The Temporomandibular Joint and Related Orofacial Disorders

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Basic Examination

The goal of the basic examination is to provide the clinician with valid indices to avoid erroneous conclusions. The validity of present measures for diagnosing or evaluating treatment outcomes in TMD patients is open to question. Arguments for and against the validity of some items are reviewed in the publications listed in this chapter's References and in Chapter 5. Issues surrounding the validity of specific signs and symptoms of TMD may never be resolved.

Content validity has been shown in some studies because the measures used to assess signs and symptoms have proven to be reliable indicators of the disorder. Construct validity has been proved by comparing certain measures of patients with different diagnoses against healthy individuals matched for age and gender. Criterion validity has been supported by findings of significant correlations between disparate samples of patients examined with different indices. Because of uncertainty about the validity of some measures, the measures adopted here are those currently used by practitioners around the world.

Several objective tests aid in the differential diagnosis of TMD from mimicking disorders. The examination measures described here have been obtained from many sources, including the Virginia Commonwealth University Pain Questionnaire and Examination Form developed in 1974, the Helkim Index, modified forms of W K Solberg, the guidelines for examination and diagnosis of TMD, the Craniomandibular Index, the Clinical Diagnostic Criteria for TMD, and Cranio-Cervical Dysfunction Criteria. The suggested guidelines for clinical normality versus TMJ abnormality have been incorporated into the examination measures. Other measures have evolved from general observations drawn from clinical experience.

These measures are divided into seven parts. The first four measures usually supply the most reliable information about the status of the TMJs. To rule out mimicking disorders, collateral measures are described for other head and neck disorders.

Facial Appearance

Initially, the examiner should observe the patient's overall facial form. The condition of the eyes, ears, skin, and lips should be noted. Although most asymmetry of the face and head is of developmental origin, recent evidence of swelling, hypertrophy, or lesions may be related to systemic or neoplastic conditions that mimic TMD symptoms.

Range of Jaw Motion

The patient is asked to **"open as wide as you can".** The following measures are determined.

Active range of motion (AROM) is the opening under voluntary effort. AROM is tested by measuring the opening between the upper central incisors and lower central incisors with a millimeter ruler or Boley gauge as the patients opens fully. Data are recorded.

Restricted opening is judged at 35 mm or less for men and 30 mm or less for women. These values allow for differences in physical stature and vertical overlap of the anterior teeth. For further reliability, the examiner may measure the difference between the alveolar crests. From extrapolation of interincisal distance, measurement at the alveolar crests would establish limits at 39 mm or less for men and 34 mm or less for women.

Pain-free opening involves stretching of the mandible in an inferior direction to the greatest extent possible without report of pain. A sensation of facial pressure or tightness by the patient can be excluded from the record. The presence of pain should be considered abnormal.

Significance: Monitoring the range of motion provides insight about the status of pain and mandibular mobility caused by joint or muscular problems. The patient's progress can be judged by comparing initial measurements with measurements during the course of treatment.

Restriction, or hypomobility, may represent either joint or muscle disorder. Excessive movement, or hypermobility, usually represents joint laxity related to instability of the capsular attachment and disk-condyle relation. Hypermobility should be considered normal, unless there is a history of joint locking in the open position or there is pain or discomfort that prevents normal function during wide opening.

Passive range of motion (PROM) or passive stretch opening is determined as the examiner pushes gently downward on the patient's mandible. Usually the opening is increased by an average of 2 mm. The PROM is positive if the opening is 37 mm or less for men and 32 mm or less for women. Measurements made between the alveolar crests are positive at 41 mm or less for men and 36 mm or less for women.

Significance: If AROM is painful and PROM is not, the problem is probably muscle related. An increased opening or "springy" feeling detected by the examiner suggests muscular restriction. A "hard" feeling suggests adhesion, arthrosis, or possible contracture.

Lateral deviation is measured at the midline as the patient opens the mouth fully and then closes the teeth together. If the deviation is more than 2 mm, it should be considered positive.

Significance: The absence of deviation should be considered normal. Unilateral deviation indicates an inability to translate the condyle properly from the restricted side. Reduced tenderness on palpation suggests a disk disorder or adhesion. A repeatable deviation

from straight opening that has been present for many years and is unrelated to other symptoms should be regarded as compensatory and, therefore, clinically normal.

TMJ Function

The patient is asked to **"move the lower jaw as far as possible in a forward direction".**

Anterior-posterior movement is measured as the patient moves the mandible from the intercuspal position to full protrusion. The measurement is made at the diastem between the labial surfaces of the maxillary incisors and the diastema between the labial surfaces of the mandibular incisors. Unless the incisors are end-to-end at the intercuspal position, the measurement is considered positive if less than 7 mm. The presence of pain should be noted.

The patient is asked to **"move the lower jaw as far as possible to the left and then to the right".**

Laterotrusion involves movement to each side. This measurement is made at the diastema between the maxillary central incisors to the diastema between the mandibular central incisors as the patient extends the mandible fully to the right and then to the left. If the diastemata differ at the intercuspal position, a correction is made in the final measurement. The measurement should be considered positive if less than 7 mm to each side. This horizontal movement should be symmetrical to be considered normal. The presence of pain should be noted.

Joint sounds are assessed by palpation, listening, and asking the patient. The patient is asked to **"open as wide as possible"** and then to **"move the lower jaw from side to side as far as possible".** To be judged positive, sounds should be audible to the patient and the examiner, and the uncoordinated disk movement should be palpable by the examiner. Uncoordinated disk movement is determined by palpating across the joint capsule during unrestricted opening and closing movements. If doubt exists, further palpation is done by inserting the little finger into the patient's auditory meatus. Additional testing can be done by asking the patient to **"chew gum or wax".** The location of sounds is related to the position of the jaw during the respective movements.

For clicking to be judged as *reciprocal*, the noise must be reproducible on opening and closing, starting from full intercuspation and extending to full opening. *Reproducible* clicks may exist exclusively during opening, laterotrusion, or closing. Some are nonrepeatable; they are considered *nonreproducible* clicks. *Fine crepitus* is a weakly perceived grating sound suggestive of mild bone-on-bone contact. *Coarse crepitus* is a strongly perceived grating sound suggestive of gross bone-on-bone contact. *Popping* is a loud sound detected on opening that is audible to the examiner without the aid of a stethoscope.

Significance: Joint sounds indicate disk disorders. Crepitus implies degeneration of the disk and usually signifies osteoarthrosis. Multiple clicks during opening indicate perforation of the disk or changes in joint form. Reciprocal clicking means the disk is displaced anteriorly, especially if the mandible shifts near full closure. Clicks associated with

painful chewing or intermittent locking are the most bothersome. These clicks and soft crepitation should be considered abnormal, unless they have shown no change in characteristics for at least 5 years and they do not bother the patient or interfere with function.

Diagnostic or *reductive manipulation* is a means of distracting the patient's condyle. The patient is asked to **"bite on a cork"** on the symptomatic side for 5 minutes. The cork is removed, and the examiner pushes the mandible inferiorly and posteriorly with one hand at the level of the molars and simultaneously raises the chin with the other hand. The patient is asked to **"move the mandible forward and then to the opposite side"** as the examiner distracts the mandible. If the distraction is of recent origin, the force necessary to accomplish disk reduction is minimal.

Significance: This test has diagnostic and treatment value. It identifies acute locking of the joint. Typically, the patient reports with a history of clicking and sudden loss of clicking. After successful manipulation, the AROM should increase immediately to within normal limits.

Masticatory Muscle Palpation

The procedures for muscle palpation have been documented. For the extraoral masticatory muscles, pressure is applied bimanually with the examiner's index and middle fingers. The recommended amount of pressure is 2 lb/in^2, a level that proved useful for examination of these muscles in another study. The amount of pressure can be determined with a pressure algometer or by simulation after practicing palpation on a postal scale with the index finger.

The patient is asked, **"Is there any difference between the two sides?"** If the answer is yes, the patient is asked, **"Does it hurt or is just uncomfortable?"**

The degree of severity is graded at 0 (no pain), 1 (mild pain), 2 (moderate pain), or 3 (severe pain), based on the patient's verbal and nonverbal responses to the pressure. Severity applies to tenderness involving bodily withdrawal or eye-wincing responses. The examiner follows the routine for palpation described below.

In palpation of the *masseter,* both the superficial head and the deep head originate from the zygomatic arch and have fibers inserting on the ramus of the mandible. The superficial head lies more anteriorly; it is easily palpated when the patient is asked to **"clench the teeth".** The deep head lies posteriorly and is palpated in the depression about 10 mm anterior to the tragus.

The *temporalis* is located along the side of the head and can be elevated by asking the patient to **"clench the teeth".** Anterior fibers are palpated as they originate on the lateral surface of the skull and insert on the coronoid process and anterior border of the mandible. Middle and posterior fibers are palpated by asking the patient to **"close on the back teeth and pull the mandible backward".**

The *digastric* region is palpated by pressing the little finger upward parallel to the ramus of the mandible. The muscle originates from the mastoid notch and is joined at the

hyoid bone by a tendinous sheath. Palpation of the posterior fibers of the digastric muscle is more appropriately designated palpation of the *stylohyoid* region because the examiner is unsure of what is being palpated.

The insertion of the *medial pterygoid* near the inferior angle of the mandible allows extraoral palpation. An index finger placed below the angle is pushed slightly upward and medially. Simultaneous intraoral palpation is done by placing the other index finger in the retromylohyoid fossa on the same side. Because of overlap with other muscles in this region, the palpation should be designated palpation of the *suprahyoid* region.

In palpation of the *temporalis tendon,* the patient is asked to **"open the mouth".** The index finger is pushed posterosuperiorly into the upper vestibule lateral to the maxillary tuberosity. The finger is moved along the coronoid process.

In palpating the *pterygoids,* the index finger is placed in the upper vestibule at a 45° angle to the sagittal plane. The finger is moved distally to the tuberosity, and pressure is applied in a downward and medial direction toward the tongue. Because the heads of the lateral and medial pterygoids originate near one another at the pterygoid plates, the region should be designated the *pterygoid* region.

Significance: Although there is a tendency to overinterpret findings of widespread tenderness, the referral pattern of pain elicited by palpation should be outlined. This mapping adds credence to the diagnosis of palpable trigger points producing localized and referred pain. The presence of numerous tender muscles may be used to augment a diagnosis of myofascial pain exclusive of true joint pain or to confirm a diagnosis of simultaneous joint-related and muscle-related disorders.

TMJ Palpation

The patient is asked to **"open slightly".** Pressure of 2 lbs/in^2 is applied bimanually with the index fingers along the lateral poles of the condyles. A similar amount of pressure is applied to the superior surface along the fossae. The finger is moved toward the ear to palpate the posterior capsule. Tenderness of the meatus is detected by placing the little finger in the auditory meatus and pulling forward with slight pressure.

Significance: Without associated tenderness of the masticatory muscles, tenderness in the joint identifies inflammation. A check should be made for swelling and temperature change, which augment a diagnosis of true joint pathology.

Craniocervical Evaluation

Because the relation between TMD symptoms and craniocervical symptoms is unclear, craniocervical status should be evaluated along with symptoms of TMD.

The range of motion for the neck is tested following movement. The patient is asked to perform a series of neck and head exercises while standing in an upright position. The minimal limits for normal ranges of motion given here are accepted from published standards.

The limits accepted for impairment are described in degrees as the patient moves as far as possible in each direction.

Flexion is recorded as the patient is asked to **"touch the chin to the chest",** starting with the head held in a vertical, neutral position (0°). The examiner judges the limitation from a sagittal position. The minimum for acceptable normal motion is 60°. At less than 60°, there is impairment.

Extension is recorded as the patient is asked to **"move the top of the head backward"** from the neutral position. Judgment is made from a sagittal position. The minimum for normal motion is 75°. For both flexion and extension, the patient should be able to move a minimum of 135° (60° + 75°).

Rotation is recorded as the patient is asked to **"turn the nose toward the right and then toward the left shoulder".** Judgment is made from a superior or anterior position. The minimum for normal motion is 80° in each direction or 160° to the right and then to the left.

Side-bending or *lateral flexion* is recorded as the patient is asked to **"tilt the side of the head toward the right and then to the left shoulder".** The minimum for normal motion is 45° in each direction or 90° to the right and left.

Cervical sounds are recorded if the noise can be reproduced by movement. The patient is asked to **"turn the head to each side".** If noise is present, the location, type (eg, clicking, popping, or crepitus), and degree of associated discomfort are recorded.

Cervical tenderness is checked bilaterally with index finger pressure of about 7 lbs/in^2, a level that proved useful in one study. This level can be judged from palpation with a pressure algometer or by simulating the pressure after practicing palpation on a postal scale. Palpation should include the anterior, lateral, and posterior cervical regions. Muscles are palpated from origin to insertion.

1. The *anterior cervical region* includes the clavicular and sternal parts of the sternocleidomastoid (SCM) and longus colli muscles. The patient is asked to **"rotate the head to each side".** Each SCM is palpated on the side opposite the direction that the nose is turned. The longus colli muscle is palpated by moving the thyroid cartilage medially and palpating deeply toward the cervical spine.

2. The *lateral cervical region* includes the scalenus, the upper part of the levator scapulae, and the splenius capitis. The scalenus passes posterior to the SCM, and fibers radiate in an superoinferior direction. Palpation extends to the transverse process of the cervical spine at the level of the first and second ribs. The splenius capitis and the levator scapulae are palpated by pressing posterosuperiorly from the scalenus muscle.

3. The *posterior cervical region* includes the lower part of the levator scapulae and the upper trapezius. These muscles are palpated from the acromion process to its origin in the base of the skull and the lateral cervical spine.

Vertebral processes are palpated from the lateral process of the first cervical vertebra and extending through the second thoracic vertebra. The lateral processes of the first cervical vertebra are palpated anterior to the mastoid process and toward the distal part of the mandible.

Craniocervical posture is evaluated from sagittal, anterior, and posterior directions to the clinician. Postural deviations such as forward or posterior head position, unequal shoulder height, and scoliosis are recorded.

Neurosensory changes include areas of numbness, tingling, or pronounced sensitivity. They are palpated to confirm location, pattern of radiation, and intensity in the neck, shoulder, arm, hands, and fingers.

Significance: Over mechanical problems in the neck and shoulder girdle compromise successful treatment of TMD complaints.

Loading Tests

Placement of the mandible under a load may aid in deciding whether the complaint originates from the masticatory muscles or from the TMJs. This testing is not recommended for routine screening purposes.

In *resistance testing,* the patient is asked to **"open the width of an index finger".** The examiner supports the patient's head with one hand and pulls the mandible inferiorly with the other hand. The patient is asked to **"resist the pull".** If pain develops at the site of the initial complaint, a positive response is recorded.

Significance: Complains correlated with resistance most likely involve the muscles responsible for jaw opening, if no joint movement occurs. This test has less value for the interpretation of referred pain.

Bitestick testing is done to put the masticatory muscles and TMJs under load. For testing of muscles, the bitestick is placed between the molars on the ipsilateral, symptomatic side. The patient is asked to **"close firmly against it".** This action may produce pain within the elevator muscles. If the pain is ameliorated, the lateral pterygoid muscle may be involved. For testing of TMJs, closure against the bitestick on the asymptomatic side aggravates the pain on the contralateral side. Ipsilateral biting relieves the pain.

Significance: To differentiate joint pain from muscle pain, bitestick testing must be supplemented with findings of palpable tenderness and with the patient's report of the pain site.

Elevator Muscle Function

In tests of the *closure-clench* function, individuals with healthy jaw mechanics should be able to close the teeth to a stable jaw position. For this test, the patient is asked to **"clench**

the teeth hard for 60 seconds". Clenching at maximal intercuspation may provoke fatigue or painful contraction of the symptomatic elevator muscles.

To test *masseter function,* the patient is asked to **"close the teeth against tongue depressors"** placed bilaterally between the molars. The pressure may ameliorate the pain.

Significance: These tests may aid in diagnosis of pain of the elevator muscles. The findings are compared with palpation data and the patient's identification of the painful site to confirm the diagnosis.

Occlusal Analysis

No definitive relation has been established between occlusion and TMD symptoms. Logic dictates that patients should have a stable jaw position at maximal intercuspation and be free of major cuspal interferences during excursive jaw movements. Dental wear and fractures should be assessed to determine the effect on occlusal stability. This information is recorded on the occlusal findings form.

Intercuspal Position

The teeth should be checked for firmness of contact at full intercuspation. The firmness is checked with occlusal registration strips or with thin articulating paper.

Gross Occlusal Interferences

Gross interferences are identified with the strips or with paper. If found to deflect the mandible significantly during opening or closing or during excursive movements, they are charted.

Dental Wear

Excessive dental wear as indicated by thinner or crazed enamel of the anterior teeth and wear facets or cupping of the molars are charted.

Movement Between Retruded Contact Position and Intercuspal Position

The "slide" or movement between retruded contact position and intercuspal position is negligible in most dentitions. If this movement is more than 2 mm in lateral, anterior-posterior, and inferior-superior directions, the finding may be important enough to chart.

Significance: Examination of the occlusion may provide insight into certain complaints. Recurrent tooth fractures and bruxism are reflective of the overall health of the masticatory system. Parafunctional habits contribute to deterioration of the dentition and may compromise function of the masticatory muscles and TMJs.

Diagnostic Blocking and Analgesic Spraying

Blocking or analgesic spraying with vapocoolant agents may help determine whether the pain complaint is of dental/osseous origin or from another source. Before blocking is attempted, the pattern of pain referral needs to be evaluated. For osseous/dental pathology, this pattern can be traced from published figures. The patient is asked to **"point to the painful area".** The examiner marks the area on the appropriate figure. Checks along the referral zone may confirm the site of the pathology.

There are several contraindications to the blocking of stellate ganglion, myofascial trigger points, and occipital nerves. Each requires expertise beyond the training of the general practitioner and is usually performed by an anaesthesiologist or neurologist. Still, the generalist should be familiar with each to discuss their use with the patient and the referral clinician.

Dental Blocks

After the patient localizes the painful site, the examiner can mark an X on the appropriate figure and follow the distribution pattern of referral. The maxillary zones to be blocked are the anterior superior alveolar, middle superior alveolar, and posterior superior alveolar zones. The mandibular zones to be blocked are the inferior alveolar and long buccal zones.

Injection with 3% mepivacaine is recommended because of the short duration of action. Because some mandibular gingiva or mucosa may not become totally numb, direct infiltration into these alternate hypersensitive zones may be necessary to obtain "full terminus".

Significance: If localized and referred pain are eliminated by zone blocking, tooth or bone pain is confirmed. If the referred pain persists after dental blocking to "full terminus", another source should be suspected.

Vapocoolant Sprays

Perception of painful impulses is negated by application of these sprays. The sprays act as counter irritants and promote local anesthesia. Examples include fluoromethane and ethyl chloride. *Caveat:* ethyl chloride is highly flammable.

Usually sprays are used before analgesic blocking. Application should be explained to the patient before use. A short burst of mist is applied to the patient's forearm to demonstrate the product. For spraying the TMJs, the patient's eyes are covered and external auditory meatus blocked. The mist is directed at a 45° angle to the surface to be sprayed. It should be moved frequently to avoid frosting the skin. After application, the patient is asked to **"open as wide as possible"** and then to **"move the mandible to each side as far as possible".** Measurements are made as the patient opens fully and then moves to the right and to the left.

Significance: The benefits of vapocoolant sprays include relief of muscle splinting, improvement in voluntary opening, and confirmation of locked TMJs. If improvement of more than 2 mm occurs in maximal opening and lateral movements, the problem is most likely muscle related. If little to no improvement occurs, the problem is most likely joint related.

Myofascial Trigger Point Blocks

Muscles difficult to palpate are typically chosen for injection. These include the deep head of the masseter and the lateral and medial pterygoids. The recommended anesthetic is 1% procaine without epinephrine.

Techniques for the injection of different muscles, including the masseter, temporalis, lateral and medial pterygoids, are described.

Injection of the masseter muscle. The needle pierces the midbody and passes at several angles to reach both deep and superficial layers of muscle. After aspiration of each layer, the anesthetic solution is injected as the needle is withdrawn.

Injection of the temporalis muscle. After aspiration at each point above the zygoma, the anesthetic solution is delivered slowly.

Injection of the lateral pterygoid muscle. The needle enters across the sigmoid notch and is directed upward and inward to about 35 to 40 mm. After aspiration, the anesthetic solution is slowly deposited.

Injection of the medial pterygoid muscle. The needle enters across the sigmoid notch and is directed downward and inward to about 40 mm. After aspiration, the anesthetic solution is slowly deposited.

Significance: Local injection may relieve pain from specific groups of muscles. Repetitive injections into different groups is unwarranted. Acute inflammatory reaction and muscle necrosis occur after injection, and regeneration requires up to 45 days. Persistent soreness may result.

Auriculotermporal Nerve Block

Blocking of the auriculotemporal nerve may reveal if the pain is totally within the joint. A technique for injection has been described. The examiner palpates the head and neck of the condyle. Ethyl chloride is sprayed on the site to achieve surface anesthesia. A dental aspirating syringe with a long needle is used to deliver 0.2 mL of 2% lidocaine with 1:100.000 epinephrine subcutaneously at the junction of the tragus and lobule. Without infiltration, the needle is pushed through the parotid gland 1 cm anterior and medial to the posterior surface of the condylar neck. The remaining anesthetic is injected at this site. Analgesia occurs within 5 minutes and lasts up to 1.5 hours.

Significance: Abolition of pain confirms joint derangement.

Stellate (Cervicothoracic) Ganglion Block

Stellate ganglion blocking may confirm that the orofacial pain is mediated by afferent sympathetic fibers. The stellate ganglion is formed by fusion of the inferior cervical and first thoracic ganglia.

A modification of the original technique has been described. The lateral surface of the cricoid cartilage is the site of delivery. The needle is positioned in a vertical-dorsal direction to a depth of 2 to 3.5 cm, until the transverse process of C6 is located. It is then withdrawn about 2 mm, followed by aspiration, and 5 mL of 1% mepivacaine is injected.

Significance: Sympathetic fibers are known vasoconstrictors. Blocking of the ganglion enhances dilation and increases circulation to the head. Pain of vascular origin in the trigeminal complex is arrested by blocking. Because autonomic changes have been observed in cases of reflex sympathetic dystrophy, the pain of this disorder and similarly related burning pains may be relieved.

Occipital Nerve Block

Blocking the occipital nerve may relieve neuralgia caused by degenerative changes in the upper cervical nerves or by muscular tension. Simultaneous injection of myofascial trigger points may improve outcome.

Needle entry for the occipitalis major nerve is made 3 cm laterally from the occipital protuberance of the linea nuchae. The occipitalis minor nerve is located posterosuperiorly to the mastoid process and 2.5 cm lateral from this site. Two to 10 mL of 1% mepivacaine is injected once the needle tip strikes bone.

Significance: Abolition of occipital pain may distinguish the complaint from TMD pain.

Collateral Examination

Dental Condition

Because some TMD-like symptoms overlap dental symptoms, the dentition and related soft and hard tissues should be checked for pathology. Significant findings are recorded in the progress notes.

Visual inspection should follow the same routine from patient to patient. Missing, broken, and carious teeth and the distribution of plaque should be documented.

Exploration of pits and fissures with an explored may detect caries. Insertion of the explorer is at a 90° angle with the occlusal surface. Resistance on withdrawal indicates possible caries.

Bursts of air into occlusal sulci or the apical third of the tooth may trigger pain. Rubbing the explorer tip along the gingival third of the tooth may cause wincing or withdrawal. Usually this implies cemental hypersensitivity.

Percussion testing is accomplished by tapping on the teeth with a mirror handle. The patient is asked, **"Is the tapping painful?"** The occlusion sounds clear if the teeth are healthy and dull if unhealthy. Painful response to tapping needs further evaluation.

Mobility testing is done by pushing against the facial surface of the teeth lingually with the blunt end of a mirror handle and bracing the lingual surface with the tip of another mirror handle. The degree of mobility is graded: 0, no mobility; 1, mobility = 1 mm horizontal; 2, mobility = 2 mm horizontal; 3, mobility = 1 mm vertical, direction, respectively.

Thermal sensitivity should be checked. Ice is applied to individual teeth under a rubber dam if the response between teeth is questionable. Application of a hot gutta-percha point to a moistened tooth may evoke pain. Positive response confirms pulpal inflammation.

Vitality testing with an electric pulp tester should be done on teeth for which pathology is suspected. The tooth is isolated under a rubber dam or with cotton rolls and then air dried. Toothpaste is used to make contact between the tip of the electrode and the gingival third of the tooth free of restoration. No contact must occur with the gingiva. The patient is asked to **"raise the hand once the sensation occurs".** Testing requires an adequate control. An unrestored, similar tooth of the contralateral side can be used. Positive or negative responses are recorded.

Transillumination can be used to check for caries. If the fiberoptic light is of sufficient intensity, apical pathology may be detected.

Bitesticks may be useful for identification of fractured teeth. Placement of a narrow tip of the stick on specific cusps and asking the patient to **"close the teeth together"** may elicit the pain. Visual inspection or exploration with the explorer tip may reveal the fracture.

Probing of the periodontium is done to record sulcular depth and pattern of bone loss. Three recordings - mesiobuccal, midbuccal, and distolingual - are made around each tooth. Sulcular depths greater than 4 mm require further evaluation.

Palpation of the gingiva, tongue, and other oral soft tissues must be done carefully. Any anatomic landmark viewed suspiciously needs to be compressed with an index finger or between the fingers. Palpation of alveolar ridges may elicit pain or tenderness.

Significance: Undetected caries or periodontal problems are often confused with TMD symptoms.

Swallowing

If swallowing is difficult, the floor of the mouth, tongue, and pharynx should be examined. Palpation of the larynx may reveal tenderness along the thyroid or cricoid cartilages. The thyroid cartilage lies inferior to the hyoid bone but superolateral to the cricoid cartilage. The latter abuts with the trachea and is covered laterally by the thyroid gland.

Provocation of the tonsillar area with a cotton swab may trigger the pain. The patient is asked to **"turn the head and neck to the side opposite the side with the complaint".** This movement may provoke the pain. Palpation of the site may create a feeling of a lump in the throat.

Significance: Occasionally, postnasal drip from the sinuses produces excessive swallowing and fatigue of the muscles of the throat. Pain evoked by probing with the swab may trigger an episode of glossopharyngeal neuralgia. Pain and discomfort that results from turning the head and neck may be caused by Eagle's syndrome, which is associated with elongation of the stylohyoid process or calcification of the stylohyoid ligament. If no other reasons are found for recurrent pain on swallowing or palpation, the patient should be referred to an otolaryngologist.

Sinuses

Nasal and paranasal sinuses should be evaluated for presence of pain, tenderness, and pathology. Fortunately, most tumors of paranasal sinuses are benign polyps and osteomas.

Palpation of the *nasal sinus* is done by applying gentle pressure with an index finger on one side of the nose and the thumb on the other side.

The *frontal sinus* is palpated by applying gentle pressure with an index finger superiorly positioned at the inner canthus of the eye and pushing likewise with the middle finger on the other side. Percussion with the index finger may provoke the pain. Transillumination can be done by directing a fiberoptic light in a darkened room against the overlying skin of the sinus.

Palpation of the *maxillary sinus* is done by applying gentle pressure with an index finger superiorly positioned below the rim of the orbit at the level of the nostrils and pushing the middle finger likewise on the other side. Percussion with the index finger may provoke the pain. Transillumination can be accomplished by directing the light beam against the hard palate.

Significance: Pain of the nasal sinus has dull, burning characteristics. Little pain emanates from the paranasal sinuses unless major inflammation exists. Some pain has been described as deep, aching, and nonpulsatile. Most tumors are painless unless malignant invasion of nerve occurs. Often, confirmation of problem depends on radiographic findings. Magnetic resonance imaging provides the greatest resolution of these areas.

Salivary Glands

Because of their proximity to the TMJs, the major salivary glands should be palpated for tenderness. Salivary flow from their respective ducts is checked for normality.

Stensen's duct of the *parotid gland* opens through the buccinator muscle into the upper oral vestibule near the second molar. The gland lies lateral to the masseter muscle, superiorly to the posterior digastric muscle, and abuts with the SCM inferiorly.

The *submandibular* gland is separated from the parotid gland by the stylomandibular ligament. It lies below the body of the mandible at the junction of the posterior and anterior digastric muscles. Numerous small muscles form the remaining boundaries. Wharton's duct opens at the salivary caruncle, an elevated area lateral to the lingual frenum.

Significance: Because the glands may become obstructed, infected, or subject to neoplasia, they should be examined if there are complaints of xerostomia, sialorrhoea, or pain. Radiography may be necessary to rule out the presence or absence of stones.

Lymph Nodes

Regions of lymph nodes in and around the TMJs should be visually inspected and palpated. Nodes are either superficial or deep, depending on location. The superficial nodes form a chain associated with the external jugular vein. The deep nodes form the largest and most prominent group.

A routine for palpation follows anatomic triangles of the neck. Palpation of the anterior chain is begun along the SCM. Other areas include the posterior chain and the supraclavicular, submandibular, submental, and suboccipital nodes.

Significance: Patients often mistake tenderness on palpation of certain masticatory muscles as swollen lymph nodes. Generalized lymphadenopathy, caused by viruses or bacteria, has other dominant features (eg, history of fever). If doubt exists, biopsy of the node may be necessary.

Cranial Nerves

The purposes is to supply diagnostic information about the functional status of specific cranial nerves. The patient is asked to respond to a series of facial and head movements outlined below. The clinician observes and listens to responses during this performance. The tests are simple to conduct, but they are not definitive for abnormality.

Separate checks are made of the three branches of the *trigeminal nerve.* For testing the sensory branches, the patient is asked to **"respond yes or no"** to the sensation of light touch tested by dragging a wisp of cotton along the brow (V1), upper lip (V2), and lower lip (V3). These same areas are then pricked with a sharply pointed object. For testing of the motor branch, the patient is asked to **"open and close the mouth and protrude to the right and to the left with the lips closed".**

The motor branch of the *facial nerve* is tested by asking the patient to **"wrinkle the forehead and pucker the lips".** The sensory branch involves the sensation of taste. Most patients recognize this loss quickly.

For the *glossopharyngeal-vagus nerves,* the patient's gag reflex is tested as the clinician stimulates the patient's soft palate with a cotton-tipped applicator. The patient is also asked to **"swallow water".** The inability to gag or cough during swallowing suggests derangement.

In testing of the *spinal accessory nerve,* the patient is asked to **"shrug the shoulders and turn the head".** This motion activates the trapezius and SCM muscles. Inability to turn suggests limitation.

In tests of the *hypoglossal nerve,* the patient is asked to **"protrude the tongue as straight as possible".** Lateral deviation suggests derangement.

Significance: There is a tendency to overinterpret mild deviations in normal movements. The clinician should be guided by the anatomic pattern of change described by the patient.

Radiography

In addition to case history and objective clinical findings, analysis of anatomic contours observed from radiographs can provide useful information about the TMJs. Conventional radiography, tomography, and bone scanning can furnish evidence of osseous disease unavailable from clinical findings. Newer technology such as magnetic resonance imaging has vastly improved the visibility of soft tissue anatomy. Still, none of these techniques has proved reliable for definitive diagnosis of TMJ.

The advantages and disadvantages of different radiographic techniques must be weighed in terms of costs, risks, and need for patient evaluation and treatment. The clinician may need to rely on them to maintain quality assurance, confirm diagnosis, and avoid problems with litigation.

Conventional Radiography

Because of location of the TMJs, radiography of the joints is difficult for the clinician. Techniques commonly used by clinicians for screening are transcranial and panoramic projections.

Transcranial projections provide a lateral view of the TMJs. They show only the laterosuperior border of the condyle and the lateral surface of the glenoid fossa. The radiographic beam is directed from the opposite side of the skull and passes across the superior surface of the petrous bone. Because of this obstacle, the superior border of the condyle between the lateral and medial poles cannot be seen.

Much has been said about the radiographic position of the condyle with respect to the fossa and abnormality within the joint. Sufficient reliability has never been established to prove diagnostic value.

Significance: Fixed positioners are available to assist in alignment of the cone with the joint. They permit multiple exposures of the condyle without changing head positions. Unfortunately, the site where most osseous changes occur cannot be obtained. Spicules and erosion of the laterosuperior surface of the condyle can be seen.

Panoramic analysis with the mandible in open and closed positions allows for bilateral viewing of condyle-fossa relation. Because of rotational capabilities, panoramic radiographic units permit an oblique anteroposterior view of the joint. Two different views can be obtained for each joint on the same radiograph. Although uncommon, occasional bilateral degeneration occurs as found in this patient with rheumatoid arthritis.

Significance: These radiographs are useful to rule out gross intraosseous disease from dental disease. No correlation has been found between joint appearance and signs and symptoms of TMD.

With *anterior-posterior* (or transorbital) projection, both condyles can be viewed simultaneously.

Significance: The size and shape of each condyle, particularly the medial and lateral surfaces, can be viewed within the glenoid fossa.

In the *submentovertex* view, as in the anterior-posterior view, the condyles can be viewed inferiorly.

Significance: This view allows determination of the horizontal condylar angles. Visualization of the sinuses and zygomatic arches makes this view valuable.

Tomography

Tomography is a specialized technique that allows detailed images of structures lying in a predetermined plane, while blurring or eliminating details of unwanted structures in other planes.

Classic tomography involves taking several exposures of a selected area at arbitrary intervals or sections. Blurring occurs in the focal plane, obscuring some desired anatomic detail. Unlike transcranial radiography, lateral, central, and medial parts of the joint can be seen on separate images.

Computed tomography (CT) scanning represents and improvement over the classic technique. It permits scanning of a well-defined area of detail, which minimizes the effect of superimposition. The computer analyses x-ray absorptions at many different points and converts them into an image on a video screen.

Significance: Condylar erosion and osteophytic changes can be seen with more detail than with conventional radiography. An advantage is gross determination of the condyle-disk relation without using invasive means. Because the head is placed in a scanner gantry during CT scanning, some patients may become claustrophobic. Reassurance may be needed.

Arthrography

Arthrography involves the injection of contrast medium into the synovial cavities followed by radiography of the injected site. Usually a fluoroscopic evaluation is done with the contrast medium. The medium is injected into the lower synovial cavity. Patients are asked to open and close the mandible. This movement changes the shape of the contrast medium. Serial radiographs are made, resulting in a series of arthrograms.

Significance: Arthrography is an invasive procedure and should be weighed against clinical findings. The position and shape of the disk can be seen relative to the condyle and eminence at various positions. Perforations in the disk or its attachments can be seen readily.

Magnetic Resonance Imaging

In magnetic resonance imaging (MRI), as in CT scanning, radiant energy is beamed into the patient. Unlike the x-rays of CT, radiofrequency waves provide the energy in MRI. Waves are beamed into magnetic fields, and a receiver coil measures the energy released. A unique feature of MRI is its ability to differentiate small differences between tissues. Resolution is so high that injuries and diseases affecting a tendon, ligament, and cartilage can be detected. A computer uses this information and constructs an image on the video screen. It is possible to see two- or three-dimensional images of the joint's interior.

Significance: It has been claimed that disks displaced anteriorly can be differentiated from normal variants. But the general usefulness of MRI in the assessment of TMD has been questioned. Studies on TMD patients indicate that the MRI appearance has little or no bearing on subjective and objective outcome of treatment.

No injection of contrast material or x-rays is necessary, and no short-term side effects have been found. MRI was as accurate as arthrography and more accurate than tomography in correlating with surgical findings of TMD cases. This feature makes if preferable to either CT or arthrography for diagnostic and surgical purposes. Because the body must remain motionless inside of the magnetic tunnel for 30 to 45 minutes, claustrophobe or anxious patients may require reassurance.

Bone Scintigraphy

Another radiologic technique useful in evaluating TMD is radionuclide bone scintigraphy. Scanning with technetium diphosphonates produces a functional display of bony metabolism and improves interpretation of joint pathology. Uptake of technetium is thought to provide a sensitive indicator of adaptive changes in the bone.

A small amount of technetium methyl diphosphonate is given by intravenous injection. Images of the head and neck are obtained about 3 hours after injection, using a conventional

gamma scintillation camera. The scan shows uptake of technetium where the bone undergoes osteogenic activity.

Significance: The role of bone scanning in clinical practice has not been established. No significant association was found between the symptomatic side of the TMD complaint and the side with highest uptake of technetium. Still, scintigraphs made with the mandible in open and closed positions permit the examiner to differentiate osteogenic changes in the glenoid fossa from osteogenic changes in the condyle. Another advantage is that uptake in areas of apical pathosis is indicative of dental disease.