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Study of the Per-Patient Cost and Efficacy of Treatment for Temporomandibular Joint Disorders

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**Prepared by:
The Lewin Group**

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I. EXECUTIVE SUMMARY

Temporomandibular joint disorder (TMD) encompasses a variety of clinical disorders involving the temporomandibular joint (TMJ), the muscles of mastication, and contiguous tissues. No clear consensus has emerged regarding the definition of TMD, its causes, how to diagnose it, or how best to treat it.

Multiple unrelated, underlying diseases can cause TMD symptoms, although no specific cause can be identified in many patients. Understanding of TMD etiology and pathogenesis is complicated by multiple risk factors, including genetic, environmental, and behavioral ones, that are poorly documented or understood. The natural history of the condition is not well understood. TMD symptoms can increase and abate over time, and can resolve spontaneously without serious long-term effects.

In 1996, the National Institutes of Health (NIH) convened a 15-member, nonfederal, expert panel for a technology assessment conference on management of TMD. After presentation and evaluation of the available evidence, the panel concluded that no treatment for TMD demonstrated effectiveness and that invasive interventions warranted caution, particularly surgery that permanently alters the tooth structure or jaw position. For these reasons, the panel recommended that noninvasive therapies are preferred for the vast majority of patients. The panel further concluded that surgical intervention may be warranted for a small percentage of patients with chronic and substantial dysfunction for whom such noninvasive therapies had failed.

Since 1996, the body of literature on treatments available for TMD has grown. Recently, the Agency for Healthcare Research and Quality (AHRQ) contracted with The Lewin Group to conduct a study of the per-patient cost and efficacy/effectiveness of treatment for TMD. This study is pursuant to a Senate Appropriations Committee request to further clarify this issue, and to follow-up on relevant developments since the 1996 NIH technology assessment conference. To this end, Lewin assembled and reviewed evidence collected from recent (i.e., 1996 to the present) published and gray literature and other pertinent input from stakeholders and other experts. This included a focused literature searching protocol, gathering of other relevant evidence, qualitative grading of the evidence to assess the methodological rigor of the available data, and developing a structured summary of the evidence.

This report confirms certain findings of the 1996 NIH technology assessment conference and of certain other reviews of this subject. Our findings reinforce previous conclusions that few randomized clinical trials (RCTs) or other types of rigorous studies exist for determining the effectiveness of treatments for TMD. Published reports of clinical research on TMD consist primarily of non-randomized uncontrolled trials, case series, case reports, and anecdotal descriptions of treatment techniques. Among the factors affecting the body of evidence on TMD treatments are insufficient understanding or consensus regarding the etiology, course of disease, and diagnosis of TMD. The main findings of this report are as follows.

- 1. Etiology unclear.** There is no consensus on the biological cause or etiology of TMD. Clinicians and biomedical scientists believe that multiple unrelated, underlying diseases can cause TMD symptoms, although no specific cause can be identified in many patients. Moreover, a TMD patient may have one or multiple of these conditions concurrently. Understanding of TMD etiology is complicated by identification of risk factors that are poorly documented or understood, including: female sex, age, relationship to pregnancy, use of hormone replacement therapy, injury, surgery, genetic susceptibility, and certain comorbid conditions.
- 2. Natural course unclear.** Knowledge regarding the natural course of TMD is limited and controversial. TMD symptoms can increase and abate over time, and can resolve spontaneously without serious long-term effects. There are insufficient longitudinal studies that have followed people with symptoms over the periods of years to provide an accurate understanding of the natural course of TMD. Without this understanding, it is more difficult to demonstrate the net effect of TMD interventions, particularly in the absence of long-term clinical trials (including RCTs) with non-intervention or placebo controls.
- 3. Lack of clear diagnostic criteria.** The breadth of signs and symptoms of TMD and inconsistent information about TMD within the clinical communities often confounds diagnosis. The wide range of TMD symptoms may be classified anatomically, by etiology, or by frequency of presentation. While most TMD patients suffer from only mild symptoms, a smaller proportion endure more persistent and severe functional loss and pain. Moreover, there is no widely accepted, standard test currently available to identify TMD. What diagnostic criteria that do exist are not well integrated into standard clinical practice.
- 4. Variation in management approaches.** The ambiguity in TMD diagnosis contributes to the use of a variety of diagnostic procedures and their attendant costs. Given its broad clinical manifestations and insufficiently understood etiology, many types of health care providers are involved in management of TMD. As such, the selection of treatment appears to be associated with the type of provider consulted, underlining the lack of consensus regarding appropriate clinical expertise for managing TMD. As a consequence, many patients endure extended searches for a definitive diagnosis and effective treatment, resulting in higher costs and exposing them to potentially adverse treatment effects.
- 5. Concerns about adverse effects.** The potential adverse effects of any treatment for TMD must be weighed against any relative benefits that it might confer relative to other TMD treatments, or to no treatment at all. Invasiveness refers to the extent to which an intervention causes permanent changes in the structure or position of the jaw, teeth, or soft tissues. Some treatments, including certain forms of the more invasive treatments, can result in greater pain, disfigurement, and other adverse effects. Given the lack of definitive evidence for the superiority of particular treatments for most TMD patients, more clinicians and researchers argue for employing conservative, reversible approaches to managing most patients with TMD, and progressing to increasingly more invasive ones only upon failure of the more conservative, reversible ones.

6. **Inconsistent outcomes measures.** There is a lack of a well-recognized or uniform set of outcome measures used for evaluating TMD interventions. In general, outcome measures fall into the categories of pain or discomfort; motion or flexibility; clinical visualization; mental health/behavioral; and neurological, neuromuscular, and sleep. Many outcome measures used in TMD studies have not been validated. This confounds attempts to integrate findings across the TMD literature, diminishing the ability to compare results of multiple studies of the same intervention and to generalize findings to clinical practice.
7. **Challenges to determining treatment effectiveness.** Without adequate understanding of TMD, including its varying underlying causes or the ability to use diagnostic criteria for staging TMD in different subgroups of patients, it is more difficult to demonstrate the effect of TMD interventions. To the extent that a treatment is truly effective for a particular subgroup, any attempt to assess its treatment effect in a clinical trial, particularly one with a small sample size, may be masked by its ineffectiveness in other subgroups of TMD patients who are enrolled in the trial. Further, the lack of clear diagnostic criteria and, in some instances, well-defined interventions compromises efforts to integrate results from multiple studies or otherwise draw inferences about the effectiveness or costs of TMD treatments.
8. **Body of evidence limited.** The body of evidence on the effectiveness of TMD treatment generated since 1996 is generally limited and lacking in rigor. This reinforces previous reviews that have concluded that there have been insufficient RCTs and other types of rigorous studies for determining the effectiveness of TMD treatments. Particularly lacking are studies with sufficient power and patient follow-up to detect any true differences in effectiveness among alternative treatments. The 45 studies that met our selection criteria exhibited a largely bimodal distribution, including 15 RCTs and 20 single case studies/anecdotes. As a group, these covered a diverse group of interventions. As a result, the literature on any one type or even group of interventions is limited, and it is difficult to draw well-founded conclusions about how well interventions for TMD work. Many of the existing clinical studies indicate that patients improve following treatment. However, few studies include non-intervention or placebo groups designed to control for such confounding phenomena as placebo effects, regression to the mean, and the spontaneous abatement or cyclical expression of symptoms known to occur in many TMD patients. Very few studies demonstrate sustained superiority of one TMD intervention over another.
9. **Behavior modification and physical therapy.** Available research on behavior modification and physical therapy suggests that some types of interventions can be helpful in reducing pain and increasing function. However, interventions studied range from physical self-regulation to posture correction to an ambiguously described "cognitive therapy." This area of the literature has few studies involving non-treatment control groups, long-term follow-up data, or direct comparisons of alternative methods of behavioral modification and physical therapy.
10. **Pharmaceutical management.** None of the published studies of pharmaceutical management for TMD identified since 1996 indicated significant, positive results. Among

the RCTs conducted since 1996, none demonstrated that pharmaceutical management of TMD symptoms was more effective than placebo for the majority of outcomes considered.

11. **Occlusal therapy.** RCTs examining the benefits of occlusal therapy found mixed results in improving TMD pain and functioning in study participants. In general, these studies found significant improvements relative to baseline in groups wearing various splints or related appliances. There was mixed evidence, including evidence from under-powered studies, that a particular appliance or pattern of wearing an appliance (e.g., day only, night only, or 24 hours) was superior to another. These studies did not have untreated control groups, although one used a control splint.
12. **Surgery.** The three RCTs reported since 1996 focused on the surgical techniques of arthroscopy and/or arthrocentesis. None of these studies included a non-surgical group or a non-treatment group. In all studies, patients were reported to show a statistically significant improvement relative to baseline. For most of the endpoints in each of the studies, the investigators failed to detect a statistically significant difference between the two treatment groups. (One study found arthroscopy to be significantly better than arthrocentesis in improving function, though not pain relief, after one year. Another study comparing alternative arthroscopy techniques found a difference after one month, but no difference at subsequent follow-ups through one year.) That is, while these RCTs showed significant within-group differences from baseline to follow-up, they nearly always failed to demonstrate significant differences among treatment groups. The non-RCT literature on surgery suggests that this option should be considered after other treatment methods have been attempted; in four of the 10 studies, patients had more pain and worse functioning following surgical intervention.
13. **Patients with history of treatment failure.** In any disease area, a consequence of conducting few rigorous studies among a diverse patient population is the inability to gain information about treatment effectiveness among particular patient subgroups. In the instance of TMD, there is little documented involvement of patients with a history of multiple treatments or treatment failures. Clinical studies in this field tend to enroll patients with new disease or with limited comorbidities, in order to limit the potential for these factors to confound any observed treatment effect. This limits opportunities to determine what types of treatment may be effective in salvaging treatment failures, particularly from invasive treatments, or otherwise improving functional status and pain in this special subgroup of TMD patients.
14. **Cost information limited.** The available recent literature on the per-patient costs of TMD is scarce. It is limited to a handful of retrospective studies, including two large case control studies and one large cohort study with a contemporaneous control group. From these, it is possible to derive a rough approximation of direct costs of services associated with TMD treatment, excluding out-of-pocket costs.
15. **Per-patient direct costs.** Among these studies, costs for TMD patients were from 57% to 100% higher than costs for non-TMD patients. Using the findings of the studies as well as

other determinations based on the results presented in them, a rough approximation for total annual per patient costs for TMD patients is \$3,100 - \$4,700. A rough approximation for the difference between total annual per patient costs for TMD and non-TMD patients is \$1,100 - \$2,300.

16. **Out-of-pocket costs.** Given that much of the care for TMD is not captured by health plan data sets, per patient out-of-pocket costs are poorly documented. To the extent that various TMD interventions are not covered by insurance, out-of-pocket costs would be expected to comprise a significant proportion of total per-patient costs. The available information concerning out-of-pocket costs for TMD patients is very limited and subject to methodological weaknesses. Nevertheless, it indicates that there is a subgroup of TMD patients experiencing very sizable out-of-pocket costs while pursuing treatment for health conditions that can be painful, debilitating, and intractable.
17. **TMD patient costs higher, but most not TMD-specific.** The limited literature on cost is consistent in two main ways. First, TMD patients use significantly more health care services and generate more costs than non-TMD patients. Second, perhaps contrary to expectation, most of the care used by TMD patients is not directly related to conditions generally recognized to be associated with TMD itself. Together, these findings are consistent with other observations that a significant portion of patients with TMD have other health problems, and that in many patients, TMD itself may be a symptom or other manifestation of one or more other health problems associated with, e.g., the musculoskeletal system, digestive system, mental health, or nervous system.

In the current era of evidence-based health care, the body of evidence on TMD treatment remains largely weak and unfocused. This contributes to ambiguity and variation in patient care for TMD. The limited data on per-patient costs of TMD make it difficult to assess the cost of managing the disorder and its broader economic impact. It is apparent that the additional health care costs generated by patients with TMD are for procedures and services that are not generally recognized to be associated with TMD. The limited evidence on the efficacy/effectiveness of TMD treatment and per-patient costs likely contributes to reluctance of third-party payers to cover TMD treatment and variation in payment patterns among those that do provide coverage. There is growing recognition in the dental profession of the importance of evidence in guiding clinical and payment decisions; however, this remains to be reflected sufficiently in the body of evidence pertaining to management of TMD.

II. INTRODUCTION

As requested by the Agency for Healthcare Research and Quality (AHRQ), The Lewin Group conducted a study of the per-patient cost and efficacy/effectiveness of treatment for temporomandibular joint (TMJ) disorders (TMD). This study is pursuant to a Senate Appropriations Committee request to further clarify these issues, following on the National Institutes of Health (NIH) technology assessment conference on the management of temporomandibular disorders, held in 1996. The conference panel concluded that no treatment demonstrated effectiveness, and that invasive interventions warranted caution, particularly surgery that permanently alters the tooth structure or jaw position (NIH 1996).

For this study, Lewin assembled and reviewed evidence from recent (i.e., since 1996) published and gray literature and other pertinent input from stakeholders and other experts. This included a focused literature searching protocol, gathering of other relevant evidence, interpretation of the evidence to assess the methodological rigor of the available studies, and developing a structured summary of the evidence.

III. WHAT IS TMD?

The TMJs are the sites on either side of the face, just in front of the ears, where the temporal bone of the skull connects to the mandible (lower jaw). The TMJs are supported by ligaments, tendons, and muscles that control jaw movement. The TMJ contains a slick piece of cartilage, known as a disc, and thin film of joint fluid, that allows smooth, low-friction operation of the juncture of the temporal bone of the skull and the rounded hingeball at the end of the mandible known as a condyle. This construction allows the TMJ not only to operate like a hinge, but also to slide forward and backward, and from side to side.

TMD refers to a cluster of medical and dental disorders in the masticatory system, including the TMJ and surrounding tissues, that share many common symptoms. TMD presents with a wide range of symptoms or conditions, including jaw-joint pain, facial pain, headaches, limited mouth opening, closed or open lock of the TMJ, clicking or popping sounds in the jaw joint, and others. TMD is often characterized as chronic, recurrent, nonprogressive pain conditions (Von Korff et al. 1992). Patients with TMD may suffer from a variety of conditions, including systemic-related problems and articular, neuromuscular, neurologic, neurovascular, and behavioral disorders (McNeill et al. 1990; NIH 1996; Shimshak and DeFuria 1998).

IV. ETIOLOGY

There is no consensus on the biological cause or etiology of TMD (Dworkin 1994). Clinicians and biomedical scientists believe that multiple unrelated, underlying diseases can cause TMD symptoms, although no specific cause can be identified in many patients (McNeill 1993; Davies and Gray 1997b; Stohler and Zarb 1999; TMJ Association 2000a). Ekberg (1998) groups the

etiologies of TMD into three categories: anatomical, including occlusion and the TMJ; neuromuscular; and psychogenic. The NIDCR (National Institute of Dental and Craniofacial Research) classifies TMD into:

- myofascial pain (discomfort or pain in the muscles that control jaw function and the neck and shoulder muscles)
- internal derangement of the joint, including dislocated jaw or displaced disc, or physical injury to the condyle (e.g., from blunt trauma)
- degenerative joint disease, such as osteoarthritis or rheumatoid arthritis in the jaw joint (NIDCR 2000)

In internal derangement, the disc inside the TMJ typically lies in front of (anterior to) its normal position. In internal derangement without reduction, the disc does not slip back into its normal position, limiting jaw movement. In the more common internal derangement with reduction, the disc lies in front of its normal position only when the mouth is closed; this movement of the disc often makes a clicking or popping sound.

A TMD patient may have one or multiple of these conditions concurrently. Understanding of TMD etiology is complicated by identification of its risk factors, which are poorly documented or understood. Among the ones that have been suggested for TMD are: female sex, age, relationship to pregnancy, use of hormone replacement therapy, injury, surgery, genetic susceptibility, and certain comorbid conditions (TMJ Association 2000a). However, these are not well documented.

V. COURSE OF DISEASE

Knowledge regarding the natural course of TMD is limited and controversial. TMD symptoms can increase and abate over time, and there are insufficient longitudinal studies that have followed people with symptoms over the course of years to provide an accurate understanding of the natural course of TMD. Without this understanding, it is more difficult to demonstrate the net effect of TMD interventions, particularly in the absence of long-term clinical trials (including RCTs) with non-intervention or placebo controls.

TMD signs and symptoms are often transient, fluctuate, and are self-limiting over time. They may resolve without serious long-term effects, often decreasing among older adults (Ekberg 1998; Greene and Laskin 1983; Mejersjo and Carlsson 1983; Sato et al. 1998; Stohler and Zarb 1999). Little is known about which TMD signs and symptoms will progress to more serious and sometimes intractable conditions (Okeson and Hayes 1986).

A prospective cohort study showed that approximately 76% of patients with disc displacement without reduction became either asymptomatic or improved within 2.5 years, with the balance of patients continuing to be symptomatic (Kurita et al. 1998). Similarly, a 30-year follow-up of a

group of 99 patients who initially had nonsurgical treatment determined that, in the first few years after treatment, the main signs of TMJ osteoarthritis and internal derangement decreased significantly, but that few changes occurred thereafter. The authors concluded that these disorders eventually reach a state of quiescence (de Leeuw et al. 1994).

In a recent review, Barkin and Weinberg (2000) conclude that the signs and symptoms of anterior disc displacement without reduction tend to be alleviated during the natural course of the condition. Further, they indicate that the progression rate of TMD symptoms is not clearly established, and that it is not apparent which patients have the greatest risk of progressing to the more advanced stages. Therefore, consistent with certain other clinicians and researchers, they encourage clinicians to take a patient and clinically vigilant (i.e., conservative and reversible) approach in treating these conditions (Skinner and Neff 1994).

Epidemiological studies indicate that TMD patients have a wide range and varying frequency of signs and symptoms, and only a small percentage of populations with TMD signs and symptoms seek care for these conditions (Dworkin et al. 1990). Significant variability among cases makes diagnosis of TMD complex. Surveys of clinical activity generally indicate that females, primarily those in the 25-44 year age group, are about three times as likely as males to seek care for TMD (McNeill 1993; Rugh JD et al. 1985; Shimshak and DeFuria, 1998).

VI. DIAGNOSIS

The broad collection of signs and symptoms of TMD and inconsistent information about TMD within the clinical communities often confounds diagnosis. TMD symptoms vary widely, and can include the following:

- facial pain; jaw joint pain; often in combination with neck, shoulder, back pain, and/or headaches
- popping, clicking, grating/crackling (crepitus) sounds with movement of the jaw joint
- pain in the joints of the face when opening or closing the mouth, yawning, or chewing
- swelling on the side of the face and/or mouth
 - a bite that feels uncomfortable, “off,” or as if it is continually changing
 - limited opening or inability to open the mouth comfortably
- deviation of the jaw to one side
- the jaw locking open or closed.

TMD may be classified anatomically, by etiology, or by frequency of presentation (Davies and Gray 1997a). The severity of TMD symptoms may also vary a great deal. While most TMD patients suffer from only mild symptoms, a smaller proportion endure more persistent and even debilitating pain (Stohler and Zarb 1999). The most frequently reported reason for seeking treatment for TMD is pain (Agerberg and Helkimo 1987; Dworkin et al. 1990; Ekberg 1998; Magnusson 1984; Wedel 1988). Many of these patients with facial pain have long histories of seeking treatment for their TMD (Turp et al 1988). As is often cited in the literature, symptoms in individual patients can intensify and abate over time in a cyclical fashion, and spontaneously diminish with or without treatment (Barkin and Weinberg 2000; Ekberg 1998; de Leeuw et al. 1994; Kurita et al. 1998; Stohler and Zarb 1999), further complicating characterization of the population of TMD sufferers.

Patients may also present with pain dysfunction syndrome, including facial arthromyalgia, TMJ dysfunction syndrome, myofascial pain dysfunction syndrome, craniomandibular dysfunction, or myofascial pain and dysfunction (Davies and Gray 1997b). As noted above, TMD patients usually present with multiple of these symptoms.

Among the more commonly used diagnostic approaches are:

- medical and dental history to assess overall health, family history, and related problems regarding, e.g., stress, bruxism, bite problems

physical exam involving, e.g., palpation of myofascial muscles and jaw joint, measurement to assess any limitation of mouth opening, use of a stethoscope to hear any clicking sounds in the jaw joint

- imaging tests, e.g., transcranial x-rays, computed tomography (CT), or magnetic resonance imaging (MRI) for bone structure, fractures, joint damage, or tumors; and magnetic resonance imaging for detailed views of soft tissue damage in discs and ligaments

dental casts to determine how muscle or jaw problems such as bruxism might have affected jaw alignment and bite

There is no widely accepted, standard test currently available to identify TMD. In cooperation with the University of Washington, the NIDCR developed a set of research diagnostic criteria (RDC) in 1992. However, these criteria have not been verified by the NIDCR (Dworkin and LeResche 1992; NIDCR representative, November 11, 2000). The RDC were developed given the realization that practitioners and researchers need to recognize and include both the physiological and psychosocial aspects of TMJ pain and dysfunction in a diagnostic system. The RDC placed diagnostic factors into two categories: physical factors and psychosocial factors. In this system, physical factors are based on clinical signs, such as muscle and/or joint tenderness, limited movement, and joint sounds. Psychosocial factors are based on symptoms, such as pain and disability, depression, and other nonspecific complaints. Physical factors are further divided into muscle disorders (tenderness with and without limited opening), disc displacements (anterior displacement with reduction and anterior displacement without reduction with and without

limited opening) and other joint disorders (e.g., arthralgia and osteoarthritis). Psychosocial factors include pain intensity and disability graded on a visual analog scale (VAS; typically a standardized scale numbered 1 to 10 that allows patients to describe their pain and assess changes in it), psychological status as revealed by a depression score, and the presence and prevalence of physical symptoms considered unrelated to the TMD (e.g., gastric acidity).

In general, these and other sets of diagnostic criteria are not well integrated into standard clinical practice and are not accepted by many in the dental profession. This is due, in part, to the discordance between the wide scope of the diagnostic criteria and the specialization among individual clinicians seeing patients presenting with TMD symptoms. In particular, some in the profession, who consider themselves more clinically than academically based, regard the RDC as being too oriented toward a psychosocial perspective rather than a pathophysiological one (Keropian 2001). This contingent considers that psychological factors are present as a secondary element only in a small percentage of TMD patients. Similarly, there is broad disagreement on the relative importance of jaw posture in diagnosis and treatment.

According to the NIDCR (2000), in most cases, the patient's description of symptoms, combined with a simple physical examination of the face and jaw, provides information useful for diagnosing these disorders in about 90% of cases. However, definitive diagnoses that point to established, effective treatments are relatively uncommon. Based on the literature and our expert interviews, only one etiology – blunt trauma to the TMJ or surrounding area – was cited as having a clear and established treatment approach. However, only a handful of articles in the recent literature involve patients with trauma-induced TMD (e.g., TMJ disc derangement following a motor vehicle accident; McNamara et al. 1996; TMD following a gunshot wound to the face; Horrell et al. 1997).

Organized efforts also have been undertaken to develop criteria for evaluating impairment and disability associated with the TMJ and functions involving the teeth, mouth, jaws, and related structures more broadly. These have been done with the intention of influencing or being incorporated into authoritative documents of the American Medical Association (AMA) and the World Health Organization, used in professional decisions about injury, illness, disease or disorder related impairment, disability, and handicap status. In 1993, the *AMA Guides to the Evaluation of Permanent Impairment* incorporated the TMJ and the masticatory musculature; however, professional groups whose members treat TMD regard this as vague about evaluation methods and without objective criteria. In 1997, with a focus on a future revision of the *AMA Guides*, representatives of these groups developed a *Guide to Evaluation of Permanent Impairment of the Temporomandibular Joint* (Phillips et al. 1997; Chase and Rosenoer 1999). Development and acceptance of such criteria are strongly influenced by professional issues, including relationships among different dental specialties as well as perceived clinical domains of physicians and dentists, and implications of these for patient care and payment.

As indicated in multiple studies of TMD patients, the ambiguity in TMD diagnosis contributes to the use of a variety of diagnostic processes and their attendant costs (Glaros et al. 1995; Shimshak and DeFuria 1998). Patients often get involved in extended, costly searches for

definitive diagnoses and effective treatment (Garro et al. 1994). This is exacerbated by overlap between the fields of medicine and dentistry, and lack of clinician awareness about the condition.

Insufficient understanding of the etiology and course of TMD, along with insufficient diagnostic criteria, confound patient identification and determination of effective treatments. The variety of symptoms that may qualify patients as having TMD, or that the course of the disease may be transient or self-limiting, may fluctuate, or may progress to being increasingly serious and intractable, suggest that there are subgroups of TMD patients who may respond differently, including not at all, to a given treatment.

VII. TREATMENTS FOR TMD

For the purpose of this report, The Lewin Group used a taxonomy of existing treatments identified in the literature. As shown in Table 1, four broad categories of treatment include: behavior modification and physical therapy, pharmaceutical management, occlusal (mouth closure/bite) adjustment (non-surgical), and surgery.

Table 1: Therapeutic Taxonomy

Therapeutic Category	Treatment Examples	
Behavior modification and physical therapy	<ul style="list-style-type: none"> • resting jaw • applying ice and heat • exercising jaw • biofeedback • relaxation techniques • counseling, support groups 	<ul style="list-style-type: none"> • jaw exercises • postural training • mobilization • electrical stimulation • ultrasound
Pharmaceutical management	<ul style="list-style-type: none"> • aspirin • nonsteroidal anti-inflammatory drugs • muscle relaxants 	<ul style="list-style-type: none"> • psychotropics • narcotics
Occlusal adjustment (non-surgical)	<ul style="list-style-type: none"> • splint • stabilization appliance 	<ul style="list-style-type: none"> • orthodontics • restorative work
Surgery	<ul style="list-style-type: none"> • arthroscopy • arthrocentesis 	<ul style="list-style-type: none"> • soft tissue repair • joint restructuring

Adapted from The Staywell Company (2000). TM disorders: a guide to managing your temporomandibular joint problem [Brochure]. San Bruno, CA: McNeill C and Rudd P.

Surgery usually entails surgical repair of the disc, e.g., reshaping and sewing it back into place, repair of connective tissue, or restructuring or replacing part or all of the disc or condyle. Arthroscopy involves the insertion of specially designed instruments through small incisions to visualize and operate on the joint in a minimally-invasive manner, as opposed to open-joint

surgery. Arthrocentesis involves the use of small needles to flush the joint and inject an anti-inflammatory agent.

A. Different Clinicians and Variation in Treatment

Given its broad clinical manifestations and insufficiently understood etiology, many types of health care providers are involved in management of TMD. In seeking effective treatment, individual patients may see several types of providers, ranging from dentists to maxillofacial surgeons to biofeedback therapists. As such, the selection of treatment appears to be associated with the type of provider consulted. This underlines the lack of consensus regarding appropriate clinical expertise for managing TMD. A survey conducted by The TMJ Association (2000c) asked respondents to note from which among a list of 29 types of professionals they had sought care for TMD. In the large case control study of enrollees in a large northeastern insurance plan (Shimshak et al. 1997), patients with at least one of four ICD-9 codes associated with TMD were seen by a variety of types of clinicians far more often than their matched controls. The clinicians included chiropractors, physical therapists, dentists, otolaryngologists, general and family practitioners, psychiatrists, and others. In a study on the treatment-seeking patterns of patients with facial pain, Turp et al. (1998) found that each patient sought treatment for the condition from an average of about five clinicians. As a group, these represented more than 40 categories, including family physicians, neurologists, ear-nose-throat specialists, chiropractors, osteopaths, rheumatologists, physical therapists, psychologists, acupuncturists, and psychiatrists.

B. Progressing from Least to Most Invasive Treatment

The treatments in Table 1 are shown in approximate order from least invasive to most invasive of the face, jaw, or joint. Invasiveness refers to the extent to which an intervention causes permanent changes in the structure or position of the jaw, teeth, or soft tissues. Some treatments, including certain forms of the more invasive treatments, are associated with greater pain, disfigurement, and other adverse effects (Stohler and Zarb 1999; American Pain Society Meeting 2000). Treatment invasiveness is generally inversely related to reversibility. The potential adverse effects of any treatment must be weighed against any relative benefits that it might confer relative to other TMD treatments, or to no treatment at all.

As documented in this report, the body of evidence on the effectiveness of TMD treatment is generally limited and lacking in rigor. Particularly lacking is evidence demonstrating relative differences in effectiveness among these treatments. As such, an increasing number of clinicians and researchers argue for employing conservative, reversible approaches to managing most patients with TMD, and progressing to increasingly more invasive ones only upon failure of the more conservative, reversible ones (Neff 1995; Skinner and Neff 1994). As stated by Stohler and Zarb (1999), "The rationale to escalate care from simple to complex treatments in patients with unmet treatment expectations is questionable, because the superiority of invasive procedures over conservative therapies has not been demonstrated by any kind of systematic