Clinical Examination Findings of Temporomandibular Disorder Patients: A Factor Analytic Study

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To assess the latent factor structure of clinical examination findings obtained from temporomandibular disorder patients, exploratory factor analysis was used to examine the relationships of a large number of variables obtained from a clinical examination to a smaller number of latent variables, or factors. Two independent samples of patients—an initial sample that consisted of 330 patients who complained of facial pain and a validation sample of 161 additional patients—were examined to determine whether the factor structure was reliable. A principal axis factor analysis with varimax rotation was used for both sets of data. The factor structure for the two samples was consistent between the two sets of data. Results identified two muscle pain factors (an "intraoral muscle" factor and an "extraoral muscle" factor), two unilateral jaw pain factors, and two factors that concern joint noise (clicking and crepitus). The implications of these findings for the current nosologic systems for temporomandibular disorders are discussed.

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At least 10 nosologic schemes for temporomandibular disorders (TMD) have been developed. Although these classification systems all purport to address the diagnostic issues important in TMD, the variability among the systems is considerable. For example, the system reported by Farrar[1] emphasizes disc derangement and ignores the muscle pain component that is common among patients who complain of facial pain. Bell's system[2] describes many "disc-interference" disorders and other problems related to the temporomandibular joint (TMJ) itself; masticatory muscle disorders are encompassed by three subcategories characterized by muscle splinting, spasm, or inflammation. In contrast, the system proposed by Block[3] emphasizes the location of the painful problem and recognizes myogenic pain, but omits disc derangements.

The methodologies used in the development of diagnostic systems for TMD also show considerable variability. Only a few systems appear to be based on clinical or population samples,[4–6] while others use data derived from published studies or adopt a conceptual/rational approach to the problem.[7–10]

None of the systems has fully addressed the degree to which the system mirrors TMD as a clinical entity. One method for doing so is to analyze data obtained from physical examination. For example, let us assume that myalgia can be assessed via several measures (eg, number of muscles with pain or pain level in the muscles) and that disc displacement can be assessed with several measures (eg, number of jaw movements that produce clicking in the joint or point of opening at which clicking occurs). If myalgia is a distinct clinical entity (separate from disc displacement) among facial pain patients, then the variables that measure myalgia should be highly correlated with one another and poorly correlated with the variables that measure disc displacement. Similarly, the variables that measure disc displacement should be highly correlated with one another and poorly correlated with those that measure myalgia. The degree to which the "clumping" of variables is mirrored in the nosologic system would then be a measure of the validity of the system.

Although numerous nosologic schemes have been developed, most have not systematically examined the latent factor structure of clinical examination findings. This study used exploratory factor analysis to examine the relationships of a large number of variables obtained from a clinical examination to a smaller number of latent variables, or factors. Two independent samples of patients were examined to determine whether the factor structure was reliable.

Materials and Methods

Initial Sample

Data for the initial sample were obtained retrospectively from 330 records of patients seen at the University of Missouri at Kansas City Facial Pain Center. The Facial Pain Center functions as a tertiary care and referral facility for dentists and physicians within the greater Kansas City area and for providers in rural areas of the midwest. During clinical examination, a variety of muscles were palpated by means of the techniques described by Dworkin and LeResche.[4] Numerous tests of the function of the TMJ were performed. These functional tests included: palpation of the joint with various methods; detection of clicking or crepitus produced by multiple activities of the jaw; observation of opening patterns; and range of motion and production of pain during opening, excursive activities, and protrusive activities. Abnormalities in the oral cavity and in the function of the cranial nerves were also noted during the examination.

All data reported in this study were obtained from physical examination, except for demographic information that was obtained from patient-completed questionnaires. Examiners were licensed dentists with specific training and experience in the diagnosis and treatment of TMD, which included proper techniques for muscle palpation.[4] Data from the examination were entered into a database program and then checked for accuracy. As many as 131 variables could be recorded for each patient. The values assigned to these 131 variables could have the numeric characteristics of continuous variables (eg, amount of opening), or of discrete variables (eg, presence or absence of clicking). For a factor analysis, the ratio of subjects to variables should be at least 5:1,[11] and all of the variables should be continuous.

For the continuous variables within the original set of 131, a preliminary principal component analysis[12] was conducted to help identify ways in which the variable set could be reduced. Variables that loaded strongly on one factor were combined to form a new composite variable. For the discrete variables within the original set of 131, the variables were examined and logically related variables were summed to create a new composite variable. For example, several tests were conducted to elicit clicking in the joint, and the result from each test was coded as clicking present or absent. For the composite variable that examined clicking, the number of tests in which clicking was detected was summed. In all cases, the new composite variable had the properties of a continuous variable, and the new composite variable typically addressed the degree to which the sign or symptom was present during examination.

The final data set consisted of 20 variables, which are described in Table 1. Of the 20 variables, 19 were composite variables generated from the original data set. Table 1 also reports the range of values theoretically possible for each variable. The 20 variables were then subjected to a factor analysis with the SPSS factor analysis program.[13] A principal axis solution that incorporated varimax rotation with Kaiser normalization[13] was used in the analysis. Principal axis factoring was selected to examine the shared variance among the variables while minimizing error and unique variance. Factors were extracted if eigenvalues were greater than or equal to 1.0.

Table 1 Variables Used in Initial Sample: Description, Range, Mean, and Standard Deviation

Variable	Description	Possible range	Mean	Standard deviation
No. of sore extraoral muscles (right)	No. of pain responses observed when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the right side	0–11	3.66	3.57
No. of sore extraoral muscles (left)	No. of pain responses observed when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the left side	0–11	3.93	3.66
No. of sore intraoral muscles (right)	No. of pain responses observed when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the right side	0–5	3.16	1.48
No. of sore intraoral muscles (left)	No. of pain responses observed when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the left side	0–5	3.19	1.51
Pain rating* during palpation of extraoral muscles (right)	Mean level of observed pain when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the right side	0–3	0.44	0.55
Pain rating* during palpation of extraoral muscles (left)	Mean level of observed pain when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the left side	0–3	0.49	0.57
Pain rating* during palpation of intraoral muscles (right)	Mean level of observed pain when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the right side	0–3	1.07	0.73
Pain rating* during palpation of intraoral muscles (left)	Mean level of observed pain when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the left side	0–3	1.09	0.74
No. of pain responses during TMJ exam (right)	No. of pain responses in the right TMJ reported by patient during auscultation with stethoscope, when palpating the lateral pole during opening and closing, and when palpating intrameatally during closing	0–4	1.03	0.92
No. of pain responses during TMJ exam (left)	No. of pain responses in the left TMJ reported by patient during auscultation with stethoscope, when palpating the lateral pole during opening and closing, and when palpating intrameatally during closing	0–4	1.11	0.92
Pain rating* during TMJ exam (right)	Mean level of observed pain in the right TMJ reported by patient during auscultation with stethoscope, when palpating the lateral pole during opening and closing, and when palpating intrameatally during closing	0–3	0.64	0.70
Pain rating* during TMJ exam (left)	Mean level of observed pain in the left TMJ reported by patient during auscultation with stethoscope, when palpating the lateral pole during opening and closing, and when palpating intrameatally during closing	0–3	0.76	0.74
No. of functional activities producing TMJ pain	No. of pain responses observed when a patient engaged in opening, protrusive, right lateral, left lateral, and retrusive movements, and during right- and left-sided biting on a cotton roll	0–7	0.57	0.48

continued on next page

Table 1 *continued*

Variable	Description	Possible range	Mean	Standard deviation
No. of activities producing clicking (right)	Clicking detected in right TMJ by palpation of lateral pole during movement toward closed and open positions; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (counted as a single event); and during auscultation on right lateral, left lateral, and protrusive movements	0–7	0.52	1.07
No. of activities producing clicking (left)	Clicking in left TMJ by palpation of lateral pole during movement toward closed and open positions; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (single event); and during auscultation on right lateral, left lateral, and protrusive movements	0–7	0.66	1.18
No. of activities producing crepitus (right)	Crepitus in right TMJ by palpation of lateral pole during movement toward closed and open positions; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (single event); and during auscultation on right lateral, left lateral, and protrusive movements	0–7	0.12	0.35
No. of activities producing crepitus (left)	Crepitus in left TMJ by palpation of lateral pole during movement toward closed and open positions; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (single event); and during auscultation on right lateral, left lateral, and protrusive movements	0–7	0.17	0.41
No. of ear, eye, and cranial nerve problems	No. of abnormal findings observed during examination of cranial nerves, ears, and eyes	0–3	0.23	0.46
No. of intraoral problems	No. of abnormal findings observed during intraoral examination, including occlusal wear and abnormal appearance of labial mucosa, buccal mucosa, hard palate, tongue mucosa, floor of mouth, and gingival architecture	0–7	1.63	1.13
Maximum opening	Maximum opening measured in mm	≥ 0	41.38	8.40

Except for maximum opening, all variables are composite. n = 276.
*Pain was rated on a four-point scale in which 0 = no pain response and 3 = very strong pain response.

Validation Sample

The data from an additional 161 patients were used as a validation sample. These patients consisted of a series of individuals who were examined after the patients in the initial sample. The overall examination procedure used in the validation sample was similar, but not identical, to the procedure used in the initial data set. As indicated in Table 2, changes were made to the TMJ portion of the examination. As many as 113 data points could be recorded for each patient in the validation sample. These data points were reduced to 17 composite measures that were originally developed for the study of the initial sample. Three variables were not used for the validation sample: number of cranial, ear, and eye problems; maximum opening; and number of intraoral problems. The first two variables were eliminated because they did not load on any factor in the study of the initial sample. "Number of intraoral problems" was eliminated because it had changed to a categoric variable in the validation sample and no longer had the desired characteristics of a continuous variable for factor analysis.

The remaining 17 variables were then subjected to a factor analysis with the SPSS factor analysis program.[13] A principal axis solution that incorporated varimax rotation with Kaiser normalization[13] was specified in the analysis. A six-factor solution was required in this analysis to determine whether the factors were stable across two sets of data.

Table 2 Variables Used in Validation Sample: Description, Range, Mean, and Standard Deviation

Variable	Description	Possible range	Mean	Standard deviation
No. of sore extraoral muscles (right)	No. of pain responses observed when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the right side	0–11	3.74	3.60
No. of sore extraoral muscles (left)	No. of pain responses observed when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the left side	0–11	3.67	3.70
No. of sore intraoral muscles (right)	No. of pain responses observed when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the right side	0–5	3.13	1.43
No. of sore intraoral muscles (left)	No. of pain responses observed when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the left side	0–5	2.95	1.60
Pain rating* during palpation of extraoral muscles (right)	Mean level of observed pain when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the right side	0–3	0.47	0.55
Pain rating* during palpation of extraoral muscles (left)	Mean level of observed pain when anterior temporalis, middle temporalis, posterior temporalis, frontalis, masseter, sternocleidomastoid, posterior digastric area, anterior digastric area, mastoid process, trapezius, and splenius muscles were palpated on the left side	0–3	0.45	0.54
Pain rating* during palpation of intraoral muscles (right)	Mean level of observed pain when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the right side	0–3	1.09	0.73
Pain rating* during palpation of intraoral muscles (left)	Mean level of observed pain when temporalis tendon, masseter, genioglossus, lateral pterygoid, and medial pterygoid muscles were palpated on the left side	0–3	1.07	0.80
No. of pain responses during TMJ exam (right)†	No. of pain responses observed when palpating the right lateral pole during opening and closing movements and when palpating intrameatally during closing	0–3	1.58	1.24
No. of pain responses during TMJ exam (left)†	No. of pain responses observed when palpating the left lateral pole during opening and closing and when palpating intrameatally during closing	0–3	1.58	1.22
Pain rating* during TMJ exam (right)†	Mean level of observed pain when palpating the right lateral pole during opening and closing and when palpating intrameatally during closing	0–3	0.80	0.77
Pain rating* during TMJ exam (left)†	Mean level of observed pain when palpating the left lateral pole during opening and closing and when palpating intrameatally during closing	0–3	0.82	0.76
No. of functional activities producing TMJ pain	No. of pain responses observed when a patient engaged in opening, protrusive, right lateral, left lateral, and retrusive movements, and during right- and left-sided biting on a cotton roll	0–7	0.66	0.51
No. of activities producing clicking (right)†	Clicking detected by palpation of the right lateral pole during movement toward open position; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (single event); and during auscultation on right and left lateral, and protrusive movements	0–6	0.47	0.98
No. of activities producing clicking (left)†	Clicking detected by palpation of the left lateral pole during movement toward open position; by palpation intrameatally during closing; during auscultation with stethoscope on opening and closing (single event); and during auscultation on right and left lateral, and protrusive movements	0–6	0.64	1.04
No. of activities producing crepitus (right)†	Crepitus detected by palpation of the right lateral pole during movement toward closed position; by palpation intrameatally during closing; and during auscultation on opening and closing (single event)	0–3	0.21	0.46
No. of activities producing crepitus (left)†	Crepitus detected by palpation of the left lateral pole during movement toward closed position; by palpation intrameatally during closing; and during auscultation on opening and closing (single event)	0–3	0.19	0.43

All variables are composite. n = 149.
*Pain was rated on a four-point scale in which 0 = no pain response and 3 = very strong pain response.
†Procedures used to calculate this measure are different from those used in the initial sample.

Table 3 Initial Sample Rotated Factor Pattern for Six-Factor Solution

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
No. of sore extraoral muscles (right)	0.305	0.758	0.372	–0.027	–0.014	0.046
No. of sore extraoral muscles (left)	0.283	0.813	0.111	0.304	–0.036	–0.032
No. of sore intraoral muscles (right)	0.869	0.126	0.140	–0.057	0.016	0.039
No. of sore intraoral muscles (left)	0.853	0.176	–0.028	0.147	–0.071	–0.013
Pain rating during palpation of extraoral muscles (right)	0.252	0.798	0.428	–0.019	–0.061	0.098
Pain rating during palpation of extraoral muscles (left)	0.265	0.849	0.180	0.287	–0.046	0.042
Pain rating during palpation of intraoral muscles (right)	0.840	0.211	0.311	–0.073	0.038	0.054
Pain rating during palpation of intraoral muscles (left)	0.836	0.272	0.103	0.238	0.006	–0.015
No. of pain responses during TMJ exam (right)	0.206	0.127	0.673	0.238	0.125	0.111
No. of pain responses during TMJ exam (left)	0.138	0.143	0.206	0.868	0.081	0.032
Pain rating during TMJ exam (right)	0.118	0.189	0.889	0.130	0.045	0.135
Pain rating during TMJ exam (left)	0.129	0.266	0.298	0.749	–0.077	0.026
No. of functional activities producing TMJ pain	0.066	0.208	0.545	0.161	–0.097	–0.057
No. of activities producing clicking (right)	0.089	0.060	0.021	–0.050	–0.070	0.564
No. of activities producing clicking (left)	–0.011	0.035	–0.073	0.130	–0.036	0.839
No. of activities producing crepitus (right)	0.018	–0.040	0.104	–0.040	0.856	0.000
No. of activities producing crepitus (left)	–0.009	0.001	–0.036	0.083	0.662	–0.122
No. of ear, eye, and cranial nerve problems	–0.007	0.114	–0.090	0.055	0.061	0.044
No. of intraoral problems	0.403	0.058	–0.024	0.073	0.011	0.065
Maximum opening (mm)	0.027	–0.042	–0.276	–0.031	–0.028	0.145

Shading indicates assignment of variables to factors.

Results

Initial Sample

Of the 330 patients entered into the analysis, 276 had nonmissing values for all 20 variables. The means and standard deviations for the 20 variables obtained from the 276 patients are listed in Table 1. The patients whose records were used in this study were predominantly females (88%) in their mid-thirties (mean 34.4 years, SD = 15.3). In this sample, 77.3% of the patients received a diagnosis of myofascial pain, 41.5% received a diagnosis of disc displacement (with or without reduction), and 28.8% received a diagnosis of degenerative joint disease (as described in the Research Diagnostic Criteria for TMD).[4] The typical duration of pain was reported to be 24.3 months (SD = 48.1).

The analysis identified six factors that met the extraction criteria, and all six factors were readily interpretable. These six factors accounted for 72.85% of the total variance. A loading of 0.40 or more on a factor was the criterion for determining that the item was meaningfully related to the factor (Table 3). If a variable loaded on more than one factor, the variable was assigned to the factor that had the highest loading. Assignment of the variable to a factor is indicated by shading in the table.

Based on this criterion, the first factor consisted of variables that measure intraoral muscle pain and abnormalities in the oral cavity. An examination of the raw data that comprised the "number of intraoral problems" variable showed that 78.1% of patients with any intraoral problem had scalloping of the lateral borders of the tongue, which was suggestive of parafunctional oral activity such as clenching.[14] The second factor consisted of variables that measure extraoral muscle pain. The third factor consisted of variables that measure right-sided TMJ pain and pain during function. The fourth factor consisted of variables that measure left-sided TMJ pain. The fifth factor consisted of variables that measure crepitus, and the sixth factor consisted of variables that measure clicking.

Table 4 Validation Sample Rotated Factor Pattern for Six-Factor Solution

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
No. of sore extraoral muscles (right)	0.849	0.323	0.261	0.069	–0.003	0.099
No. of sore extraoral muscles (left)	0.755	0.056	0.358	0.424	0.025	0.000
No. of sore intraoral muscles (right)	0.296	0.421	0.695	0.035	0.093	0.082
No. of sore intraoral muscles (left)	0.233	0.081	0.742	0.367	0.120	0.028
Pain rating during palpation of extraoral muscles (right)	0.836	0.350	0.174	0.056	0.032	0.108
Pain rating during palpation of extraoral muscles (left)	0.799	0.076	0.279	0.437	0.053	0.005
Pain rating during palpation of intraoral muscles (right)	0.352	0.494	0.624	0.033	0.074	0.129
Pain rating during palpation of intraoral muscles (left)	0.393	0.057	0.713	0.437	0.065	–0.009
No. of pain responses during TMJ exam (right)	0.187	0.830	0.187	0.197	0.018	0.003
No. of pain responses during TMJ exam (left)	0.172	0.240	0.195	0.803	–0.064	0.093
Pain rating during TMJ exam (right)	0.217	0.920	0.102	0.195	0.084	–0.014
Pain rating during TMJ exam (left)	0.195	0.172	0.152	0.885	0.005	0.017
No. of functional activities producing TMJ pain	0.178	0.391	0.258	0.346	–0.189	–0.034
No. of activities producing clicking (right)	0.062	0.080	–0.027	–0.013	0.795	–0.008
No. of activities producing clicking (left)	–0.008	–0.029	0.147	–0.025	0.635	0.006
No. of activities producing crepitus (right)	0.003	0.059	0.046	–0.033	0.028	0.479
No. of activities producing crepitus (left)	0.095	–0.085	–0.001	0.114	–0.043	0.706

Shading indicates assignment of variables to factors.

Validation Sample

Of the 161 patients entered into the analysis, 149 had nonmissing values for all 17 variables. The means and standard deviations for the 17 variables obtained from the 149 patients are listed in Table 2. The patients whose records were used in this study were predominantly females (88%) in their mid-thirties (mean 37.1 years, SD = 15.2). In this sample, 76.7% of the patients received a diagnosis of myofascial pain, 45.9% received a diagnosis of disc displacement (with or without reduction), and 70.4% received a diagnosis of arthralgia or degenerative joint disease (as described in the Research Diagnostic Criteria for TMD).[4] The typical duration of pain was reported to be 39.6 months (SD = 58.3).

All of the six factors in this factor solution had initial eigenvalues greater than 1.0, and all six factors were readily interpretable. No additional factors had eigenvalues greater than 1.0. The six-factor solution accounted for 83.02% of the total variance. As with the initial sample, a loading of 0.40 or more on the factor was the criterion for determining that the item was meaningfully related to the factor (Table 4). If a variable loaded on more than one factor, the variable was assigned to the factor that had the highest loading. Assignment of the variable to a factor is indicated by shading in the table.

Based on this criterion, the first factor consisted of variables that measure extraoral muscle pain, while the third factor consisted of variables that measure intraoral muscle pain. The second and fourth factors consisted of variables that measure right-sided and left-sided TMJ pain, respectively. The fifth and sixth factors consisted of variables that measure joint clicking and crepitus, respectively.

Discussion

The concordance between the factor analytic structures for the two samples was excellent. Both factors identified two muscle pain factors (intraoral

Table 5 Summary of Rotated Factor Structures for Initial and Validation Samples

Factor	Initial sample % of variance	Validation sample % of variance
1 Intraoral muscle pain	17.32	14.32
2 Extraoral muscle pain	14.85	19.07
3 Right-sided TMJ pain	11.34	14.47
4 Left-sided TMJ pain	8.57	13.80
5 Crepitus	6.15	4.61
6 Clicking	5.59	6.61

Percent of variance values obtained after varimax rotation.

muscle pain and extraoral muscle pain), two unilateral joint pain factors, and two factors that concern joint noise (clicking and crepitus) (Table 5). This concordance suggests that the latent structures that describe the variables are stable and reproducible. The results imply that the conceptualization of TMD as a multicomponent problem that consists of muscle pain, joint pain, and joint noises is valid.

There appears to be a reasonably good match between the findings and at least some of the nosologic systems. For example, many of the nosologic systems recognize myofascial pain, but not one separates pain in the intraoral muscles from pain in the extraoral muscles. Joint pain is recognized by multiple nosologic systems, typically as a clinical entity independent from muscle pain. Finally, both clicking and crepitus are often recognized as separate problems in nosologic systems.

The separation of intraoral muscle pain from extraoral muscle pain might be related to differential effects of parafunctional activities on the muscles, differential effects of jaw position, and examination technique. It is possible that different types of parafunctional activities, maintained over a long time, might have differential effects on the musculature. For example, the muscles that are activated when an individual engages in deliberate tooth contact are different from the muscles that are activated when an individual chronically protrudes or retrudes the mandible. The differing pain levels experienced by patients when the intraoral and extraoral muscles were palpated may thus be proxy measures for long-term and differing parafunctional activities. It is also possible that operator error might be partly responsible for the results. The intraoral muscles palpated during the physical examination are smaller than many of the extraoral muscles. If the examiner palpated an intraoral muscle and then inadvertently palpated another branch or area of the same muscle, the correlations among the variables that assess intraoral muscle pain, and thus the factor that represents the intraoral muscles, would be spuriously elevated, resulting in a false positive conclusion. Such spurious elevations would raise doubts about the diagnostic utility of intraoral muscle palpation.

The analysis identified two factors that concern unilateral TMJ pain. In both of these factors, a muscle pain component was clearly present although the loading of muscle pain on these TMJ pain factors was not as high as for the muscle pain factors. These findings suggest that joint pain is often associated with muscle pain. The common pathway that underlies joint pain associated with muscle pain is not known at present, but it could involve both behavioral and biologic mechanisms. For example, parafunctional activity might produce loading on the joint, which may in turn lead to an inflammatory process that involves the joint capsule. Studies by Glaros and coworkers[15,16] showed that deliberate low-level clenching can produce arthralgia and myofascial pain in otherwise healthy individuals. Further research of the relationship between joint pain and muscle pain may clarify the relationship between these purportedly separate problems.

Two variables in the initial sample did not load on any of the factors; one variable dealt with the number of ear, eye, and cranial nerve problems, and the other variable measured maximum opening. The first variable identified infectious or neurologic conditions that may be present in TMD patients. The proportion of patients from the initial sample who presented with infections or neuralgia was very small, which possibly accounted for the failure of this variable to load on any factor. The failure of the variable that measured maximum opening to load on any factor may indicate that limited opening is not a single diagnostic entity. Several diagnostic systems are consistent with this finding. For example, the system presented by Dworkin and LeResche[4] considers limited opening a subcategory of both myofascial pain and disc displacement.

Joint noises were identified as two separate factors by the analysis, and both of these factors accounted for the smallest percentage of variance in the total solution. Clicking appeared as a factor separate from crepitus. These findings imply that the physical processes that produce these two different types of joint noises are unrelated.

The findings raise a number of research questions. One fundamental question involves the reason for the separation of intraoral muscle pain from extraoral muscle pain. It may be argued that the orthogonal rotation used in the factor solution artificially

separated intraoral muscle pain from extraoral muscle pain. However, the findings from the validation sample suggest that the separation of intraoral muscle pain from extraoral muscle pain has validity (assuming that the intraoral muscles can be accurately and reliably palpated). If further research confirms the proposed separation, it would be valuable to test theoretic models that account for the separation. Research that examines the factors responsible for TMJ pain would also be valuable.

The findings presented here overlap to differing degrees with the systems that are currently used to diagnose TMD. Composite variables were used in the factor solutions, and it is possible that a different set of composite variables might produce a different factor solution. Until further research confirms the findings presented here, it would be premature to conclude that one or more of the systems was particularly consistent or inconsistent with the findings. Our findings are consistent with some aspects of some nosologic systems, but they also raise questions about current nosologic systems for TMD.

An empirically validated nosologic system would likely have considerable clinical utility. For example, let us assume that a nosologic system differentiates intraoral and extraoral muscle pain, and that this separation is empirically supported. Research could then examine the behavioral or biologic factors responsible for the separation. This research could lead to the development of different treatment programs for the two different kinds of muscle pain problems, each specifically targeted to the disorder.

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Resumen

Hallazgos del Examen Clínico en Pacientes con Desórdenes Temporomandibulares: Estudio del Factor Analítico

El propósito de este estudio fue el de evaluar la estructura del factor latente de los hallazgos obtenidos durante el examen clínico de pacientes con desórdenes temporomandibulares, por medio del análisis de factor exploratorio para así examinar las relaciones de un gran número de variables obtenidas de un examen clínico en comparación de un número menor de variables latentes, o factores. Con el propósito de determinar si el factor estructura era confiable se examinaron dos muestras independientes de pacientes. La muestra inicial consitió de 330 pacientes que se quejaban de dolor facial y una muestra de ratificación de 161 pacientes adicionales. Se utilizó un eje principal para el factor analítico con una rotación Varimax, para ambos grupos de información. El factor estructural de las dos muestras fue consistente entre los dos grupos de información. Los resultados indetificaron dos factores de dolor muscular (un factor "muscular intraoral" y un factor "muscular extraoral"), dos factores de dolor mandibular unilateral, y dos factores relacionados a ruidos de la articulación (clic y crepitación). Se discuten las implicaciones de estos hallazgos en los sistemas nosológicos corrientes del desorden temporomandibular.

Zusammenfassung

Klinische Untersuchungsbefunde von Patienten mit Temporomandibulären Erkrankungen: Eine Faktoranalysen-Studie

Um die Struktur der latenten Faktoren der klinischen Untersuchungsbefunde, erhalten von Patienten mit temporomandibulären Erkrankungen, zu beurteilen, wurde eine erklärende Faktorenanalyse verwendet, um die Beziehungen einer grossen Anzahl von Variablen aus der klinischen Untersuchung zu einer kleineren Anzahl von latenten Variabeln oder Faktoren zu untersuchen. Zwei unabhängige Patientengruppen—eine ursprüngliche Gruppe, die aus 330 Patienten bestand, welche über faziale Schmerzen klagten, und eine Kontrollgruppe mit 161 zusätzlichen Patienten—wurden untersucht, um zu bestimmen, ob die Struktur der Faktoren verlässlich war. Eine Hauptachsen-Faktorenanalyse mit Varimax-Rotation wurde für beide Datensätze verwendet. Die Struktur der Faktoren für die beiden Gruppen war übereinstimmend zwischen den zwei Datensätzen. Die Resultate identifizierten zwei Muskelschmerz-Faktoren (ein „intraoraler Muskel"-Faktor und ein „extraoraler Muskel"-Faktor), zwei unilaterale Kieferschmerz-Faktoren und zwei Faktoren, welche Gelenkgeräusche (Knacken und Krepitus) betreffen. Die Folgerungen aus diesen Befunden für die aktuellen nosologischen Systeme bei temporomandibulären Erkrankungen werden diskutiert.