What MR imaging finding best correlates with TMJ pain?

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Learning Objectives

1. To illustrate unusual and less well understood causes of temporomandibular joint (TMJ) pain and dysfunction.
2. To illustrate the MR difference of internal derangement in asymptomatic and symptomatic patients.

Introduction

Improvements in diagnostic imaging of the temporomandibular joint (TMJ) (Fig.1) during the last two decades have shown that disk displacement is the most frequent abnormality in patients with pain and dysfunction relative to the TMJ.

The clinical introduction of the MR imaging in the mid 1980s has evolved as a prime diagnostic method for soft tissue abnormalities of TMJ including disk derangements. In diagnosing TMJ, more recent studies have demonstrated that MRI is equally or possibly better than at least standard tomography.

The etiology of TMJ pain is not completely understood. There are several possible sources of TMJ pain, such as disk displacement, osteoarthritis, bone marrow alterations of the mandibular condyle, inflammatory changes in the retrodiskal tissue and inflammatory changes in the joint space resulting in joint effusion.

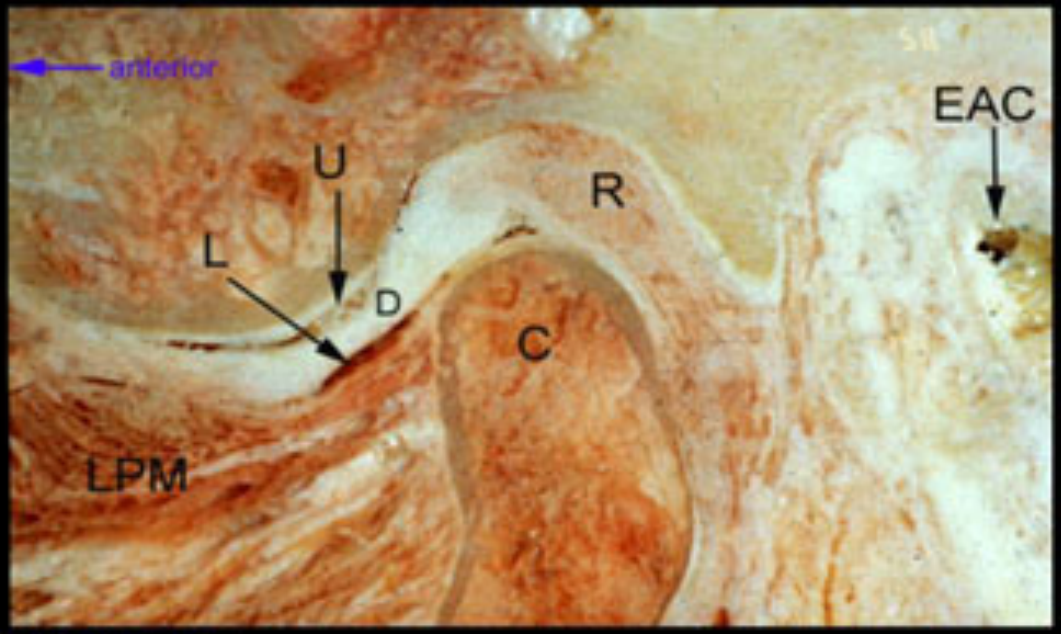


***Fig. 1** TMJ in sagittal section.*
The posterior band of the disk (D) is lying over the condyle (C). The disk is between upper (U) and lower (L) joint spaces. R; retrodiskal tissue, EAC; extraauditory canal, LPM; lateral pterygoid muscle.

Disk Displacement

Most of asymptomatic individuals show normal disk position (Fig.2). Disk displacement (Figs. 3,4) is found in approximately 80% of patients with symptoms of TMD referred for MRI. Several forms of disk displacement are also seen in up to one third of asymptomatic volunteers. This may initially appear confusing but asymptomatic volunteers demonstrates that most, if not all, the volunteers have early stage disk displacement where more later stages are seen in patients. Larheim et al. reported that complete disk displacement was found in 46 (40%) of 115 joints in patients compared with three (2.4%) of 124 joints in asymptomatic volunteers, whereas partial disk displacement (Fig.5) occurred in 26 (22.6%) and 27 (21.8%) joints, respectively.

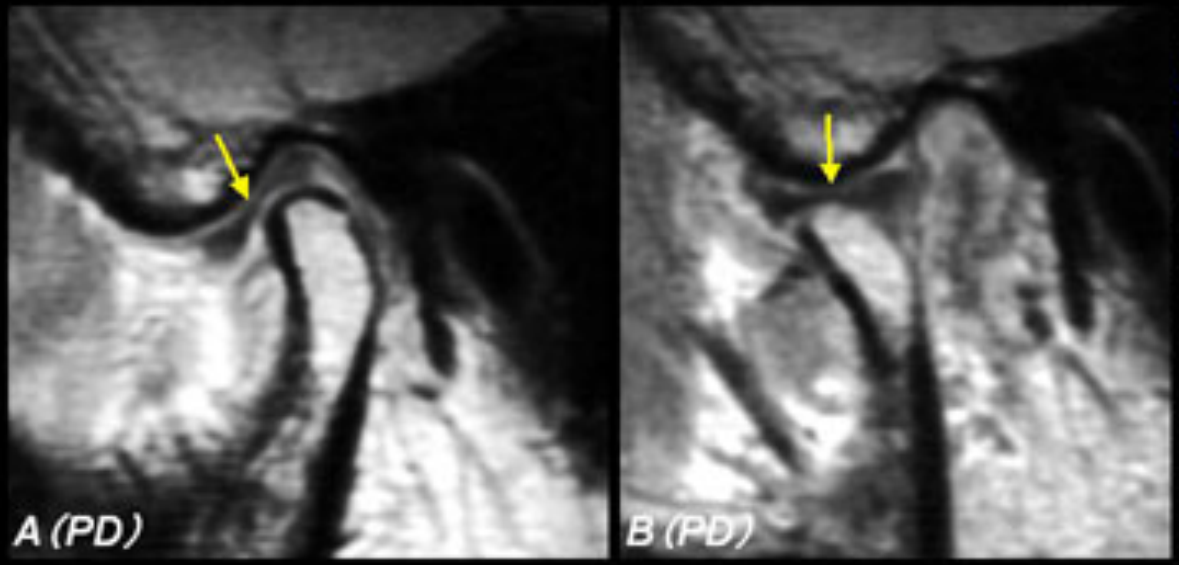


Fig.2

Normal disk position with normal function.

A, In the proton density (PD) closed mouth image the disk (arrow) is between the condyle and the articular eminence.

B, On opening, the disk (arrow) is also located between the condyle and the articular eminence during condylar movement, indicating normal disk position with normal function.

Fig.3

Anterior disk displacement with reduction.

A, In the closed mouth image the disk (arrow) is anterior to the condyle.

B, On opening, the disk (arrow) is located between the condyle and the articular eminence, indicating anterior disk displacement with reduction.

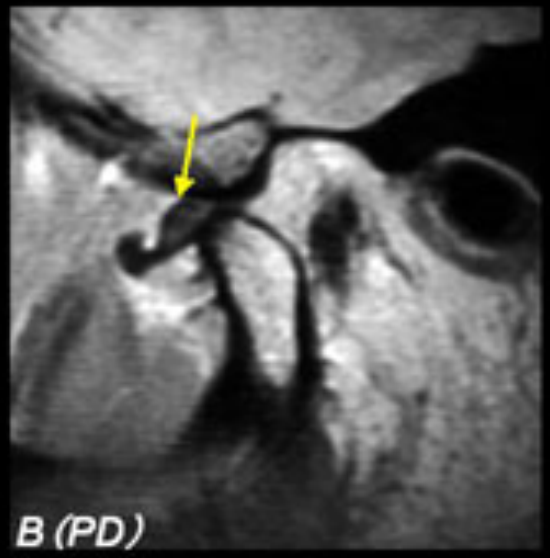


Fig.4

Anterior disk displacement without reduction.

A, In the closed mouth image the disk (arrow) is anterior to the condyle.

B, On opening, the disk (arrow) remains anterior to the condyle, indicating anterior disk displacement without reduction.

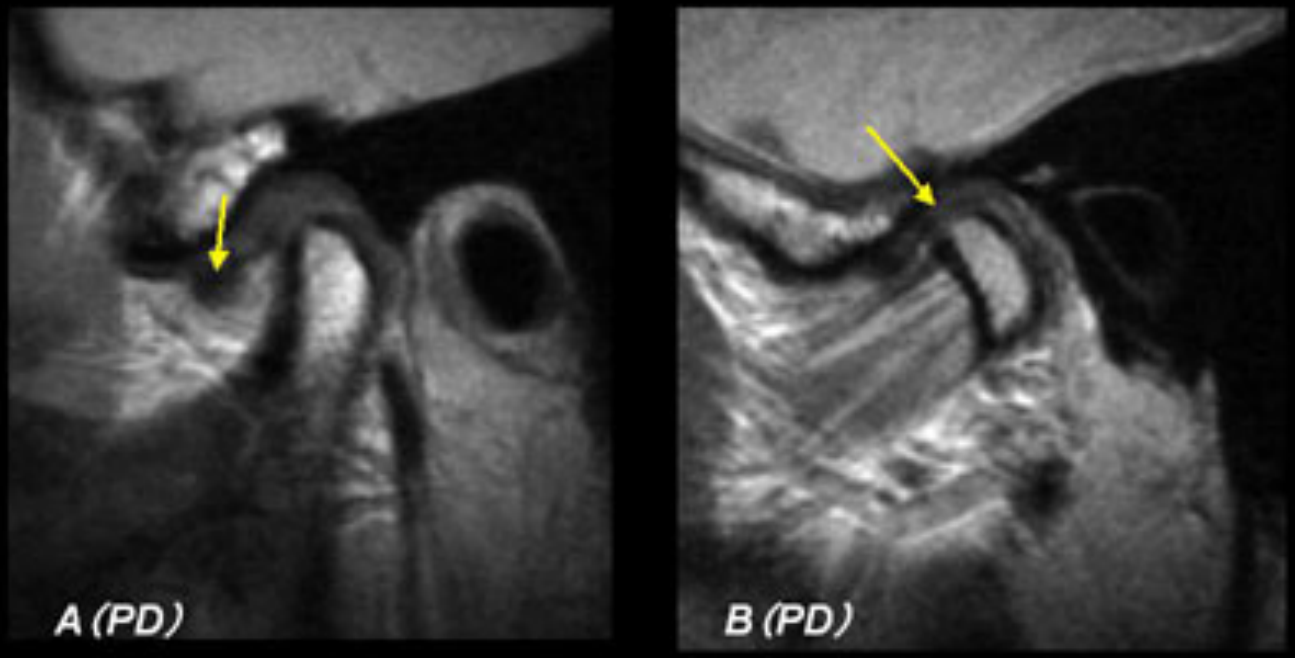


Fig.5
Partial anterior disk displacement.
A, In the lateral part of the joint the disk (arrow) is anteriorly displaced.
B, In the medial part of the joint the disk (arrow) is located in a normal superior position. This indicates a partial anterior disk displacement.

Osteoarthritis

Osteoarthritis (Figs.6,7) has also been indicated as a source of the pain but a recent study has indicated that there is no statistically significant difference in the degree of pain in patients with osteoarthritis compared with those without. This is also in accordance with the findings of osteoarthritis in a large proportion of older individuals and is usually completely asymptomatic. It is well recognized that symptoms of TMJ decreases with age and is often remitting and self-limiting.

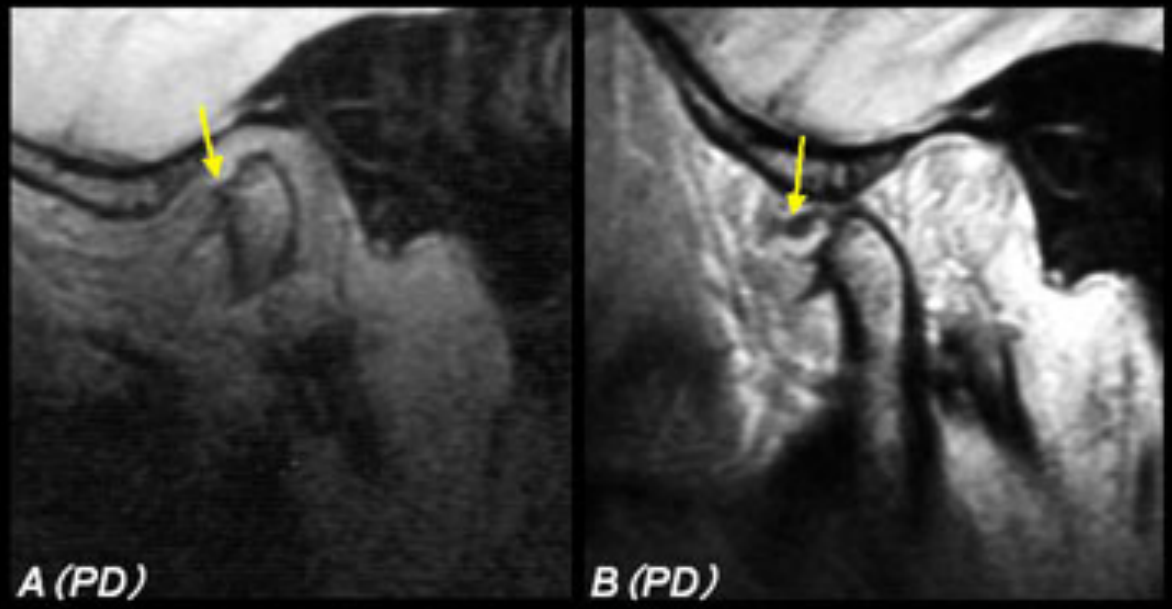


Fig. 6
Osteoarthritis.
A, Proton density closed mouth image shows an anterior osteophyte of the condyle (arrows). This change is consistent with degenerative joint disease. B, On opening the disk remains anterior (arrow).

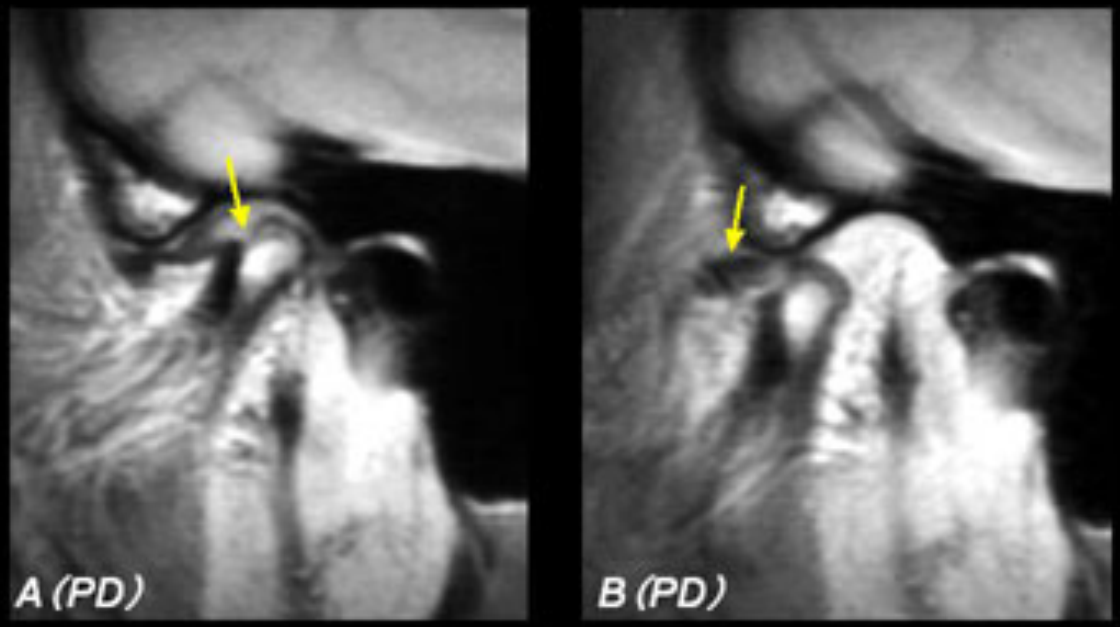
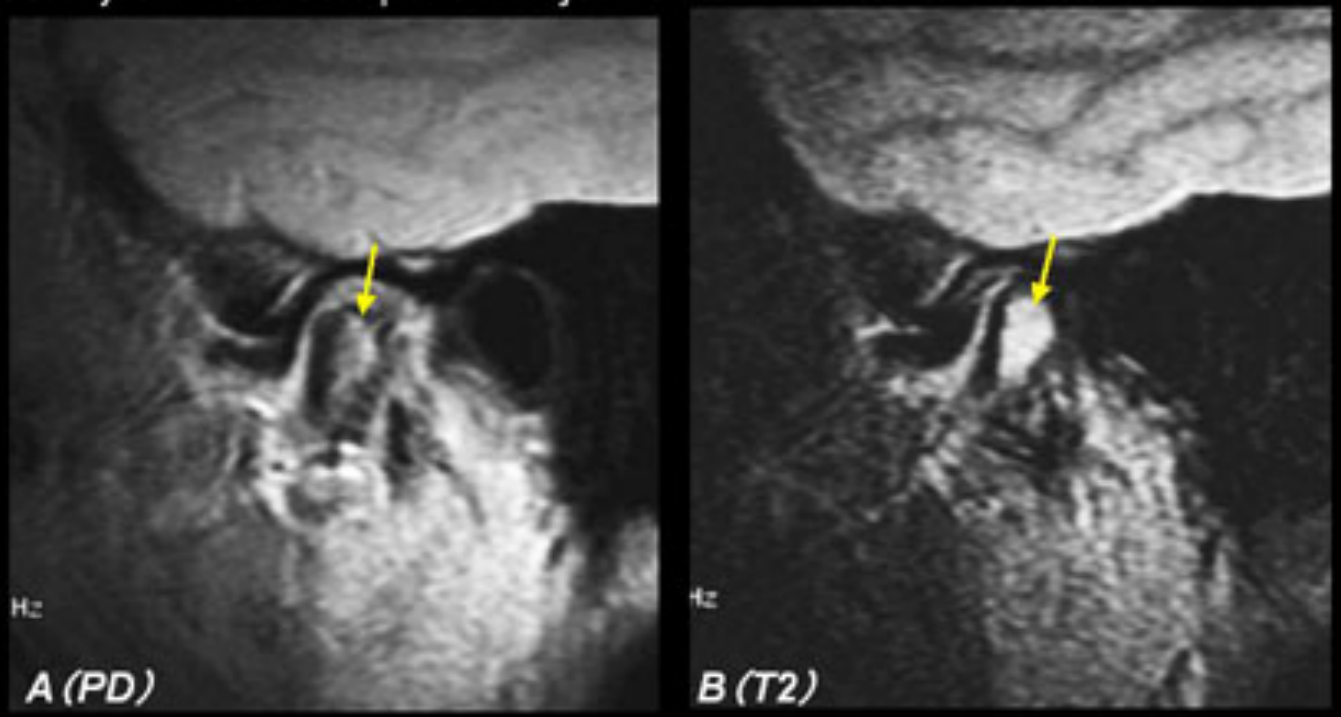


Fig. 7
Osteoarthritis.
A, Proton density closed mouth image shows an erosion of the condyle (arrows). B, On opening the disk remains anterior (arrow).

Marrow Abnormalities of the Mandibular Condyle

Multiple MRI studies have described abnormalities of the mandibular condyle similar to the appearance of osteonecrosis (aseptic necrosis) in the femoral head. One study used core biopsy to document that edema (Fig. 9) and osteonecrosis (Figs.10,11) may occur in the marrow of the mandibular condyle.

Histologic evidence of bone marrow edema (Fig. 9) was also found without evidence of osteonecrosis (Figs.10,11), suggesting that edema may be a precursor to osteonecrosis as is known from investigation of other joints. A study has shown markedly greater pain in joints that have bone marrow alterations in the mandibular condyle when compared to joints with normal bone marrow.



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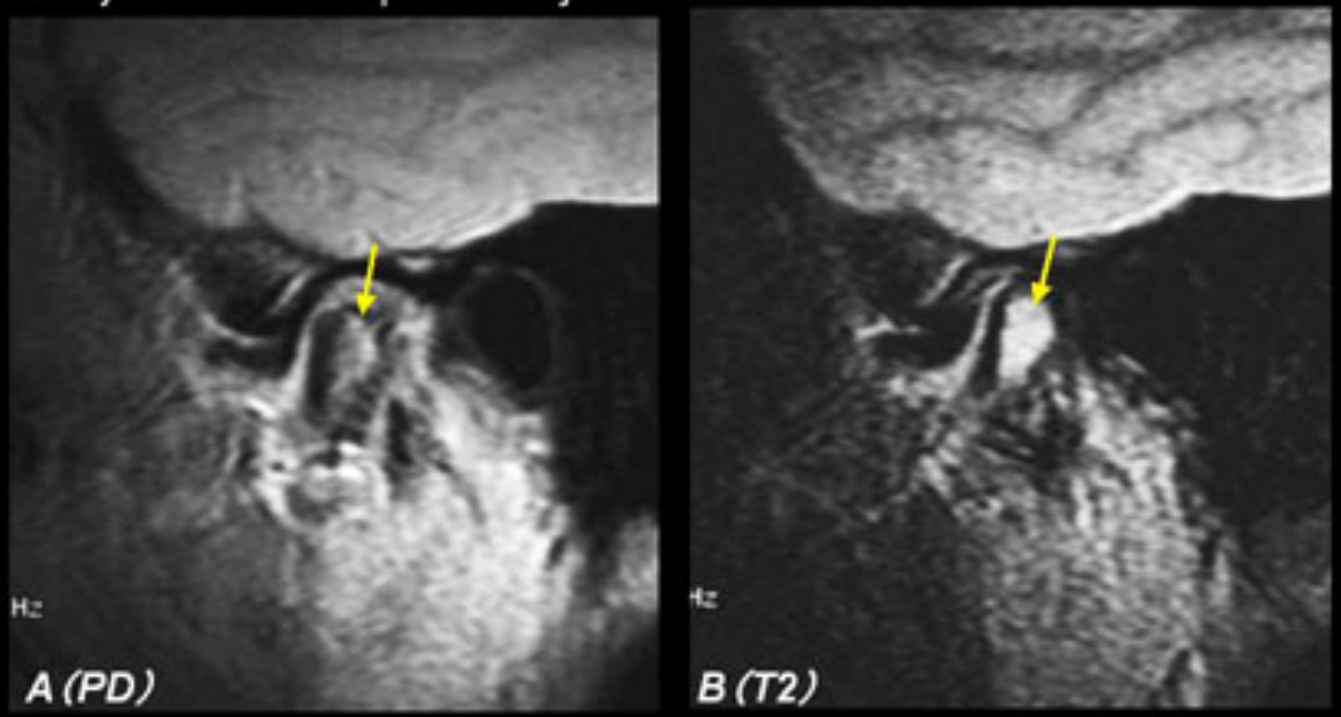

***Fig. 9** Marrow abnormalities.*

Parasagittal (A) proton density MR images show intermediate signal from the bone marrow of the condyle (arrow). The disk is anteriorly displaced and deformed. Parasagittal (B) T2 weighted MR images shows increased signal from the bone marrow of the condyle (arrow) suggesting bone marrow edema. There are also small joint effusions in the upper and lower joint spaces.

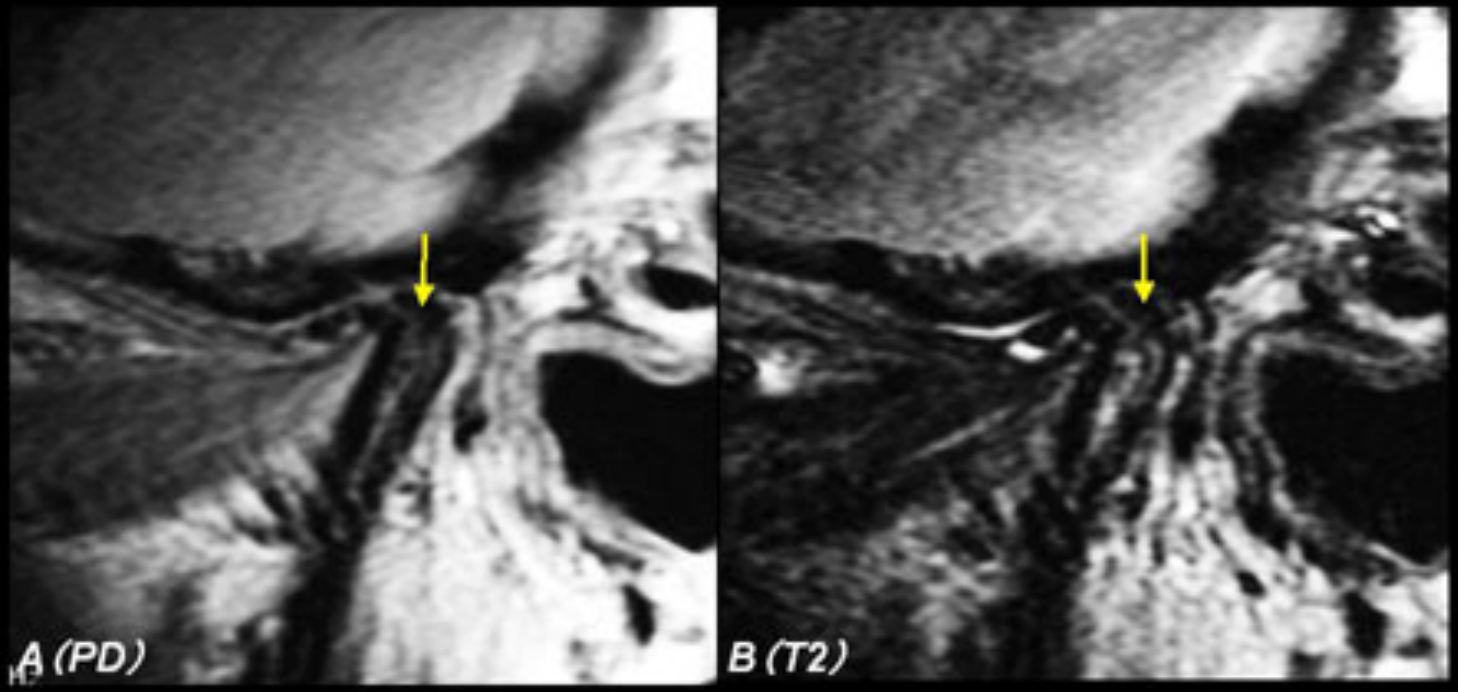

***Fig. 10** Marrow abnormalities.*

Parasagittal (A) MR image shows decreased signal from the bone marrow of the condyle (arrow). There is also irregularity of the upper surface of the condyle and the temporal joint component suggestive of osteoarthritis. The disk is anteriorly displaced and deformed. Parasagittal (B) T2 weighted image shows decreased signal from the bone marrow condyle (arrow) suggestive of osteonecrosis, and there is a moderate effusion in both upper and lower joint spaces.

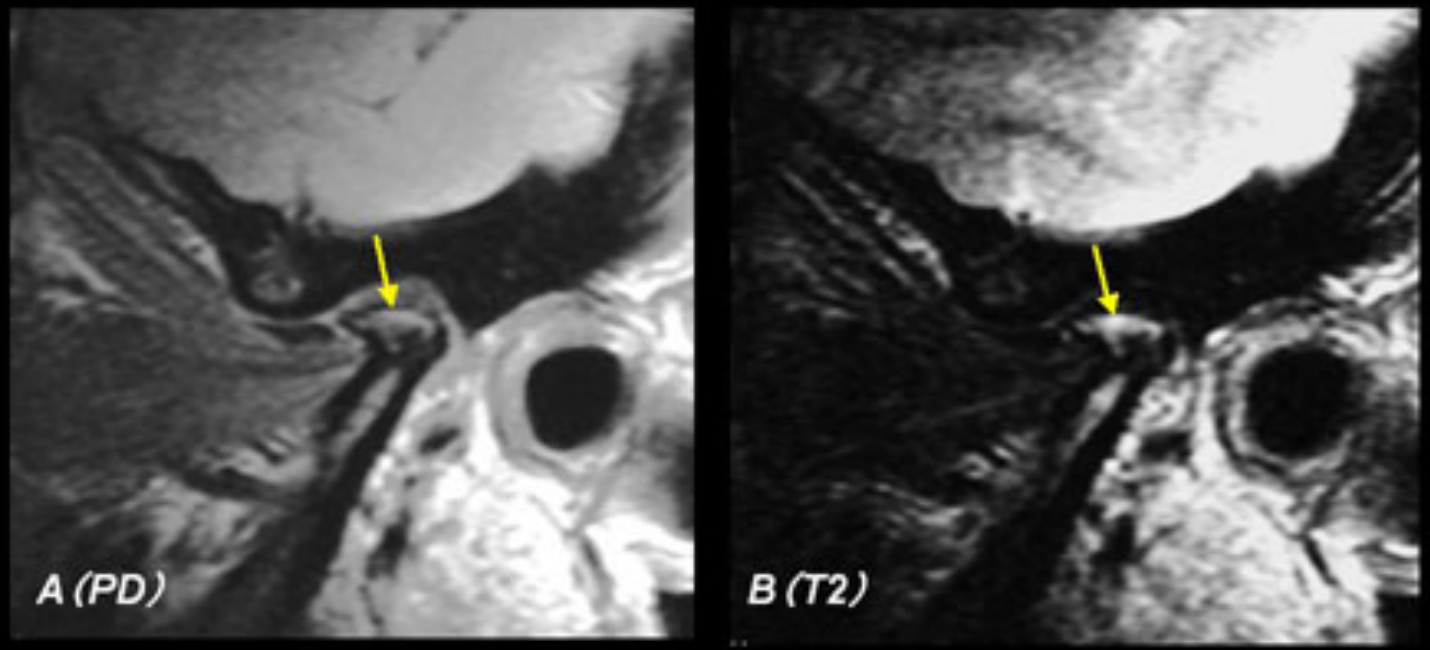

***Fig. 11** Marrow abnormalities.*
Parasagittal (A) proton density MR image shows an area of low signal in the inferior portion of the condyle and an area of higher signal in the more superior medial portion of the condyle (arrow). There is also displacement and deformation of the disk and an anterial osteophyte of the condyle indicating osteoarthritis. T2 weighted parasagittal (B) MR image shows an area of increased signal in the upper portion of the condyle (arrow) and decreased signal in the lower portion of the condyle. This is consistent with the combined edema and sclerotic pattern suggestive of osteonecrosis.

Changes in the Retrodiskal Tissue

On an enhancement MR studies, TMJs with pain and dysfunction indicate a higher signal intensity in the retrodiskal tissue than those without. On a T2 weighted MR study, Sano et al. indicate a slightly increased signal intensity from the retrodiskal tissue in painful joints when compared with nonpainful joints (Fig.12). These indicate a higher degree of vascularity in the retrodiskal tissue in the painful joints compared with the nonpainful joints.

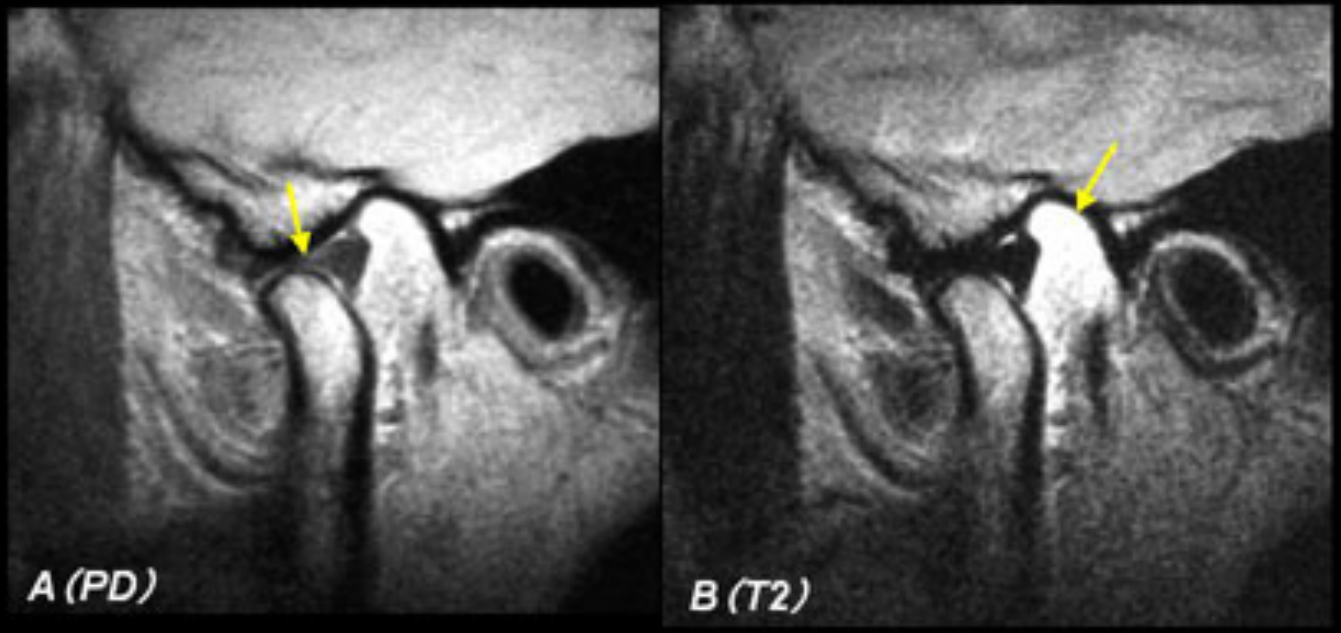

Fig.12
Painful TMJ with increased T2 weighted signal intensity from retrodiskal tissue.
(A) On open mouth proton density image the disk (arrow) is quite normal. On open mouth T2 weighted image (B), however, the retrodiskal tissue shows increased signal intensity (arrows), which may cause the TMJ pain.

A decreased signal in the retrodiskal tissue (Fig.13) may or may not be associated with fibrous changes. It has been theorized that the decreased pain that is frequently observed in longstanding disk displacement is the result of fibrous changes in the retrodiskal tissue, however, the exact relationship between TMJ pain and a decreased signal in the retrodiskal tissue has not been fully elucidated.

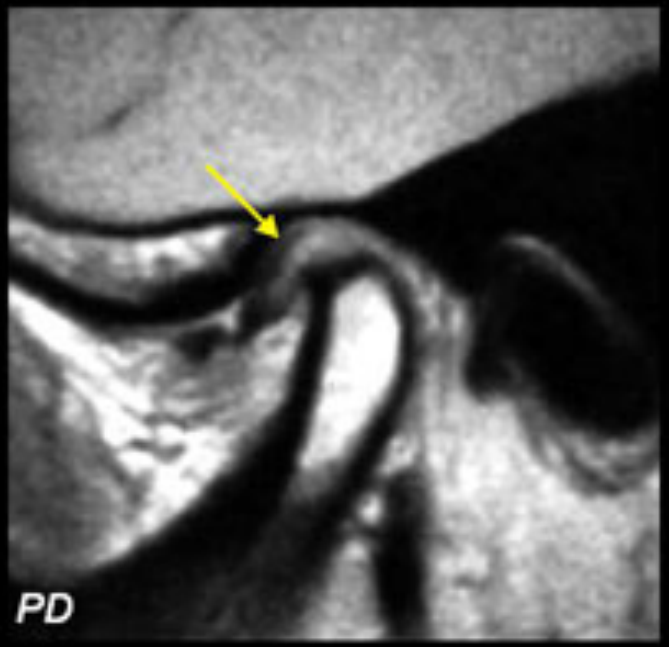

Fig.13
A decreased signal from retrodiskal tissue.
A proton density image shows a decreased signal (arrow) in the upper portion of retrodiskal tissue.

Other pathological conditions

Most imaging evaluations are done for possible internal derangements and their sequelae, however, many other types of pathology occasionally affect the TMJ and may cause the pain and dysfunction.

Tumors and tumor-like conditions include synovial chondromatosis (Fig.14), pigmented villonodular synovitis, osteochondroma, and Calcium pyrophosphate dehydrate (CPPD) deposition disease (pseudogout). The TMJ is infrequently affected by tumors and tumor-like conditions. The most common neoplastic lesion affecting the TMJ is synovial chondromatosis (Fig. 14). This tumor can be locally aggressive, and cases with intracranial extension have been described.

Arthritides includes rheumatoid arthritis, ankylosing spondylitis, and psoriatic arthritis. The TMJ is involved in approximately 50% of patients with such rheumatoid diseases, however, MRI is not routinely used for such patients.

Acute trauma to the mandible can be evaluated with plain films, panoramic examinations or CT. MRI may occasionally show fractures and effusions not seen on other imaging studies. Both CT and MRI can be helpful in cases with intracapsular fractures.

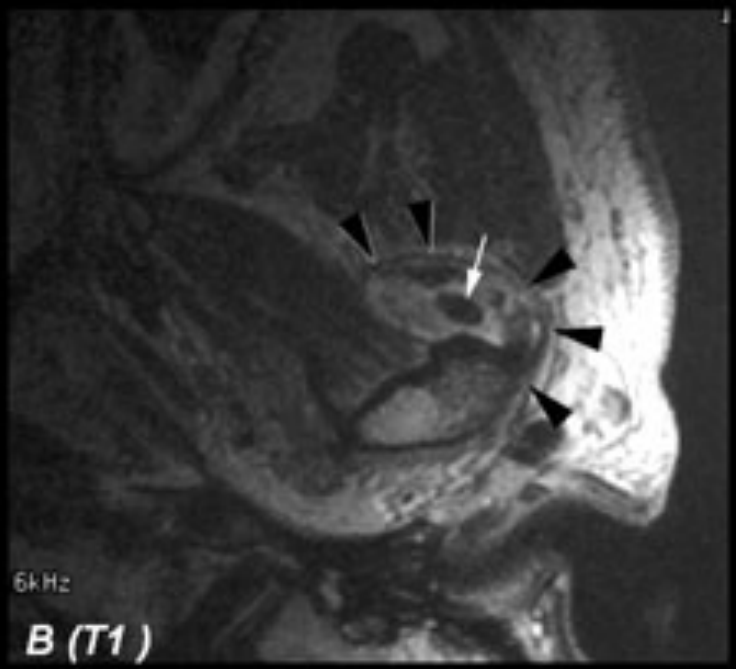

Fig.14 *Synovial chondromatosis.*
The axial CT image (A) shows multiple calcifications (white arrow) anterior to the condyle. On the axial T1-weighted MR image (B) there is expansion of the anterolateral capsule wall (arrowheads). This indicates a neoplastic intraarticular process. There are multiple areas (white arrow) of low signal within the expanded joint capsule, corresponding to the calcifications on the CT image. These findings are consistent with synovial chondromatosis.

Conclusion

The etiology of TMJ pain is not fully understood. There are also discrepancies between imaging findings and patient symptomatology. Further studies using the latest imaging techniques will allow a better understanding of the sources of joint pain and the discrepancy between imaging findings and patient symptomatology.

References

1. Westesson PL, Yamamoto M, Sano T, Okano T. Temporomandibular joint, In: Som PM, Curtin HD ed. Head and neck imaging. 4th ed. St. Louis: Mosby-Year book, Inc; in press.
2. Larheim TA, Westesson PL, Sano T. Temporomandibular joint disk displacement: comparison in asymptomatic volunteers and patients.Radiology. 2001;218:428-432.
3. Sano T, Westesson PL, Larheim TA, Rubin SJ, Tallents RH. Osteoarthritis and abnormal bone marrow of the mandibular condyle. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999;87:243-252.
4. Sano T. Recent developments in understanding temporomandibular joint disorders. Part 1: Bone marrow abnormalities of the mandibular condyle. Dentomaxillofac Radiol. 2000;29:7-10.
5. Sano T, Westesson PL, Larheim TA, Takagi R. The association of temporomandibular joint pain with abnormal bone marrow in the mandibular condyle. J Oral Maxillofac Surg. 2000;58:254-257.
6. Sano T, Westesson PL. Magnetic resonance imaging of the temporomandibular joint. Increased T2 signal in the retrodiskal tissue of painful joints. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1995;79:511-516.
7. Sano T. Recent developments in understanding temporomandibular joint disorders. Part 2:Changes in the retrodiscal tissue.Dentomaxillofac Radiol. 2000;29:260-263.
8. Larheim TA, Westesson PL, Sano T. MR grading of temporomandibular joint fluid: association with disk displacement categories, condyle marrow abnormalities and pain.Int J Oral Maxillofac Surg. 2001;30:104-112.