

Myogenous or Arthrogenous Limitation of Mouth Opening: Correlations Between Clinical Findings, MRI, and Clinical Outcome

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The reproducibility and predictive power of MRI diagnosis was evaluated in a group of 70 patients with limited mouth opening. The predictive reliability of the MRI findings was assessed by comparing the images with a final clinical diagnosis that was based on the initial clinical diagnosis, adjusted and refined, when possible, by findings made during the treatment period (conservative treatment in 51 patients, conservative and surgical treatment in 19 patients). The overall reproducibility of the MRI interpretation by the radiologist appeared very good. The predictive reliability was excellent for normal disc position and fair for anterior disc displacement with reduction. For disc displacement without reduction, however, the predictive power was questioned because of false-positive MRI findings.

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Magnetic resonance imaging (MRI) offers a noninvasive, hazard-free means to evaluate the spatial relationship between the articular disc and the bony components of the temporomandibular joint (TMJ).¹⁻³ As such it has been suggested repeatedly for use as a diagnostic tool for craniomandibular disorders (CMD) during the last few years. With respect to the recently developed classification system for CMD,⁴ MRI could be especially valuable in elucidating the etiology of limited mouth opening, ie, the differentiation between a myogenous limitation (muscle cramp [ICD 728.85] or reflex splinting [ICD 728.89]) and limitation due to internal derangement of the TMJ, expressed as an anterior disc displacement without reduction (ICD 718.28).

The aim of the present study was to evaluate the reproducibility of MRI readings and to correlate the MRI diagnosis with the clinical diagnosis supplemented and/or reinforced by the treatment outcome. Recent technical developments have enabled serial motion studies⁵ of both right and left joints simultaneously, which might render MRI diagnosis very accurate and reliable. From this perspective, the use of static images (as in this study) has obvious limitations. Nevertheless, the evaluation of the reliability and usefulness of the static technique is necessary, since it is used very often.

Materials and Methods

The subjects of this study comprised patients who presented at the Clinic for Temporomandibular Disorders (Department of Oral and Maxillofacial Surgery) with limited mouth opening, for which

the preliminary clinical diagnosis was disc displacement without reduction or for which the preliminary clinical diagnosis was unclear. Such patients are routinely referred to the Radiology Department for MRI of the joint on the symptomatic side. In the evaluation period (September 1987 to September 1990), 82 patients were referred, 15 men (range 22 to 62 years, mean 33 years) and 67 women (range 18 to 62 years, mean 33 years), and these patients comprised the sample. In 6 patients, the joints were pictured bilaterally, giving a total of 88 joints.

The TMJ was imaged with the mouth closed and in maximally opened position using a Siemens Magnetom, 1.5 Tesla, with the body coil as transmitter and a 12-cm diameter surface coil as the receiver. Seven or eight 3-mm-thick parasagittal T1-weighted images (repetition time = 500 to 600 ms; echo time = 15 ms; two acquisitions) were obtained for each position. The orientation of the parasagittal plane was perpendicular to the condyle. The angulation of the condyle was determined using an axial localizer (three slices with a 100-ms repetition time, flip angle 40, a 10-ms echo time, 8-mm section thickness, 2 acquisitions). Different sized syringes were used to obtain and stabilize maximal mouth opening.

For each joint, the position of the articular disc was evaluated on all images, and one of the following determinations was made: (1) normal position of the disc, suggesting myogenous origin of limitation (MYO); (2) anterior disc displacement with reduction on jaw opening (ADDR); or (3) anterior disc displacement without reduction (closed lock, CL). Examples of the MRI pictures for each diagnosis are shown in Figs 1a and 1b to 3a and 3b.

Reproducibility of the MRI Interpretation

The reproducibility of the MRI diagnosis as formulated by the radiologist was tested on part of the sample (34 joints of 28 patients). After one year, the radiologist reevaluated the pictures with regard to disc position. Overall agreement and reproducibility were statistically evaluated, resulting in a 95% confidence interval (lower limit = piL , upper limit = piU) around the predictive power (pi) of the method used.⁶

Correlation Between MRI and Clinical Diagnosis

For each patient, a trained examiner made a tentative clinical diagnosis concerning the limitation of mouth opening. The diagnosis was based on the

anamnesic information and routine clinical examination (active vs passive range of motion and end-feel; comparison of opening, lateral, and protrusive movements actively and passively; joint play; dynamic and resistance tests; palpation of joints and muscles⁷⁻¹¹). After the clinical examination, the patients were sent for MRI.

Of the 82 patients in the study, 6 were sent in for diagnosis only and were treated elsewhere, and 4 were lost to follow-up. Excluded from the study were 1 patient with condylar metastasis and another with osteochondromatosis as the source of their pain and dysfunction. Consequently, the test group consisted of 70 patients.

Conservative reversible treatment was initiated for all patients and included counseling and information, home care and rest, muscle relaxants and/or nonsteroidal anti-inflammatory drugs, exercises and physiotherapy, and/or nightly use of a stabilization splint. In 19 patients, conservative therapy did not lead to alleviation of pain and restoration of functional jaw movements after 4 to 6 months and MRI indicated CL as the cause of their problems. In these patients arthroscopy was performed with disc repositioning and repair.

Based on the outcome of the conservative treatment concerning jaw movements (51 patients) and the report of the surgeons performing the arthroscopy (19 patients), a final clinical diagnosis was obtained. This final diagnosis was correlated with the initial MRI diagnosis using the same statistical method as for the reproducibility,⁶ resulting in a measure of the predictive power of MRI in the diagnosis of the different conditions.

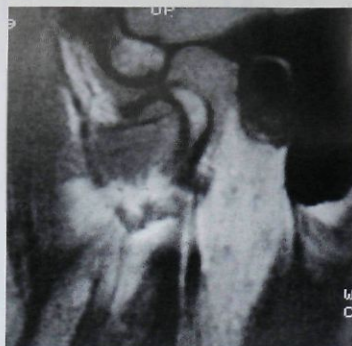
Results

Reproducibility of the MRI Interpretation (Table 1)

At the original examination, 18 joints were diagnosed by the radiologist as CL, 5 as ADDR, and 10 as MYO while one joint could not be interpreted. At the second examination, after 1 year, 16 joints were interpreted as having CL, 6 as ADDR, 11 as MYO, and 1 uninterpretable. Overall, an agreement between the first and second examination was present in 30 of 34 joints. The prediction rate (pi) was .8235 (piL = .616, piU = .9130).

Correlation Between MRI and Clinical Diagnosis

Based on the initial anamnesis and clinical examination, closed lock was evident in 24 patients. In the remaining 46 patients, some doubt



Figs 1a and 1b Example MRI of closed lock (anterior disc displacement without reduction).



Figs 2a and 2b Example MRI of anterior disc displacement with reduction.



Figs 3a and 3b Example MRI of normal disc position (myogenous limitation of mouth opening).

Table 1 Reproducibility of the MRI Interpretation

Diagnosis at 2nd evaluation	Initial diagnosis		
	CL	ADDR	MYO
CL	16	-	-
ADDR	1	5	-
MYO	1	-	10

CL = closed lock (disc displacement without reduction), ADDR = anterior disc displacement with reduction, MYO = myogenous limitation of mouth opening (normal disc position).

Table 2 Correlation Between MRI and Clinical Diagnosis

MRI	Clinical diagnosis		
	CL	ADDR	MYO
CL	28	4	10
ADDR	1	11	2
MYO	-	-	12

CL = closed lock (disc displacement without reduction), ADDR = anterior disc displacement with reduction, MYO = myogenous limitation of mouth opening (normal disc position).

remained on a pure myogenous limitation or ADDR, or no decision could be reached (4 patients).

All patients had conservative treatment for 3 weeks to 4 months, after which 51 of them were free of pain and had fair to normal range of movement. Posttreatment evaluations were made subjectively and objectively and were based upon the treatment course and outcome with regard to pain-free normal range of movement, interferences during movement, and pain during the different tests and during palpation. The following "final" diagnoses were reached: 25 patients had myogenous limitation, 15 patients had CL, 11 joints had ADDR.

In the remaining 19 patients, in which the MRI indicated CL, conservative treatment could not eliminate the symptoms satisfactorily, and arthroscopy was performed with disc repair. During the surgery, CL was confirmed in 14 patients. Serious doubt was expressed by the surgeons concerning the "anterior displacement" of the disc in 3 patients, whose joints suffered from adhesions. In 1 patient, the disc was found to be reducing during

jaw movement and in another patient the position and function of the disc were perfectly normal. The MRI findings and the correlating final clinical diagnosis are shown in Table 2. Of the 70 patients, the radiologist diagnosed 12 as having normal disc position (MYO), 42 as closed lock, 14 as ADDR, and 2 as uninterpretable. The π for CL was .6667 ($\pi_L = .5578$, $\pi_U = .7876$). For ADDR, π equaled .7857 ($\pi_L .5093$, $\pi_U = .9534$), while for MYO, total agreement was reached ($\pi = 1$, $\pi_L .7417$, $\pi_U = 1$).

Discussion

In most cases of limited mouth opening, anamnesis and clinical examination will be sufficient to arrive at a clinical diagnosis of myogenous (muscle cramp) or arthrogenous (disc displacement without reduction) limitation. When diagnosis is difficult or when overlapping disc and muscle problems occur, the use of MRI might be very valuable because it does not necessitate injection of contrast medium (as in arthrotomography) or higher radiation doses (as in computed tomography). For every new technique, however, information concerning reproducibility, specificity, and predictability are warranted. Direct comparison with existing imaging techniques that yield good and predictable results (such as arthrotomography and computed tomography¹²) is one way to test this new technique. Rao et al¹³ correlated MRI findings with surgical evaluation of disc position and concluded that MRI is more accurate than arthrography. The Donlon and Moon study¹⁴ correlated MRI and arthrotomography with clinical and surgical findings in 24 patients. They concluded that MRI is as accurate as arthrotomography in confirming disc displacement, although the best correlation to the surgical findings was shown by the clinical examination. Correlating MRI with clinical and surgical (33 patients) findings in 55 patients, Kerstens et al¹⁵ stressed the frequency of partial anterior displacement, which in their study could explain why the MRI could not show the disc displacement in some cases.

The present findings confirmed the reproducibility of the method: after 1 year, the radiologist found that the position of the disc was similar to that determined upon initial examination in 90% of the patients.

The most apparent problem with all clinical TMD studies is that a "gold standard" is lacking. This is a serious handicap especially in evaluating the usefulness and reliability of a new technique,

as in this study. In an attempt to approximate the gold standard more accurately than with the findings of the initial clinical examination alone, the present study correlated the MRI diagnosis with a "final" clinical diagnosis based also on the outcome of the conservative or surgical treatment. Further, the statistical method used allowed the reliability of the MRI findings to be assessed for each of the diagnoses. The results indicated that the use of MRI for determining disc position is a very sensitive but less specific technique: a false-positive result for CL was frequently noted. For ADDR the predictive capacity was fair, while the use of MRI to indicate normal disc position (MYO) could be considered very reliable.

One can question the way in which the final clinical diagnosis was reached; however, the course and result of the treatment provided a clear diagnosis in many doubtful cases. For example, a patient with a mouth opening limited to 25 mm is given muscle relaxants and instructions not to clench the teeth. If the patient were to return after 3 weeks with a normal mouth opening of 50 mm, with no recollection of "feeling something slip back in the joint," a diagnosis of myogenous origin of limitation became more probable.

In 5 patients in whom joint surgery was performed, the CL situation could not be confirmed. Several explanations are possible: (1) the total muscle relaxation induced by the general anesthesia might have enabled the disc to slip back (partially); (2) the disc was only partially dislocated, ie, on the medial side of the condyle, while the surgical technique used enabled a clear view only of the lateral and posterior parts; (3) other factors (capsular impingement, compression of retrodiscal tissue, irritation of synovial tissue, hypervascularity) could have contributed to the problem of limitation of mouth opening.¹⁶ Some explanations, on the other hand, also exist for a false MRI diagnosis. Since in some cases the distinction between the disc and the tendon of the lateral pterygoid muscle is difficult, confusion might arise concerning disc position. Similarly, a problem might exist in discerning the location of the posterior band because of the fibrous adaptation of the retrodiscal tissue. Further, the fat pad of the lateral pterygoid muscle, which is often taken as a landmark by the radiologist, might in fact blur the view of the disc and muscle attachment. This error would occur more frequently if a sagittal projection were used and would be prevented using a projection following the axis of the lateral pterygoid muscle.¹⁷ Finally, some recent studies indicate that the orientation of the collagen fibers might cause confusing

images, especially in the posterior band and retrodiscal zone.¹⁸

Conclusion

The results of this study confirm the great potential of MRI in diagnosing the cause of limited mouth opening, although that false-positive results for closed lock lower its specificity. Recent developments allowing serialization of static pictures into a "dynamic" MRI, may enhance the diagnostic precision. The reliability, sensitivity, and specificity of this technique must be established.

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References

1. Harms SE, Wilk RM, Wolford LM. The temporomandibular joint: Magnetic resonance imaging using surface coils. *Radiology* 1985;157:133-136.
2. Katzberg RW, Bessette RW, Tallents RH. Normal and abnormal temporomandibular joint: MR imaging with surface coil. *Radiology* 1986;158:183-189.
3. Carr AB, Gibilisco JA, Berquist TH. Magnetic resonance imaging of the temporomandibular joint: preliminary work. *J Craniomandib Disord Facial Oral Pain* 1987; 1:89-96.
4. American Academy of Craniomandibular Disorders. *Craniomandibular Disorders: Guidelines for Evaluation, Diagnosis, and Management*. Chicago: Quintessence, 1990.
5. Casselman JW, et al. L'IRM dynamique de l'articulation temporo-mandibulaire: technique et application. *Ann Radiol* 1990;33:379-389.
6. Armitage P, Berry G. *Statistical methods in Medical Research*, ed 2. London: Blackwell, 1987;115-120, 512.
7. Hansson N, Wessman C, Öberg T. Säkrare diagnoser med ny teknik. *Tandläkartidningen* 1980;72:1372-1374.
8. Friedman MH, Weisberg J. *Temporomandibular Joint Disorders: Diagnosis and Treatment*. Chicago: Quintessence, 1985.
9. Palla S. Neue Erkenntnisse und Methoden in der Diagnostik der Funktionsstörungen des Kauapparates. *Schweiz Monatsschr Zahnmed* 1986;96:1329-1351.
10. Naeije M, Hansson TL. Electromyographic screening of myogenous and arthrogenous TMJ dysfunction patients. *J Oral Rehabil*, 1986;13:433-441.
11. Bezuur N. *The Recognition of Craniomandibular Disorders* (thesis). Acta Amsterdam, 1988.
12. Helms CA, Kaplan P. Diagnostic imaging of the temporomandibular joint: Recommendations for use of the various techniques. *Am J Radiol* 1990;154:319-322.

13. Rao VM, Farole A, Karasick D. Temporomandibular joint dysfunction: Correlation of MR imaging, arthrography and arthroscopy. *Radiology* 1990;174:663-667.
14. Donlon WC, Moon KL. Comparison of magnetic resonance imaging, arthrotomography and clinical and surgical findings in temporomandibular joint internal derangements. *Oral Surg Oral Med Oral Path* 1987;64:2-5.
15. Kerstens HCJ, Golding RP, Valk J, van der Kwast WAM. Magnetic resonance imaging of partial temporomandibular joint disc displacement. *J Oral Maxillofac Surg* 1989;47:25-29.
16. Nitzan DW, Dolwick MF, Heft MW. Arthroscopic lavage and lysis of the temporomandibular joint: A change in perspective. *J Oral Maxillofac Surg* 1990;48:798-801.
17. Yang X, Hong M, Hu X. A new imaging projection for the temporomandibular joint and lateral pterygoid muscle. *J Craniomandib Disord Oral Facial Pain* 1991;6:32-40.
18. Roberts D, Scapino RA, El-Moneim Zaki A, Daniel J, Lenkinski RE, Cohen SG. Relationships between magnetic resonance signal and TMJ tissue. In: *Temporomandibular Joint Imaging*. St Louis: Mosby, 1989;129-146.

Resumen

Correlaciones entre los hallazgos clínicos, las imágenes de resonancia magnética y los resultados clínicos en casos de limitación de la apertura bucal miógena o artrógena

Se evaluaron la reproducibilidad y el poder pronosticable del sistema de diagnóstico a base de imágenes de resonancia magnética (IRM), en un grupo de 70 pacientes que estaban limitados en su apertura bucal. Se evaluó la fiabilidad del poder pronosticable de los hallazgos suministrados por las IRM, a través de la comparación de las imágenes con el diagnóstico clínico final. Este estaba basado en el diagnóstico clínico inicial, corregido y mejorado, en lo posible, por medio de los hallazgos hechos durante el periodo de tratamiento (tratamiento conservativo en 51 pacientes, tratamiento conservativo y quirúrgico en 19 pacientes). En general la reproducibilidad de la interpretación de las IRM por parte del radiólogo fue muy buena. La fiabilidad del poder pronosticable fue excelente en los casos en que la posición del disco estaba normal, y buena en los casos de desplazamiento anterior del disco con reducción. En los casos de desplazamiento del disco sin reducción, sin embargo, el poder pronosticable fue cuestionado debido a los hallazgos positivos-falsos de las IRM.

Zusammenfassung

Myogene oder arthrogene Einschränkung der Mundöffnung: Wechselbeziehungen zwischen klinischen Befunden, MRI und Behandlungsergebnis

Die Reproduzierbarkeit und die Voraussagekraft der MRI-Diagnostik wurde an einer Gruppe von 70 Patienten mit eingeschränkter Mundöffnung untersucht. Der prognostische Zuverlässigkeitswert der MRI-Befunde wurde durch den Vergleich der MRI-Diagnosen mit der definitiven klinischen Diagnose beurteilt. Diese basierte auf der initialen Diagnose, wurde aber wenn nötig durch Befunde während der Behandlungsperiode im Detail berichtigt und verfeinert. 51 Patienten erhielten nur eine konservative, 19 eine kombinierte konservativ-chirurgische Behandlung. Die Reproduzierbarkeit der MRI-Diagnosen durch den Radiologen war sehr gut. Die prognostische Zuverlässigkeit war für normale Diskuspositionen ausgezeichnet und für Diskusverlagerungen mit Reposition ausreichend. Jedoch war die Voraussagekraft von Diskusverlagerungen ohne Reposition wegen zahlreicher falsch-positiver Befunde im MRI fraglich.
