft tissues). Magnetic resonance imaging may be required if further information regarding the extent of soft tissue invasion is required.

Septic Arthritis. If the initial images in conjunction with the clinical information suggest the presence of inflammatory disease within the joint (septic arthritis), then CT and nuclear imaging may be required to confirm the diagnosis. Clinical signs may include swelling, redness, and increased temperature in the tissue lateral to the joint. Often septic arthritis is the result of spread of osteomyelitis of the mandible or inflammatory disease from

chronic mastoid or ear infections. A preliminary diagnosis of osteomyelitis is indicated by the presence of inflammatory periosteal new bone or sequestra in the mandible, and sclerosis of the mastoid air cells suggests chronic inflammatory disease. Usually CT is the most accurate method to confirm the presence of osteomyelitis of the mandible. Nuclear imaging can confirm a diagnosis of septic arthritis by employing a technetium bone scan followed by a gallium scan.

Other Arthritides. Usually tomography will provide adequate documentation of these abnormalities, but if more detail is required, then CT can be employed.

Condylar Hyperplasia. In the initial examination, the panoramic film may reveal a profound asymmetry, indicating the presence of hyperplasia of the mandibular condyle with varying degrees of involvement of the mandibular ramus and body. If corrective orthognathic surgery is contemplated, it may be important to determine whether there is active condylar growth. This is difficult to ascertain with a single study alone. Technetium bone scans may be employed to determine the metabolic activity of the bone of the mandibular condyle. Since the number of parameters influencing the results of this study prohibit a meaningful value for bone activity, it is reasonable to compare the activity of one condyle to the other. However, abnormally high activity does not necessarily indicate continued growth of the hyperplastic condyle, since other conditions such as remodeling and osteoarthritis may result in increased activity. The nuclear scan is more useful if bone activity is equal to that in the normal condyle, which indicates that there is no longer abnormal bone growth. If nuclear scans are not available or inconclusive, a longitudinal study may be employed. Lateral oblique cephalometric views of the mandible, projected at right angles to the body of the mandible (using the submentovertebral view of the mandible as a guide), are produced, and the mandibular length is measured. This can be repeated on an annual basis to determine whether the dimension of the mandible has changed.

Trauma. In cases where there is a history of trauma to the mandible or to the joint, the right-angled views, especially those in the anteroposterior direction, are of paramount importance. If greater detail is required regarding the number and position of bone fragments, then CT imaging should be ordered. If further information is needed regarding the articular disc and surrounding ligaments, then either MRI or arthrography is indicated.

Ankylosis. Ankylosis may be suspected with an inability to move the mandible, especially with a history of previous trauma or arthritis. Approaches employing CT, specifically the coronal image slices, are useful in detecting small regions of ankylosis, which may not be apparent in conventional tomographic images, and CT can help to determine the exact extent of the ankylosis.

Prosthetic Joints. Where unusual symptoms or pain suggest the presence of a giant cell reactive lesion to a joint prosthesis, the initial radiologic series of films may be omitted, and CT should be used. Coronal image slices are the most useful in determining erosion of the glenoid fossa.

Imaging Protocol for Soft Tissues

Usually, diagnostic images of the soft tissues are ordered to determine the direction and severity of displacement of the articular disc and whether there is abnormal morphology of the disc. Either arthrography or MRI can be employed. There are several studies that compare these imaging modalities. Often the conclusion is that MRI is more accurate and represents the gold standard. However, Liedberg et al,² in a review of all the literature, suggested that arthrography has the highest diagnostic outcome for anterior disc position but not for medial displacement. In reality, it is likely that the 2 methods are comparable, with each having its particular strengths and weaknesses. Also, the parameters concerning the quality of the images and the experience of the clinician analyzing the images are not factored into these studies. In reality, both of these factors have a profound effect on the accuracy of the findings.

When these 2 imaging modalities are compared, it is apparent that arthrography has the following advantages: the cost is lower, it provides a good dynamic study of joint movement, and it can detect the presence of perforation and adhesions.

The disadvantages include its radiation dose, a small amount of patient morbidity, and a lack of accuracy in detecting medial disc displacements. The advantages in the use of MRI include a lack of ionizing radiation dose, no apparent patient morbidity, the ability to see surrounding soft tissues such as the muscles, and the ability to demonstrate abnormal tissue signals of the disc and condyle. Disadvantages include its higher cost and minimal information regarding joint movement, perforations, or adhesions. It is interesting to compare these 2 modalities, but if the information, for example the presence of a perforation, has no influence on the treatment provided, then it is of academic importance only and brings into question the need for these diagnostic images.

Conclusions

A different approach to the development of guidelines for the application of diagnostic imaging for abnormalities of the TMJ has been presented. Assuming that the clinician does not know the ultimate diagnosis, this paper suggests an initial imaging protocol, along with supplemental images that can help in arriving at a diagnosis. Lastly, guidelines are no more than suggestions, and the number and types of images should be based solely on the needs of individual patients.

References

1. Brooks SL, Brand JW, Gibbs SJ, Hollender L, Lurie AG, Omnell KA, et al. Imaging of the temporomandibular joint: A position paper of the American Academy of Oral and Maxillofacial Radiology. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997;83:609-618.
2. Liedberg J, Panmekiate S, Petersson A, Rohlin M. Evidence-based evaluation of three imaging methods for the temporomandibular disc. *Dentomaxillofac Radiol* 1996;25:234-241.