Cervical spinal pain in chronic craniomandibular pain patients. Recognition, prevalence and risk indicators
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Citation for published version (APA):

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Chapter 1

General introduction
General introduction

Craniomandibular disorders (CMD) is a collective term that comprises a number of clinical problems that involve the musculoskeletal structures of the masticatory system. Although already in the fourth decade BC Hippocrates reported a patient suffering from 'a condition of temporomandibular joint dislocation', it was not until 1934 that the first definition of what is now called CMD, was published. The otolaryngologist Costen described in his legendary treatise pain in and around the jaw and 'related ear symptoms', and suggested that the pain improved with alteration of the bite (Costen, 1934). Throughout the following decades, the definition of CMD has changed much. In brief, in the sixties of the previous century, attention was especially concentrated on disorders of the temporomandibular joint (Ireland, 1952; Christie, 1953) and occlusal factors were seen as the primary etiological factor. Later, Laskin (1969) drew the attention to a specific subgroup of CMD patients with pain from the masticatory muscles, and other etiological factors, like oral habits and psychological factors, were also recognised (Laskin, 1969; Rugh and Solberg, 1976; Scott and Gregg, 1980; Greene et al., 1982). Nowadays, muscle pain is considered the most common source of CMD pain (Dimitroulis, 1998) and occlusal factors are only attributed a minor (if any) role in the development of CMD (Seligman and Pullinger, 1991).

In several ways, chronic CMD resembles other chronic musculoskeletal disorders, like spinal disorders, fibromyalgia, or myofascial pain. For instance, the pain complaints are often difficult to attribute to a specific derangement in the anatomy or physiology, and psychosocial factors seem to play an important role in their development. For CMD patients with chronic pain complaints, in particular an association with cervical spine disorders (CSD) has frequently been suggested (e.g., Alanen and Kirveskari, 1985; De Wijer et al., 1996; De Laat et al., 1998). In the light of diagnosis and treatment of CMD, a better insight into this association is important. Since pain is the dominant symptom of disorders of the craniomandibular system and of the cervical spine, this thesis focuses on the association between craniomandibular and cervical spinal pain.
Craniomandibular pain

Pain originating from the musculoskeletal structures of the masticatory system is the most frequently reported symptom of CMD (Solberg, 1986; McNeill et al., 1990; Okeson, 1996) and is the main reason to seek treatment (Al-Hasson et al., 1986). The pain usually fluctuates over time and exacerbates by chewing or other jaw function (Solberg, 1986; McNeil et al., 1990; Mersky and Bogduk, 1994; Okeson, 1996). Craniomandibular pain has been identified as the major cause of nondental pain in the orofacial region: about 2-7% of the adult population reports to suffer from pain originating from the musculoskeletal structures of the masticatory system (De Kanter, 1993; Lipton et al., 1993; Goulet et al., 1995). Fortunately, in most cases, CMD is a mild and self-limiting disorder (Okeson, 1996) and the treatment need is estimated to be 2-5% of the adult population (De Kanter, 1992; Goulet et al., 1995). Other signs of CMD are limited or asymmetric mandibular movements and temporomandibular joint sounds, like crepitation or clicking. The prevalence of CMD generally increases in frequency and intensity from the second through the fourth decade of life, whereafter it slowly declines with age. In addition, female patients outnumber male patients by at least four to one (Okeson, 1996).

Cervical spinal pain

Pain arising from the musculoskeletal structures of the cervical spine is the main characteristic of CSD (Spitzer et al., 1987). The pain can be felt locally or may be referred to the head, shoulders, or arms (Spitzer et al., 1987; Dwijer et al., 1990; Mersky and Bogduk, 1994). Moving the neck or adopting certain head postures usually aggravates the pain and limited cervical spinal movements may occur (Grant and McKenzie, 1994). Diagnosis and treatment of CSD have usually been scattered over many clinical disciplines, like orthopedics, rheumatology, neurology, and physiotherapy (Hagberg, 1984; Spitzer et al., 1987). As a result, many diagnostic terms have been applied, depending on whether the examiner focused on the main symptom (cervical spinal pain), on the radiological aspect (e.g., arthrosis), or on a pathophysiologic hypothesis (e.g., disc degeneration) (Spitzer et al., 1987). Some Scandinavian investigations showed that about 10-19% of the adult general population suffers from chronic neck pain. Also for cervical spinal pain, the prevalence increases
with age up to the fifth decade, and is higher among women than among men (Mäkelä et al., 1991; Andersson, 1994; Bovim et al., 1994).

**Relationship between the craniomandibular system and the cervical spine**

The craniomandibular system and the cervical spine are often considered a functional entity. Already in 1950, Brodie described a biomechanical model of the musculoskeletal structures of the head and the neck. A change in position of the neck or in the activity of its muscles would influence the function of the masticatory system, and vice versa. Experimental studies later corroborated this hypothesis. For example, Forsberg et al. (1985) recorded increased masseter EMG activity during neck extension, and Browne et al. (1993) showed, under specific conditions, a co-inhibition of masticatory and cervical muscles by trigeminal nerve stimulation. In addition, Eriksson et al. (1998) have shown that opening movements of the mandible are always accompanied by head-neck extension and closing movements by head-neck flexion. However, several aspects of the functional coupling between the craniomandibular system and the cervical spine remain unclear. For instance, the relationship between head posture and the delicate movements of the condyle-disc complex within the temporomandibular joint is still unknown, just as the association between head posture and the curvature of the cervical spine.

Clinical studies also frequently report a relationship between the craniomandibular system and the cervical spine. De Wijer et al. (1996) found considerable overlap in the prevalence of signs and symptoms of the cervical spine between CMD and CSD patients. Other studies have indicated that patients seeking care for CMD more often show signs and symptoms of CSD than non-CMD patients (Clark et al., 1987; Cacchiotti et al., 1991; De Laat et al., 1998; Ciancaglini et al., 1999). For example, CMD-patients rated more pain on palpation of neck musculature (De Laat et al., 1998; Clark et al., 1987) and showed more segmental limitations at the high cervical region (De Laat et al., 1998). However, the methodology used to recognise the two disorders varied considerably between (and sometimes within) the studies, which makes it difficult to compare the results. Since CMD and CSD are both disorders of the musculoskeletal system, in studies to their relationship it is better to use similar diagnostic criteria for their recognition.


**Recognition of craniomandibular and cervical spinal pain**

Modern classification schemes for CMD are the Research Diagnostic Criteria (RDC; Dworkin and LeResche, 1992), and the Guidelines for Assessment, Diagnosis, and Management of the American Academy of Orofacial Pain (AAOP; Okeson, 1996). The RDC, as its name already suggests, is mainly designed for research purposes, whereas the classification scheme proposed by the AAOP is primarily intended for clinical use. Both classification schemes look for subtypes of CMD based upon a combination of symptoms described by the patient and signs found in a clinical examination of the masticatory system. In these schemes, CMD is subdivided into disorders of the muscular or joint structures. However, pain does not play a prominent role in all of these subtypes of CMD, see for example the subgroup of CMD patients with only a disc displacement with reduction.

For cervical spinal pain, often used classification schemes are the ones proposed by the International Association for the Study of Pain (IASP; Merskey and Bogduk, 1994) and by the Quebec Task Force on Spinal Disorders (Spitzer et al., 1987). The IASP expresses the diagnosis of cervical spinal pain along two axes: an anatomic axis, specifying the structure that is the source of the pain, and a pathologic axis, specifying the pathological basis for the pain. Imaging techniques and diagnostic nerve blocks play an important role in many of the subdiagnoses of cervical spinal pain, although the IASP admits that for some of the subdiagnoses there is only weak evidence that the cervical spinal pain is causally associated with the condition as diagnosed by the imaging techniques. The Quebec Task Force emphasises that the cause of cervical spinal pain often cannot be attributed to a specific derangement of the anatomy or physiology. They therefore recommend a classification based upon the most frequent clinical entities and their stage of development. Moreover, they indicate that an oral history and a physical examination are usually sufficient to identify the majority of patients that require a specific treatment. The two classifications have in common that pain plays a prominent role in the recognition of the cervical spine disorder.

The choice of classification is an important one, because the technique used to recognise a musculoskeletal disorder may influence the outcome of the study. For CMD, this is illustrated in a study of Clark et al. (1987) to the prevalence of CSD in CMD patients and controls: differences were only found when the results were based
upon both a questionnaire and a clinical examination, and not when these items were considered independently. The examination techniques of the earlier-described classification schemes for CMD and CSD are partly different, and it is also not possible to translate all the subtypes of CMD to those of CSD, and vice versa. So, there is no universal diagnostic system that can be applied for the recognition of both craniomandibular and cervical spinal pain.

In most classification schemes the recognition of musculoskeletal pain is based upon the symptoms reported in an oral history, and the signs found in a physical examination. In this physical examination, tests like active or passive movements, palpation of the muscles and joints, and resisted movements play an important role (Dworkin and LeResche, 1992; Cyriax and Cyriax, 1998). These tests, however, may yield contradictory results and then the relative importance of the tests in the recognition of the musculoskeletal pain is important. One of the few studies evaluating this topic is the study by Lobbezoo-Scholte et al. (1993). They evaluated to what extent six orthopedic tests could be used to distinguish between (subgroups of) CMD patients and controls. However, their subgroups were not solely based upon the presence of pain, but also included non-painful conditions such as internal derangements within the temporomandibular joint. This makes it difficult to extrapolate their results to the recognition of patients with especially craniomandibular pain. For the recognition of cervical spinal pain, Cyriax and Cyriax (1998) suggested that function tests, like active or resisted movement tests, better discriminate between patients and non-patients than palpation. However, scientific evidence to support this suggestion is lacking. So, the relative importance of the various orthopedic tests in the recognition of craniomandibular and cervical spinal pain needs further investigation.

Since isolated signs of CMD and CSD are quite common in the general population, cut-off values for the orthopedic tests need to be established as well. This is illustrated by Dworkin et al. (1990a), who showed that the prevalence of pain on palpation of intraoral muscle sites in community controls varied from 8- 45%, and by Kirveskari et al. (1988), who reported tenderness on palpation of the neck and shoulder muscles in more than half of a group of participants without neck complaints.
Risk indicators of craniomandibular and cervical spinal pain.

It is generally agreed upon that the etiology of craniomandibular and cervical spinal pain is multifactorial (Grant, 1994; Okeson, 1996). The ideas on the factors contributing to their development or perpetuation, however, have changed much over the last decades. This is illustrated by the fact that disturbances in occlusion and articulation of the masticatory system have long been considered a primary factor in the etiology of CMD. However, extensive research has shown that these disturbances only play a minor (if any) role (Seligman and Pullinger, 1991).

In general, it is believed that overload plays an important role in the etiology of musculoskeletal disorders. Apart from parafunctional habits such as clenching and grinding, which are frequently reported in CMD patients and are therefore often held responsible for the chronic pain in the musculoskeletal structures of the masticatory system (Okeson, 1996), abnormal head posture is sometimes mentioned as a possible overloading factor. Specifically, an anteroposition of the head would increase the activity of the dorsal neck musculature (Grant, 1994; Haughie, 1995) and of the masticatory muscles (Okeson, 1996). However, studies on the relationship between head posture and CMD or CSD yield contradictory results. Some authors claim to have found a positive relationship between an anteroposition and CMD (Huggare and Raustia, 1992; Lee et al., 1995), whereas others did not (Darlow et al., 1987; Hackney et al., 1993; Refshauge et al., 1995; Grimmer, 1996). These contradictory results may partly be due to difficulties in measuring head posture. Some studies use reference points of the head and the cervical spine, as seen on lateral photographs; others use anatomic reference points on lateral radiographs. However, these reference points are sensitive to the soft tissues overlying the head and the cervical spine, or to the morphology of the head and the cervical spine, respectively. Thus, so far, no consensus is reached on the role of head posture as a possible risk indicator for craniomandibular and cervical spinal pain.

Another risk indicator frequently associated with chronic musculoskeletal pain is psychological distress, such as depression or anxiety. Patients with widespread pain, such as fibromyalgia (Boissevain and McCain, 1991), or with regional soft tissue pain (Inanici et al., 1999) often show signs of psychological distress. A longitudinal study to chronic musculoskeletal pain has shown that psychological distress may promote
chronic pain and that chronic pain may promote distress (Magni et al., 1994). Moreover, the level of psychological distress seems positively related to the number of painful body areas (Dworkin et al., 1990b; Von Korff et al., 1992; Ektor-Andersen et al., 1999). This suggests that craniomandibular pain patients with a coexistent cervical spinal pain would show higher levels of psychological distress than patients with only local craniomandibular pain. However, for CMD, most studies have focused on psychological differences between subgroups of CMD patients, with equivocal results. Some studies concluded that CMD patients with a myogenous disorder suffer from increased levels of psychological distress (Eversole and Machado, 1985; Lundeen et al., 1987; De Leeuw et al., 1994; Kight et al., 1999), whereas others did not find differences between subgroups of CMD patients (Marbach and Lund, 1981; Michelotti et al., 1998). Although it has been suggested that many CMD patients suffer from cervical spinal pain as well, it is still unknown whether patients with both pain disorders suffer from higher levels of psychological distress than patients with only craniomandibular pain.
Summary of the aims

The aim of this thesis is twofold. The first aim is to increase insight in the functional relationship between the craniomandibular system and the cervical spine. The second aim is to determine the relationship between craniomandibular and cervical spinal pain, and to evaluate some of the risk indicators associated with this relationship. In summary, the following questions are addressed:

Part I: Experimental studies
- Does head posture influence the movements of the temporomandibular condyle within the joint?
- How can head posture be measured on lateral radiographs?
- Is there a relationship between head posture and curvature of the cervical spine?

Part II: Clinical studies
- Which orthopedic test, or combination of orthopedic tests, can best be used in the recognition of craniomandibular and cervical spinal pain?
- What are the cut-off values of the orthopedic tests to optimally discriminate between persons with or without craniomandibular or cervical spinal pain complaints?
- What is the prevalence of cervical spinal pain in persons with or without craniomandibular pain?
- Is there a difference in the prevalence of cervical spinal pain between subgroups of craniomandibular pain patients with the pain originating from the muscular or joint structures?
- Is head posture a risk indicator for chronic craniomandibular pain patients with or without cervical spinal pain, or with a myogenous or arthrogenous origin of pain?
- Is the level of psychological distress a risk indicator for chronic craniomandibular pain patients with or without cervical spinal pain, or with a myogenous or arthrogenous origin of pain?
Outline of the thesis

In Chapter 2 (Part I), the influence of head posture on the kinematics of the temporomandibular condyle is measured in healthy subjects by an opto-electronic jaw movement recording system, which can record mandibular movements with 6 degrees of freedom. In Chapter 3 (Part I), a new method to quantify head posture on lateral radiographs is presented, and the relationship between head posture and the curvature of the cervical spine in healthy subjects is investigated.

In Chapters 4 to 7 (Part II), the results of a large clinical study, using a controlled, single blind design, to the relationship between craniomandibular and cervical spinal pain are described. In this study, 250 persons with or without craniomandibular pain participated. In Chapter 4, it is investigated which orthopedic test, or combination of tests, best discriminates between persons with or without craniomandibular or cervical spinal pain complaints. Also the cut-off values for the various tests are determined. In Chapter 5, the prevalence of cervical spinal pain in craniomandibular pain patients is studied and compared to persons without craniomandibular pain. The prevalence of cervical spinal pain is also established in subgroups of craniomandibular pain patients (i.e., patients with myogenous and/or arthrogenous pain). Chapters 6 and 7 deal with some of the possible risk indicators for craniomandibular and cervical spinal pain, i.e., abnormal head posture and psychological distress. In Chapter 6, differences in head posture between craniomandibular pain patients with or without cervical spinal pain, and also in subgroups of CMD patients, are studied. In Chapter 7, the level of psychological distress in craniomandibular pain patients with or without cervical spinal pain and healthy controls is compared. Furthermore, differences in psychological distress between subgroups of CMD patients are analysed.

A summary and the conclusions of the research findings in English and in Dutch are found in Chapter 8.