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PERFORATION OF THE TEMPOROMANDIBULAR JOINT MENISCUS: DIAGNOSED BY MAGNETIC RESONANCE IMAGING

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Abstract

Advancement of surgical techniques has made it necessary to accurately diagnose internal derangements. Arthrography and computerized tomography have been used to diagnose the majority of temporomandibular joint disorders, however, these methods have had their disadvantages.

Magnetic resonance imaging utilizing surface coils has greatly improved the ability to diagnose meniscus abnormalities without using intrarticular injections or ionizing radiation. Ninety-two patients (184 joints) were evaluated by means of magnetic resonance imaging (MRI). Thirty-one patients (39 joints) were diagnosed as having meniscus perforation. Retrospective review of fifteen patients (20 joints) with a perforated meniscus diagnosed by magnetic resonance imaging pre-operatively demonstrated a sixty-five percent correlation between the radiographic diagnosis and the surgical findings.

INTRODUCTION

Diagnosis of temporomandibular joint internal derangements requires an accurate pre-operative radiographic diagnosis of the TMJ soft tissues, in particular the meniscus. Plain film radiographs are useful for diagnosing bony abnormalities, however, are inadequate for the soft tissue diagnosis. Computerized tomography has provided better soft tissue definition, however, the resolution is limited and exposes the patient to ionizing radiation. Arthrography although a reliable technique is an invasive procedure and technically difficult to perform. Magnetic resonance surface coil imaging produces high quality soft tissue contrast images without the use of ionizing radiation. Although the soft tissue detail is excellent with MRI imaging, accurate evaluation of joint dynamics and meniscus perforation is thought not to be as reliable as TMJ arthrography.

In this study, various radiographic parameters were utilized in order to more specifically diagnose meniscus perforation by magnetic resonance imaging. Correlation of the pre-operative radiographic diagnosis with the surgical findings is presented.

MATERIALS AND METHODS

A total of 92 patients (184 joints) underwent magnetic resonance imaging scans for the detection of temporomandibular joint internal derangement. Thirty-one patients (39 joints) were diagnosed as having a perforated meniscus after radiographic review. Ret-

rospective analysis of 15 patients (20 joints) with meniscal perforation who underwent a surgical procedure was carried out in order to correlate the accuracy of the preoperative radiographic diagnosis with the surgical findings. In addition, to the radiographic diagnosis of meniscus perforation, other determinations included bone to bone contact of the condylar head and fossa, degenerative changes of the condylar head and articular eminence, decreased joint space, an attenuated bilaminar zone. fibrosis and contracture of the superior belly of the lateral pterygoid muscle, facial thickening between the pterygoid muscle bellies, and meniscal position and condition. The quality of each radiograph was graded on a four point scale from nondiagnostic to artifact free, while condylar translation was scored on a three point scale (poor, moderate and good).

All radiographic studies were performed using a 1.5T General Electric sign system using a 3 inch receive only surface coil. Images in both the open and closed mouth position were obtained in all cases. Six patients (7 joints) were imaged using the sagittal T1 weighted 3mm thick continuous slice thickness through the joint utilizing a spin echo (SE) pulse sequence. Four of these patients were examined using a repetition time (ATR) of 500 msec, an echo time (TE) of 2-msec, a 256×128 matrix, a 12cm. Field of view (FOV), and 4 acquisition. The studies required 4 minutes and 18 seconds of imaging time for each set of images. Two patients were examined using a TR=1000 msec, T6=20 and 40 msec, ×256×128 matrix, a 12cm FOV, and 2 acquisition. The examination time was identical to the TR=500 msec set. Three dimensional fourires transformation (3 DFT) images of six patients (9 joints) were obtained in the sagittal plane with a TR 60 msec, a TE=16 msec, a flip angle of 30°, a 256×128 matrix, a .12cm FOV and 1 acquisition (3 DET) which is a volumetric acquisition that does not use the 180° refocusing pulse required in SE imaging. This technique therefore allows 1.25mm contiguous slices with an enhanced signal to noise as compared to the SE imaging. The 3 DEF studies require 4 minutes and 8 seconds of imaging time for each set of images.

RESULTS

Of the 20 joints treated surgically, 13 joints (65%) were found to have meniscus perforations at the time of surgery which correlated with their pre-operative radiographic diagnosis (Table 1). Four joints (20%) did not have perforations of the meniscus as previously diagnosed while three joints (15%) had a negative diagnosis of perforation by pre-operative magnetic resonance imaging, however were found to have a perforated meniscus at the time of surgery. All the patients were female and ranged in age from 25 to 56 years with a mean age of 42 years. Preoperative symptomacology included pain and dysfunction with an associated click or crepitus and limitation of motion. The duration of symptoms ranged from one to eight years (mean 4.3 years). All of the patients studied had a combination of two or more symptoms. The magnetic resonance imaging radiographic findings are presented in Table 2. all cases demonstrated anterior displacement of the meniscus without reduction on open mouth views. Each examination was considered diagnostic, although the 3 DET study was marred by moderate motion artifact, particularly on the open mouth set. Fifty percent of the studies demonstrated moderate or good condylar translation without evidence of disc fixation which might suggest adhesions. The remainder of the cases studied had poor translation, which did not allow assessment of disc fixation.

Fifty percent of the patients with poor translation had anteromedial displacement of the meniscus without reduction and demonstrated one or more of the findings in Table 2 indicating a possible perforation ; bone to bone contact (N=3) ; meniscal discontinuity (N=4) ; and deformity of the meniscus (N=5) (Fig. 5, 6). Direct bone to bone contact between the condylar head, glenoid fossa and articular eminence on closed mouth images was noted in 6 of 16 joints

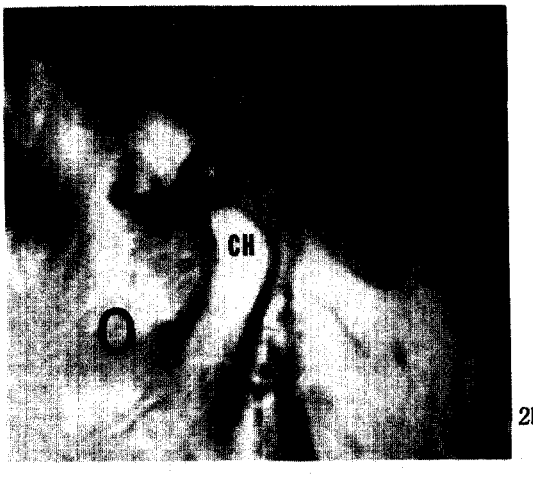
la

1b

Figs. la and 1b

Normal closed(a) and open(b) mouth images demonstrate MR features of a normal TMJ. The meniscus(*) appears as a dark structure between the condylar head(CH) and articular eminence. Note normal location of the posterior band(*)and intermediate zone(↓).

2a



2b

Figs. 2a and 2b

Anterior displacement with reduction. On a closed mouth image(C), the meniscus is displaced anterior to the condylar head. On opening(O), the meniscus reduces to a normal position atop the condylar head. (CH, condylar head : *, posterior band of meniscus : ↓, intermediate zone : G, glenoid fossa)

Table 1.

Patient	MRI findings	Surgical findings
1. F(25)	R-Perforation	R-Perforation
	L-Perforation	L-Perforation
2. F(42)	L-Perforation	L-Perforation
3. F(39)	R-Perforation	R-AD with reduction

4. F(28)	R-Perforation	R-AD with reduction
	L-Perforation	L-Perforation
5. F(52)	L-Perforation	L-Perforation
6. F(45)	R-AD without reduction	R-Perforation
	L-AD without reduction	L-Perforation
7. F(37)	R-Perforation	R-Perforation
8. F(55)	R-Perforation	R-AD without Reduction, adhesion
9. F(55)	R-Perforation	R-Perforation
10. F(39)	L-Perforation	L-AD without reduction, adehsion
11. F(42)	R-Perforation	R-Perforation
12. F(56)	R-Perforation	R-Perforation
	L-Perforation	L-Perforation
13. F(43)	L-Perforation	L-Perforation
14. F(43)	L-AD without reduction	L-Perforation
15. F(41)	R-Perforation	R-Perforation
	L-Perforation	L-Perforation

Fig. 3. Open mouth view shows bone to bone contact in this patient with a proven perforation. A spur extends superiorly off the condylar head (CH) and contacts the articular eminence(↓).

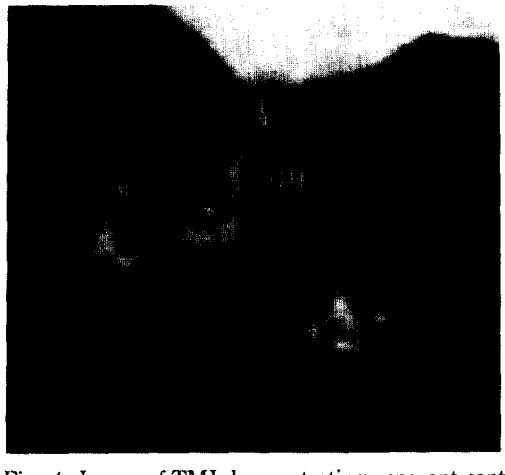


Fig. 4. Image of TMJ demonstrating apparent contact (↓) between condylar head(CH) and glenoid fossa(G). Meniscus(*) is displaced anteriorly and deformed.

(37.5%) and condylar spurring was present in 11 joints (69%) (Fig. 3, 4).

The majority of these joints demonstrated anterior spurs (N=10) as opposed to superior spurring (N=4), and one joint had a superior spur without anterior spurring. Abnormally decreased signal intensity indicated dogenerative changes within the condylar head and was seen in 87.5% (N=14). Flattening of the articular eminence was seen in 75% (N=12) of the joints.f Eleven joints demonstrated moderate or mild changes with severe flattening which was seen in one joint. Decreased joint space was seen 69% of

Table 2

MRI findings in sixteen surgically proven joints with meniscus perforation.

Findings	Present	Absent
Bone to bone contact	6	10
Condylar spurring	11	5
Flattened articular eminance	12	4
Loss of joint space	11	5
Discontinuous meniscus	7	9
Meniscal deformity	10	6
Degenerative changes of the condylar head	14	2
Attenuated bilaminar zone	9	7
Fibrosis of the superior belly of the lateral pterigoid	0	16
Thickening of the fascia bone between the pterigoid bellies	0	16

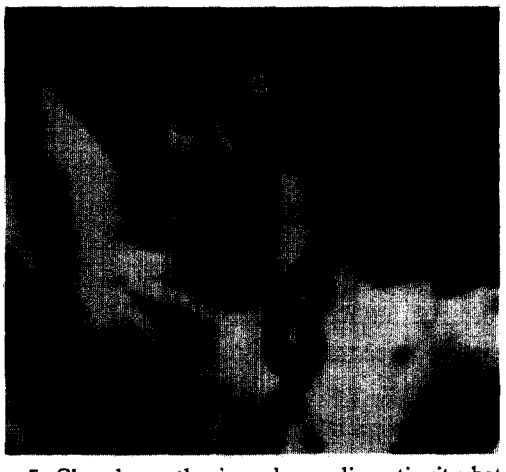


Fig. 5. Closed mouth view shows discontinuity between bilaminar zone(↓) and deformed anteriorly displaced meniscus(*). (CH, condylar head : G, glenoid fossa)

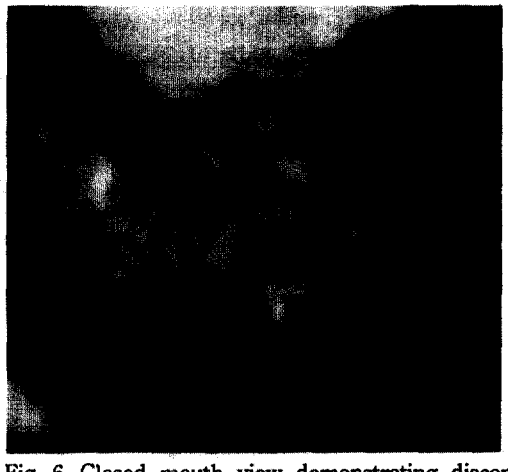


Fig. 6. Closed mouth view demonstrating discontinuity between bilaminar zone(↓) and deformed, bulky shaped meniscus(*). (CH, condylar head : G, glenoid fossa)

the time with severe loss present in two joints, moderate loss in five joints, and mild loss in four joints.

Meniscal discontinuity was seen 44% of the time (N=7). Deformation of the meniscus was identified in 62.5% of the joints ; with eight cases having disc atrophy and two showing enlargement. Attenuation of the bilaminar zone was seen in nine joints (56%).

Medial dislocation of the meniseus (N=10) was more common than lateral dislocation. None of the joints showed radiographic changes of the superior belly of the lateral pterygoid muscle which would indicate fascial thickening between the muscle bellies.

DISCUSSION

Advanced stages of meniscal displacement is cha-

racterized by perforation. Perforation may occur in the posterior attachment tissue or within the meniscus itself when there is anterior dislocation of the meniscus without reduction. Ireland[1] in 1951 described the progression of perforation from clicking to intermittent limited opening to permanent limited openfing, to crepitus and finally perforation. Progressive degenerative joint disease occurs rapidly on the articular surfaces of the condylar head, glenoid fossa, and articular eminence which leads to condylar flattening with osteophyte formation. In very advanced stages bone to bone contact occurs with condylar remodling, and crepitus will result from movement across these irregular surfaces[2-5]. Therefore, crepitus is a clinical indication of meniscal perforation or its posterior attachment[6].

Arthrography is the most useful diagnostic radiographic technique available today to detect a meniscus perforation. The diagnosis is made when simultaneous opacification of the upper joint space occurs when contrast is injected into the lower joint space. Arthrography has two disadvantges in diagnosing internal derangements; needle misadventure may create a false positive and the technique is invasive[7-12].

Computerized tomography has also been utilized to diagnose internal derangements, however it is a non-dynamic study and the diagnosis of meniscus perforation cannot be made.[13-14].

Magnetic resonance imaging is rapidly becoming a widely accepted radiographic technique to diagnose temporomandibular joint internal derangements. The technique is non-invasive, and presents no radiation hazard. Refinement of the techinque is providing a more accurate soft tissue diagnosis[15-22], and is considered by many to have the potential to replace both computerized tomography and arthrography[19]. Donlan[21] did not report any evidence of perforation in his study, and Wilk[20] stated that perforation of the retrodiscal tissue was difficult to identify unless there was bone to bone contact. Shellhas[22] described perforation as a common false positive with magnetic resonance imaging secondary to the attenuated appearance of the stretched bilaminar zone in chronic meniscus displacement.

In this study all cases demonstrated a combination of two or more findings of perforation. Degenerative changes of the condylar head (87.5%) and flattening of the articular eminence (75%) indicated a high frequency of perforation; condylar spurring (69%), joint space narrowing (69%) and meniscal deformity (62.5 %) were relatively frequent. Although bone to bone contact and a discontinuous meniscus were infrequently seen; patients who did have these findings also had large perforations at the time of surgery. These findings suggest that bone to bone contact and meniscus discontinuity appears in the late stages of perforation, or could exist prior to magnetic resonance imaging.

SUMMARY

Although a sixty-five per cent correlation was found between pre-operative magnetic resonance imaging and the surgical finding of meniscus perforation we feel that this can be significantly improved. The ability to utilize the radiographic findings as described in table 2, in particular degenerative condylar changes (87%) flattening of the articular eminence (75%), condylar spurring (69%), joint space narrowing (69%), and meniscal deformity (62%) will improve the accuracy of the radiographic diagnosis of meniscus perforation. This in addition to the continuing refinement of the technique will eventually make magnetic resonance imaging the radiograph of choice for the diagnosis of all temporomandibular joint internal derangements including meniscus perforation.

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MAGNETIC RESONANCE IMAGING을 이용한 악관절 원판 천공 진단

국문초록

최근의 악관절(TMJ) 방사선학적 진단에 있어 많은 발전과 진단방법이 고안돼어 왔다. 또한 새로운 외과적 술식의 발달로 인하여 악관절내장증(Internal Derangement)의 보다 정확한 진단을 요하게 되었다.

가장 새로운 진단방법으로 핵자기공명촬영법(Magnetic Resonance Imaging : MRI)이 악관절내장증 진단 평가하는데 사용되어지고 있다. 핵자기공명촬영법은 surface coil을 이용하여 관절원판(meniscus)의 비정상적 변화를 효과적으로 진달할 수 있으며, 지금까지 이용되어오던 악관절조영술(arthrography)이나 컴퓨터 단층촬영법(C-T scan)의 단점인, 관절내 조영제 주입이나 방사선 노출등의 문제점을 배제할 수 있다. 본 연구는 악관절 핵자기공명촬영을 한 92명(184 joints)중 천공(perforation)으로 진단된 31명(39 joints)를 대상으로 하였으며, 핵자기공명촬영법의 취약점으로 지적되고 있는 악관절원판 천공 진단의 정확도를 측정하기 위하여 가역적 조사를 통해, 악관절원판 천공으로 진단되어 수술받은 15명(20 joints)에서 65%(13 joints)의 정확성을 확인하였다. 또한 핵자기공명촬영법을 통한 악관절원판 진단의 정확도를 높이기 위하여 condyle head의 퇴행성 변화, articular eminence의 변화, condyle spurring, bone to bone contact 등의 경조직 변화와 meniscus의 discontinuity, meniscal deformity, loss of joint space, alternated bilaminar zone 등이 악관절원판 천공진단의 중요한 findings임을 증명하였다.