MRI Grading of the Temporomandibular Joint for Internal Derangement

Dissertation submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH I
ORAL AND MAXILLOFACIAL SURGERY
FEBRUARY – 2005

CERTIFICATE

This is to certify that the dissertation entitled "**MRI GRADING OF THE TEMPOROMANDIBULAR JOINT FOR INTERNAL DERANGEMENT"** is the bonafide work done by **Dr. SRIKAR M.V,** Post Graduate student, in the Department of Oral and Maxillofacial Surgery of Saveetha Dental College and Hospitals, Chennai under our guidance and supervision towards the partial fulfillment of the requirement for the degree of **"MASTER OF DENTAL SURGERY"** Branch – I Oral and Maxillofacial Surgery, February 2005 under The Tamil Nadu Dr. M.G.R. Medical University, Chennai.

Prof. M.R. MUTHUSEKHAR, M.D.S,
Guide & Head of the Department,
Dept. of Oral & Maxillofacial Surgery
Saveetha Dental College & Hospitals
Chennai – 600 077.

Prof. M.F. BAIG, M.D.S.,
Dean
Saveetha Dental College & Hospitals
Chennai – 600 077.

Place : Chennai
Date :

CONTENTS

1. INTRODUCTION

2. MRI ANATOMY OF TMJ

3. AIMS AND OBJECTIVES

4. REVIEW OF LITERATURE

5. CASE REPORTS

6. RESULTS

7. DISCUSSION

8. SUMMARY AND CONCLUSION

9. BIBLIOGRAPHY

INTRODUCTION

Technological Advances continue to give us clinicians better and advanced tools while looking at the marvel of the human body.

What started as an event of Scerendibity on that eventful night of Nov. 16th 1986, in the Laboratory of Prof. Welhelm Conard Roentgen, has metamorphosised into a science fiction.

The scenario of digital imaging in which all the principles of image formation have been turned on its head.

Naul L.G. Santiago J.M. (Post. Grad. Med. 2007) has emphasized that ever imaging have revolutionized, health care by providing details of anatomical depth which were not evident earlier.

Scientists started looking at newer concepts of imaging modalities and found that magnetic waves, sound waves and heat waves could give us safe image of differing sharpness.

Paul Leutenbar, in the year 1973 was the first to demonstrate the use of MRI as Magnetic Waves to generate readable images from these, we have

come along way to such fine digital images that specific technique are being recognized for MRI Imaging for the Temporomandibular joint.

The advent of Magnetic Resonance imaging of the Temporomandibular joint has gained wide acceptance in the evaluation of various osseous pathologic conditions, articular disc position, synovial fluid effusion Condyle marrow abnormalities and its relations to various functional disturbances of the joint.

It provides a direct form of soft tissue visualization with excellent spatial and contrast resolution on sagittal and coronal Magnetic resonance images of the joint.

It also offers the advantages of being non-invasive painless, of minimal risk potential and above all, free of ionizing-radiation exposure.

Over the years, MRI has been shown to have high sensitivity and specificity for identification of condyle disc relationships.

The rapid progress in the TM joint imaging techniques specially referring to the MR imaging, Internal Derangements have increasingly thought to be involved in the development of pain and joint dysfunction.

Magnetic resonance imaging provides almost 95% diagnostic accuracy in determining the disc-condyle relationship in patients diagnosed for dysfunction of joint, when coronal and sagittal imaging techniques are made use of.

The signal intensity within the temporomandibular joint spaces, T_1 and T_2 (weighed), explains the relaxation time and determines various morphologic changes related to both hard and soft tissue structures including the synovial fluid.

Effusion is the term need by radiologists for a hyperintensity signal seen inside a joint on an MRI.

The behaviour of various structures within the joint, like the disc, the retrodiscal tissue, bilaminar zone, osseous and soft tissue articulating surfaces, their relationship to the adjacent structures undergoing progressive morphologic changes associated within pain and dysfunction of the joint are very clearly evident on both the sagittal and coronal spatial positions on an MRI.

When Imaged in various spatial planes the meniscus is clearly identified and its anatomy and relationship to the condyle is clearly related on image sequences.

Fast imaging sequences allow rapid data acquisitions and it is possible to study the total volume of the joint.

The signal depends on the sequence used contrast increases as the repetition time (TR) between radio-frequency pulses is increased.

This is because the meniscus consists of fibrous material with no signal compared to the surrounding tissues, the signals of which increase with TR.

Unfortunately longer TR leads to an increased examination time.

It is possible to page through slices in real time giving a dramatic feel for the anatomy of the joint.

A normal disc has a bi concave or peaked cap appearance on Sagittal MR Images that begins to deform after the disc is displaced anteriorly.

The degree of disc deformation is related to the degree of disc displacement.

The disc in an acute locking state could be reducible, but a non-reducing disk and the surrounding tissues experience gradual alterations.

The clinical Diagnostic criteria for temporomandibular disorders classifies the most common forms of temporomandibular disorders into the main diagnostic sub-groups of masticatory muscle disorder, temporomandibular joint degenerative disease, Internal derangement and fluid effusion.

The temporomandibular joint imaging techniques can be used to validate the criteria for the diagnosis of the temporomandibular joint internal derangement and degenerative disease.

Magnetic resonance imaging is currently the most accurate imaging modality for identification of disc condyle relationships, positions, morphologic changes, staging of various derangements associated with the disc, early degenerative joint disease and finally fluid effusion.

Magnetic resonance imaging might be regarded as the Gold Standard for imaging the soft tissue components of the complex apparatus of the Temporomandibular joint.

REVIEW OF LITERATURE

1. HARMS SE, in the year 1985, studied the various disc positions and its morphogenic pattern in 57 patients using surface coils. Described the relationship between the disc and the condyle on the MRI and was able to demonstrate internal derangement on the same in patients with limited mouth opening and pain.

2. ISBERG A, 1986, studied the joints in patients with chronic temoporomandibular joint dysfunction. 88 patients with TM joint dysfunction were imaged with T_2 weighed sequences and found hyperplastic soft tissue formation associated with internal derangement of the T.M. joint.

3. DONLON W.C. 1987, evaluated 24 temporomandibular joints by means of tomography and magnetic resonance imaging. The joints were evaluated for disc displacement degenerative joint disease and for perforations.

4. KERSTENS HC, 1989, evaluated 55 patients who were symptomatic, by performing unilateral MRI and observed the position of the anticular disc in relation to the condyle, particular alteration was paid to partial or complete anterior positioning of the disc.

5. MITCHELL DG, 1989, studied the mri images of 29 hip joints for alterations within the osteonecrosis and reactive zones

6. SCHELLHAS KP, 1990, did an imaging study of MRI on 100 patients, and studied the facial skeletal remodeling due to temporomandibular joint degeneration.

7. MUSGRAVE MT, 1991, studied the magnetic resonance imaging of the temporomandibular joint by various oblique scanning planes in patients diagnosed for internal derangement.

8. HOLMUND, ABM, 1992, studied disc derangement and inflammatory changes in the posterior disc attachment of the temporomandibular joint. He reported low signal intensity in the posterior disc attachment in patients diagnosed for disc displacement with reduction.

9. PAESANI D, 1992, studied to determine the prevalence of temporomandibular joint interval derangement in patients with cranio-mandibular disorders. With variations in the condylar morphology and osseous changes in the Glenoid compartment, he reported the incidence of internal derangement in such patient on magnetic resonance imaging of the TM joint.

10. PER-LENNART WESTESSON, 1993, observed decreased signal intensity from the Retro discal tissue which he evaluated in 69 patients with pain using MRI and concluded that decrease signal in that region was associated with late stages of disc displacement.

11. MARK M TASAKI, 1993, studied to determine the value of axial Images for Diagnosis of disc displacement and osseous changes in 29 TM joints.

12. ROMANELLI GG, 1993, performed a prospective study on patients with signs and symptoms of temporomandibular joint pain dysfunction on sagittal recording MRI device, and examined for presence of internal derangement by methods under consideration.

    Incidence of bilateral internal derangement was also assessed.
    Internal derangement was found more in asymptomatic volunteers than in patients with dysfunction.

13. WILLIAM. S, 1994, reported 73 patients (104 joints) with MRI signal intensity changes of the mandibular condyle as described by Schellhas and Wilkes and findings of condyle surface disease in staged internal derangements.

14. BYUNG HO CHOI, 1994, studied Ten Temporomandibular joints with closed lock treated non surgically on MRI, relationship of the non-reducing disc to the condyle was established.

15. MARGUELLES – BONNET RE, 1995, compared the clinical diagnosis of patients with internal derangement of temporomandibular joint with findings on magnetic resonance imaging.

Clinical examination was conducted on 242 patients. They were divided into:

1. Disc displacement with reduction.
2. Disc displacement without reduction
3. Stuck disc
4. Degenerative arthrosis with or without one of the above.
5. Normal temporomandibular joint on the contralateral side.

The best clinical diagnosis in relation to the magnetic resonance imaging findings was arthrosis followed by categories of normal joint, disc displacement with reduction, stuck disc and disc displacement without reduction in the descending order.

16. MULLER – LEISSE C, 1996, studied various magnetic resonance images of temporomandibular joints of both patients with anterior disc

dislocation with reduction and without reduction and correlated with the clinical history and data.

MRI images showed that patients with disc dislocation without displacement revealed variable degree of disc deformation, and a thinned bilaminar zone in each of the joints which clearly differed from patients with disc dislocation with reduction.

17. CHOLIT GUL W, 1997, did a study to describe the clinical and MRI findings in patients with disc displacement of the T.M. joint. 88 joints were examined in which 51 patients were suspected for disc displacement as examined by MRI.

    Clinical findings were obtained by retrospective review of patients records.

    Anterior disc displacement with reduction was found in 39 joints, anterior disc displacement without reduction in 30 joints, and abnormal configuration of both disc and condyle in 5 patients.

18. TORE-A LARHEIMM, 1998, study was based on 35 joints and posterior disc displacement and a control material of bilateral TM J images of 62 healthy volunteers. The images were analysed, and criteria for posterior disc displacement were developed.

19. BRIAN NEBBE, 1998, 104 adolescent patients were evaluated using Sagittal magnetic resonance imaging and slices were observed and concluded that reduction in disc length associated with increased severity of disc displacement.

20. ADAM CG, 1998, studied to correlate the clinical and imaging features of synovial fluid effusion with the ultimate purpose of clarifying its meaning in dysfunctional processes of the temporomandibular joint. Thirty patients randomly selected, and five clinical variables (articular pain, radiating pain, limited mouth-opening, clicking and clinical staging were included. Five Image findings like disc displacement, effusion, disc morphology, Osteophytes, avascular reccosis and Osteochondritis desseeans). His study concluded that effusion may be a market of articular degeneration in the temporomandibular joint.

21. TAKAKU. S, 1998, made a comparatative study between magnetic resonance imaging and pathologic findings in patients with disc displacement without perforation.

Eleven symptomatic patients and thirty asymptomatic patients underwent MRI using three dimensional fast imaging with a steady precession sequence (FISP) acquisition technique.

FISP (3D) showed low signal intensity in the anterior band and the intermediate zone of the disc, and high signal intensity in the posterior and of disc and retrodiscal tissue in symptomatic patients, where as odematous changes were seen in 7 patients.

Study showed that pathologic changes in the disc and the retrodiscal tissues were accurately depicted on an MRI using FISP – 3D.

22. STEPHEN B. WILLIAM, 1999, observed the association between temporomandibular joint pain with abnormal marrow in the mandibular condyle, evaluated patients with T.M. joint disorders on T_2 – weighed proton density images, and association of bone marrow effusion on MRI related to pain.

23. HIROSHI KURITA, 2000, studied the morphology of the articular eminence of the temporomandibular joint as a predisposing factor for disc displacement. 151 patients with disorders were chosen, and it

appeared that disc displacement is likely to be found in joints with shallow articular eminence.

24. B. NEBBE, 2000, studied 60 MRI's of adolescent temporomandibular joints were randomly drawn for evaluation by 4 observers. All observers independently classified disc position on sagittal magnetic resonance images. Outcome of his study was that interobserver agreement is however, not uniform across all categories of disc position described.

25. RUDIGER EMSHOFF, 2000, studied the relationship to interval derangement type, Osteoarthrosis and synovial fluid mediator levels of tumor nurosis factor – α in 23 patients with T.M. joint disorders.

    Bilateral Sagittal and coronal MRI images were obtained. The results suggested that the T.M. joint condition of capsulitis / synovitis are related to TM J – side specific. MRI diagnosis of internal derangement and the type, and synovial fluid aspirate findings of TNF α – level.

26. TSUKASA SANO, 2000, investigated the association between temporomandibular joint pain and bone marrow alterations in the

mandibular condyle seen on magnetic resonance imaging 112 patients with disc displacement without reduction, were compared with a control group of 78 patients with normal bone marrow. The analysis was based on T_2 weighed MR images in both sagittal and coronal images. Concluded by saying that intense pain in patients with non reducable disc were associated with bone marrow abnormalities.

27. RUDISCH A, 2001, evaluated Magnetic resonance images to investigate the relationship between the presence of temporomandibular joint pain and magnetic resonance imaging finding of internal derangement and effusion. Study comprised of 41 patients with TM Joint pain. Study revealed a significant relationship between the clinical finding and TM Joint internal derangement and effusion.

28. WESTESSON P, 2001, performed a comparative study for prevalence and type of temporomandibular joint disc displacement in asymptomatic patients with those in patients.

    58 patients were examined using both sagittal and coronal images.

The study concluded with TM Joint disc displacement was less prevalent and of a different type in asymptomatic volunteers compared with patients with dysfunction.

29. LARHEIM TA, 2001, studied the evidence of temporomandibular joint fluid and condyle marrow alterations, in asymptomatic and symptomatic patients.

Using T_2 weighed images of 62 asymptomatic and 58 symptomatic patients were analysed for fluid and condyle marrow alterations.

10% of Symptomatic patients had abnormal bone marrow, six patients had disc displacement and 2 patients had moderate or marked fluid.

30. INNER HOFER K, 2001, performed a study to investigate whether in patients with TM J related pain, the variable of TM J pain may be linked to magnetic resonance findings of internal derangement.

The study comprised 163 consecutive TM J pain patients.

Results of the study suggested that the clinical variable of TM J pain may have a significant effect on the prevalence of MR imaging diagnosis of TM J Internal Derangement.

31. RUDIGER EMSHOFF, 2001, studied the reliability of clinical diagnosis in predicting magnetic resonance imaging diagnosis of T.M. joint internal derangement and Osteoarthrosis in patients with temporomandibular joint disorders.

Concluded that the classification system of the clinical diagnostic criteria for T.M. joint disorders, and should be supplemented by evidence from cross-sectional and longitudinal. Investigations to access decisive differences in areas of pathogenesis, treatment and prognosis.

32. OGUTEN – TOLLER, 2002, studied 126, temporomandibular joints of 63 patients with T.M. joint disorders and investigated using MRI with clinical findings.

In this study, they found that smaller the degree of displacement, the milder the internal derangement and the intra capsular effusion was more frequently associated with T.M. joints with anterior disc displacement without reduction.

33. EMSHOFF R, 2002, studied magnetic resonance imaging findings of internal derangement in temporomandibular joints without a clinical diagnosis of T.M. joint disorder.

109 patients without a clinical diagnosis of T.M. joint disorder were chosen for the study.

The results suggest TM J's with a clinical diagnosis of absence of T.M. joint disorders to be associated with a high rate of internal derangements, while in these instances the clinical variable of T.M. joint pain may have no effect on prevalences of Magnetic Resonance Imaging.

34. STYLES C, 2002, evaluated MRI in assessment of internal derangement and pain within the temporomandibular joint.

It was in this pictorial essay they aimed to illustrate the normal temporomandibular joint and common abnormalities of the Osseous, Cartilaginous and Soft tissue components. These included disc displacement, deformities perforations, abnormalities of disc condylar movement, joint effusions, etc.

35. HAITER – NETO, 2002, studied the disc position and the bilaminar zone of the temporomandibular joint in asymptomatic young individuals by Magnetic resonance imaging.

80 TM Js of 40 symptom free individuals were taken for the study.

The results revealed that the superior band remained consistently in contact with the fossa at both closed and open mouth position in these individuals.

36. TASKAYA YALMAZ, 2002, studied 131 temporomandibular joints with internal derangement using magnetic resonance imaging in addition to clinical examination. As the MRI results correlated well with the clinical findings, they concluded that diagnostic methods such as MRI could be used for surgical planning and in difficult cases to diagnose pathological conditions of the T.M. joint.

37. JONG-KI HUH, 2003, evaluated 612 bilateral temporomandibular joints to determine the features of synovial fluid, the shape of the disc and the presence of disc displacement. The study concluded with results as synovial fluid collection, which was observed on T_2-weighed MRI's, is more frequent in early stage of disc displacement with reduction, in addition high signal intensity within the disc space should be considered a simple matter of fluid collection.

38. EMSHOFF R, BRANDLMAIER, 2003, evaluated 338 MRI's of 169 patients to study whether common magnetic resonance imaging variables such as temporomandibular joint, internal derangement, Osteoarthrosis, effusion and bone marrow Odema were predictive of TM Joint pain.

39. YAMAMOTO M, 2003, studied the magnetic resonance evidence of joint fluid with temporomandibular joint disorders on 293 patients, who were divided into painful and non-painful categories. Larheim et. al grading system was used for analyzing the relationship between TM joint fluid and TM joint status and pain.

    The study revealed that joint effusion is likely to appear in painful T.M. joints with disc displacement without reduction. Joint effusion may be an abnormal entity suited to joints with disc displacement without reduction.

40. HUH JK, 2003, studied 614 bilateral T.M. joints to determine the features of synovial fluid, shape of the disc, presence of disc displacement without reduction.

    The states of the joint was categorized as

1. Normal disc position.
2. Disc displacement with reduction
3. Acute disc displacement with reduction.
4. Sub-acute disc displacement with reduction.
5. Chronic disc displacement with reduction.

The shape of the disc was characterized as one of the following:

1. Bi concave
2. cap shaped
3. Cup shaped
4. flattened
5. eye glass shaped
6. Amorphous or discontinuous.

The results of the study concluded that synovial fluid effusion was seen in early stages of disc displacement with reduction using T_2 – weighed images.

41. JAIME GATENO, 2004, studied 26 MRIs of the temporomandibular joints with anterior disc displacement and compared them with 14 normal joints to determine the position of the mandibular condyle in both the control group and patients with anterior disc displacement.

The position of the Condyle was determined by using 2 different methods.

a. measuring the horizontal and vertical normalized distances.

b. Calculating the anteroposterior joint space ratio.

The results of the study reported that the condyles of patients with Anterior disc displacement were situated more posterior and superior in the fossa than in the control group.

42. MARC SCHMITTER, 2004, performed a comaparative analysis of Magnetic Resonance Imaging and a clinical examination based upon a specific set of criteria, of temporomandibular joint pathosis in patients with myofasical pair. 61 patients were chosen of whom 2 groups were divided as first foup who were diagnosed to have myofascial pain and limited mouth opening, whereas 25 patients who belonged to the second group had myofascial pain without limited mouth opening.

The study reported that restricted mandibular mobility is frequently associated with temporomandibular joint disease that were not identified during clinical examination and an adaptation of the classification scheme used for TM joint disorders may result in improvement of the sensitivity of clinically joint related diagnosis.

SUMMARY AND CONCLUSION

The present MRI study was designed to evaluate the temporomandibular joint dysfunction and its characteristic changes on these images which could be correlated in patients suffering from the same disorder.

Out of the 5 joints, of the symptomatic group patients with moderate to severe pain had progressive joint disease with the diagnosis of non-reducible disc with no degenerative changes.

Although one case of clinically diagnosed case of dysfunction did not show any signs of disc displacement and effusion on the MRI.

Based on the results of this study, Magnetic Resonance Imaging for T.M. joint dysfunction i.e. for disc displacement categories associated with effusion and condyle marrow abnormalities along with varying degrees of pain, MRI is the imaging technique of choice to diagnose, evaluate, the components of the joint and their relationships between each other in normalcy and disease, which has already been proven as the Gold standard technique for imaging of the T.M. joint.

The relationship between clinical diagnosis of T.M. joint dysfunction and its correlation on an M.R.I. can be considered and recommended as an confirmatory imaging technique of choice considering the cost and availability of this facility, for patients where all conservative treatments have failed, so that a proper diagnosis and treatment can be decided and carried over .

More such studies with large patient groups are necessary in this regard.

BIBLIOGRAPHY

1. Adam C.G. Effusion In Magnetic Resonance Imaging of the Temporomandibular Joint. A Study of 123 joints.
   Journal of Oral and Maxillo-Facial Surgery 1998 March Vol. 56 (3) 314 – 318.

2. BRANDLAMAIER, Relative Odds of Temporomandibular Joint Pain as a function of Magnetic Resonance Imaging findings of Internal Derangement, Osteoarthritis, Effusion and Bone Marrow Odema.
   Oral Surg Oral Med Oral Path Oral Radiol End Od 2003 Vol. 4 p. 437 – 445.

3. BRAINNEBBE P.W. MAJOR:- Quantitative Assessment of Temporomandibular Joint Disc Status. Oral Surg Oral Pathol 1998, Vol. 85, 598 -607.

4. B. NEBBE, S L BROOKS,

Magnetic Resonance Imaging of the Temporomandibular Joint: Interobserver Agreement in subjective classification of Disk status.

Oral Surg Oral Med Oral Pathol Oral Radiology Endodontics 2000, Vol 90, p 102 – 107.

5. BYUNG HO CHOI AND JAE HA YOO:- Comparison of Magnetic Resonance Imaging before and after non-surgical treatment of closed lock.

Oral Surg Oral Med Oral Pathol 1994, Vol.78, p. 31-35.

6. CHOLIT GUL. W, NISHIYAMA. Clinical and Magnetic Resonance Imaging findings in Temporomandibular Joint Disc displacement.

Journal of Dentomaxillo Facial Radiology 1997 May 26 Vol. 3 p.183 – 188.

7. DONLON W C, MOON K L,

Comparison of Magnetic Resonance Imaging, Arthrotomography and Clinical and Surgical Findings in Temporomandibular Joint

Internal Derangement. Oral Surg Oral Med Oral Pathol 1987 July vol. 64, p. 2 – 5.

8. EMSHOFF. R

Magnetic Resonance Imaging Findings of Internal Derangement in Temporomandibular Joints without a clinical diagnosis of Temporomandibular Disorder.

Journal Oral Rehabilitation 2002 June 29 Vol. 6 p 516-522.

9. EMS HOFF RUDIGER,

Christoph Schmid. Bone Marrow Edema of the Mandibular Condyle related to Internal Derangement, Osteoarthrosis and Joint Effusion. Journal of oral and Maxillo Facial 2003 Surgery Vol. 61 p. 35-40.

10. EMS HOFF RUDIGER,

Clinical Versus Magnetic Resonance Imaging Diagnosis of Temporomandibular Joint Internal Derangement and Osteoarthrosis.

Oral Surg Oral Med Oral Path Oral Radio Endod 2001. Vol. 91, p 50-55.

11. HAITER NETO HOLLENDER. L. Disk position and the Bi Laminar zone of the Temporomandibular Joint in Asymptomatic Young individuals by Magnetic Resonance Imaging.

Oral Surg Oral Med. Oral path Oral Radio Endod 2002 Sep. Vol.3 p.372 – 378.

12. HIROSHI KURITA, AKILIO OHTSUKA

The Relationship between the Degree of Disk Displacement and ability to perform Disc Reduction Oral Surg Oral Med. Oral Pathol Oral Radiol Endod 2002, Vol. 90 p.16-20.

13. HOLMUND ABM. GYNTHER GW.

Disk Derangement and Inflammatory changes in the posterior Disk attachment of the Temporomandibular Joint. Oral Surg Oral Med. Oral Pathol Oral Radiol Endod 1992 Vol.73 p. 9 – 12.

14. HUH JK.,

Magnetic Resonance Imaging of Temporomandibular Joint Synovial Fluid Collection and Disk Morphology Oral Surg Oral Med. Oral Pathol Oral Radiol Endod 2003 Vol.95 p.665-671.

15. INNER HOFER, K. RUDISCH relationship between Temporomandibular Joint Pain and Magnetic Resonance Imaging findings of Internal Derangement. Int. Journal of Oral and Maxillo Facial Surgery 2001 April 30 Vol. 2 p. 118 – 122.

16. ISBERG. A. ISACSSON G.

Hyperplastic Soft Tissue – Formation in the Temporomandibular Joint associated with Internal Derangement. Oral Surg Oral Med. Oral Pathol. 1986, Vol.61, p.31 – 38.

17. JAIME GATENO PAUL B. ANDERSON

A Comparative Assessment of Mandibular Condylar position in patients with anterior disc displacement of the Temporomandibular Joint.

Journal of Oral and Maxillo- Facial. Surg. 2004 Vol.62 p.39 – 43.

18 KERSTENS H.C.

Magnetic Resonance imaging of partial Temporomandibular Joint Disc Displacement.

Journal Oral Maxillofac Surg. 1989. Jan. 47 Vol. 1 p.25 – 29.

19. LARHEIM T.A.

MR Evidence of Temporomandibular Joint Fluid and Condyle Marrow Alterations: Occurrence in Asymptomatic Volunteers and Symptomatic patients.

Int Journal Maxillo Fac Surgery 2001. April 30. Vol. 2 p.113 – 117.

20. MARC SCHMITTER

Temporomandibular Joint Pathosis in Patients with Myofascial Pain. A comparative analysis of Magnetic Resonance Imaging and A clinical examination based on a specific set of criteria.
Oral Surg. Oral Med. Oral Pathol Oral Radiol Endod 2004 Vol.97 p.318-324.

21. MARGUELLES, BONNET RE
Clinical Diagnosis compared with findings of Magnetic Resonance Imaging in 242 patients with Internal Derangement of the T.M.J.
J. Orofac Pain 1995 9 Vol. 3 p.244 – 253.

22. MARK M. TASAKI
Magnetic Resonance Imaging of the Temporomandibular Joint. Valud of Axial Images.
Oral Surg. Oral Med. Oral Pathol 1993 Vol. 75 p. 528 – 531.

23. MULLER - LEISSE
Anterior Disc Displacement without reduction in the Temporomandibular Joint. MRI and Associated Clinical Findings.
J Magn Reson Imaging 1996 Sept. Oct. Vol.6(5) p.769-774.

24. MUSGRAVE M T, WESTESSON P L, Magnetic Resonance Imaging of the Temporomandibular Joint by Oblique Scanning Planes Oral

Surg Oral Med. Oral Pathol, Oral Radiol Endod 1991 Vol. 71 p. 525 – 528.

25. MITCHELL DG, Steinberg M.E. Magnetic Resonance Imaging of the Ischemic Hip: Alterations within the Osteonecrotic, viable and Reactive Zones . clinical orthop 1989 vol 60 p - 244

26. OGUTCEN – TOLLER. M

Evaluation of Temporomandibular Joint Disc Position in TMJ Disorders using MRI. Int J. Oral Maxillo Fac Surg. 2002 Vol.31 p.603 – 607.

27. PAESANI D

Prevalence of Temporomandibular Joint Internal Derangement in Patients with Cranio Mandibular Disorders.

AM J Ortho Dentofacial Orthop 1992, Vol.101, p. 41-47.

28. RUDISCH A.

Relationship between Temporomandibular Joint Pain and Magnetic Resonance Imaging Findings of Internal Derangement.

Int. J. Oral MaxilloFac Surg 2001 Apr. 30. Vol. 2 p.118 – 122.

29. ROMANELLI G.G – HARPER. R.

Evaluation of Temporomandibular Joint Internal Derangement.

J Orofac Pain 1993 Vol. 3 p.254-262.

30. RUDIGER EMSHOFF:

Temporomandibular Joint Pain:

Relationship to Internal Derangement Type, Osteoarthrosis and Synovial Fluid Mediator Level of Tumour Neorosis Factor – x.

Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000 Vol.90 442- 449.

31. SCHELLAHAS K P, PIPER M.A.

Facial Skeletal Remodelling due to Temporomandibular Joint Degeneration – An imaging study of 100 patients. AJNR 1990 Vol.II P.541 – 551.

32. STEMEN M.S., PHILIP R.B.

MRI Assessment of Acute Soft Tissue Inflammation.

Journal Oral Maxillofac Surg. 1995, Vol.53, p. 763 – 766.

33. STEPHEN B. MILLAM

The Association of Temporomandibular Joint Pain with Abnormal Bone Marrow in the Mandibular Condyle.

J Oral Maxillo Fac Surg – 1999, Vol. 58, 258 – 259.

34. STYLES C, WHYTE A

MRI in Assessment of Internal Derangement and Pain within the Temporomandibular Joint: A pictorial Essay.

British J Oral Maxillofac Surgery 2002 Jun. Vol.40 (3) p. 220-228.

35. SULLIVAN, S BHAGATHI

MRI of Acute Soft Tissue injuries of the T.M. Joint.

36. TAKAKU. S

A comparison between Magnetic Resonance Imaging and Pathologic findings in patients with Disc Displacement.

J Oral Maxillofac Surg. 1998. Feb.56 Vol. 2 p.171-176.Journal of Oral Maxfac Surg. 1995, Vol.53 p.763 – 767.

37. TASAKAYA YALMAZ

The Evaluation of Temporomandibular Joint Disc Position in TMJ. Disorders using MRI

INJ Journal of Oral Maxillofac Surgery 2002 Dec.31 Vol. (6) p.603 – 607.

38. TORE A LARHEIM

Posterior Disc Displacement in the Temporomandibular Joint.

Journal Oral Maxillofac Surg. 1998, Vol.56, 1266 – 1273.

39. TSUKASA SANO

The Association of Temporomandibular Joint Pain with Abnormal Bone Marror in the Mandibular Condyle.

Journal Oral Maxillofac Surg 2000 p.254 – 257. Vol.58

40. WESTESSON PL

MR Evidence of Temporomandibular Joint Fluid and Condyle Marrow Alterations: Occurrence in Asymptomatic Volunteers and Symptomatic patients.

INT Journal Oral Maxillofac Surg. 2001 Apr – 30 Vol. 2 p.113-117.

41. WILLIAM S.

Sagittal Magnetic Resonance Image Characteristics and Surgical Findings of Mandibular Condyle Surface Disease in staged internal derangements.

J Oral Maxillofac Surg. 1994. Vol. 52 P. 64 – 68.

42. YAMAMOTO. M

Magnetic Resonance evidence of Joint Fluid with Temporomandibular Joint Disorders.

J Comput Assist Tomography 2003 Sept – Oct: Vol. 27(5) 694 – 698.