Review article

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THE IMPORTANCE OF MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS

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The addition of new imaging modalities, specifically mangnetic resonance imaging has and will continue to increase the amount of diagnostic information available to the clinician. Imaging is the only method of obtaining visual information on the status of the joint tissues short of arthroscopy or open joint surgery. The magnetic resonance imaging capacity to contrast soft tissue types makes it an ideal tool for investigating internal derangements. Its ability to image in multiple planes is well suited for examining the three-dimensional nature if internal derangements of temporomandibular joints. A major bonus is its freedom from ionizing radiation and other known health hazards making it a low-risk method for research and clinical investigation. A major disadvantage is its cost and associated limited availability. Magnetic resonance imaging examinations of the temporomandibular joints are part of the current standard of care in the evaluation of temporomandibular disorders, providing the clinician anatomic information that can guide treatment decisions.

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Key words: *magnetic resonance imaging, temporomandibular joint, temporomandibular disorders*

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Introduction

The radiologic investigation of the temporomandibular joints may bring to light pertinent information. However, only after relating these findings to the clinical symptoms will the diagnostic significance become apparent. Since some osseous changes may not be detectable in the radiologic examination, the final diagnosis becomes a clinical procedure. The addition of new imaging modalities, specifically magnetic resonance imaging (MRI) has and will continue to increase the amount of diagnostic information available to the clinician (1). Imaging is the only method of obtaining visual information on the status of the joint tissues short of arthroscopy or open joint surgery. Its primary purpose is to provide information to assist the diagnosis and treatment planning process. Despite the temporomandibular joint imaging long history of research and clinical application, the quality of information gleaned from imaging is often less than desired (2). The small size of the TMJ, the widely varying fossa and condylar morphology and the surrounding dense osseous structures make clear und undistorted imaging of the joint hard tissue technically difficult (3).

TMJ anatomy and function

Major components of the temporomandibular joint include the mandibular condyle, the articular disc, the glenoid fossa, and the articular eminence of the temporal bone. Unlike most joints, the articulating surfaces are fibrous and not cartilaginous. The fibrocartilaginous articular disc is biconcave, dividing the joint space into superior and inferior compartments; this relationship is well seen in the presence of joint effusion (4). The anterior and posterior portions of the articular disc, which are thickened by the morphology of the disk annulus, are designated the anterior band and the posterior band, respectively, with a thinner intermediate zone in between. The disc is attached to the temporal bone and condyle posteriorly by elastic and loose connective tissue; this tissue is also known as the retrodiscal soft tissue or the bilaminar zone. The lateral pterygoid muscle, the only muscle of mastication serving to open the jaw, inserts on the mandibular condyle inferior to

the articular surface but can partially insert on the joint capsule and disc as well (5).

Magnetic resonance imaging technology

Magnetic resonance imaging technology exploits the varying proton content of different tissues. The protons in tissue fluids are polar, analogous to tiny bar magnets, with their magnetic fields or dipoles aligned in random fashion (6). When exposed to the strong magnetic field of the Magnetic resonance imaging scanner, some of the protons align parallel to the direction of the external field. Radio waves of a specific frequency (similar to broadcast signals) are directed at the tissue inducing proton precession, a motion similar to toy top winding down. The magnitude of precession is proportional to the amount of radio frequency energy absorbed. When the radio frequency excitation is stopped, the protons relax to their original low energy state and, in the process, emit the absorbed energy which can be detected by receiver antennae placed over the areas of interest (7).

Magnetic resonance imaging examination of the temporomandibular joint has gained an important role in the diagnosis of internal derangement, because it allows direct visualization of the articular disk in both the open- and closed-mouth positions. Nuclear magnetic resonance was introduced 40 years ago as a research tool in chemistry and physics. The development of large superconducting magnets and high speed computers has paved the way for adaptation of the technology to clinical diagnosis. The technology as applied to medicine was renamed "magnetic resonance imaging" to avoid the stigma attached to the term "nuclear" (8). Its key advantages over other imaging technique are elimination of ionizing radiation and the capacity to produce high resolution images in most anatomic planes (axial, sagittal, frontal and oblique), without positioning of the patient as required wit direct sagittal CT scanning.

Specially small coils placed over both temporomandibular joint areas enhance the clarity of received signals and allow both joints to be imaged in a single exam sequence (9). The strength of the emitted signals is proportional to the amount of protons in the tissue. Signals are location coded as a result of strength gradation in the primary magnetic field (10). This allows the computer to assign an intensity and location values to the emitted signals which are then manipulated by the computer into cross sectional images.

Magnetic resonance imaging is most commonly applied to the diagnosis of internal derangements (11). However, it has potential to diagnose hard tissue lesions. Some authors reported that number of bony abnormalities were noted on coronal views that were not appreciated on sagittal views nor in some case, on tomography. Magnetic resonance imaging has been reported to be 95% accurate in assessment of disk position and form, and 93% accurate in assessment of osseous changes (12). However, several authors have noted a lack of correlation between magnetic resonance imaging findings of disk displacement and the extent of pain and dysfunction of the temporomandibular joint in patients with painful limitation of mandibular opening (13, 14). Moreover, disk displacement was found in a substantial number of asymptomatic volunteers. For example, Ahmad and colleagues reported a 21% prevalence of internal derangement on magnetic resonance imaging evaluation of 57 asymptomatic people (15).

The clinical significance of imaging findings of internal derangement is controversial (16). The prevvalence of displacement of the temporomandibular joint disk among asymptomatic volunteers was previously reported as nearly 33% and the prevalence of normal articular disk in symptomatic joints was reported to be 16%–23% (17). Moreover, arthroscopy and magnetic resonance imaging have shown that the temporomandibular joints with anteriorly displaced disks have the capacity to form remodeled retrodiscal tissue that resembles cartilage (i.e., pseudo-disk formation) (18). Furthermore, the retrodiscal tissues have adaptive capacity and often respond appropriately to the functional loads placed on the tissues (19, 20).

Conclusion

Magnetic resonance imaging capacity to contrast soft tissue types makes it an ideal tool for investigating internal derangements. Its ability to image in multiple planes is well suited for examining the three-dimensional nature if internal derangements of the temporomandibular joints. A major bonus is its freedom from ionizing radiation and other known health hazards making it a low-risk method for research and clinical investigation. A major disadvantage is its cost and associated limited availability. Magnetic resonance imaging examinations of the temporomandibular joints are part of the current standard of care in the evaluation of temporomandibular disorders, providing the clinician anatomic information that can guide treatment decisions. This article has reviewed some of the key findings and imaging appearances of the degenerated temporomandibular joint. Further research will continue to enhance our understanding of the potential contributions of contrast-enhanced studies and dynamic imaging.

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ZNAČAJ MAGNETNE REZONANCE TEMPOROMANDIBULARNOG ZGLOBA U DIJAGNOSTICI TEMPOROMANDIBULARNIH POREMEĆAJA

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Uvođenje novih načina rendgenskih snimanja, posebno magnetne rezonance, pruža sve veći broj dijagnostičkih informacija koje su dostupne kliničarima. Magnetna rezonanca je jedan od načina dobijanja vizuelnih informacija o stanju zglobnog tkiva bez artroskopije ili otvorene operacije zgloba. Magnetna rezonanca ima sposobnost da pomoću kontrastnih supstanci određuje tipove mekih tkiva, što je čini idealnim alatom za istraživanje unutrašnjih poremećaja. Njena sposobnost da daje slike u više ravni pogodna je za ispitivanje trodimenzionalne prirode unutrašnjih poremećaja temporomandibularnih zglobova. Glavna prednost je odsustvo jonizujućeg zračenja i drugih agenasa opasnih po zdravlje, što je čini metodom niskog rizika za istraživanje i kliničko ispitivanje. Glavni nedostaci su njena cena i ograničena dostupnost. Ispitivanja temporomandibularnih zglobova magnetnom rezonancom deo su standarda u proceni temporomandibularnih poremećaja, pružajući kliničarima anatomske informacije koje mogu uticati na donošenje konačne odluke o lečenju.

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Ključne reči: *snimanje magnetnom rezonancom, temporomandibularni zglob, temporomandibularni poremećaji*