# Anterior Repositioning Appliance Therapy for TMJ Disorders: Specific Symptoms Relieved and Relationship to Disk Status on MRI

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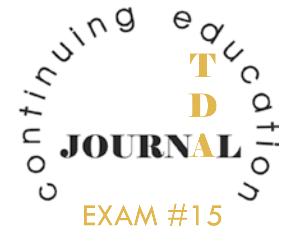


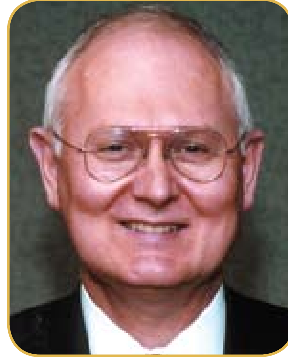
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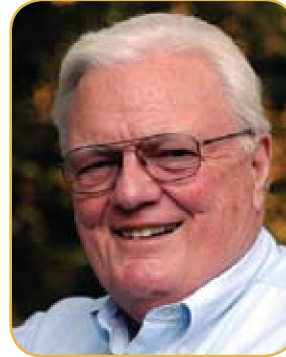
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## Abstract

Forty-eight consecutive patients seeking treatment in a referral based practice for complex chronic painful temporomandibular joint (TMJ) disease were enrolled in a prospective study to assess specific symptom relief from anterior repositioning appliance (ARA) therapy and the relationship between specific symptom relief and the status of the TMJ disk. Each patient was assessed on 86 symptoms based upon whether each symptom was present before treatment and absent, better, unchanged or worse after Maximum Medical Improvement (MMI). The most common symptom was occipital cephalalgia (94%). The least common symptom was pain and burning of tongue (8%). A profile of a temporomandibular disorder (TMD) patient was developed. The typical TMD patient has cephalalgia, mainly in the occipital, temporal and frontal region, pain upon chewing food, pain upon opening and closing the mouth, TMJ pain, pain in the back of the neck and difficulty chewing food. Before treatment, patients with bilateral displaced disks had more symptoms than those with unilateral displaced disks and the opposite side normal. After MMI the maximum benefit (percent of pretreatment symptoms relieved) was found in patients with normal or recaptured disks. The minimum occurred in patients whose disks did not recapture with therapy. ARA therapy improved or eliminated symptoms in all patients in the study.


## Introduction

This communication reports the continuation of the authors' research relating to anterior repositioning appliance (ARA) therapy and its effect on patients with craniofacial pain and temporomandibular disorders (TMD).[1,2] Symptom relief has been described in a general sense by Fricton et al. and Dworkin et al.[3,4] The ability to relieve specific symptoms of craniofacial pain and TMD patients has not been reported.

The visual analog scale[5] (VAS) is a popular method of evaluating pain. The patient is instructed to rate pain on a scale of 0 to 10 with no pain at 0 and the worst pain imaginable at 10 points. This method can be customized to address specific symptoms, but is time-consuming and thus is not typically used among research subjects to evaluate more than a few symptoms.

The TMJ Scale[6,7] is a proprietary quantitative and qualitative assessment of patient symptoms from TMJ disorders and includes pain evaluation. A few papers have been published that used the TMJ Scale to rate symptom improvement at treatment completion.[8,9] Specific symptoms have been tracked but outcome of specific symptom improvement was not given.

The purpose of the present study is: (1) to determine the effect of ARA therapy on specific symptoms in TMD patients; and (2) to relate these changes to the position of the TMJ disk; and (3) to relate the changes to the disk status at maximum medical improvement (MMI).

## Materials and Methods

### *Patients:*

Fifty-eight consecutive patients seeking care in a referral-based practice for complex chronic craniofacial pain and TMD were recruited for the study. Criteria for inclusion in the study were chronic temporomandibular pain and dysfunction by history and examination; age at least 18 years and informed consent. Exclusion criteria were inability or unwillingness to undergo magnetic resonance imaging (MRI) (such as implanted electronic devices, claustrophobia, etc.) and pregnancy. Forty-eight patients completed initial therapy and are reported here. Ten withdrew from the study for the reasons shown in **Table 1**. Six of the ten were doing well but elected to stop treatment for a variety of reasons. The other four terminated before sufficient treatment time to achieve significant symptom reduction. It is extremely unlikely that these departures biased the results of the study. There were 47 female participants and 1 male. The mean age of participants at appliance delivery was 38 years. The youngest was 18 and the oldest was 67.

The protocol was approved in advance by the Institutional Review Board of Vanderbilt University. Informed consent was obtained from each patient before entry into the study.

### *Treatment:*

Maxillary and mandibular anterior repositioning appliances were constructed for each patient. The mandibular appliance was worn whenever the patient was awake, e.g., eating, speaking. The maxillary appliance was worn whenever the patient was reclined for more than an hour and during sleep. The maxillary appliance had a ramp that extended lingual to the mandibular incisors to hold the mandible either open or protruded while the patient was reclined. The patients were instructed to leave one appliance in during teeth brushing while brushing the opposing dental arch. One appliance was, therefore, in the patient's mouth 24 hours a day. There is a consensus in the literature supporting the use of dual appliances on the same patient in

ARA therapy with the wearing schedule described.[5,10, 11,12]

The ARA established the treatment position for the condyles in the fossae as the Gelb 4/7 position,[1,13] which is its normal position, as published by recognized authorities.[14,15,16] This position was derived by first determining the location of the condyles on cephalometrically corrected tomograms in relation to the Gelb 4/7 grid. Before treatment, the condyles in this study were consistently located posterior to the Gelb 4/7 position. The amount of repositioning required to place the condyle in the Gelb 4/7 block was determined. The mandible was repositioned anteriorly by this amount. Cephalometrically corrected tomograms were repeated on each joint with the patient biting into the newly constructed mandibular appliance to verify that the condyles were repositioned as planned.

*Imaging:*

Disk position immediately before delivery of the ARA was determined by magnetic resonance imaging (MRI) using a superconducting MR scanner operated at 1.5T. (Magnetom, Siemens Corp., Iselin NJ). According to Katzberg and Westesson[17] MRI is the gold standard for TMJ disk position. Closed-mouth images consisted of sagittal oblique and coronal oblique T1-weighted images plus sagittal oblique T2-weighted images. A published MRI protocol was used to perform the scans.[18] Closed-mouth images were performed with the teeth in centric occlusion. Open-mouth studies were composed of T1-weighted sagittal oblique and coronal oblique images. T1-weighted images used a conventional spin-echo sequence, TR = 700ms, TE = 12-15 ms, 2 acquisitions. T2-weighted images were obtained with turbospin-echo sequences, effective TR = 5 s, TE = 90 ms, 10-echo chain, 1 acquisition. All images used a slice thickness of 3 mm with no interslice gap, matrix of 192 x 256 and field of view 12 x 12 to 14 x 14 cm. Each image set was composed of at least seven slices, to include the entire condyle plus adjacent structures. The patient was biting on a stack of tongue blades at a predetermined vertical dimension when the open-mouth scans were performed. Imaging times ranged from 3 to 4.5 minutes. The complete examination was performed for each subject in approximately 35 minutes. Closed-mouth T1-weighted images were repeated immediately after insertion of the mandibular appliance, with the patient closed on the appliance in the prescribed position.

Disk position in relation to the condyle was categorized from MR images for each joint in each position, using a modification of a scheme proposed by Tasaki et al.[19] as normal (N), anterior (A), anterolateral (AL), anteromedial (AM), medial (M), lateral anterior rotary (LAR, disk rotated anteriorly toward the lateral pole, i.e. anterior at the medial pole and in normal position at the lateral pole), and medial anterior rotary (MAR, rotated toward the medial pole, or anterior at the lateral pole and normal at the medial pole). No posterior or lateral dislocations were identified in the sample.

**Table 1. Patients Who Did Not Reach Maximum Medical Improvement***

| Patient | Reason |
|---|---|
| TB 9-17-94 | 80% of symptoms relieved in 3 months of care – never came back |
| BB 7-1-95 | Wanted pain medication – came to only 1 follow-up visit after appliance delivery – never came back |
| RC 7-22-95 | 50% of symptoms and popping relieved but most pain from a cervical disorder – referred for treatment |
| AD 2-6-95 | Withdrew after 2 follow-up visits – elected TMJ surgery |
| LD 8-5-95 | Had 1 follow-up visit and injections – decided not to have further treatment |
| BG 10-15-94 | 90% of symptoms relieved in 3 months of care – never came back |
| JH 12-3-94 | 100% of symptoms relieved in 3 months of care – insurance company disapproved further treatment |
| MH 3-12-94 | Could not speak in mandibular appliance –patient discontinued treatment after 2 months |
| CR 2-5-94 | Discontinued treatment for financial reasons – returned after two years with 75% of symptoms relieved – continued to wear maxillary appliance during sleep |
| HW 2-19-94 | 90% of symptoms relieved in 3 months of care – divorced and discontinued treatment for financial reasons |

** From original study content of 58 patients*

Magnetic resonance imaging and evaluation of the results, especially disk position, were the only procedures in the study that were performed solely for purposes of the study. All other procedures were routine patient treatment.

*Evaluation of Symptoms:*

Each patient was asked how long they had been seeking care for the head, neck and facial pain disorder, for which treatment was now sought. Presence of each symptom listed in **Table 2**, at any time since the pain disorder started, was then determined. The list of specific symptoms was accumulated by the authors over several years from numerous undocumented sources. The symptom list was then reviewed at the first follow-up appointment, three weeks after delivery of appliances and every six weeks during active treatment. The same evaluation was done at MMI. Each symptom in the list was evaluated as absent, better, unchanged or worse on average in the preceding three weeks compared with its presence and severity before treatment.

This study compares the patients presenting symptoms at a diagnostic appointment to the patient's evaluation at the MMI visit and categorizes them by disk status pretreatment and disk status at MMI. Each patient had a known disk status based upon three-dimensional MRI evaluation prior to ARA treatment. The improvement in symptoms after MMI was related to disk position after treatment.

Twenty patients in this study were given trigger point injections as part of their treatment. Ten patients in this study were given iontophoresis as part of their treatment.

## Statistical Analysis

Numbers of symptoms per patient versus disk status before treatment and disk recapture after MMI were subjected to Chi square tests for independence and paired t tests.

## Results

This research presents results of tracking 86 specific symptoms on 48 patients. The patients were asked if they now have or have had any of the

## Table 2 -Symptoms Surveyed in 48 Patients

Pre-treatment Symptoms vs. Symptoms After Maximum Medical Improvement
(Number of Patients / % of Total)

| Symptom | Pretreatment | | After MMI | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Same | | Better | | Absent | | Worse | |
| | R | L | R | L | R | L | R | L | R | L |
| Cephalalgia - frontal | 41/85 | 40/83 | 1/2 | 2/5 | 15/37 | 14/35 | 25/61 | 24/60 | 0/0 | 0/0 |
| Cephalalgia - temporal | 44/92 | 44/92 | 0/0 | 0/0 | 20/45 | 17/39 | 24/55 | 27/61 | 0/0 | 0/0 |
| Cephalalgia - parietal | 28/58 | 26/54 | 0/0 | 0/0 | 8/29 | 6/23 | 20/71 | 20/77 | 0/0 | 0/0 |
| Cephalalgia - occipital | 46/96 | 44/92 | 1/2[a] | 1/2[a] | 14/30 | 14/32 | 31/67 | 29/66 | 0/0 | 0/0 |
| Cephalalgia - mastoid | 37/77 | 36/75 | 0/0 | 0/0 | 13/35 | 11/31 | 24/65 | 25/68 | 0/0 | 0/0 |
| Cephalalgia - vertex | 25/52 | | 0/0 | | 6/24 | | 19/76 | | 0/0 | |
| Retroorbital pain | 40/83 | 35/73 | 1/3 | 0/0 | 12/30 | 11/31 | 27/68 | 24/69 | 0/0 | 0/0 |
| Photophobia | 39/81 | | 2/5 | | 13/33 | | 24/62 | | 0/0 | |
| Loss of equilibrium | 31/65 | | 1/3 | | 11/35 | | 19/61 | | 0/0 | |
| Vertigo | 38/79 | | 2/5 | | 8/21 | | 27/71 | | 1/3[b] | |
| Otalgia | 41/85 | 36/75 | 2/5 | 2/6 | 10/24 | 8/22 | 29/71 | 26/72 | 0/0 | 0/0 |
| Tinnitus | 32/66 | 32/66 | 2/6 | 1/3 | 10/31 | 10/31 | 20/63 | 21/66 | 0/0 | 0/0 |
| Fullness/stuffiness - ear | 40/83 | 37/77 | 4/1 | 3/8 | 12/30 | 6/16 | 24/60 | 28/76 | 0/0 | 0/0 |
| Itchiness – ear | 31/65 | 30/63 | 1/3 | 2/7 | 12/39 | 8/27 | 18/58 | 20/67 | 0/0 | 0/0 |
| Preauricular pain | 28/58 | 30/63 | 0/0 | 0/0 | 8/29 | 3/10 | 20/71 | 27/90 | 0/0 | 0/0 |
| TMJ pain | 42/88 | 43/90 | 0/0 | 1/2 | 16/39 | 10/23 | 26/63 | 32/74 | 0/0 | 0/0 |
| Maxillary sinus pain | 38/79 | 35/73 | 3/8 | 3/9 | 19/50 | 15/43 | 16/42 | 17/49 | 0/0 | 0/0 |
| Frontal sinus pain | 35/73 | 35/73 | 3/9 | 3/9 | 10/29 | 10/29 | 20/57 | 20/57 | 2/6 | 2/6 |
| Sinus drainage | 38/79 | | 3/9 | | 18/47 | | 14/37 | | 3/8 | |
| Pain in cheek | 37/77 | 36/75 | 0/0 | 0/0 | 10/27 | 6/17 | 27/73 | 30/83 | 0/0 | 0/0 |
| Numbness - side of face | 10/21 | 9/19 | 0/0 | 0/0 | 3/30 | 1/11 | 7/70 | 8/89 | 0/0 | 0/0 |
| Pain in mandible | 35/73 | 34/71 | 0/0 | 1/3 | 8/23 | 4/12 | 27/77 | 29/85 | 0/0 | 0/0 |
| Popping in TMJ - opening | 33/69 | 37/77 | 1/3 | 4/11 | 5/15 | 7/19 | 27/82 | 26/70 | 0/0 | 0/0 |
| Popping in TMJ - closing | 25/52 | 29/60 | 1/4 | 3/10 | 3/12 | 6/21 | 21/84 | 20/69 | 0/0 | 0/0 |
| Visual disturbances | 30/63 | | 2/7 | | 9/30 | | 19/63 | | 0/0 | |
| Paresthesia - arm | 19/40 | 18/38 | 0/0 | 0/0 | 5/26 | 3/17 | 13/68 | 13/72 | 1/5 | 2/11 |
| Paresthesia - hand | 19/40 | 19/40 | 0/0 | 0/0 | 4/21 | 3/16 | 14/74 | 14/74 | 1/5 | 2/11 |
| Paresthesia - fingers | 16/33 | 18/38 | 0/0 | 0/0 | 2/13 | 5/28 | 13/81 | 12/67 | 1/6 | 1/6 |
| Crepitus - TMJ | 25/52 | 25/52 | 1/4 | 1/4 | 5/20 | 4/16 | 19/76 | 20/80 | 0/0 | 0/0 |
| Limited opening | 36/75 | | 2/6 | | 10/28 | | 24/67 | | 0/0 | |
| Jaw deviates upon opening | 27/56 | 8/17 | 0/0 | 0/0 | 5/19 | 2/25 | 21/78 | 6/75 | 0/0 | 0/0 |
| Inability to move jaw | 16/33 | 18/38 | 1/6 | 1/6 | 5/31 | 4/22 | 10/63 | 13/72 | 0/0 | 0/0 |
| Mouth locks open | 6/13 | | 0/0 | | 1/17 | | 5/83 | | 0/0 | |
| Mouth locks shut | 18/38 | | 0/0 | | 0/0 | | 18/100 | | 0/0 | |
| Maxillary odontalgia | 25/52 | | 1/4 | | 5/20 | | 19/76 | | 0/0 | |
| Mandibular odontalgia | 23/48 | | 2/9 | | 3/13 | | 18/78 | | 0/0 | |
| Pain or burning - tongue | 4/8 | 4/8 | 0/0 | 0/0 | 1/25 | 1/25 | 3/75 | 3/75 | 0/0 | 0/0 |
| Metallic taste | 22/46 | | 1/5 | | 2/9 | | 19/86 | | 0/0 | |
| Painful mastication | 45/94 | | 1/2 | | 11/24 | | 33/73 | | 0/0 | |
| Difficulty chewing | 41/85 | | 0/0 | | 14/34 | | 27/66 | | 0/0 | |
| Dysphagia | 22/46 | | 0/0 | | 4/18 | | 18/82 | | 0/0 | |
| Constant clearing of throat | 30/63 | | 1/3 | | 9/30 | | 19/63 | | 1/3 | |
| Constant sore throat | 17/35 | | 0/0 | | 2/12 | | 15/88 | | 0/0 | |
| Foreign object in throat | 22/46 | | 0/0 | | 3/14 | | 19/86 | | 0/0 | |
| Pain – nape | 43/90 | 41/85 | 2/5 | 1/2 | 18/42 | 16/39 | 22/51 | 23/56 | 1/2 | 1/2 |
| Inability to turn head | 22/47 | 22/47 | 1/5 | 2/9 | 7/32 | 7/32 | 13/59 | 12/54 | 1/5 | 1/5 |
| Stiff neck | 39/81 | 35/73 | 2/5 | 2/5 | 15/38 | 12/34 | 21/54 | 20/57 | 1/3 | 1/3 |
| Cervical crepitus | 27/56 | | 2/7 | | 9/33 | | 16/59 | | 0/0 | |
| Shoulder pain | 34/71 | 31/65 | 3/9 | 2/6 | 16/47 | 12/39 | 15/44 | 17/55 | 0/0 | 0/0 |
| Pain - opening or closing | 43/90 | | 0/0 | | 11/26 | | 32/74 | | 0/0 | |
| Backache | 36/75 | | 4/11 | | 14/39 | | 18/50 | | 0/0 | |
| Nausea - occasionally | 33/69 | | 1/3 | | 5/15 | | 24/73 | | 3/9[c] | |
| Nausea – frequently | 5/11 | | 1/20 | | 1/20 | | 3/60 | | 0/0 | |
| Clenching/grinding - day | 34/71 | | 5/15 | | 12/35 | | 17/50 | | 0/0 | |
| Clenching/grinding - night | 35/73 | | 5/14 | | 17/49 | | 13/37 | | 0/0 | |
| Awakening - jaws clenched | 34/71 | | 6/18 | | 9/26 | | 19/56 | | 0/0 | |

[a]neck injury [b]not related [c]pregnant

## Table 3 -Disk Status at MMI vs Symptoms Pre-treatment and Symptoms at MMI

| Patient | Right Disk Status | Left Disk Status | Number of Symptoms Pre-treatment | Number of Symptoms Same Post-MMI(%) | Number of Symptoms Better Post-MMI(%) | Number of Symptoms Absent Post-MMI(%) | Number of Symptoms Worse Post-MMI(%) |
|---|---|---|---|---|---|---|---|
| M.A. 10-16-93 | N | N | 46 | 0 | 10(22%) | 36(78%) | 0 |
| S.B. 10-04-95 | N | A/WR | 47 | 1(2%) | 0 | 43(91%) | 3(sinus)(6%) |
| C.B. 03-25-95 | A/WR | A/WOR | 31 | 0 | 16(52%) | 15(48%) | 0 |
| V.B. 01-28-95 | N | N | 43 | 0 | 7(16%) | 36(84%) | 0 |
| T.B. 03-01-94 | A/WOR | MAR/WOR | 44 | 0 | 8(18%) | 36(82%) | 0 |
| L.B. 09-02-95 | A/WOR | A/WR | 59 | 0 | 23(39%) | 36(61%) | 0 |
| B.B. 07-09-94 | LAR/WR | LAR/WR | 67 | 0 | 0 | 67(100%) | 0 |
| C.B. 01-08-94 | AM/WOR | AM/WOR | 60 | 0 | 13(22%) | 47(78%) | 0 |
| T.B. 08-05-95 | AL/WOR | AM/WOR | 64 | 0 | 21(33%) | 43(67%) | 0 |
| A.B. 02-09-95 | A/WR | A/WOR | 48 | 28(58%) | 11(23%) | 9(19%) | 0 |
| M.B. 04-23-94 | MAR/WR | MAR/WR | 77 | 5(6%) | 0 | 71(92%) | 1(1%) |
| B.C. 09-04-93 | N | A/WOR | 47 | 1(2%) | 21(45%) | 25(53%) | 0 |
| V.C. 05-05-95 | A/WR | AM/WR | 50 | 0 | 14(28%) | 36(72%) | 0 |
| J.D. 08-14-94 | M/WOR | M/WOR | 76 | 6(8%) | 37(49%) | 21(28%) | 12(neck)(16%) |
| D.D. 01-28-95 | MAR/WR | MAR/WR | 76 | 0 | 9(12%) | 67(88%) | 0 |
| D.D. 10-15-94 | AL/WOR | AL/WOR | 65 | 0 | 6(9%) | 59(91%) | 0 |
| J.D. 02-10-95 | N | M/WR | 41 | 3(7%) | 26(63%) | 12(29%) | 0 |
| S.D. 01-14-95 | A/WR | A/WR | 33 | 0 | 0 | 33(100%) | 0 |
| S.E. 09-17-94 | N | N | 80 | 0 | 12(15%) | 68(85%) | 0 |
| L.E. 12-18-93 | AL/WR | AL/WR | 54 | 0 | 8(15%) | 46(85%) | 0 |
| B.H. 02-19-94 | AL/WOR | AL/WOR | 62 | 0 | 48(77%) | 14(23%) | 0 |
| C.H. 04-15-94 | AM/WOR | A/WOR | 59 | 9(15%) | 27(46%) | 23(39%) | 0 |
| N.H. 01-14-95 | A/WOR | A/WOR | 68 | 0 | 31(46%) | 37(54%) | 0 |
| R.H. 05-07-94 | N | N | 57 | 9(16%) | 1(2%) | 47(82%) | 0 |
| S.H. 09-17-94 | A/WR | A/WR | 62 | 16(26%) | 19(31%) | 27(43%) | 0 |
| J.J. 09-23-95 | A/WOR | A/WOR | 51 | 3(6%) | 4(8%) | 39(76%) | 5(pregnant)(10%) |
| Q.J. 09-16-95 | M/WR | M/WR | 75 | 0 | 48(64%) | 27(36%) | 0 |
| D.K. 12-17-94 | M/WOR | AM/WOR | 46 | 0 | 4(9%) | 41(89%) | 1(pregnant)(2%) |
| D.L. 12-03-94 | AL/WR | AL/WR | 38 | 8(21%) | 11(29%) | 19(50%) | 0 |
| C.M. 07-01-95 | A/WR | A/WOR | 44 | 0 | 1(2%) | 43(98%) | 0 |
| A.M. 08-14-93 | N | MAR/WR | 20 | 0 | 0 | 20(100%) | 0 |
| L.M. 05-07-94 | A/WR | AL/WR | 62 | 0 | 10(16%) | 52(84%) | 0 |
| D.M. 02-24-95 | M/WOR | M/WOR | 56 | 0 | 33(59%) | 23(41%) | 0 |
| K.N. 08-24-96 | A/WOR | A/WR | 82 | 8(10%) | 40(49%) | 33(40%) | 1(pregnant)(1%) |
| J.N. 11-04-95 | A/WOR | A/WOR | 71 | 0 | 35(49%) | 36(51%) | 0 |
| L.P. 12-18-93 | AL/WR | AL/WOR | 44 | 0 | 23(52%) | 21(48%) | 0 |
| D.P. 01-28-95 | A/WOR | A/WR | 60 | 0 | 9(15%) | 51(85%) | 0 |
| L.P. 02-19-94 | AM/WR | N | 57 | 2(4%) | 11(19%) | 44(77%) | 0 |
| A.R. 10-01-93 | N | AL/WR | 69 | 0 | 32(46%) | 37(54%) | 0 |
| C.R. 03-14-94 | N | N | 24 | 0 | 8(33%) | 16(67%) | 0 |
| M.S. 08-20-94 | AM/WOR | AM/WOR | 31 | 0 | 1(3%) | 30(97%) | 0 |
| M.S. 04-09-94 | N | N | 61 | 2(3%) | 31(51%) | 26(43%) | 2(3%) |
| R.T. 02-26-94 | A/WOR | A/WR | 57 | 0 | 29(51%) | 28(49%) | 0 |
| A.W. 10-23-93 | N | N | 25 | 0 | 0 | 25(100%) | 0 |
| B.W. 02-26-94 | A/WOR | AL/WOR | 33 | 1(3%) | 13(39%) | 19(58%) | 0 |
| D.W. 08-21-93 | MAR/WR | A/WR | 49 | 0 | 11(22%) | 38(78%) | 0 |
| B.W. 09-16-95 | A/WOR | A/WR | 54 | 1(2%) | 5(9%) | 48(89%) | 0 |
| N.W. 08-07-93 | A/WOR | A/WOR | 45 | 5(11%) | 25(56%) | 15(33%) | 0 |

N - Normal, A - Anterior, M - Medial, AM - Anteromedial, AL - Anterolateral, MAR – Medial Anterior Rotary, LAR - Lateral Anterior Rotary, WR - With Recapture (not to be confused with reduction), WOR - Without Recapture (not to be confused with reduction)

86 symptoms during their time of pain prior to beginning treatment and then the symptoms that they responded by a "yes" were then asked at subsequent visits if the symptom was the same as before treatment, better than before treatment, absent or worse.

**Table 2** lists the 86 symptoms surveyed for each of 48 patients before starting ARA therapy. The number of patients with each symptom is shown. Before treatment the average patient had 54 ± 4 symptoms (mean ± 95% C. I.). Patients with bilateral displaced disks had more symptoms (56 ± 5) than those with bilateral normal or unilaterally displaced, opposite side normal (47 ± 10). The difference was statistically significant ($\chi 2 = 12.3$, df = 1, p<0.001). Conversely, the average symptom was present in 30 ± 2 patients.

At MMI patients had a weighted average of 11 ± 2.8 symptoms. Symptoms at MMI were weighted as absent, 0; improved, 0.5; unchanged, 1; and worse, 2. The average symptom was present in 6 ± 1.3 patients. This decrease was statistically significant ($\chi 2 = 2153$, d.f. = 1, p<0.0001). The weighted average improvement in number of symptoms per patient at MMI was 80 ± 5%. Overall, of the 2,570 symptoms noted as present before treatment, 1,699 (66%) were absent, 737 (29%) improved, 108 (4%) unchanged, and 26 (1%) worse after MMI. Thus, 95% of pretreatment symptoms were absent or improved after MMI.

The six most common pre-treatment symptoms for this patient population and the percentage of the patients with this symptom were:

1. Cephalalgia - occipital area (94%)
2. Painful to chew food (94%)
3. Cephalalgia - temporal area (92%)
4. Pain upon opening or closing mouth (90%)
5. TMJ pain (89%)
6. Pain in back of neck (88%)

The three least common symptoms were:

1. Pain or burning side of tongue (8%)
2. Nausea – frequently (11%)
3. Mouth locks open (13%)

**Table 3** and **Figures 1 and 2** show disk status versus symptoms pre-treatment versus symptoms after MMI. As shown in **Figure 1**, there were considerable variations in both the pretreatment frequency and posttreatment frequency of specific symptoms. The overall weighted frequency after MMI was significantly less than the pretreatment frequency ($\chi 2 = 1345$, df = 1, p<0.0001). In Figure 2, symptoms were reordered in decreasing order of frequency before treatment. Because the number of patients in each disk-status group differed, frequencies are shown as percentages of patients in each group. Since there was only one patient with one normal and one disk that did not recapture, that patient was included in the group having one disk that recaptured and one that did not. Thus, patients were divided into five categories based on pretreatment disk status (**Table 4**) and whether or not the disk was recaptured by ARA therapy. Frequency of symptoms before treatment, weighted frequency at MMI, and improvement (as percentage of pretreatment symptoms) were significantly different among the five categories (**Table 4**). In each group, the frequency of symptoms before treatment and weighted frequency at MMI were significantly different (**Table 5**). No patients with nonreducing disks before treatment had their disks recaptured by treatment. Only five patients had reducing disks that were not recaptured by treatment. That is, disk reduction on opening the mouth before treatment was tantamount to disk recapture by ARA therapy, while nonreducing disks before treatment predicted failure of recapture. Pretreatment symptom frequencies can be grouped as 47-48% in patients with at least one normal disk and 54-58% in patients with bilateral disk abnormalities. Similarly, there were two groupings of patients by symptom improvement: 81-87% in patients with both disks either normal or recapturing, and 76% in patients with at least one disk that did not recapture. The overall range of symptom frequencies was 20 to 82 (23-95%).

These data also demonstrate that a normal disk position on MRI does not indicate absence of a temporomandibular disorder. Seven patients with bilateral and five with unilateral normal disks achieved significant alleviation of symptoms by ARA therapy.

**Table 6**
**Frequent Symptoms Pretreatment**

| Frequent Symptoms Pretreatment |
|---|
| Frontal cephalalgia |
| Temporal cephalalgia |
| Occipital cephalalgia |
| Otalgia |
| TMJ pain |
| Painful mastication |
| Difficult mastication |
| Back of neck pain |
| Pain on opening/closing mouth |

**Table 7**
**Infrequent Symptoms Pretreatment**

| Infrequent Symptoms Pretreatment |
|---|
| Paresthesia, side of face |
| Lateral deviation of jaw on opening |
| Mouth locks open |
| Pain or burning, tongue |
| Frequent nausea |

## Discussion

Patients with craniofacial pain and temporomandibular disorders report a variety of symptoms. These same symptoms are also described by patients who have been diagnosed with other painful disorders of the head and neck region. This study shows that most of the symptoms tracked improved with ARA therapy. These results should provide a basis for investigating the utility of evaluating specific symptoms, especially in combination with disk status on MRI, in the differential diagnosis of facial pain. **Table 6** lists specific symptoms found most commonly (>85%) in these patients. TMJ disease should be highly placed in the differential diagnosis of patients presenting with these symptoms. **Table 7** lists those specific symptoms found least commonly (<20%) in these patients. Other sources of pain should be strongly considered in the differential diagnosis of patients presenting with only

**Table 4 - Symptom Frequency vs Disk Status**

| Disk status at MMI | Patients (no.) | Pretreatment frequency | | Weighted frequency at MMI[a] | | Improvement (%) | |
|---|---|---|---|---|---|---|---|
| | | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI |
| All | 48 | 54 | 50-58 | 11 | 8-14 | 80 | 75-85 |
| | | | | | | | |
| N-N | 7 | 48 | 34-62 | 7 | 2-12 | 87 | 79-95 |
| N-WR | 5 | 47 | 31-63 | 10 | 4-16 | 81 | 68-94 |
| WR-WR | 11 | 58 | 49-67 | 9 | 4-14 | 85 | 76-94 |
| WR-WOR | 9 | 55 | 43-63 | 13 | 6-20 | 76 | 63-89 |
| WOR-WOR | 16 | 54 | 47-61 | 14 | 8-20 | 76 | 68-84 |
| | | | | | | | |
| $\chi^2$ | | 13.6 | | 31.2 | | 12.2 | |
| Df | | 4 | | 4 | | 4 | |
| P | | <0.01 | | <0.001 | | <0.02 | |

[a]Weights for symptom frequencies at MMI: absent 0, improved 0.5, unchanged 1, worse 2.

these symptoms.

Symptom groups (**Table 2**) have been established to allow ease in evaluating the results of this study:

Cephalalgia group: Occipital headache occurred in 95% of the patients. Headaches after MMI were unchanged in 1% of the patients, better in 33% of the patients and eliminated in 66% of this patient population. No patient's headaches were made worse.

Retroorbital pain group: Retroorbital pain after MMI was unchanged in 1% of the patients, better in 30% of the patients and eliminated in 68% of the patients. Travell and Simons[20] stated that eye pain is most often referred from the sternocleidomastoid muscle. The relief in retroorbital pain by using ARA therapy suggests the involvement of the relationship between the arthrokinetic reflex from the TMJ and the neck musculature.

Loss of equilibrium and vertigo group: Balance problems after MMI were unchanged in 4% of the patients, were made better in 28% of the patients and were eliminated in 66% of the patients. No balance problems were made worse.

Ear symptoms group: Otalgia, tinnitus, fullness and stuffiness in ears and itchiness in ears can be combined to form an ear symptom profile. Earache is a common complaint of TMD patients and occurred 80% of the time. Ear symptoms after MMI were the same in 5% of the patients, were better in 27.5% of the patients and were eliminated in 67% of the patients. No ear symptoms were made worse.

Preauricular pain occurred in 60% of the patients. Preauricular pain after MMI was unchanged in no patients, better in 19% and absent in 81% of the patients.

TMJ pain group: Of the 43 patients reporting TMJ pain pretreatment, 29 (67%) reported complete relief, 13 (30%) reported improvement, and 1 (2%) reported no change at MMI. That is, TMJ pain was improved or eliminated in 42 of the 43 patients.

Sinus symptoms group: Some symptoms were tracked to enable the clinician to discriminate between a non-temporomandibular disorder, such as sinus drainage, and a temporomandibular disorder. Sinus symptoms after MMI were the same in 9% of the patients, were better in 40% of the patients and were eliminated in 48% of the patients. No patient had worse maxillary sinus pain after MMI. Six percent of the patients had worse frontal sinus pain and 8% of the patients had worse sinus drainage after MMI.

Popping in TMJ group: TMJ popping was unchanged in 7% of the patients, was better in 17% of the patients and was eliminated in 76% of the patients. No patient's TMJ popping was made worse.

Paresthesia in arms, hands and fingers

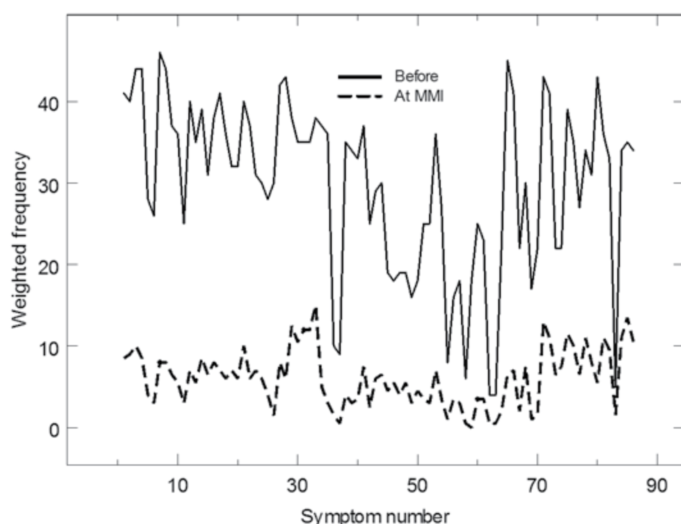


*Figure 1. Frequency of specific symptoms before treatment and weighted frequency of the same symptoms at maximum medical improvement. Symptoms are numbered sequentially as listed in table 2. Those symptoms listed bilaterally in table 2 are assigned separate numbers for each side. Symptoms at MMI were weighted as absent, 0; improved, 0.5; unchanged, 1; and worse, 2. ARA therapy produced a statistically significant decrease in the frequency of these symptoms (χ2 = 1345, df = 1, p<0.0001).*

## Table 5 - Reduction in Symptom Frequency vs Disk Status

| Disk status at MMI | Symptom Frequency (Mean±95% CI) | | t | df | p |
|---|---|---|---|---|---|
| | Pretreatment | MMI[a] | | | |
| All | 54±4 | 11±3 | 20.7 | 47 | <0.001 |
| N-N | 48±14 | 7±5 | 6.2 | 6 | <0.001 |
| N-WR | 47±16 | 10±6 | 6.9 | 5 | <0.003 |
| WR-WR | 58±9 | 9±5 | 12.3 | 13 | <0.001 |
| WR-WOR | 55±8 | 13±7 | 8.9 | 8 | <0.001 |
| WOR-WOR | 54±7 | 14±6 | 10.8 | 11 | <0.001 |

[a]Weights as in Table 5.

group: Paresthesia in the arms, hands and fingers can be grouped to get a symptom profile. Paresthesia was the same in no patients, better in 20%, absent in 73% and worse in 7%. Paresthesia in the arms, hands and fingers can be from multiple causes. Nerve entrapment in muscle in spasm can cause paresthesia and relieving an arthrokinetic reflex explains the positive response from ARA therapy. There is no known factor associated with ARA therapy that could contribute to the worsening of 7% of the patients paresthesia in the arms, hands and fingers.

Pain on opening or closing mouth was unchanged in no patients, better in 26%, absent in 74% and worse in 0%.

Mouth locking shut was eliminated in 100% of the patients in this study.

Teeth pain group: Teeth pain after MMI was the same in 6% of the patients, better in 16% and absent in 77%. None of the patients reported worse teeth pain. These patients were wearing a mandibular appliance on their teeth during their waking hours and a maxillary appliance on their teeth during sleep. One can conclude that wearing an appliance does not cause teeth pain. Also, it is well known that many patients have occult teeth pain from dental causes that is not related to their craniofacial pain or TMD.

Pain and difficulty chewing food group: Pain and difficulty chewing food after MMI were the same in 1% of the patients, better in 29%, absent in 70%. None of the patients reported worse pain or difficulty chewing food. Those who had never worn an appliance felt that they could possibly not eat in the appliance. The results of this study clearly show that this patient population had no problem eating in their mandibular appliance.

Throat symptoms group: Dysphagia, constant clearing of the throat, feeling of constant sore throat and feeling of foreign object in the throat can be combined to get a throat symptom profile. When these were combined and averaged, throat symptoms were reported by 48% of the patients. Of the four categories that are lumped together only one patient reported that throat symptoms remained the same at MMI. Nineteen percent said their throat symptoms were better at MMI. Eighty percent said their throat symptoms were absent at MMI. Only 1 patient said their throat symptoms were worse after treatment.

Neck and shoulder group: Pain in right and left back of neck, inability to turn head to right and left, stiff neck right and left, cervical crepitus upon movement of head, right and left shoulder pain can be grouped to form a neck and shoulder profile. Of the nine categories lumped together neck and shoulder symptoms after MMI were the same in 5% of the patients, were better in 36% of the patients and were eliminated in 56% of the patients. Patient's neck and shoulder symptoms were worse 3% of the time. This probably indicates that neck and shoulder pain can be either referred from the TMJ apparatus or can be independent from the TMJ apparatus.

Nausea group: There were only 5 patients who had nausea frequently.

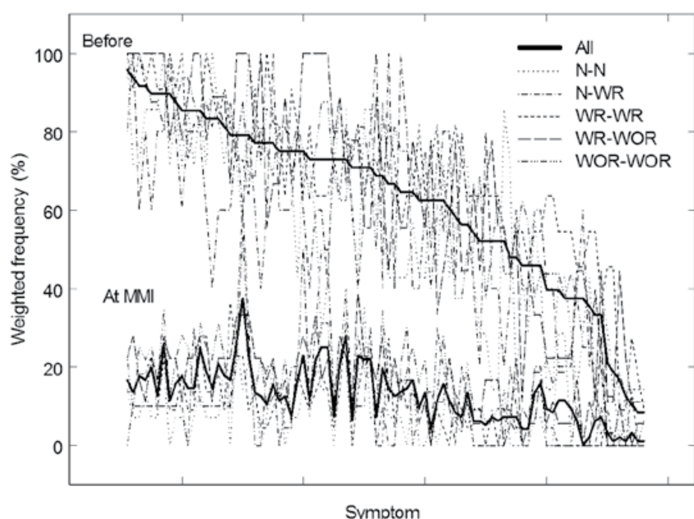


*Figure 2. Frequency of specific symptoms before treatment and weighted frequency at maximum medical improvement, by disk status before treatment. Symptoms are reordered in decreasing order of pretreatment frequency in all patients. Weights for symptom frequencies at MMI as in Figure 1. Symptom frequencies before treatment were significantly different among the five disk-status groups ($\chi 2 = 13.6$, $df = 4$, $p<0.01$). There were similar significant differences among these groups at maximum medical improvement ($\chi 2 = 31.2$, $df = 4$, $p<0.0001$). Disk status groups: N-N, bilateral normal; N-WR, unilateral normal and unilateral displaced with recapture; WR-WR, bilateral displaced with recapture; WR-WOR, unilateral displaced with and unilateral displaced without recapture; WOR-WOR, bilateral displaced without recapture.*

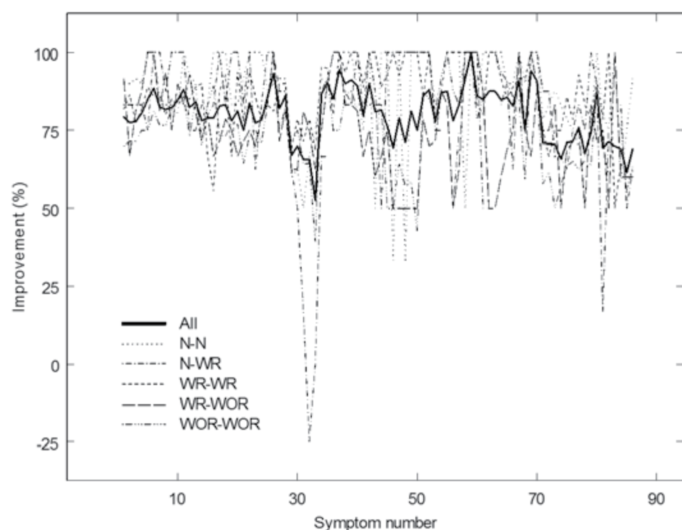


***Figure 3.** Relief of specific symptoms at maximum medical improvement, as per cent of symptoms present pretreatment. Weights for symptom frequencies at MMI as in Figure 1. Disk status groups as in Figure 2. Numerous specific symptoms were completely relieved (100%) in several disk-status groups, but only one in all patients (mouth locked closed, present in 18 patients). The appearance of worse symptoms at MMI in the N-WR group was the result of one patient with sinusitis. See figure 1 for symptom numbering.*

There were 33 patients who had nausea occasionally. Only 1 patient in each nausea type reported their symptoms stayed the same. The nausea group after MMI were better in 18% of the patients and symptoms were eliminated in 66% of the patients. Three patients' occasional nausea was worse after MMI but they were all pregnant.

Clenching and/or grinding teeth group: The clenching and grinding teeth group after MMI were the same in 16% of the patients, better in 37% of the patients and absent in 48% of the patients. None of the patients clenching or grinding were worse after MMI.

Symptoms that were not very common in this patient population were pain or burning right (8%) and left (8%) side of tongue, nausea frequently (11%) and mouth locking open (13%).

Four patients believed that 100% of their symptoms had been relieved by ARA therapy. Each of these patients had a different status of disk position.

It should be noted that all categories of TMJ disk status were included in this study of ARA therapy. According to recent research by Paesani et al.,[21] TMJ authorities can accurately diagnose the status of the TMJ disk only 43% of the time from clinical exam and history. This means that the authorities in the Paesani et al. research erred in their assessment of disk position by using clinical methods 57% of the time. Most clinicians treating TMD today use clinical exam and history to assess the status of the disk in their patients and do not have MRI data. Therefore, most clinicians do not truly know the status of their patient's disks. Ribeiro et al.[22] found that patients who have symptoms of TMD have disk displacement 86% of the time. Katzberg et al.[23] found that patients who have symptoms of TMD have disk displacement 77% of the time. Patients in this study had disk displacement 79% of the time according to MRI. ARA therapy for TMD is appropriate because it is effective in recapture of disks when they are recapturable and provides symptom relief when the disk is not recapturable.[1] ARA therapy is also effective in symptom relief in joints with a normal disk status on MRI with symptoms of TMD.

There seems to be relief from symptoms of temporomandibular disorder from the orthopedic effect of recapturing the TMJ disk to a more normal relationship or repositioning the condyle to a more normal position in the fossa. Gelb and Gelb[11] have stated that ARA can relieve symptoms without disk recapture. This orthopedic effect is predictable to a high degree of certainty and should be a part of treatment of temporomandibular disorder patients. This seems to be the most effective treatment to reverse the arthrokinetic reflex pain described by Isberg et al.[24] and Bertolucci[25] in muscles, ligaments and tendons associated with joint injuries. Pharmacotherapeutics, physical therapy, biofeedback therapy and flat plane appliance therapy are supportive therapy and do not accomplish these same goals. Treatment of the temporomandibular disorder patient may require all of these modalities, but as seen in this study, the orthopedic effect of anterior repositioning appliances can achieve high levels of MMI without other modalities in many patients.

The results of this study cannot be translated to any other type of appliance or splint therapy other than that which was described in this study. These results may not be achieved from other treatment protocols.

## Conclusions

Anterior repositioning appliance therapy for temporomandibular disorders provides significant relief for most symptoms tracked in this study, for most patients. Presence of many of the nine most frequent symptoms (**Table 6**) should suggest that TMJ disease should be strongly considered in the differential diagnosis of facial pain. Conversely, presence of only the least frequent symptoms (**Table 7**) should guide the differential diagnosis away from TMD. The typical TMD patient has headaches, mainly in the occipital, temporal and frontal region, earache, TMJ pain, pain and difficulty chewing food, back of neck pain, and pain on opening and closing the mouth. Since headache is two of the top six complaints of TMD patients in this patient population, health care providers should include TMD in their differential diagnosis of headache patients.

After MMI patients with both disks either normal or recaptured showed the greatest symptomatic improvement, 81-87%. Patients with at least one disk that did not recapture showed less improvement, 76%. This agrees with previous reports showing that ARA therapy relieves more symptoms in patients with disks that are recaptured than those that do not. Overall, ARA therapy resulted in either absence or

improvement of 95% of symptoms present before treatment.

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REFERENCES


1. Simmons HC, Gibbs SJ: Recapture of temporomandibular joint disks using anterior repositioning appliances: an MRI study. J Craniomandib Pract 1995;13:227-237
2. Simmons HC, Gibbs SJ: Initial TMJ Disk Recapture with Anterior Repositioning Appliances and Relation to Dental History. J Craniomandib Pract 1997;15:281-295
3. Fricton JR, Kroening R, Haley D, Siegert R: Myofascial pain syndrome of the head and neck: a review of clinical characteristics of 164 patients. Oral Surg Oral Med Oral Pathol. 1985;60(6):615-23
4. Dworkin SF, Huggins KH, LeResche L, et al: Epidemiology of signs and symptoms in temporomandibular disorders: clinical signs in cases and controls. J Am Dent Assoc. 1990;120(3):273-81
5. Kaplan AS, Assael LA: Temporomandibular disorders diagnosis and treatment. W.B. Saunders Company, 1991
6. Lundeen TF, Levitt SR, McKinney MW: Discriminative ability of the TMJ Scale: age and gender differences. J Prosthet Dent 1986;56:84-92
7. Lundeen TF, Levitt SR, McKinney MW: Clinical application of the TMJ Scale. J Craniomandib Pract 1988;6:339-345
8. Brown DT, Gaudet EL Jr: Outcome measurement for treated and untreated TMD patients using the TMJ Scale. J Craniomandib Pract 1994 Oct;12(4):216-22
9. Gaudet EL Jr, Brown DT: Temporomandibular disorder treatment outcomes: first report of a large-scale prospective clinical study. J Craniomandib Pract Jan 2000;18(1):9-22
10. Bledsoe WS Jr: Selection, application and management of Phase I orthotics. Intraoral Orthotics, Cranio Clinics International. Bledsoe WS Jr, (eds) Baltimore: Williams & Wilkins 1991
11. Gelb ML, Gelb H: Gelb Appliance: mandibular orthopedic repositioning therapy. In Bledsoe WS Jr (ed), Intraoral Orthotics, Cranio Clinics International. Baltimore: Williams & Wilkins, 1991:81-98
12. Pertes RA, Gross SG: Clinical management of temporomandibular disorders and orofacial pain. Quintessence Books 1995
13. Gelb H: Clinical management of head, neck and TMJ pain and dysfunction, 2nd Ed. WB Saunders Co., 1985
14. Katzberg RW, Westesson P-L: Diagnosis of the temporomandibular joint. W.B. Saunders Company, 1993
15. Okeson JP: Management of temporomandibular disorders and occlusion. 5th ed, Mosby, Inc., 2003
16. Netter FH: Atlas of human anatomy. Summit, NJ: Ciba-Geigy Corp., 1990
17. Katzberg RW, Westesson P-L: Selection of imaging modalities for patients presenting with symptoms of internal derangement. Cranio Clin Int 1991;1:127-132
18. Gibbs SJ, Simmons HC III: A protocol for magnetic resonance imaging of the temporomandibular joint. J. Craniomandib. Pract. 1998;16:236-241
19. Tasaki MM, Westesson, P-L, Isberg AM, et al: Classification and prevalence of temporomandibular joint displacement in patients and asymptomatic volunteers. Am J Orthod Dentofac Orthop 1996;109
20. Travell JG, Simons DG: Myofascial pain and dysfunction The trigger point manual. Williams & Wilkins Baltimore,1983
21. Paesani D, Westesson P-L, Hatala MP, et al: Accuracy of clinical diagnosis for TMJ internal derangements and arthrosis. Oral Surg Oral Med Oral Path 1992;73:360-363
22. Ribeiro RF, Tallents RH, Katzberg RW, Murphy WC, Moss ME, Magalhaes AC, Tavano O: The prevalence of disc displacement in symptomatic and asymptomatic volunteers aged 6 to 25 years. J Orofac Pain 1997;11(1):37-47
23. Katzberg RW, Westesson P-L, Tallents RH, Drake CM: Anatomic disorders of the temporomandibular joint disc in asymptomatic subjects. J Oral Maxillofac Surg 1996 Feb;54(2):147-53
24. Isberg A, Widmalm SE, Ivarrson R: Clinical, radiographic and electromyographic study of patients with internal derangements of the temporomandibular joint. Am J Orthodontics 1985;88:453-460
25. Bertolucci L: The trilogy of the “triad of O’Donoghue” in the knee and its analogy to the TMJ derangement. J Craniomandib Pract Vol 8, No 3, July 1990, 268



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## Questions for Continuing Education Article - CE Exam #15

1. A popular method of evaluating pain is:
   a. the visual analog scale
   b. the alphabetical scale
   c. the phonetic scale
   d. the musical scale

2. The literature supports:
   a. the use of dual appliances
   b. only the use of the Gelb appliance
   c. only appliances with flexible occlusal surfaces
   d. extended lingual ramps on lower appliances
   e.

3. Disk position immediately prior to delivery of the ARA was
   a. determined by MRI
   b. determined by sagittal radiographs
   c. determined by anterior/posterior and lateral radiographs
   d. determined by contrast media

4. The improvement of symptoms after MMI was related to
   a. disk position before treatment
   b. disk position after treatment
   c. onset of pain before treatment
   d. the type of appliance used

5. Numbers of symptoms per patient vs. disk status before treatment were
   a. determined by MRI
   b. subjected to chi-square and paired t tests
   c. weighted toward improvement
   d. favorable toward T-1 weighted images

6. Disk reduction on opening mouth before treatment was
   a. never observed
   b. tantamount to disk capture by ARA therapy
   c. not part of this study
   d. not classified as TMD

7. A normal disk position on MRI
   a. precludes any pain
   b. precludes bruxism
   c. does not indicate absence of TMD
   d. indicates absence of TMD

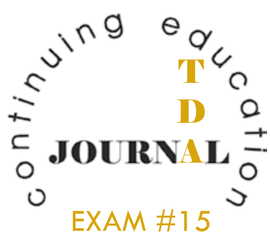
8. What symptom in this study was present in 95% of patients with TMD?
   a. Rhinitis
   b. Tinnitus
   c. Cephalalgia
   d. Vertigo

9. A study by Gelb and Gelb stated:
   a. That ARA was not effective in symptom reduction
   b. Disc recapture was always dependent on ARA
   c. Orthopedic effect of disc recapture did not relieve symptoms
   d. That ARA can relieve symptoms without disk recapture

10. Anterior repositioning appliance therapy for TMD
    a. was determined by MRI
    b. caused significant orthodontic problems for many patients
    c. caused headache s in many patients
    d. provided significant relief for most TMD symptoms

# Answer Form for TDA CE Credit Exam #15:

*Anterior Repositioning Appliance Therapy for TMJ Disorders*

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| 2. | a | b | c | d | 7. | a | b | c | d |
| 3. | a | b | c | d | 8. | a | b | c | d |
| 4. | a | b | c | d | 9. | a | b | c | d |
| 5. | a | b | c | d | 10. | a | b | c | d |

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