Multi-site RDC/TMD Validation Study
Specifications for TMD Examination
Gold Standard Examiner

Version Date: Feb 10, 2005

Contents

General Directions for Examination

1. Scope of Examination. The examination is comprised of three parts: (1) a revised core RDC/TMD examination as originally described in the **Specifications for TMD Examination** (Dworkin and LeResche, 1992); (2) additional examination items which supplement the core examination; and (3) assessment of pressure pain thresholds with algometry.

2. Text conventions in this document. All verbal statements by the examiner are indicated within double quotation marks "". Phrases within examiner questions that are optional, depending on context, are indicated within angle brackets <>. Example verbal responses from the subject are indicated within double quotation marks "". References to verbal text (e.g., a phrase that might be stated) are indicated within single quotations marks ' '. Optional instructions are inserted within angle brackets < >.

   Specific examination items (procedures) are listed in **Bold underline** as headers in this document, and are otherwise listed in **Bold** within the text. References to a particular response field within an item will be indicated as underlined text within braces {___}. Possible response options for an item or response field are indicated within {}, each option separated by commas. Specific coding on the examination form, following interpretation by the examiner of verbal responses from the subject, is indicated as the specific option within braces {}. Text to be written on the examination form is indicated within double quotation marks "".

   To illustrate: An examination item listed as a header might be **Extraoral Muscle Pain with Palpation**, while a specific examination item might be **Masseter (origin)** palpation; a response field to that palpation is {Familiar Headache Pain} which can be coded as {yes, no}. Following the examiner's question during the palpation

procedure, "When I pressed on the area, was that pain like your mild-to-moderate headache?" (recognizing that this subject had two types of headache, a mild-to-moderate one and a severe one), the subject indicated “yes”, which the examiner then coded as {yes}.

3. Completing all items. All interview and examination items need to be completed unless the subject refuses or is unable to cooperate. In this case, write “SR” (Subject Refuses) in large block letters adjacent to the interview or examination item and note why the subject refuses or cannot do the item. For some items (e.g., muscle palpation), there is a specific field for indicating subject refusal; when the muscle palpation is not done due to refusal, no information is entered other than for indicating that the subject refused. When the procedure is performed, however, that same field is used to indicate whether any referred pain has a familiar pattern (i.e., the bubble is marked) or not (i.e., the bubble is left unmarked).

4. Jaw posture. All measurements will be conducted with the jaw in a passive state and the joints and muscles should not receive additional weight or pressure, except as designated for **Maximum Assisted Opening** and for palpation of the joint’s **Posterior Attachment**. Procedures which require that the subject bring the teeth together do not require that the subject clench (unless otherwise stated), and the intent is for the individual to close fully into maximal intercuspal position. The phrases “best bite” or “where your teeth fit best” can be used to help the subject accomplish that goal; subjects with dual bite should be encouraged to close teeth together with the mandible in the more posterior position.

5. Millimeter measurements. All millimeter measurements will be recorded as double digits. If a millimeter measurement is less than 10 mm, precede the recorded value with a leading zero. If a measurement is between two millimeter markings, always record the lesser value.

6. Subject positioning. Subjects will sit in chairs with the chairback in a vertical position (i.e., 90 degrees relative to the floor). There are three exceptions to this: (1) The orthopedic provocation testing requires that the back of the chair vary between 90 and 45-degrees relative to the floor. (2) The occlusal exam requires that the back of the chair vary between 45 degrees and parallel to the floor. (3) The pressure pain threshold tests requires that the back of the chair vary between 45 degrees and parallel to the floor. (See the respective exam sections of this document for the specific positions for each test.)

7. Infection control. Examiners will wear gloves at all times and a mask as appropriate.

8. Replacement prostheses. Subjects with replacement prostheses will be examined with the prostheses in their mouth unless it is necessary to remove them for performing intraoral palpations or observing the mucosa and gingiva for other examination purposes. If the subject is wearing replacement prostheses and it is loose, the examiner will compress it against the ridge for measurements that use

the teeth as a landmark. Bite plates and other appliances that do not replace teeth are to be removed at the beginning of the examination.

9. Physical barriers to examination. If the subject has a beard, a neck brace or any other potential physical barrier that may interfere with the examination, indicate this by checking {Yes} to **Physical Barriers to Examination** (item E) on the exam form.

10. Measurements of Range of Motion. Millimeter measurements of opening, protrusive, and lateral excursive movements are recorded as described in items 4 and 5. Items **4d. Vertical Incisal Overlap** and **4f, Midline Deviation** are included so corrections to measurements in items 4 and 5, respectively, can be done to determine actual values of openings and excursions. The examiner during the exam does not do these corrections but rather the collected data is adjusted post hoc.

    Specifically, the actual amount of mouth opening is calculated post hoc by adding the amount of vertical incisal overlap (item 4d) to the three vertical range of motion measurements (items 4a through 4c). If the vertical incisal overlap is negative, such as with an anterior open bite, then subtract value in item 4d from the value in items 4a through 4c. For items 5a and 5b, a post hoc correction is done if midline deviation (item 4f) is greater than 0, this measurement should be added to one side of the lateral excursion and subtracted from the other side. For example: If a subject has a 2 mm midline deviation to the right, then subtract 2 mm from the value given to the right lateral excursion and add 2 mm to the value given to the left lateral excursion. Finally, for protrusive movements, the post hoc correction is that the horizontal overjet (item 4e) is added to the measurement of protrusive movements (item 5c) in a normal incisal relationship is present but is subtracted when an anterior crossbite or prognathic relationship occurs.

11. Movement even with pain. With one exception [**4a: Unassisted (Mandibular) Opening Without Pain**], every time the subject moves his/her mouth vertically or excursively, s/he moves it as far as possible in that direction, even if it is painful.

12. Sequencing of examination procedures. The examination data collection form follows the sequence of tests as specified in this document. The sequence of examination steps as indicated on the form should be followed exactly. Record all measurements in the appropriate places on the specified form.

13. Basic palpation. Palpations must be done in the following sequence: Right Extraoral Muscles, Left Extraoral Muscles, Right Joint, Left Joint, Right Intraoral Muscles, Left Intraoral Muscles.. For the standard muscle examination, the palpation pressure per site is: (1) two pounds of pressure for the Temporalis and Masseter and (2) one pound of pressure for the Posterior Mandibular Region, Submandibular Region, Lateral Pterygoid Area, Tendon of the Temporalis, Lateral Pole of the TMJ, and Posterior Attachment of the TMJ. The pressure used for clarifying pain location is a light touch, and should be clearly less than the palpation pressure of 1 pound.

14. Ambiguous responses from subject. When appropriate, the subject must clearly indicate “pain” or “no pain”. If the subject provides other descriptors (e.g., achiness, tightness, pressure, uncomfortable, etc), the examiner will clarify this with a follow-up probe: “Is that pain or not?” “Clarifying questions” are included in the below specifications and should be used only if the subject requests clarification of a question or the examiner needs clarification of the subject’s response. These optional “clarifying questions” are intended to be “neutral probes” since the intent is to clarify and not to lead the subject towards making specific responses.

15. Identification of locations of pain. When a subject indicates that a test is painful, the examiner determines the location(s) of the pain induced during the procedure by asking the subject to point to each area of pain with one fingertip. The examiner then determines what area(s) the subject has indicated by recording the following locations: {Joint; Masseter Region; Other Muscles (i.e., Posterior Mandibular Region, Submandibular Region and Intraoral Areas); and Temporalis}.

    These locations are independent: any or all can be used. It is essential that the examiner correctly identifies the area(s) the subject is indicating. To insure accuracy, the examiner can place his/her digit on the extra-oral or intra-oral area(s), and/or the subject can put the examiner’s digit on the area(s) that the subject indicates as the location(s) of their pain. The examiner then asks the subject to report if their pain includes any of the area that the examiner just touched.

    If the examiner needs to localize specific muscle area(s), s/he can say to the subject: "I would like you to clench your teeth together gently and then relax your jaw with your teeth slightly apart from each other.” The examiner’s decision is made independent of feedback from the subject. For example, if the subject reports “pain in the joint” but the examiner identifies the location as muscle, the examiner’s findings are those which are recorded.

16. Identification of specific structures. If it is unclear to the examiner whether the subject is indicating a joint, muscle or both, press on the area as lightly as possible to correctly identify the anatomic structure. If the examiner is still unclear about the location of pain, ask the subject to protrude his/her jaw and/or open and close the mouth (until movement in the joint is felt), then return to a “comfortable position” and then clench his/her teeth together. The examiner asks the subject, "Slide your jaw straight out in front of you until I ask you to stop and then slide your jaw back to a comfortable position with your back teeth completely touching”; and/or “Open your mouth until I ask you to stop and then close in a comfortable position with your back teeth completely touching." After the subject does this [these] movements, the examiner asks; "Now, gently clench your teeth together, and relax.” Record as follows, based on the tissue responses beneath the examiner’s finger in the area of pain as localized by the subject:

    (a) “Masseter muscle”: If muscle contraction during clenching can be felt by the finger; or if after the subject protrudes, or opens/closes, and returns to his/her “comfortable position“.

(b) "Joint": If after the subject protrudes, or opens/closes, and returns to their "comfortable position "and the lateral pole *is* felt.

(c) The examiner's decision is made independent of feedback from the subject. For example, if the subject indicates pain in the joint but the examiner identifies the location as muscle, the examiner's findings are those which are recorded.

17. Repeating examination items. 1. The examiner can repeat a procedure if the subject is unable to provide a clear response or if the subject requests that the procedure be repeated. For **Opening Pattern** (Item 3), **Joint Sounds on Opening and Closing** (Item 6), and **Joint Sounds on Excursions** (Item 7), up to three sets of three trials each are allowed.

18. Familiar Pain. If a subject reports "pain" to an examination item, the examiner will ask the subject if the pain is familiar. Specifically, the examiner asks the subject, "Was that pain familiar?" or "When I pressed on the area, was that pain familiar?" If the subject is confused, then the examiner asks, "Is that like or similar to your pain?" The examiner should clarify that the reference pain for "familiar" is the subject's usual pain (if pain was reported in the last month) or pain previously experienced (if pain was not reported during the past month but has been experienced prior to that and not a pain induced by any prior examinations). If the subject states that examination produced greater intensity of pain compared to what s/he typically experiences, the examiner asks, "Yes, but is that similar or like your pain?", and the verbal responses are coded as {yes, no}. If a subject is asymptomatic on one side (and symptomatic on the other side), and says that procedure-induced pain on the asymptomatic side is "familiar", the examiner should clarify that symptoms are unilateral; if so, pain cannot be "familiar" on the asymptomatic side, and should be coded as "not familiar" or the laterality of the pain at present and/or during the past month (GSE items 0, 2) is changed to reflect that the pain is bilateral, and hence consistent with the present report of the pain being "familiar".

19. Familiar Headache Pain. If the subject reports pain with palpation of the temporalis muscle, the examiner will inquire about **Familiar Headache Pain** if the subject has a history of headaches in the temporal area; in addition, the examiner will automatically ask about **Familiar Headache Pain** the first time there is induced pain in the temporalis muscles from any procedure, regardless of whether the subject reported headache or not in the history, in order to address any possible underreporting of headache pain or confusion of headache and facial pain by location. The examiner determines whether the subject has a current history of headache(s) in the temporal area(s) by (1) reviewing the appropriate section of the Initial Supplemental History form or, (2) asking the subject about headache during the first instance when the subject reports "familiar pain" in the temporalis muscle from any procedure. In the first case, if the subject reports headache in the temporalis area on the Supplemental History Questionnaire, then the Familiar Headache Pain question is asked during the examination. Even if the subject does not meet the IHS criteria for tension type headache (of either infrequent, episodic, or chronic sub-types) within the mild-moderate headache type, these questions are

asked in order to understand the examination correlates of the headache experience. Headache diagnosis is based on the IHS guidelines. If a subject reports two types of headaches in the temporal area (ie, mild to moderate type, and severe type) that both otherwise meet the tension-type headache criteria, examination procedures that produce temporalis area pain are followed by inquiry regarding the mild-to-moderate intensity headache only. The mild-moderate headache is also referenced even if it is the less common of the two temporal area headaches. If the subject is positive for history of temporal-area headache, then the examiner determines whether the procedure-induced pain replicates the subject's temporal area headache by asking the subject, "When I pressed on the area, was that pain like your <mild-to-moderate> headache?" Clarification of this question for the subject is done as with {Familiar Pain} (above). Note that the examiner will inquire about Familiar Headache Pain even if the subject reports that the procedure-induced pain is not {Familiar Pain}.

20. Migraine headache at time of clinical visit. If a subject appears for evaluation while having an active migraine headache, as defined according to IHS criteria for any type of migrainous headache, the subject should be rescheduled at a later date for the clinical examinations.

21. Referred Pain. If the subject reports pain with palpation of any structure, then the examiner assesses for possible referred pain. Referred pain is defined as pain report pain that originates at a palpation site but is felt beyond the boundary of the underlying muscle or joint such as a report of pain in the ear, forehead area, or tooth. To assess for referred pain, ask: "When I pressed on that area, did that cause pain anywhere else other than only under my finger?" If the subject says yes, then the examiner asks, "Could you point with one fingertip to each of the areas where you just felt pain when I pressed on you?" If the subject is unclear in their response, a neutral probe is used to obtain an unambiguous response that can be coded. The subject must point to a structure for pain to be classified as referred; terms like "it went deep" are too vague. One option is that if, for example, masseter pain "goes deep" during palpation, the examiner can place his/her finger intraorally by the internal aspect of the masseter/ramus, and ask the subject if the pain went as deep as the finger; responses deeper than the finger would be correctly classified as "referred", though further clarification of which structure (teeth? sinus?) should be confirmatory. If referred pain is positive for a structure, the examiner then asks if the referred pain pattern was familiar, and if so, uses the "Subject Refused" bubbles {yes} but leaves the bubbles blank if {no}. Specific format of the question is listed under Pain Inquiry Protocol.

22. Discrepancy between locations of pain during last month and familiar pain during examination. If the responses to Question 2a do not include areas that are subsequently reported as both painful *and* familiar during the examination, the examiner reassesses the subject's response to question 2a by asking the subject, "Have you had this pain [the one just reported as familiar] in the past month?" If the subject reports "yes", then the endorsed responses to Question 2a are modified. If the subject reports that the familiar pain on examination is indeed

familiar but was last experienced more than one month ago, responses to Question 2a are not modified.

23. Pain Inquiry Protocol. *(note: this section contains the full set of questions used to ask about pain associated with an examination procedure; this information is also present in separate sections related to each aspect. The information is repeated here in order to provide the full sequence of questioning in one place.)* There is a standard set of questions related to the inquiry of presence of pain, its location, whether it is familiar, whether it is headache familiar, and, for some examination items, whether the provoked structure causes referred pain and whether referred pain pattern (if present) is familiar. The inquiry into pain starts with an examination-specific probe based on the particular procedure. This probe is stated in the specifications after each procedure. That probe is then followed by a standard hierarchy of questions, as follows:

    (1) If the response from the initial probe about presence of pain from the procedure is “no”, then record {no}. If initial probe response is “yes”, then the examiner will ask, "Could you point with one fingertip to each of the areas where you just felt pain?” Alternatives to this query include “Could you point with one fingertip to each of the areas where you felt pain with that movement?" or “Could you point with one fingertip to each of the areas where you felt pain when I pushed on you?", etc. The specific extension to the basic question is shown in **bold** in conjunction with the probe.

    (2) After the subject indicates the area(s) of pain, the examiner asks: “Are there any other areas where you felt pain with that movement?” or, if a static test, “Are there any other areas where you felt pain <when I pushed on you>?” Repeat until the subject says "No". Record the location(s) where the subject reported pain. The intent of this question is to elicit all of the areas of pain that the subject has during the procedure (such as movement of the jaw) as the procedure (i.e., movement) is done.

    (3) If the response to the initial probe is “yes”, then ask if the pain is familiar: "Was that pain familiar, that is, like or similar to your pain?" Code as {yes, no}.

    (4) If the subject responded positively for temporal area pain, and the subject meets criteria for tension-type headache in the temporal area, then ask the subject, "Was that pain like your headaches?" Code as {yes, no}.

    (5) If the examination item also includes response fields for referred pain, then ask the subject, “When I pressed in that area, did that cause pain anywhere else other than only under my finger?” If the subject reports “yes”, the examiner directs “Show me with one finger tip all of the areas you felt pain when I pressed on you.” Record referred pain as {yes} if the reported pain is outside the boundaries of the involved structure, and record referred pain as {no} if the reported pain remains completely within the structure boundaries.

(6) For items with referred pain, also inquire if the referred pain pattern was familiar. The examiner asks, Is that pain [beyond my finger] familiar?", and the bubble-option for "subject refused" on the examination form is completed if "yes", and remains blank if "no". In this last inquiry about whether the referred pain pattern itself was familiar, the examiner can also touch the referred pain site(s) in order to highlight that it is the referral pattern familiarity that is being questioned, not the pain beneath the palpating finger.

24. Critical self-report items for diagnosis (CSID). On the lower right of page 1 of GSE1, TE, and GSE2 exam forms, there are three history items within a boxed area. These are critical items for RDC/TMD algorithmic diagnosis: HQ#3, HQ#14a, HQ#14b.

(1) Phase III study. The CSID on the GSE1 and GSE2 forms are administered directly to the subject, with the subject completing the items as self-report. The CSID responses from the GSE2 form are transferred to the TE form. The GSE at each respective visit reviews the CSID responses on the appropriate GSE examination form against the respective items in the RDC Patient History Questionnaire and in the Initial Supplemental History Questionnaire, and interviews the subject as needed per any discrepancies. Unintentional discrepancies are corrected as appropriate; that is, the GSE1 may correct either the Initial Supplemental History Questionnaire or the GSE1/GSE2 exam form CSID (depending on time period and subject's understanding of item intent), but the GSE2 should, in principle, only need to correct the CSID. The GSE2 should not change the responses, if discrepant, on the RDC Patient History Questionnaire, as the item responses on this instrument are used for testing validity of the Patient History. The GSE2 should be cautious about correcting the respective items on the Initial Supplemental History Questionnaire, in that memory may be the problem, and such changes on the Initial Supplemental History Questionnaire could unintentionally alter the validity of the GSE1 diagnoses. Discrepancies due to change in symptoms (i.e., the symptoms changed since the subject last responded to the respective items) are left as is. Diagnosis is formulated according to the subject's status as reflected in the boxed items completed on the day of that GSE evaluation; that is, diagnosis will be as current as possible with the respective history.

(2) Calibration study. If the study is a calibration or reliability study, then the questions in the box at the bottom of page one of the examination form are directly asked of the subject.

25. For Calibration Studies. (GSE & TE)

(1) The lower right box on the examination form is administered to the subject by either the recorder or the examiner. The recorder transfers the responses to subsequent examination forms. The answers to HQ#3 frames the inquiry by the examiner: if HQ#3 is {no}, then the examiner asks Q#0 but not Q#1 or Q#2, while if HQ#3 is {yes}, the examiner asks Q#1-3.

(2) Discrepancies between responses on the Supplemental Questionnaire and HQ#3 (from either the RDC Initial Patient History or lower right hand box on the examination form, depending on data source and administration needs of the reliability study) are clarified by the first examiner, and the pain status established for that subject (i.e., pain either {yes, no} in the past month) is the reference for all subsequent examiners.

(3) “Familiar” pain is qualified, as necessary, for the individual’s “usual pain”, and it is not used to reference any pain that the subject may have experienced *only* as a result of clinical examination.

26. Recording Form. This set of specifications references the recording form, “Gold Standard Examiner: RDC/TMD Examination”.

A: Expanded RDC Exam

Preamble

At the first visit, the subject is given the GSE1 examination form at the outset of the examination by either the recorder or the examiner, and asked to complete the three diagnosis questions in the box. At the second visit, the subject is given the GSE2 form and asked to complete the three questions in the box; the recorder then transfers the responses from the GSE2 form to the TE examination form so that the examiner has that information directly available at the outset of the examination. See instructions under General Directions 24 for detail regarding how the GSE should review those responses.

The examiner provides a written sheet of Study Instructions, which contain the following: "During the examination, you will be asked questions about your pain. The information below will help you answer questions about your pain for this study. (1) We want you to report "pain" whether you consider the pain to be mild, moderate, or severe. (2) Familiar pain is a pain that you have felt before, that is similar to or like your pain, but should not include any pain from prior examination of your jaw or head. (3) If you have pain as I am pressing, you will be asked if that pain extends beyond where my finger is pressing."

0 Pain Locations Right Now

The intent of this question is to (1) identify with the subject the areas of interest with respect to pain, (2) capture all of the areas where the subject has pain at the present time, and (3) for the examiner to identify with the assistance of the subject the exact location of each of the stated areas where the subject has pain RIGHT NOW. The examiner first says, "I am going to ask about areas of pain, and there are the areas that I am primarily interested in… here… here… here… and also possible areas within the mouth." As the examiner says this, s/he touches, bilaterally, the temporalis, TMJ, masseter area, posterior-mandibular area, and sub-mandibular areas. The examiner does not identify the areas by name. Then, the examiner asks the subject: "Could you point with one fingertip to each of the areas where you feel pain right now? If the subject points to at least one area, then ask the subject, "Are there any other areas where you feel pain right now?" Repeat until the subject says "No". The optional probe to determine location of pain is "Do you have pain in this area right now?" as the examiner touches the area(s) in question. Code the appropriate answer.

1 Side of Pain in the Last Month

Ask the subject, "In the past month, have you had pain on the right side of your face, the left side, or both sides?" Code the appropriate answer. If the subject indicates midline pain, code as {Both}.

2 Pain Locations in the Past Month

The intent of the question is to capture where a subject has had his or her pain in the past one month, and to minimize undue influence based on 'right now'. Ask the subject, "Could you point with one fingertip to each of the areas where you have

felt pain in the past month." If the subject points to at least one area, then ask the subject, "Are there any other areas where you felt pain in the past month?" Repeat until the subject says "No". The optional probe to determine location of pain is: "Have you felt pain in this area in the past month?" as the examiner touches the area(s) in question. Circle the appropriate answer. In addition, the intent of this question is for the examiner to correctly label the associated anatomic structures with the assistance of the subject.

Notes regarding Items 0 through 2:
There is no necessity for consistency in response between Question 0 and 2 since pain 'right now' may include areas not previously experienced as pain in the last month. However, pain 'right now' should not consist of fewer areas of pain than pain 'in the last month'.

Question 1 is an initial probe for pain in the last month; if the subject indicated unilateral pain in Question 1, but in Question 2 indicated pain bilaterally, then the examiner should address any inconsistency in these two questions by using appropriate neutral probes ("Have you felt pain in this area in the past month?") regarding pain laterality. Corrections to Question 1 or Question 2 coded responses can be made as necessary.

2a Muscle Tissue Assessment

Assessment of redness, heat, and swelling over the masticatory muscles is performed as follows. These are all coded as {yes, no}.

a. Swelling is clinically observed as a fluctuant or pitting edema in the skin overlying the muscle. It is assessed by comparing the contralateral muscle and so determining its presence.
b. Redness is clinically observed as a red or redder color in the skin overlying the muscle and it is compared to the same contralateral muscle site or the bilateral frontal area.
c. Heat is clinically determined as increased warmth relative to the same contra-lateral muscle site or the bilateral frontal area. The examiner assesses it by placing the palm of his/her open hand against the skin overlying the muscle. For bilateral involvement the examiner's palm may be used as a reference frame.

Note: Examiner is to insure that one side of face is not ischemic such that the contra-lateral side *appears* red or warm, when in fact it is normal in color and warmth.

2b TMJ Tissue Assessment

Assessment of swelling, redness, and heat over the TMJ is identical to the assessment as noted for "Muscle Assessment", 2a.

3 Opening Pattern

General Instruction: Ask the subject to "Place your mouth in a comfortable position with your back teeth completely together – that is, where they fit together the best." The examiner can, if necessary, place his/her thumb under the subject's lower lip

so that the lip reveals the lower teeth. This will facilitate observing midline deviation. Then ask the subject to open the mouth as wide as possible, even if s/he feels pain. ("I'd like you to open your mouth as wide as you can, even if it's painful.") If the degree of deviation is unclear, then use a millimeter ruler held vertically between the maxillary and mandibular incisor embrasures (or mark mandibular incisor if midlines do not match) as a guide. Ask the subject to open three times. Only the opening pattern is assessed and recorded. Furthermore, if it is difficult for the examiner to determine the opening pattern the subject can be asked to open more slowly. If the subject exhibits more than one opening pattern then ask the subject to repeat the three openings and code the most reproducible pattern according to the following criteria.

a. Straight. If there is no perceptible deviation upon opening, that is, deviation is less than 5 mm from the midline.
b. Lateral Deviation (uncorrected). For deviations that are visually perceptible to one side at maximum opening, that is, 5 mm or greater from the midline, determine which side of the subject's face the deviation goes towards and record accordingly.
c. Lateral Corrected Deviation. The subject exhibits a perceptible deviation to the right or left, that is, 5 mm or greater from the midline, but corrects to the midline before or upon reaching the maximum unassisted mandibular opening. A “C” opening pattern deviates only to one side and then returns to the midline. An “S” opening pattern deviates to one side and crosses the midline and then returns to the midline. The first side that the jaw opening deviates to is the recorded side of the corrected deviation when “S” opening patterns occur. “C” and “S’ opening patterns are recorded as “Corrected Deviation” on the form.
d. Other. The subject exhibits jerky opening (not smooth or continuous) or has an opening other than those provided; indicate this and the type of deviation. If there is no dominant pattern, also indicate “other” and write “no dominant pattern”.

4a-f Vertical Range of Motion

General Instructions: Measurements do not include a correction for overlap (overbite or underbite) during the exam since this correction is done post hoc. All vertical measurements should use the right maxillary incisor unless (1) the left maxillary incisor is more vertically oriented or less rotated than the right maxillary incisor, or (2) the right maxillary incisor is missing; in either of these cases, use the left maxillary central incisor. Indicate on the form which incisor {8, 9} was selected for these measurements. To record vertical opening, place the edge of the millimeter ruler at the mesial-distal center of the incisal edge of the mandibular central incisor that is the most vertically oriented and measure vertically to the labioincisal edge of the opposing maxillary incisor. Note that **Vertical Incisal Overlap**, **Horizontal Incisal Overjet** and **Protrusion** will also be measured with reference to the mesiodistal center of the same mandibular incisor tooth.

4a Unassisted Opening Without Pain

Obtaining Measurement. Ask the subject to “Place your mouth in a comfortable position” and then say: "I would like for you to open your mouth as wide as you can without feeling any pain, or without increasing your current pain." The examiner then measures the extent of opening. If the subject does not open at least 30 mm, the opening measurement is repeated in order to insure the subject understood the instructions. If the second opening still is not greater 30 mm opening, the greater of the two observed values is recorded.

4b Maximum Unassisted Opening

Obtaining Measurement. Ask the subject to “Place your mouth in a comfortable position.” Then ask the subject to open the mouth as wide as possible, even if s/he feels pain. Specifically the examiner will say, “I would like for you to open your mouth as wide as you can, even if it’s painful.” The examiner will measure the extent of opening.

Pain. The examiner will ask the subject if s/he felt pain on maximum unassisted opening. (“**When you opened this time**, did you have any pain?”) Follow this question with the Pain Inquiry Protocol.

If the response to {Familiar Pain} anywhere in the muscle(s) or joint(s) is positive, then ask the subject "Did opening your mouth as wide as you can make your pain worse, same, or better?" The target of the comparison is the pain level prior to the test. The subject’s responses will be interpreted as either ‘worse’, ‘same’, and ‘better’, which are coded as {W, S, B}, respectively. The intent of this exam item is to record all of the areas of pain that the subject has during this movement as the movement is done. Note that, logically, pain can be “same” or “better” from maximum unassisted opening only if there was pain in that location prior to the examination procedure (question 0, Pain locations right now), which should be addressed in data analysis.

4c Maximum Assisted Opening

Obtaining Measurement. Ask the subject to “Place your mouth in a comfortable position.” Explain to the subject that "I would like you to open your mouth as wide as you can, even if it's painful. I will be checking to see if I can push your mouth open a little further and I will stop if you raise your hand." Then the examiner will say to the subject, “I would like you to open your mouth as wide as you can, even if it’s painful.” After the subject has opened maximally, the examiner places his/her first digit (thumb) on the subject's maxillary central incisors, and cross his/her second digit (index finger) over to the subject's mandibular central incisors. From this position the examiner will potentially gain the leverage necessary to open the subject's mouth wider. The examiner will use moderate pressure, and will not forcefully open the mouth wider. Before initiating pressure to further open the subject’s mouth, the examiner will tell the subject, “I am checking to see if I can push your mouth open a little further and I will stop if you raise your hand.” Measure the extent of opening. If the subject raises his/her hand to terminate the test, the appropriate item (4c1) for test-termination is endorsed, and the maximal opening achieved during the test is

recorded; the subject in this case is still asked about pain provocation from the test.

Pain. Record whether or not the subject felt pain and the location. The examiner asks the subject, "Did you feel any pain **when I tried to open your mouth wider with my fingers**?" Follow this question with the Pain Inquiry Protocol.

4c1 Maximum Opening Terminated

If the subject raises his/her hand to terminate the test, {Yes} is recorded; otherwise, {No} is recorded.

4c2 Vertical Range of Motion (end-feel)

As part of the assessment of **Maximum Assisted Opening**, the examiner determines the status of the end-feel {soft, hard} at the end of this passive stretch. A {soft} end-feel is defined as a feeling of laxness or as a springy feeling. A {soft} end-feel will typically be the default observation if the subject terminates the test before end-range is obtained. A {hard} end-feel is defined as the inability to have any further movement in a vertical direction.

4d Vertical Incisal Overlap

The examiner will ask the subject to close the teeth completely together by stating, "Put your back teeth completely together <or: where they fit together the best>." With a pencil or fingernail, mark a line on the mandibular incisor where the incisal edge of the selected maxillary central incisor, used previously for vertical measurements, overlaps the mandibular incisor. Identify the mesiodistal center of the maxillary incisor as the reference for the mesiodistal positioning of the ruler on the mandibular incisor. This insures that vertical incisor overlap is measured consistent with the measurements for vertical range of motion. Measure the distance from the marked line to the incisal edge of the mandibular incisor, in line with the vertical range of motion measures. Code {- } on the exam form when an open bite is present.

4e Horizontal Incisal Overjet

The examiner will ask the subject, "Put your back teeth completely together <or: where they fit together the best>." Measure the distance from the mesial-distal center of the labial incisal edge of the selected maxillary central incisor to the labial surface of the mandibular incisor and record the measurement. The positioning of the ruler in the horizontal plane will insure that horizontal overjet will be in-line with the resultant protrusive range of motion measurement. Code { - } on the exam form when a prognathic relationship or anterior crossbite of the central incisors is present.

4f Midline Deviation

The examiner will ask the subject, "Put you back teeth completely together." If the incisal embrasures of the maxillary and mandibular incisors are not aligned, determine the horizontal difference between the two embrasures while the subject has the teeth positioned in maximal intercuspation. The examiner will measure in millimeters how far the mandibular embrasure is from the maxillary embrasure and

on which side of the subject the mandibular embrasure is located. If the midline deviation is less than 1 mm, or there is no deviation, code {00}. If there is a space between the teeth, then the measurement is done from the middle of this space. If one central incisor is missing, measure from the mesial incisal edge of the central incisor that is present. If neither central incisor is present and is not prosthetically replaced, measure from the incisal papilla.

5a-c Mandibular Excursion Movements

General Instructions. Maxillary and mandibular reference points are selected. Typically, they are the labioincisal embrasure between the maxillary central incisors, and the labioincisal embrasure of the mandibular incisors. If one central incisor is missing, the examiner will measure from the mesial incisal edge of the remaining central incisor. If neither central incisor is present, then the measurement will be taken from the incisal papilla. If there is a diastema between the teeth, then the measurement is done from the middle of this space.

With the teeth slightly separated, the examiner uses a millimeter ruler to measure from the maxillary reference point to the mandibular reference point while the mandible is deflected maximally. Record this measurement. The examiner records on the form {Cannot Assess} if the subject is unable to move his/her jaw in the direction specified by the examiner. To ensure understanding, the examiner may say to the subject "Move your jaw towards this hand." and touch the subject's jaw on the side of the desired movement.

Assessment of Pain

The initial probe regarding presence of pain with the procedure is asked; follow this question with the Pain Inquiry Protocol.

5a Right Lateral Excursion

Obtaining Measurement. The examiner asks the subject, "Open slightly, and move your jaw as far as possible towards the right, even if it is painful. Then hold it in that position with your teeth slightly apart until I take a measurement." With the teeth slightly separated, use a millimeter ruler to do the measurement. Then tell the subject to "Move your jaw back to a comfortable position". If necessary, the examiner will repeat the movement.

Pain. The examiner will ask the subject, "Did you feel any pain **when you moved your jaw to the side**?" Follow this question with the Pain Inquiry Protocol.

5b Left Lateral Excursion

Obtaining Measurement. The examiner asks the subject, "Open slightly, and move your jaw as far as possible towards the left, even if it is painful. Then hold it in that position with your teeth slightly apart until I take a measurement." With the teeth slightly separated, use a millimeter ruler to do the measurement. Then tell the subject to "Move your jaw back to a comfortable position". Record this measurement in the same manner as for right excursion (6a).

Pain. The examiner will ask the subject, "Did you feel any pain **when you moved your jaw to the side**?" Follow this question with the Pain Inquiry Protocol.

5c Protrusion

Obtaining Measurement. The examiner will ask the subject, “Open slightly, and slide your jaw straight out in front of you as far as you can, even if it is painful.” After the measurement is done tell the subject "Move your jaw back to a comfortable position". If the subject has a deep overbite, ask him/her to open wider so s/he can protrude without interference from the maxillary incisors. The examiner will measure from the mesio-distal center of the labial incisal edge of the selected maxillary incisor to the labial incisal surface of the mandibular incisor, as previously described under Vertical range of motion with respect to measurement landmarks.

Pain. The examiner will ask the subject “Did you feel any pain **when you moved your jaw forward**?” Follow this question with the Pain Inquiry Protocol.

6a Joint Sounds on Opening and Closing (palpation)

General Instructions: The examiner will state to the subject at the outset of this part of the examination: “We are now going to assess joint sounds, and at the end will ask for your final assessment about any sounds that occur during this part of the examination.”

If the examiner is facing the subject, place left second digit (index finger) over the subject’s right TMJ and the right second digit over the subject’s left TMJ. If the examiner is behind the subject, then place the right second digit over the subject’s right TMJ and the left second digit over the subject’s left TMJ. The pad of the digit is placed anterior to the tragus of the respective ear. The examiner will ask the subject to slowly open the mouth as wide as possible, even if it causes pain. Each closure must bring the teeth completely together in maximum intercuspation. The examiner will ask the subject: “While I have my fingers over your joint, I would like you to slowly open as wide as you can even if it is painful and then slowly close until your back teeth are completely together.” The examiner asks the subject to open and close 3 times and determines the speed of the subject’s movements. If the subject is opening too slowly for the examiner, the examiner can ask the subject to open faster or vice versus. Independently assessing joint sound(s) in each joint is allowed

The examiner should also ask the subject if s/he is hearing or feeling any sounds, and if the subject says “Yes”, the examiner asks the subject what type of sound(s) is present and from which joint. The examiner says “Did you hear or feel any sounds in either of your jaw joints when you opened and closed your mouth”. If the subject says “yes”, then the examiner will ask “What sounds did you hear and on which side did you hear them?” If the examiner detects a “click” or an “eminence click” in either joint, then the subject is asked "Did you have any pain or any increased pain in your jaw joint when it clicked?" If the subject answers “Yes”, then the subject is asked whether the pain with the click was a {Familiar Pain}.

The examiner records the sound that the joint produces on opening and/or closing only as detected by palpation and as defined below. The examiner should apply

minimal pressure (i.e., less than 1 pound of pressure) while determining presence/absence of sounds; the subject should be as relaxed as possible while doing movements.

If the examiner can determine the status of {Click} and/or {Crepitus} sounds in the TMJ being examined in the first set of 3 movements in a specified direction (i.e., vertical or excursive movement), then the examiner stops examining for the sound(s) in that joint for that movement. If the examiner cannot determine the status of either clicks and/or crepitus in the first set of 3 movements, then s/he is allowed to do up to 2 additional sets of 3 movements each in the same direction in the same joint to assess for either sound. Thus, up to three sets of three assessments for clicking or crepitus sounds in any direction can be conducted per joint. The examiner then records the findings from the final assessment when s/he has determined that either clicks or crepitus are or are not present in the selected TMJ for a specific movement.

If a joint sound was present during previous parts of the examination but is not present during the formal assessment of joint sounds, only the sounds present at this stage of the examination are recorded. Likewise, if a new or different joint sound appears after the formal joint sound assessment has been conducted, then such sound is not recorded in this section but instead is recorded in **H. Reassessment of Joint Sounds**.

Recording findings for joint sounds

(1) More than one joint sound(s) per joint per movement can be recorded from a single joint during a single movement (e.g., opening). That is, a click {1, 2, 3}, crepitus {coarse, fine}, and/or eminence click {yes, no} can all be recorded per joint per movement.
(2) If a click but not crepitus is present, the appropriate number {1, 2, 3} of clicking sounds is coded, and the crepitus fields are left blank. If crepitus but not a click is present, the click fields are not coded, but the crepitus field is coded {coarse, fine}. However, if neither click nor crepitus is present within a particular movement within a specific joint, the response {None} is coded to reflect the absence of both sounds.
(3) Eminence clicks are coded as {yes, no}.
(4) The examiner codes {pain with click} following the presence of a standard click and/or an eminence click as {yes, no}. The subject is asked whether the click, if present, was painful during the examination. Painful clicking is assessed independently for both opening and closing movements in each of right and left joints.
(5) If {pain with click} is coded as {yes}, then the questions for {Familiar Pain} are asked, and coded as {yes, no}.

Definition of Sounds

a. None. The absence of sounds as defined by these guidelines.
b. Click. A distinct sound, of brief and very limited duration, with a clear beginning and end, which usually sounds like a "click", “snap” or “pop”. Record any of

these 3 related sounds as positive for {click}. If clicking is present, the examiner indicates whether the click occurred 1, 2, or 3 times out of the 3 trials performed with the specified movement (opening, closing, excursions).

c. Coarse Crepitus. A sound that is continuous over a longer period of jaw movement than a click or pop. This sound may make overlapping continuous noises. This sound is not muffled; it is the noise of bone grinding against bone and it may sound like a rubbing or crackling sound on a rough surface. This sound is audible to the examiner when the examiner's ear is within 6 inches of the subject's TMJ.
d. Fine Crepitus. Fine crepitus is the same as course crepitus except that it can only be felt on the examiner's fingertip and is not audible to the examiner when the examiner's ear is within 6 inches of the subject's TMJ.
e. Eminence Click. The eminence click has to include at least an opening click; it is detected when the condyle-disk unit translates around the eminence, which is accompanied by a bodily shift of the mandible.

6b Measurement of Reciprocal Click (palpation)

A reciprocal click is a click that is present on opening and closing and occurs between maximum intercuspation and Maximum Unassisted opening. Only reciprocal clicks are measured; eminence clicks, even if they occur on both opening and closing, are not measured. With the millimeter ruler, measure the interincisal distance at which the first opening and last closing clicks are heard. Position the millimeter ruler as previously described for vertical range of motion. Measurements of the click can be either subject-directed or examiner-directed. If the subject is aware of the click, and can stop as the click occurs then the subject-directed method can be used. If the subject is unaware of the click, or cannot stop the movement at the click, then the examiner must direct the subject to stop the movement. The examiner asks the subject "I would like you to slowly open your mouth as wide as you can, even if it's painful, until you feel a click (OR: "…I ask you to stop") and I will take a measurement." Then the examiner will ask the subject "Open your mouth as wide as you can, even if it's painful, and then close until you feel a click (OR: "…I ask you to stop") and I will take a measurement." The examiner then takes the measurement. If multiple clicks occur with opening or closing, the examiner measures the first click with opening and the last click with closing. If the subject's click has ceased to exist at the time of the measurement of the click or the subject cannot perform these tests, {Cannot Assess} is coded on the form for the appropriate movement and side. (For reciprocal clicks only, computer analyses will then indicate this is not a reciprocal click; even though a click *had* been present, it did not *continue* to be present.) If there was no reciprocal click present when *Temporomandibular (TMJ) Sounds on Opening and Closing (palpation)* was done, then mark "NA" (i.e., "not applicable") on the form.

6c Reciprocal Click Eliminated on Protrusive Opening (palpation)

The examiner will assess elimination of reproducible reciprocal clicks on protrusive opening by asking the subject to maximally protrude the mandible and to then maximally open from that protruded position. During the first opening in the protrusive position, the examiner should detect a click in the respective TMJ. Next

the examiner will ask the subject to close maintaining this protruded jaw position and then again open from this protruded jaw position. If the test is successful at eliminating the reciprocal click(s), no further clicks will be noted after the first protrusive/opening maneuver. If the subject cannot open fully from a maximally protrusive position, they should then first open fully and click. Then the subsequent jaw-close and jaw-open procedure can be accomplished in the full protrusive position.

The examiner asks the subject: "Open slightly and slide your jaw straight out in front of you as far as you can, even if it is painful. Keep your jaw forward and open and close from this position." If the reciprocal click is eliminated on the first set of opening and closing movements from the protrusive position, code {Yes} on the exam form. Otherwise, this procedure can be repeated up to two more times in order to evaluate whether this maneuver eliminates the reciprocal click. Of three possible trials, elimination of click needs to happen on only one trial; if this is the case then the examiner will code {Yes} (i.e., click eliminated). If the click is not eliminated at all after three trials, then the examiner will code {No} (i.e., click not eliminated). If the subject's click has ceased to exist at this time (i.e., the click was not present when the subject protruded and opened their mouth the first time) or if the subject cannot adequately perform the protrusive and opening maneuver due to apparent difficulty in coordination of movement, then code {Cannot Assess}. If the subject had no clicks, a non-reproducible reciprocal click, or only an opening or closing click, when **Joint Sounds on Opening and Closing (palpation)** was assessed, code {Not Applicable} for the side that lacks a reproducible reciprocal click.

6d **<u>Joint Sounds (superior loading)</u>**

While using superior loading on the TMJ during opening and closing, identification of joint sounds is performed as previously specified, with the following differences. Only clicks are assessed, and any crepitus is not assessed or recorded. The examiner will apply firm pressure (i.e. up to approximately 2 pounds of pressure) superiorly with the thumb placed in the antegonial notch area on the inferior aspect of the mandible during which the subject opens and closes their mouth to his/her maximum amount. The pressure is directed superiorly, parallel to the posterior border of the mandible. This force may need to be decreased if it induces momentary catching or locking of the jaw. Note joint sounds while the subject does vertical range of motion movement three times. Tell the subject "I am going to place my fingers beneath your jaw on each side and press upward lightly. While I do that, I would like you to slowly open as wide as you can, even if it is painful, and then slowly close until your back teeth are completely together." One joint at a time is loaded. The opposite hand is used to both stabilize the head and to palpate the lateral pole of the condyle in order to more directly detect any noises. Sets of three can be repeated up to three times; this procedure is done only with opening and closing and not with excursions. Pain with click is also assessed; if click is painful, the question about familiar pain is asked. See 6a for details.

7a **Joint Sounds on Excursions (palpation)**

The examiner will ask the subject to move to the right, to the left, and protrude (see 6a for recording guidelines). For right excursive movements, ask the subject to "Open slightly and move your jaw as far as possible towards the right, even if it is painful, and move your jaw back to a comfortable position and put your back teeth completely together every time." For left excursive movements, ask the subject to "Open slightly and move your jaw as far as possible towards the left, even if it is painful, and move your jaw back to a comfortable position and put your back teeth completely together every time." For protrusive movements, ask the subject to "Open slightly and slide your jaw straight out in front of you as far as you can, even if it is painful and move your jaw back to a comfortable position and bring your back teeth completely together every time." If the subject is confused about which direction s/he should move his/her jaw, say "Move your jaw towards this hand." and touch the subject's jaw on the side of the desired movement. For all excursive movements, ask the subject to repeat the movement for a total of three times. Then after each movement, ask the subject "Did you hear or feel any sounds in either of your joints when you moved <to the specified position>?" If the subject says "Yes", the examiner asks the subject "What sounds did you hear and on which side did you hear them?" For all excursive movements, "Pain with click" and "familiar pain" with click are assessed as described with item 6a.

Make sure the subject closes into maximum intercuspation after each movement, as with opening/closing sound assessment. The guidelines for assessing sounds are the same as for **Joint Sounds on Opening and Closing (palpation)**. Additionally, a sound is scored as positive whether the sound occurs as the subject moves excursively out to the lateral or protrusive position or if the sound occurs as the subject returns in to the 'middle', neutral position.

7b **Joint Sounds (stethoscope)**

While using a stethoscope during opening and closing, identification of joint sounds is performed as previously specified, with the following differences. Only crepitus (without distinguishing fine from coarse) is assessed; thus, response options are {none, crepitus}. The bell side of the stethoscope is used and it is placed lightly over the lateral pole of the TMJ; the diaphragm side may also be used as an additional procedure, but this is an optional method for clarifying any sounds detected with the bell side. If TMJ pain is already present or if TMJ pain is not present but placement of the stethoscope causes TMJ pain, then the force of the stethoscope bell over the TMJ should be decreased in order to minimize the pain. Tell the subject "I am going to place a stethoscope over your jaw joint. I would like you to slowly open as wide as you can, even if it is painful, and then slowly close until your back teeth are completely together."

7c **Subject Report of Sounds with any Movement**

Any sounds that the subject perceives during any part of the joint sound(s) evaluation are recorded separately in the field for that purpose at the end of joint assessment as {None, Click, Crepitus} for each of right and left sound(s). When the examiner is done assessing joint noise, the subject is asked if s/he felt or heard any joint noise "Did you hear or feel any sounds in your right joint, left joint or both with any of those movements? These sounds could include clicking, popping, snapping, grating, grinding, or crunching, or any other sound." If the subject says "yes", the examiner follows with "What sounds did your joint(s) make and on which side did you hear these sounds?" If the subject reports distinct sounds such as clicking, popping or snapping sounds, these are coded as a {Click} on the form. If the subject reports longer duration sounds including crunching, grinding or gratings sounds, these are coded as {Crepitus} on the form. Otherwise, {None} is coded for that side.

8-11 **Muscle and Joint Palpation**

General Instructions. Examining the muscles and joint capsules for pain requires that the examiner applies standardized pressure on a specific site using the fingertips of two fingers (the second and third digits; or index finger, middle finger), if possible. Expected deviations are the posterior and submandibular areas, due to individual variation in personal anatomy of the subject as well as differences in the size of the examiner's hands. When the masseter's origin and insertion are palpated, the examiner must orient his/her two palpating fingers horizontally. Orientation of the 2 palpating fingers for the body of the masseter and all sites in the temporalis is per the preferance of the examiner but one suggested pattern is shown in the Figure. When palpating posterior mandibular area, TMJ, and both intraoral sites, the spade-like or finger-tip pad of the distal phalanx of only a single finger is used. Palpation will be done with 2 pounds (lbs) of pressure for extraoral muscles, except for the Posterior Mandibular Region and Submandibular Region, which are each palpated with 1 lb of pressure. One lb. of pressure is used for the joints and intraoral muscles. The examiner will palpate the muscles and joints while using the opposite hand to brace the head or mandible to provide stability. The subject's mandible should be in a resting position, without the teeth touching and with the muscles in a passive state except for palpation of the Posterior Attachment of the jaw joint. In the latter instance, the back teeth are completely together unless the subject can not physically do this such as when all posterior teeth are missing or there is a bilateral posterior open bite present.

The examiner then explains to the subject "In the next part of the exam, I will ask you whether you feel pain or pressure when I press on your head and jaw. I want you to consider pressure to be no pain. I also want you to consider pain to be present regardless of whether the pain you feel is mild, moderate, or severe. If any pain is present, I will then ask you if the pain is familiar; this does not include any pain induced by prior examinations of your jaw. Finally, I will ask you if that procedure caused pain anywhere else other than under my finger."

The examiner then starts the exam and says "Relax your jaw and have your teeth slightly apart from each other during this part of the exam." The examiner then locates the site of palpation using the landmarks described below and then presses. Because the site of maximum pain may vary from subject to subject and may be localized, it is important to palpate ALL parts of the muscles and joints that are assessable in order to determine if pain exists. If the examiner needs to localize specific muscle area(s), say to the subject: "I'm going to press on some muscles. I would like you to clench your teeth together gently and then relax your jaw with your teeth slightly apart from each other." If it is unclear to the examiner where the subject's joint is, then the examiner asks the subject to protrude his/her jaw until movement in the joint is felt by the examiner, and then return to a neutral position. The neutral probe used is "Open slightly <or: open and close>, and slide your jaw straight out in front of you and then move it back to its normal position with your teeth slightly apart".

When the examiner palpates an area to determine if pain is present, s/he asks the subject: "Was that painful or not?" The subject needs to determine if the palpation was painful or not. For any equivocal response such as 'tightness' or 'pressure', the examiner uses the neutral probe, "Is that pain, yes or no?" Follow this with the Pain Inquiry Protocol. This Protocol includes consideration of referred pain reports; see Section D, Myofascial and Joint Pain Examination, for details about referred pain response options.

The examiner may provide optional clarifying questions, as needed, as described under General Directions. As needed, tell subject not to decide about the presence or absence of pain until the palpation is complete. The examiner does not make any suggestion or lead the subject regarding the subject's response about presence of pain. If the examiner is unable to palpate at the specified amount of pounds of pressure due to the subject's physical withdrawal or the subject's request for the palpation to be more gentle or the subject asks the examiner not to palpate an area, then record on exam form "Subject Refused".

Specific Guidelines

(1) Locate then palpate;
(2) Press on the site using the correct amount of pressure for one second;
(3) Apply the prescribed amount of pressure on the site without moving the fingers sideways or rubbing the area; and
(4) Cover the full area of the muscle within each defined region.

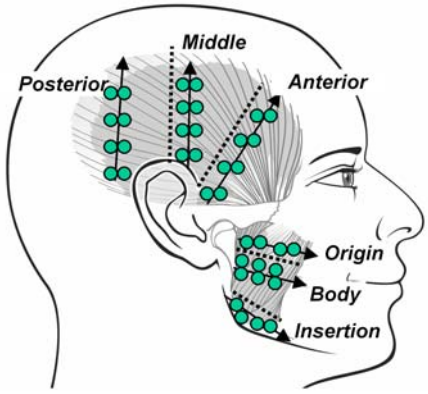


Figure. Suggested pathways for starting palpation in temporalis and masseter. The goal is to palpate each area completely; see text for full explanation.
Key: filled circle denotes one finger tip.

8 Extraoral Muscle Pain with Palpation

See figure for additional information.

a. Temporalis (Posterior). The posterior region is defined as that area posterior to a line that extends in a vertical direction from the top of the ear perpendicularly towards the top of the head. Palpate the posterior fibers starting at the back of the ear, and continue to the superior border of the muscle. Then, depending on the posterior extent of the muscle, move anteriorly to the area adjacent to the area just examined and continue inferiorly to the area just posterior to the top of the ear.

b Temporalis (Middle). The middle temporalis region is defined as that area anterior to the posterior region, extending to a line running at about 45° from the anterior aspect of the ear. Palpate fibers starting just above the ear and continue perpendicularly to the superior border of the muscle. Then move anteriorly to the area adjacent to the area just examined and continue inferiorly to above the zygomatic arch. Continue this technique until all of this part of the muscle is examined including the depression about 4-5 cm lateral to the lateral border of the eyebrow.

c. Temporalis (Anterior). The anterior portion of the temporalis extends anteriorly from the boundary with the middle portion, notably including the infratemporal fossa. Palpation begins at the posterior part of this area, just superior to the zygomatic arch, and extends perpendicularly to the superior border of the muscle. Then move anteriorly to the area adjacent to the area just examined and continue inferiorly to above the zygomatic arch. Continue this technique until all of this part of the muscle is examined

d. Origin of the Masseter. The masseter origin is defined as that area parallel to the zygomatic arch where the tendon of the masster attaches to the zygomatic arch, extending about 1 cm inferiorly. Palpate the origin of the muscle beginning in the area 1 cm immediately anterior to the TMJ and immediately below the zygomatic arch, and palpate anteriorly to the border of the muscle. This area extends approximately one cm. inferiorly from the zygomatic arch; see Figure.

e. Body of the Masseter. The body of the masseter extends from the masseter origin boundary to 1 cm superior to the inferior mandibular border. Palpate the body of muscle beginning in the area 1 cm immediately inferior to the TMJ and palpate anteriorly to the border of the muscle. Note that the two palpating fingers are held with one finger superior to the other.

f. Insertion of the Masseter. The masseter insertion region is parallel to the inferior mandibular border, and extends 1 cm superiorly. Palpate the insertion of the muscle beginning in an area 1 cm superior and anterior to the angle of the mandible and palpate anteriorly to the border of the muscle.

g. Posterior Mandibular Region. *(Stylohyoid / Posterior Digastric)* Ask the subject to tip the head back a little. This region is defined as that area between the insertion of the SCM and the posterior border of the mandible. Place single digit so it is going medially and upwards (and not on the mandible). Palpate the area immediately medial and posterior to the angle of the mandible. If needed to locate the muscle, ask the subject to protrude his/her jaw or to tip his/her head backwards slightly.

h. Submandibular Region. *(Medial Pterygoid, Suprahyoid, Anterior Digastric)* This region is defined as the area 2 cm anterior to the angle of the mandible, and medial to the mandible. Palpate superiorly and laterally, keeping the two fingers close to the medial aspect of the mandibular body. If a subject has a lot of pain in this area, try to determine if the subject is reporting muscle or nodular pain. If it is nodular pain, indicate “no pain” for this area on the form.

9 Joint Pain with Palpation

The joints are examined one at a time; procedure sequence is lateral pole and posterior attachment of the right TMJ, followed by lateral pole and posterior attachment of the left TMJ. Use 1 lb finger pressure.

a. Lateral Pole. Place second digit (index finger) just anterior to the tragus of the ear and over the subject’s TMJ. Ask the subject "Open slightly so your teeth are not touching, slide your jaw forward and then back to its normal position <or: open and close> with your teeth slightly apart”. The examiner feels the lateral pole of the condyle translate forward; the examiner’s digit will then be in the depression where the lateral pole of the condyle was before it translated forward. Then the subject retrudes his/her jaw until the lateral pole is again under the examiner’s digit and with the teeth slightly separated. Use 1 lb pressure on the side that is being palpated, supporting the head with the opposite hand.

b. Posterior Attachment. This site can be palpated intrameatally. Standing in front of the subject, place tips of the right fifth digit (little finger) into the subject’s left external meatus *or* the tip of the left fifth digit (little finger) into the subject’s right external meatus, depending on which side being examined. Point the fingertip anteriorly (towards the TMJ), and ask subject to slightly open the mouth (or wide open if necessary) to make sure that joint movement is felt with the fingertips. The examiner says, "Open your mouth and I am going to put my little finger in your ear and then put your back teeth completely together." Place firm pressure on the side being examined while the subject’s posterior teeth are completely together. Use 1 lb pressure on the side that is being palpated, supporting the head with the opposite hand.

10 Intraoral Muscle Pain with Palpation

Explain to the subject that you will now be palpating the inside of the mouth: "Now I am going to palpate around the inside of your mouth. While I do these palpations I would like you to keep your jaw in a relaxed position with your teeth apart."

a. Lateral Pterygoid Area. Before palpating, make sure the fingernail of the single finger to be used is trimmed to avoid false positives. Ask the subject to open his or her mouth and move the jaw to the side that is being examined. (“Move your jaw towards this hand.”) Place the second digit on buccal side of alveolar ridge above the maxillary molars. Move digit distally, upward, and medial to palpate. If the second digit is too large, use the 5th digit (little finger).

b. Tendon of Temporalis. After completing the lateral pterygoid palpation, rotate your second digit (index finger) laterally near the coronoid process, ask the subject to open slightly, and move your second digit up the anterior ridge of the coronoid process. Palpate on the most superior aspect of the process. Note:

If it is difficult to determine whether the subject is feeling pain in the lateral pterygoid or the tendon of the temporalis, rotate and palpate with the second digit medially then laterally. If there is still difficulty, the lateral pterygoid is usually the more tender of the two.

11 Pericranial Sites

Three sites will be examined using the same criteria as indicated in Section 8 for Extra-oral muscles including using two pounds of pressure and with two fingers.

a. Vertex ("Top of head"): Palpate on highest convexity of the head, 1 cm lateral to the midline.
b. Frontalis ("Forehead"): Palpate the forehead 5 cm above the brow line and directly above the subject's pupil in anatomical position.
c. Mastoid ("Behind the ear"): Palpate the body of the mastoid bone in one central spot where it is most prominent, directly behind the lower portion of the ear.

B: Orthopedic Provocation Testing

General Instructions for Six Diagnostic Provocation Tests

(1) During most provocation tests, the examiner will ask the subject to assess the presence of pain as {Yes, No}. This probe is followed by the Pain Inquiry Protocol.
(2) Before beginning the tests, the subject will be instructed that at any time during the provocation tests s/he can raise a hand to interrupt the testing.
(3) The subject position is adjusted from upright (joint play tests) to partial recline (static and dynamic tests). The neck of the subject should be supported. If the headrest does not provide support for the neck, a towel roll or small cervical pillow is used.
(4) During orthopedic tests, the examiner's hand will contact soft tissue during the execution of the diagnostic test. When asking the subject about pain location, always insure that any area identified as pain caused by the test is not due to soft tissue contact from the examiner's hand.

1 Joint Play Tests

General Instructions. Conduct all tests first on the subject's right side, then conduct all tests on the left side. In this test, the examiner assesses joint accessory motion and compression: (1) traction, (2) translation in an anterior-medial direction, and (3) posterior compression. The examiner uses joint traction and translation to compare (1) joint mobility, (2) self-report of pain by the subject, and (3) familiarity or replication of the pain. The following instructions apply to the examination of the right TMJ; they are reversed for examination of the left TMJ.

The subject is instructed to raise his/her hand if s/he would like to swallow or interrupt the tests at any time. "During these next tests, you can raise your hand if you need to swallow or interrupt the tests at any time."

1a,d Joint Traction

This is a test of traction of the condylar head away from the mandibular fossa.

Subject preparation: The subject sits upright and in a relaxed position; the neck will be supported by the headrest or by a towel roll.

Examiner preparation: The examiner stands to the left of the subject to examine the right TMJ. The examiner stabilizes the side of the head by placing his/her right hand on the subject's right temporal region of the head. The palmar surface of the hand rests against the head and the fingers are spread apart with the third digit (middle finger) extending inferiorly in order to palpate the lateral aspect of the TMJ during any movement of the joint. The examiner's chest or torso (a pillow can be used between the chest and head of the subject) is placed against the left side of the subject's head; the subject's head should remain upright and in a neutral position, not tilted or turned from the mid-sagital plane. The examiner's left hand will be positioned with the first digit (thumb) resting intraorally on the right mandibular molars. The second and third digits of the left hand gently grasp the

mandible to support it while the fourth and the fifth digits (ring and little fingers) rest against the inferior aspect of the chin.

Performing the test: The examiner tells the subject, "Relax your jaw. I am going to put my thumb over your back teeth and gently push down. Then I want you to tell me if it is painful or not." The subject should be relaxed enough to have the mandible resting in the examiner's hand. It is important that the subject does not resist the force applied. It is helpful to ask the subject to take a deep breath and exhale slowly. The traction force coincides with the exhalation. The test can be repeated for a total of three times.

While the third, fourth, and/or fifth digits stabilize the inferior chin with a gentle upward force, the examiner's left first digit (thumb) pushes vertically towards the floor along the long-axis of the molars causing the condylar head to gently distract away from the mandibular fossa. The force applied, dependent upon soft tissue laxity, will range between two to four pounds. It is important to apply the traction force slowly and to release it slowly, simultaneously interpreting the feel of the joint tissue. The right middle fingertip, palpating the lateral aspect of the TMJ, will also be able to detect and confirm the distraction of the lateral pole from the mandibular fossa.

Any pain from these tests is assessed using appropriate guidelines as specified in General Instructions for Provocation Tests. Pain is assessed in each area of Joint, Masseter Region, Retro/Sub Region, and/or Temporalis. A positive pain response is followed by inquiry regarding whether familiar {yes, no). Any positive temporalis area pain *and* positive headache history is followed by the headache replication question.

If there is a dental contraindication to performing the test such as missing molars, an unstable bridge, fractured teeth, etc. record this on the form, do not do the test, and leave the respective test fields blank. If the subject cannot relax enough to allow the test to be conducted correctly, the test should still be performed, and indicate on the form that the subject could not relax the mandible.

1b,e Joint Translation

Subject preparation: Same as for Joint Traction.

Examiner preparation: The positioning of the examiner is the same as for Joint Traction, except that the examiner's left hand grasps the entire right portion of the mandible. The left hand supports the mandible with the left thumb resting intraorally on the occlusal surface of the right mandibular molars while the fingers provide a firm grasp around the mandible. The examiner's right hand again stabilizes the temporal head with the palmar surface and the fingers spread. The third digit or middle finger is placed over the lateral aspect of the TMJ to monitor movement. The examiner stabilizes the head against his/her chest or torso (a small pillow can be used between the chest and the patient's head).

Performing the test: The examiner then says "Relax your jaw. I am going to put my thumb over your back teeth and then move your jaw forward. Then I want you to tell me if it is painful or not." The examiner grasps the relaxed mandible and gently pulls it in an anterior and slightly medial direction according to the laxity or resistance of the subject's soft tissue. The force applied is equal or slightly greater than the resistance of the tissue. There is no traction force during this test. In a normal joint, the right condylar head translates across the mandibular fossa.

The subject should be relaxed and not resist the force applied. If the subject is tense, ask him/her to take a deep breath and exhale slowly. The translational force coincides with the exhalation. The head or neck should not move. The test can be repeated for a total of three times. If the subject cannot relax enough to correctly conduct the test, indicate on the form that subject could not relax and do not do the test; the test fields are left blank.

Any pain from this test is assessed using guidelines as specified under Joint Traction.

1c,f Joint Compression Test

Subject preparation: The subject is sitting upright with the cervical spine supported passively by the headrest, small pillow or towel roll. The subject is relaxed and is asked to not assist with the movement.

Examiner preparation: The examiner is still positioned to the left of the subject in order to test the right TM joint. The examiner's right hand is placed over the posterior-superior (parietal) head in order to stabilize the subject's head. The left hand of the examiner is then placed with the first digit (thumb) resting on the right mandibular premolars, canine, and the lower incisors, while the left first metacarpal (second digit or index finger) palmar surface is placed against the chin anteriorly. The second and third digits (index finger, middle finger) are extended so that the third digit is just inferior to the angle of the mandible. The gentle compressive force will be in a posterior and superior direction. The force is applied posteriorly through the metacarpal pad into the chin and superiorly by pressing the angle of the mandible upward with the third digit. The force is a gentle loading of the posterior TM joint with about one pound of compression for 1-2 seconds.

Performing the test: The examiner says, "Relax your jaw. I am going to put my hand over your jaw and gently push up on it. Then I want you to tell me if it is painful or not."

Any pain from this test is assessed using guidelines as specified under Joint Traction. Soft tissue pain, if any, from the examiner's left hand is not recorded as "pain".

Test Protocol

If there were any dental contraindications to performing the test, such as missing mandibular molars or fragile mandibular molars, code {Yes} for each of right and

left sides. If subject was able to relax his/her jaw, code {Yes}, and if subject was not able to relax jaw during any part of the joint play and compression tests, code {No}. If in doubt about whether the subject was relaxed or not, code {No}; this will ensure that post-hoc analysis of the utility of these tests can be performed only on subjects where it was clear to the examiner that the subject's masticatory muscles were relaxed during the test. In case joint play and compression tests were not done at all {Was test done?}, code {No}. If some of the tests were done but not others (e.g., due to dental contraindications), code {Yes} for having done the test.

Joint Test Interpretation

Following the completion of the bilateral joint play and compression tests, the degree of translation is assessed in both joints via comparison: Hypomobility (limitation of translation) vs. Normal extent of translation. Hypomobility can affect one joint while the other joint is normal, or it can affect both joints (i.e., both joints could be equal in translatory mobility but be restricted). Or, both joints can exhibit normal translation. Hypomobility of the condyle on translation is defined as minimal to no movement of the lateral condylar pole as determined through the palpating finger.

2 Dynamic Testing

General Instructions. In this test, the examiner assesses pain as the subject moves his/her jaw repetitively against the resistance of the examiner's hand.

*Subject preparation***:** The subject is reclined at 45 degrees with the head resting at a level parallel to the examiner's forearms when the elbows are flexed to 90 degrees. This position allows the examiner to (1) observe the subject's face and the pattern of mouth movement; and (2) apply symmetrical force to the jaw while stabilizing the head. The headrest, small cervical pillow or a towel roll supports the cervical spine while gentle force is applied to the mandible.

The examiner tells the subject, "Relax your jaw and have your teeth slightly apart from each other during this part of the exam. I am going to put both of my hands on your jaw while you open, close and move your jaw side to side and forward as far as you can, even if it is painful, against light resistance. After a series of three repetitions for each movement, I want you to tell me if it is painful or not."

Examiner position: The examiner gently cups the mandible with the second and third digits (index finger, middle finger), bilaterally, wrapped around the chin while the thumbs extend, relaxed above the anterior chin. The palms of each hand are resting on the cheek area of the face; the examiner applies no force to any other sites. Do not apply any forces with the 4^{th} or 5^{th} digits (ring finger, little finger) against the throat. The examiner's arms should be relaxed with the elbows at about 90 degrees so that there is no force exerted from the examiner's arms, shoulders or back. During dynamic testing, the examiner's resistive force to the mandible will be just the intrinsic weight of the fingers. As the mandible opens, it will gently extend or straighten the examiner's second and third digits.

The examiner will apply only the intrinsic weight of the fingers (depending on the direction of movement) as a resistive force. The tests will be repeated for opening, closing, lateral excursive, and protrusive movements. The subject can practice each movement up to three times. If the subject has difficulty performing the movement, the examiner can use tactile stimulation (e.g., tapping the chin with the fingertips in the direction of movement) and can practice three times with the subject before actually performing the dynamic test.

Any pain from these tests is assessed using appropriate guidelines as specified in General Instructions for Provocation Tests. Joint, Masseter, Other Muscles, and Temporalis areas are assessed for presence of pain {yes, no}, familiar {yes, no}, and, for the temporalis area, familiar headache {yes, no, N/A}, using Pain Inquiry Protocol.

2a **Dynamic Opening**

The examiner asks the subject, "While I have my fingers under your chin, I would like you to open as wide as you can even if it is painful and then close." The starting position is with the teeth resting gently together. The examiner can observe if the subject is opening through the full range of motion. The test can be practiced and then repeated to assure full mobility. There is no resistance applied to the closing movements. Once the subject opens the mouth three times against light resistance, the examiner then asks pain questions. Only pain during jaw opening (not closing) is assessed.

2b **Dynamic Closing**

The examiner asks the subject, “While I have my fingers on your jaw, I would like you to open as wide as you can even if it is painful and then close your mouth.” The starting position is after the subject has attained full opening of the mouth. The lengths of the examiner’s thumbs are lightly placed across the chin and the mandible. The tips of the thumbs are almost touching along the anterior part of the chin. The fingertips can rest lightly along the inferior mandible on either side. The subject closes three times with the intrinsic weight of the examiner's thumbs providing light resistance. The examiner gives no additional resistance beyond the weight of the thumbs resting on the chin while the subject simply closes the mouth. There is no resistance to the opening movement. Only pain during jaw closing (not opening) is assessed.

2c **Dynamic Right Lateral Excursion**

The examiner asks the subject, “Move your jaw as far as possible towards the right, even if it is painful, and then move your jaw back to its normal position.” (Right chin can be tapped.) Examiner places left hand on the left temporal head region to stabilize subject’s head. Right index and middle fingers are to the right of the chin with the palm resting gently along the side of the subject’s face. The subject has their teeth slightly apart. The movement is repeated three times. Again, the resistance is very light, only the intrinsic weight of the examiner’s fingers is used. That is, the subject's mandible is actually moving the examiner’s fingers into extension. The examiner can observe whether the subject does move through

the full range of motion against this light resistance. The questions regarding pain are repeated and the answers recorded.

2d <u>Dynamic Left Lateral Excursion</u>

The examiner asks the subject, "Move your jaw as far as possible towards the left (other) side, even if it is painful, and then move your jaw back to its normal position." (Left chin can be tapped.) Examiner places right hand on the right temporal head region to stabilize subject's head. Left index and middle fingers are to the left of the chin with the palm resting gently along the side of the subject's face. The subject has their teeth slightly apart. The movement is repeated three times. Again, the resistance is very light, only the intrinsic weight of the examiner's fingers is used. That is, the subject's mandible is actually moving the examiner's fingers into extension. The examiner can observe whether the subject does move through the full range of motion against this light resistance. The questions regarding pain are repeated and the answers recorded.

2e <u>Dynamic Protrusion</u>

The examiner asks the subject, "Slide your jaw straight out in front of you as far as you can, even if it is painful, and then move your jaw back to its normal position." The examiner's hand placement is again with the lengths of the thumbs resting along the anterior surface of the chin and mandible, as used for Dynamic Closing. Ask the subject to "Slide your jaw straight out in front of you as far as you can, even if it is painful". The examiner gently allows the extension of the thumbs to occur as the subject protrudes the jaw against the thumbs. The movement is repeated three times. Ask pain questions and record pain responses.

3 Static Testing

General Instructions. In this test, the examiner is assessing for pain while resisting the subject's movement of opening, closing, lateral and protrusive movements. The intent is for the examiner to apply counter-pressure against the subject's increasing force in the desired direction, such that the jaw does not move. That is, the examiner's resistant force increases in order to continually match that of the subject's effort. The maximal amount of pressure exerted by the examiner will be a function of how much force the subject exerts while making sure the jaw does not move. The examiner applies maximal resistance until maximal effort is achieved (5 seconds maximum). The basic instructions consist of (1) telling the subject to move the jaw to the specific position, (2) saying "Good….hold it there", (3) coaching the subject to increase the force, "hold….hold….hold", and (4) concluding the test after 5 seconds.

<u>Subject preparation</u>: The examiner informs the subject: "I am going to press against your chin while you attempt to open, close, and move your jaw side to side and forward. You will need to push back against my hand so that I do not move your jaw. Then I want you to tell me if it is painful or not." Specific instructions for coaching the subject through each test consist of: "I want you to hold your jaw in this position while I apply more force. Do not move your jaw. Hold ….hold….hold….and hold."

Examiner position: The position of the subject and the examiner's hand placement is the same as described with dynamic testing. After reaching the maximal force that the subject can resist, the examiner can cue the subject verbally to maintain that level of effort, by repeating "hold, hold, hold." At the end of 5 seconds, the examiner then releases the force slowly, and asks, "Was that painful or not?" and continues with the standard pain questions.

Any pain from these tests is assessed using appropriate guidelines as specified in General Instructions for Provocation Tests. Joint, Masseter, Other Muscles, and Temporalis areas are assessed for presence of pain {yes, no}, familiar {yes, no}, and, for the temporalis area, familiar headache {yes, no, N/A}.

Interpretation: A negative finding for static testing is strong, pain-free muscle response to subject-specific maximal resistance.

3a Static Opening

The subject is asked to partially open his/her mouth, using rotation movement only (i.e., about 5-10 mm of incisal opening). While the subject keeps their mouth partially open at the same position, the examiner applies a gradually increasing force with the second and third digits. The force applied by the examiner gradually reaches the maximum effort and resistance of the subject. To initiate the test of opening, the examiner says, "I am going to press against your chin while you attempt to hold it open. You will need to push against my hand so that I do not move your jaw." Record pain responses.

3b Static Closing

Ask subject to partially open, which is intended to use only a rotational movement (i.e., 5-10 mm of incisal opening). Place the first digits (thumbs) on the anterior portion of the chin and apply maximal pressure. "I am going to press against your jaw. You hold against my resistance. You will need to push against my hand so that I do not move your jaw". Often, a subject may have more force and power than the examiner can exert on the chin, so the examiner may fatigue before the subject. Record pain responses.

3c Static Right Lateral Excursion

The same hand placement is used as with dynamic testing. The examiner's left hand will stabilize the left temporal region of the head while the second and third digits of the right hand apply force against the right mandible. The teeth are slightly apart. The examiner says "I am going to press against your jaw while you hold it against my hand. You will need to push against my hand so that I do not move your jaw to the opposite side." The subject moves their jaw to the right halfway, about 5 mm, and keeps it there. The force is then gradually applied until the maximum effort is reached. The pain response is recorded.

3d Static Left Lateral Excursion

The same hand placement is used as with dynamic testing. The examiner's right hand will stabilize the right temporal region of the head while the second and third

digits of the left hand apply force against the left mandible. The teeth are slightly apart. The examiner says “I am going to press against your jaw while you hold it to the left. You will need to push against my hand so that I do not move your jaw.” The subject moves their jaw halfway, or about 5 mm to the left, holding that position against r2esistance until maximal effort is reached. The pain response is recorded.

3e **Static Protrusion**

The subject brings the jaw forward about 5mm. The thumbs of the examiner are across the anterior chin and along the mandible. Tell subject, “I am going to press against your jaw while you hold your jaw out in front of you. You will need to push against my hand so that I do not move it”. The examiner applies the maximal resistance through the thumbs, gradually increasing force until maximal effort is reached. The pain response is recorded.

3f **Muscle Weakness**

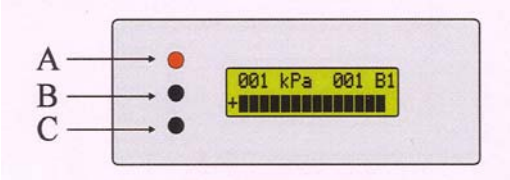
Weakness is defined as the inability of the subject to maintain the static position against the subject-specific maximal resistance provided by the examiner. Muscle weakness is indicated if either (1) the subject’s maximal effort was of low force, or (2) the subject could exert normal maximal effort but could not sustain it for the duration of the 5-second test.

C. Standardized Site PPT Measurements

Part 1: Instrumentation and Methods

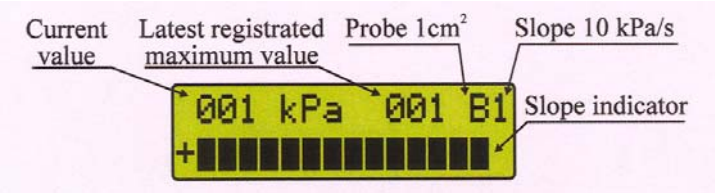
General Algometer Procedures

(1) Example of Somedic algometer display



(2) Algometer controls
- (a) To switch algometer on, press A
- (b) Allow algometer to remain on for one minute to stabilize, and then press A again.
- (c) To reset the algometer after obtaining a value, press A.
- (d) To switch algometer off, press B.

(3) Detail of algometer display



(4) The rate of force application should be set to 30 kPa/s; this rate is based on research of Thomas List (JOP 9: 347-356, 1995) and of Peter Svensson (personal communication). Slope indicator will be '3' (not '1' as in the Figure). See Algometer Manual for details.

(5) Probe size should be set to 1 cm^2 tip (Probe 'B'). This probe measures approximately 0.5cm in diameter. See Manual for details.

(6) Calibration. See manual for detailed instructions; instrument should be checked every 10^{th} day of instrument usage. There is a recording table within the instrument manual.

(7) The subject switch is connected to the connector at the base of the instrument handle.

(8) When applying pressure with the algometer for obtaining a PPT, the marker within the Slope Indicator should remain approximately in the middle of the bar. The instrument does not provide any indication of error should the applied rate fall too much outside that goal. If the operator considers the rate to have not been adequate, the trial should be repeated. At present, there is no evidence for deciding if the rate of pressure application is outside an acceptable range. For the

purposes of this study, if the indicator falls to either extreme for more than 1 second (i.e., momentary), the trial should be repeated.

(9) Subject positioning. The back of the subject's chair varies between 45 degrees and parallel to the floor.

Obtaining Pressure Pain Thresholds (PPT) Measures

(1) Pressure Pain Thresholds. The algometer is explained to the subject. The pain threshold from a PPT measurement is explained to the subject as "when the pressure turns into pain". Specifically, tell the subject that "I am now going to press on different areas of your hand, head and face with this instrument. This is a switch for you to hold in your hand. I want you to press the button immediately when the pressure turns into pain, and then immediately release the button." If the subject is confused about pain threshold, clarification should be provided: "Press the button when the pressure turns into something that you clearly do not like; that is probably pain." It may be necessary to emphasize that we are measuring the first instance of pain, as some subjects will interpret the instruction as signifying "pain tolerance" despite the above instructions. If the subject confuses pain threshold with pain tolerance, tell the subject: "We want you to press the button when the pressure first turns to pain. This is not a test of how much pain you can tolerate."

(2) Hand switch. The subject is given the hand switch and told to press the switch immediately at the first instance that they feel that the applied pressure is painful, that is, the pressure-pain threshold. Emphasize to the subject that s/he needs to press and immediately release the button at the moment of pain threshold.

(3) Practice trial. After explaining the PPT procedure, the examiner should feel confident that the subject understands the distinction between pressure and pain. If the subject seems confused or apprehensive about this part of the study, a practice trial can be done in a relatively neutral area of the subject's body; for example, a convenient area is the hypothenar eminence on the palm of the subject's non-dominant hand. Tell the subject "We will now do a practice trial on your hand. Remember to press the button immediately when the pressure turns into pain." Note that the underlying anatomy of this area is complex, and that reliable PPTs (i.e., over two or more trials) can be difficult due to problems in consistent placement of the algometer tip over those structures. However, the purpose of a practice trial is to acquaint the subject with the algometer. After obtaining the PPT, the examiner asks the subject if s/he understood the procedure or has any questions. "Do you feel like you understand what we are trying to measure?" Then say "Do you feel like you need another practice trial?" The practice trial can be repeated to verify that the subject understands. The examiner should feel confident that the subject understands the distinction between pressure and pain based on the practice trial(s), if they are used. To reassess the subject, ask him/her, "Do you have any questions?"

(4) Measurement order. Sites are measured in order specified.

(5) Locate measurement sites. Locate selected sites based on the respective guidelines.

(6) Mark site. Examiner marks each PPT site with delible marker, as needed. Marking the sites is required when reliability studies are being conducted but optional for the validation study data collection. The examiner says, "I will mark the places on your head and face where I will be taking the measurements. The marks help guide me to the correct locations, and the marks will wash off when we are finished. I will be taking measurements twice at each site that I mark. There will be one site on your hand, seven on your head and face, and one over your jaw joint, on each side."

(7) Algometer placement. Place the tip of algometer over the (site, with the instrument tip perpendicular to the surface of the skin or underlying bone. Tip placement and tip stability, can be improved by placing the tip with some mild firmness (e.g., about 20 kPa) on the underlying tissue. This is particularly relevant for areas such as the masseter origin, body, insertion, and lateral pole of the TMJ where placement is not as secure. When performing PPT measurements, place the opposite hand to support the mandible or head in order to provide stability and security to the subject. While the PPT measurement is obtained, the subject's mandible should be in resting position, with the teeth apart, and the jaw muscles in passive relaxed state.

(8) Force application. The algometer is steadily pressed against the underlying tissue at the rate required according to feedback from the slope indicator. Repeat the trial if the actual rate of force is not sufficiently close to the desired rate, per guidelines stated above. When the subject presses the button signifying pain threshold, immediately remove the tip from the tissue. Show the algometer's display to the recorder, who will then record the value on the form. Do not read the values aloud so that the subject remains blind to the PPT values.

(9) Two trials for reliability. Two trials are performed at each site, in succession, in order to maximize reliable placement of algometer tip. Approximately 3 seconds between trials is sufficient.

(10) Special coding.
- (a) For some subjects, the examiner may not be able to exert enough force to reach the pressure pain threshold. If this happens, the maximal pressure value obtained should be entered on the form, and the field {Examiner Stopped} should be coded. If this is trial one for a given site, skip to the next site.
- (b) The subject may refuse to have the PPT measured at a given site. Mark {Subject Refused}. Move to the next site.

Part 2. Standard Site PPT Measurements

Location of Sites.
All standard sites are as described in the **Specifications for TMD Examination**. All sites are measured in the order listed.

1. CONTROL SITES

   Lateral palm area. The site is next to the medial edge adjacent to the little finger (hand in anatomic position), immediately proximal to the distal palm crease formed when the fingers are flexed, and about 1cm from the edge of the palm.

   Supra-Frontalis Area. The site is superior to the pupil with the eyes focused directly ahead, and about 6 centimeters above the brow line. The intent is to be above the frontalis muscle and on the fascia.

2. JOINT SITE

   TMJ, lateral pole. To locate the site, place an index finger just anterior to the tragus of the ear and over the TMJ. Ask the subject to protrude until the examiner is certain of the position of the lateral pole of the condyle. Subject then returns the mandible to the normal position, and is asked to keep the teeth slightly separated during PPT measurement. Tell the subject "Open slightly, and slide your jaw straight out in front of you and then move it back to its normal position with your teeth slightly apart".

3. MUSCLE SITES

   If the examiner needs to localize specific muscle area(s), they can say to the subject: "I would like you to clench your teeth together gently and then relax your jaw with your teeth slightly apart from each other."

   Temporalis, posterior. The site is 2 cm directly superior to the highest point of ear.

   Temporalis, middle. The site is in the depression about 4-5 cm lateral to the lateral border of the eyebrow.

   Temporalis, anterior. The site is in the infratemporal fossa 2 cm lateral to the ridge adjacent to the eye and in-line with the eyebrow.

   Masseter, origin. Ask the subject to first clench then relax and observe masseter for location. Locate the site beginning approximately in the area 1 cm immediately anterior to the TMJ and immediately below the zygomatic arch. Place the algometer tip in the area 2 cm immediately anterior to the TMJ (in closed position) and immediately below the zygomatic arch such that the edge of the algometer tip is clearly not pressing on the zygoma but remains on the muscle tendon.

   Masseter, body. The site, in the vertical plane, is equal distance between the origin and insertion sites. In the horizontal plane, the site is equal distances between the anterior and posterior borders of the masseter.

Masseter insertion. The site is 1 cm superior and anterior to the angle of the mandible. The tip can be oriented superiorly if necessary in order to insure firm tissue contact and decrease possibility of slipping off the tissue.

Obtaining PPT Measures

Two PPT measures are obtained at each site according to the order stated on the Algometry recording form. Start with the right side of the subject's face, and then do the left side. The order per side is: Palm, frontalis, lateral pole (of TMJ), temporalis posterior, temporalis middle, temporalis anterior, masseter origin, masseter body and masster insertion.

The examiner says, "We will begin now. You can ask questions at any time, and you can stop the measurement process at any time if obtaining the pain threshold at a particular site is of concern to you."

If necessary to confirm the location of the lateral pole of the TMJ, the examiner says, "Open slightly, and slide your jaw straight out in front of you and then move it back to its normal position with your teeth slightly apart".

D. Myofascial and Joint Pain Examination

Overview

Each muscle (temporalis and masseter, bilaterally) and the lateral aspect of the TMJ (bilaterally) are examined for identification of specific pain areas. The examination method and goal are different from that used for the standard RDC-based palpation procedure. Specifically, examination techniques reported for detection of putative trigger points should be used in order to locate specific areas in muscle that are responsible for referred pain, if present The presence of a single referred pain site in a given subject is sufficient for a diagnosis of Myofascial Pain with Referral. Similarly, the lateral aspect of the TMJ will be re-assessed using a modified examination technique. The diagnosis of myofascial pain with referral can result from either the standard muscle examination procedures or from the more specialized myofascial examination procedures.

Clinical Examination Protocol

Muscle examination. The goal is to fully examine the muscle, as needed; that is, once maximal findings (i.e., referred familiar pain) are obtained from a designated muscle region, there is little to be gained by continuing to examine that region. The general method for examining the muscle region includes careful and systematic application of indicated pressure; the pressure can include wiggling the fingers, rolling the finger tips in circles, or using a small rubbing motion across the fibers, while using the spade-like pad of one finger. Other strategies that might assist in locating pain areas associated with potential referral include: (1) placing the muscle on a slight stretch; (2) locating so-called “taut bands” in the temporalis and masseter muscles by palpating across or along the long axis of the muscle fiber; (3) sliding the finger across the muscle fibers or along the muscle fibers (with muscle slight stretched); or (4) asking the subject to clench his/her back teeth together and examining the area of greater bulk during the contraction. A thorough search of each area within each muscle must be performed in order to locate possible pain areas that might be associated with referred pain.

Once a presumed painful site is identified, palpation pressure is applied. Between 2 and 4 lbs is considered typical for this procedure, but there is no specification for exactly how much pressure to use. The pressure needs to be sustained for up to five seconds, as necessary, in order to allow sufficient time to elicit any referred pain phenomena.

Joint examination. Two to three pounds of pressure rather than 1 pound will be used. This additional palpation will be **Around the Lateral Pole**. The examiner asks the subject to “Open slightly so your teeth are not touching.” The examiner locates the lateral pole of the TMJ and then, keeping the outer edge of his/her palpating finger on the lateral pole of the subject’s TMJ, the examiner rotates his/her finger around the lateral pole using 2 pounds of pressure. The examiner then asks the subject the same questions used for the myofascial examination.

Palpation Site Characteristics

The general instruction to the subject is, “I am now going to press on different areas of your head and face. This procedure will be slightly different from the one we did

previously, as I will examine the muscles and the jaw joints in a slightly different manner; I may use more pressure, and may hold it for a longer period of time – sometimes up to five seconds or more. As I press on these areas, I will ask you to tell me if it is painful or not. If it's painful, I will ask you if the pain was familiar. If the pain is familiar to you, I will also ask whether you felt pain anywhere else other than under my finger."

Before palpating the subject, the examiner says "Relax your jaw and keep your teeth apart from each other with your mouth slightly open during this part of the exam." Having the subject's mouth open about 25 mm will put the muscle in a slight stretch. If the examiner is having difficulty identifying any "trigger points", then ask "I would like you to clench your teeth together gently and then relax your jaw and have your teeth slightly apart with your mouth slightly open".

After locating the specific site for the myofascial palpation procedure, the subject should be asked the following:

a. Presence of pain. "Is this painful or not when I press here?", and responses are coded as {yes, no}. If response is coded as {Yes}, then proceed with (b), (c), and, as appropriate, (d).

b. Familiar. "Was that pain familiar?" If the subject is confused or not sure, then ask: "Is that pain like or similar to your pain?" Responses are coded as {yes, no}. For temporalis sites in conjunction with positive history of temporal area headache, a response of "no" to the question of {Familiar Pain} is followed by Headache replication query. If there is no temporal headache, then a response of "no" to the question of {Familiar Pain} completes the evaluation at that site; that is, referral patterns are queried only if the pain is reported as familiar or as replication of headache.

c. Headache replication. A special case exists when the temporalis muscle exhibits palpation pain AND the subject reports current history of headache. In addition to asking the subject about familiar pain, the subject is also asked if the palpation produces pain that is similar to their headache. Ask: "Was that pain like your headaches?" Responses are coded as {yes, no}.

d. Referral. Referral of pain is queried if the pain either was familiar or, as applicable, elicited headache replication. "(When I pressed in that area), did that cause pain anywhere else other than only under my finger?" If the subject says "yes", the examiner asks, "Show me with one finger tip all of the areas you felt pain when I pressed on you."

e. Replication of referral. If pain is referred, then the subject is asked if the pattern of referral is itself familiar; the examiner can use his/her hand to touch the areas that the subject just reported as referral targets in order to emphasize that it is the referred pain, not the localized pain beneath the palpating finger, that is being queried. If the subject say "yes", then the Subject Refused" {yes} bubble is

marked; if the subject says “no”, then no coding is entered.

Pain is recorded as referral {yes, no} based on pain report in an area that is beyond the boundary of the underlying muscle. Obvious examples include ear pain, forehead area pain, and tooth pain. Responses are coded as {yes} if the reported pain is in an area clearly beyond the boundary of the muscle, or {no} if not. If the subject’s response is ambiguous, a probing question can be asked in order to obtain a clear verbal description, but the examiner should also use some judgment and consider accepting an ambiguous response as a {no} since pain referral is generally considered to be a clearly distinct experience. Finally, to reiterate, the examiner asks the subject to show him/her where the pain is experienced; it is the examiner’s task to classify the demonstrated pain area(s) as referred.

E. Physical Barriers

If the subject has a beard, a neck brace, or any other potential physical barrier that may interfere with any part of the examination, indicate the presence of a barrier, and then specify the nature of the barrier in the appropriate field on the examination form. The data fields for examination procedures that could not be performed due to the barrier are left blank.

F. General Instructions for Occlusal Examination

General Instructions. The subject is seated in a semi-reclined to fully reclined position (i.e., the back of the chair is between 45 degrees and parallel to the floor). The subject is asked, “Close your teeth together in your best bite, the place where your teeth fit together the best.” The following items are assessed based on this reference occlusal position. For all occlusal tests, any replaced teeth are included, whether replaced by removable or fixed prostheses.

1 Occlusal Characteristics

Any tooth identified as missing and not prosthetically replaced is recorded by number (#1-32) on the appropriate grid. The total number of missing and not replaced teeth is also recorded.

2 Cross Bite

This item is evaluated in the anterior and posterior dental segments. A response {yes, no} is required for both right and left, and for both anterior and posterior.

Anterior: A positive finding results from any mandibular anterior tooth with an incisal edge facial to the incisal edge of a maxillary antagonist.

Posterior: A positive finding results from any mandibular posterior tooth with a portion of the buccal cusp ridge facial to the buccal cusp ridge of a maxillary antagonist.

3 Open Bite

This item is evaluated in the anterior and posterior dental segments. A response {yes, no} is required for both right and left; and anterior and posterior.

Anterior: A positive finding results when the incisal edges of any two adjacent maxillary anterior teeth have a vertical separation of > 0 mm from the incisal edges of their mandibular antagonists. If the two central incisors are the only involved teeth, this is coded as {Yes} for each of Right and Left **Anterior Open Bite**.

Posterior: A positive finding results when any two adjacent maxillary posterior teeth have a vertical separation of > 0 mm from their mandibular antagonists.

4 Occlusal Intercuspal Contacts

Mylar strip (shimstock) is inserted in a Miller forceps, with the strip extending out from the end, parallel to the long axis of the instrument. The subject is first instructed, “Close your teeth together in your best bite, the place where your teeth fit together the best”. After establishing this position, the subject is instructed to open so the examiner can place a piece of shimstock sequentially between each occluding pair around the dental arch; the maxillary teeth are the reference point. For each occluding pair, after the shimstock is inserted between the pair of teeth, the subject is told, “Close firmly on your back teeth in your best bite and hold until I say open.” After teeth closure, the examiner pulls on the shimstock to determine if

it is held or slips free. Occluding pairs that hold the shimstock in place are judged to be in contact, and are coded as {Yes}. If the shimstock slips free, it is coded as {No}. If the shimstock 'drags' out, {No] is coded. Missing teeth pairs (i.e., either maxillary, mandibular, or both within one reference location) are coded {Missing}.

5a-d Guided Jaw Position

General Instructions. The subject is reclined in a supine position, chair back parallel with the floor. The examiner is seated directly behind the subject. The subject's head is stabilized against the center of the examiner's lower torso. Extension of the subject's neck is often helpful and facilitates visualization of the teeth. The examiner aligns the second through fifth digits of each hand along the lower border of the mandible with the fifth digit even with or slightly behind the mandibular angle. The first digits (thumbs) reach across the mandibular symphysis resulting in the examiner's hands forming an open, letter "C". No pressure is applied at this time. With a very gentle touch the subject is instructed to "Relax your jaw as much as possible and open and close it slowly without letting your teeth touch." The opening and closing is in a slow, rhythmical tempo (1-2 seconds per opening closing cycle), opening to no more than 15 mm and closing to just before tooth contact. Do not let the teeth touch. This is a gentle hinging motion most effectively achieved with cooperation between the examiner and subject. Any excessive pressure at this point will often result in subject resistance and bracing of the jaw. Jiggling of the jaw should also be avoided.

5a Guidance

Any difficulty in achieving a relaxed, rotational, hinging motion is coded as {Difficult}. If no difficulty in achieving a relaxed, rotational, hinging jaw, that is, the guidance is achieved easily, then {Easy} is coded.

5b Initial Contact in Guided Position

The subject is instructed to close to initial contact with examiner bimanual guidance as described above. "Lightly close your teeth until you first feel your teeth touch. Does one side touch before the other side?" If the subject indicates there was contact only on one side of the dental arch, then {Unilateral} is coded. If the subject indicates that there was contact on both sides of the dental arch, then {Bilateral} is coded.

5c Horizontal Incisal Overjet

While guiding the subject in the same rotational closing pattern, the subject is instructed, "Close again until your teeth just touch feather light. Hold that position." The horizontal overjet is determined at this initial contact in the Guided Position. The measurement of the horizontal incisal overjet is performed as described under **A.4e Horizontal Overjet**.

5d Dental Midline Discrepancy

Any discrepancy in the mandibular dental midline relative to the maxillary midline is noted at the initial contact in the Guided Position. Use the same measurement procedure as indicated under **A.4f Midline Deviation**. Also record if the midline is

deviated to the right or left in this position.

G. Provocation Tests

1 Pain with Biting on Cotton Roll

Subject position: First determine if there are dental contraindications to the test and record. The subject is sitting upright.

Examiner: The examiner says, “I will put a cotton roll between your back teeth on one side and then I want you to bite on the cotton roll as hard as you can for 10 seconds. I want you to tell me if it is painful or not.” The cotton roll is placed with the long axis along the occlusal surfaces of the posterior teeth (premolars and molars); the distal end of the cotton roll is aligned with the distal aspect of the terminal tooth, and the proximal end no further anterior than the cuspid; adjust the cotton roll accordingly. The test is not done if there are no posterior teeth. Start with the right posterior teeth first. The subject is instructed to bite on the cotton roll for 10 seconds.

Repeat for left side.

Any pain from these two tests is assessed using appropriate guidelines as specified in Pain Inquiry Protocol.

Indicate if there was a dental contraindication to performing the test {yes, no}.

2 Pain with Clenching

Subject position: First determine if there are dental contraindications to the test and record.

Examiner: Ask subject, “I want you to clench on your back teeth as hard as you can for 60 seconds. You may stop the test at any time. Then I want you to tell me if it is painful or not."

Any pain from this test is assessed using appropriate guidelines as specified in Pain Inquiry Protocol.

Indicate {yes, no} if there was a dental contraindication to performing the test.
Indicate {yes, no} if the subject terminated the test prior to the full 60 seconds.

Interpretation: A negative test is pain free. A positive finding is pain. The location of the pain is considered and whether or not the pain is familiar.

H. Joint Sound Reassessment (One examiner)

General Instructions. Joint sounds will be reassessed using the same fields and criteria as used during the first joint sound assessment. The GSE1 will perform a full joint sound reassessment; the GSE2 will reassess only those variables deemed necessary based on overall joint status at that clinical visit.

The joint sound reassessment will occur at the end of the full examination (i.e., after algometry and myofascial examination) *unless* reassessment is initiated by the appearance of a new type of sound. New types of sounds are defined as:

(1) A click not present previously emerges with any jaw movement (e.g., a click was present previously only on opening, but now appears also on closing or with eccentric movements);
(2) Change in a click from a non-reproducible click to a reproducible click;
(3) Crepitus not present previously becomes apparent; or
(4) Previously apparent but non-audible crepitus becomes audible.

If the click was not a reproducible reciprocal click but then becomes a reproducible reciprocal click, then the examiner does measurements of click locations and performs the protrusive test. A new type of sound that appears only because the subject engages in an extreme jaw movement should not initiate joint sound reassessment. The subject may notice the new sound and/or the examiner may notice the new sound. But only sounds that are actually detected by the examiner are recorded.

If a new type of sound appears, then the joint sound reassessment will occur at that time. If subsequent to that second evaluation, there is yet another appearance of a new sound during the examination, then the joint sound reassessment will occur again; for the GSE, joint sound reassessment can occur as many times as deemed necessary to capture all possible types of joint sounds that may appear in that individual. Sounds that may appear subsequent to the first joint sound assessment will be coded on the joint sound reassessment form; if joint sounds subsequently disappear after they have been assessed and coded, they are not uncoded. Thus, the final coding of any or all joint sound reassessments will represent, for the GSE, the best composite of any sounds that appear during the examination subsequent to the initial joint sound assessment. If no new types of sounds appear during the examination, the joint sound reassessment will occur at the end of the examination.

I. Jaw Locked

At the conclusion of the exam, the examiner records whether the subject's jaw locked, even momentarily, either in, or from, a closed position or a wide-open position during the exam.

If the jaw did lock during the examination, the examiner will also indicate whether the jaw unlocked during the exam {yes, no}, and whether it was in, or from, a closed position or a wide-open position during the exam.

J. Joint Sound Reassessment (Two examiners)

General Instructions. Joint sounds will be reassessed using the same fields and criteria as used during the first joint sound assessment. The GSE1 and GSE2 may reassess joint sounds together at the second visit if there are joint sound discrepancies between visits that need to be addressed. This joint examination of the joints is initiated, independent of whether the GSE2 performs a standard reassessment of joint sounds or not. The findings from any shared reassessment will be regarded as the final determination of clinical joint status.

K. Jaw Locked

At the conclusion of the shared joint sound reassessment, the examiner records whether the subject's jaw locked, even momentarily, either in, or from, a closed position or a wide-open position during the exam.

If the jaw did lock during the examination, the examiner will also indicate whether the jaw unlocked during the exam {yes, no}, and whether it was in, or from, a closed position or a wide-open position during the exam.

Last edits: 2/10/05 RO