Cluster headache (CH), or migraine neuralgia, involves intense unilateral facial pain manifesting in the form of crises that last 15 minutes to 3 hours that are associated with tearing, nasal congestion, ptosis, miosis, and enophthalmos on the affected side. The attacks may reappear 1 or more times in the course of the day for periods of weeks or even months and are more common in young males. Nevertheless, the condition may develop in either sex at any age. The pain usually commences in the upper premolar region, and the differential diagnosis is established with dental pain. The trigeminal nerve is the principal afferent pathway for the sensory perception of headaches and facial pain. Neurogenic and vascular mechanisms are implicated in the pathogenesis of many “atypical” forms of orofacial pain, as well as of some forms of chronic orofacial pain. The trigeminal nerve is the principal afferent pathway for the sensory perception of headaches and facial pain. Neurogenic and vascular mechanisms are implicated in the pathogenesis of many “atypical” forms of orofacial pain, as well as of some forms of chronic orofacial pain.2

Relatively slow-conducting nonmyelinated fibers mediate visceral-type vascular pain. Evidence points to the existence of sensory axons that innervate the blood vessels of the head and form part of the so-called trigeminovascular system.2 Vascular orofacial pain may be due to alterations in the perivascular trigeminal amyelinc fibers.3 These trigeminal axons would in turn transmit nociceptive information to the central nervous system and would induce neurogenic inflammation in response to antidromic stimulation. In addition to their afferent (sensory) function, the trigeminal sensory fibers play a neuroeffector role in the regulation of blood flow. These fibers likewise belong to the trigeminovascular system. The nonmyelinated fibers contain potent vasodilating neuropeptides such as the calcitonin gene-related peptide, substance P, and neurokinin A. On the other hand, depolarization of the type C nonmyelinated fibers releases potent vasodilating neuropeptides at the vascular wall, causing vasodilatation and edema of the wall by calcium-dependent mechanisms. As a result, these fibers become sensitized and pain is prolonged.2,3

The neuroeffector function of the trigeminal sensory system involves substance P and neurokinin A release from the distal tip of the stimulated nonmyelinated fiber. The release of these substances is regulated via serotonergic receptors and causes vascular dilatation and edema or neurogenic serosal inflammation of the vascular walls that are innervated by these fibers. The serosal inflammation in turn contributes to the further sensitization of these fibers and prolongs pain. The efficacy of certain drugs in combating headache can be explained in terms of the correction of these physiopathologic mechanisms. Serotonergic receptor

**Objective.** We sought to evaluate the possible relationship between oral surgery and endodontic procedures and the subsequent appearance of cluster headache (CH) in 54 patients.

**Study design.** This study included 54 patients diagnosed and treated for episodic CH. The characteristics of pain, the extractions, and the endodontic procedures performed in the same or a contralateral quadrant were recorded and analyzed by using the chi-square test.

**Results.** Prior tooth extraction or endodontics had been performed in the pain-affected quadrant in 58% of cases and in the contralateral quadrant in 33%. The differences between quadrants were statistically significant. After the onset of pain, extractions were performed in the affected quadrant in 44% of patients.

**Conclusions.** Although the appearance of pain after dental extraction could suggest a relationship between damage to the nerve supply and the development of CH, the possibility that dental extraction and endodontics may have been performed in response to CH-related pain must also be taken into account. With respect to the differential diagnosis of pain, it is easy for CH to be misdiagnosed as dental pulp pain.

agonists such as ergotamine and sumatriptan antagonize vasodilating neuropeptide release during headache crises, inducing vasoconstriction and preventing the development of serosal inflammation.3

Both homolateral local and general autonomic manifestations (some sympathetic, some parasympathetic) develop in the course of a facial vascular pain episode. Increased lacrimation, nasal secretion or plugging, and conjunctival injection may reflect local parasympathetic hyperactivity triggered through a reflex circuit consisting of a trigeminal afferent pathway and a parasympathetic efferent trajectory through the greater superficial petrosal nerve and the sphenopalatinal ganglion. Palpebral ptosis, miosis, and sweat alterations are attributed to sympathetic involvement, whereas activity of the trigeminovascular systems induces serosal inflammation of the carotid wall that in turn compresses the perivascular sympathetic fibers against the narrow bony canal through which the carotid passes.4

The cervical sympathetic trunk possesses visceral afferents that follow the branches of external carotid artery to innervate the depth of the mandible, the teeth, and the auditory regions of the head. These afferents do not receive painful stimuli, although they may be activated by the sympathetic nerves. Direct stimulation of the superior cervical ganglion causes intense pain in the lower teeth and behind the ear of the same side. Compression of the carotid sinus likewise induces pain in the teeth and ear. Much remains to be learned of the relationship between the sympathetic nerves and pain perception.1

Myelinated trigeminal fiber alterations appear to be related to essential trigeminal neuralgia—a condition that involves intense, unilateral, and momentary pain crises preferentially distributed through territories I and III of the trigeminal pathway.4 Carbamazepine and other antiepileptic drugs are the most effective medical treatment in such cases.

Unmyelinated nerve fibers have been identified entering the dental pulp and correspond to C fibers and autonomic nerves. Myelinated A-δ fibers and A-β fibers have also been identified. Nerve fibers exhibiting substance P and calcitonin gene-related peptide immunoreactivity have been demonstrated in the dental pulp and oral mucosa in several species, including human beings.5,6 After antidromic electrical nerve stimulation, neurogenic inflammation has been demonstrated in the dental pulp of dogs and in the dental pulp and lower lip of rats.7 Because neurogenic inflammation in the trigeminovascular system seems to play a central role in the genesis of vascular-type headache, the same mechanism could function in the oral mucosa and teeth. It is tempting to further extrapolate the model and compare the trigeminovascular system within the space limited by the skull with the neurovascular system in the dental pulp—similarly confined by the dental hard tissues. In turn, pressure build-up might play a role in intrapulpal pain sensation.5

The purpose of the present study was to investigate whether oral surgery procedures (simple extraction or surgical extraction) or endodontic procedures in a quadrant can influence the posterior development of CH in the same quadrant.

MATERIAL AND METHODS

This study included all the patients diagnosed and treated at Valencia University Dental School (Valencia, Spain) for episodic CH in the period 1987-1999, without any exclusion criteria. In compliance with the guidelines of the American Academy of Orofacial Pain5 and the International Headache Society,10 the diagnosis of CH was made on the basis of the following criteria: (1) at least 5 attacks of severe and strictly unilateral pain orbital, supraorbital, and/or temporal, lasting 15 to 180 minutes and occurring from once every other day to 8 times per day; (2) the association of pain with 1 or more of the following autonomic manifestations: conjunctival injection, lacrimation, nasal congestion, rhinorrhea, forehead and facial sweating, miosis, ptosis, and eyelid edema; and (3) attacks occurring in series lasting for weeks or months and separated by remission periods usually lasting months or years.

The sample was formed by 54 patients, with a mean age of 41 years (range 22-65 years), 35 men and 19 women. In all cases a previously established protocol was used to record patient antecedents of oral pathology, tooth extractions, and endodontics before the onset of pain and involving both the side initially affected by pain and the contralateral side. The teeth extracted in the quadrant initially affected by pain after the appearance of CH were also documented.

The characteristics of pain were recorded as intensity, quality, type, frequency, and invalidity grade with respect to what the pain produces in the patients and the quality of life that they have. In terms of the activities that patients could do during the periods with pain, we coded the levels of pain as low, uncomfortable, moderate, or severe/terrible. Autonomic manifestations associated with the pain were also recorded as follow: rhinorrhea, nasal congestion, lacrimation, conjunctival injection, ptosis, miosis, and facial blushing. The data corresponding with the edentate zones were in turn contrasted with the results of clinical and x-ray exploration. Maxillofacial computed tomography scans were performed in all cases, and no alterations of the paranasal sinuses were observed.
The data obtained were coded for posterior statistical analysis. A descriptive study was made of each variable, and the associations between qualitative variables were evaluated with the chi-square test. Statistical significance was considered as \( P < .05 \).

RESULTS

Thirty-one patients (58%) had undergone tooth removal or endodontic treatment before the onset of CH in the quadrant initially affected by pain. Extractions were exclusively performed in 22 cases (41%), endodontics only in 1 (2%), and both extractions and endodontics in 8 patients (15%), all before the appearance of CH. Among those who had undergone extraction, the mean number of teeth removed per patient was 2.3 (range 1-8), whereas the average number of endodontic treatments was 1.2 (range 1-2). The time between the last extraction and the appearance of pain was 14 months (range, 1-54 months).

Treatment before CH appearance had in turn been carried out in the contralateral quadrant in 18 patients (33%). Extractions were exclusively performed in 12 cases (22%), endodontics only in 2 (4%), and both extractions and endodontics in 4 patients (7%), all before the appearance of CH. Among those who had undergone extraction in the contralateral quadrant, the mean number of teeth removed per patient was 2 (range 1-8), whereas a single endodontic treatment was provided to each patient who had undergone endodontics. Statistically significant differences (chi-square, \( P = .000 \)) were observed between the dental treatments carried out in the affected and in the contralateral quadrant.

In 4 patients the pain appeared less than 1 month after the last extraction in the affected quadrant. After the onset of pain, tooth extractions were performed in the painful quadrant in 24 cases (44%) in an attempt to solve the problem, although only 1 patient reported improvement.

DISCUSSION

CH usually affects young individuals in the second or third decades of life, although cases have been reported involving patients in the 8- to 62-year-old age range. The mean age in our series was 41 years, with male predominance that coincides with the observations in the literature (3:6:1 over females). Nevertheless, according to Manzoni et al., such male predominance diminishes progressively over the years.

Oral surgical and endodontic procedures can affect normal perception and transmission of the sensory afferents by altering the peripheral nerves as a result of sectioning and amputation of their terminal branches, although in human beings this mechanism remains to be demonstrated. In patients with trigeminal neurogenic pain, dental treatments can influence the appearance of pain; for instance, experiments in cats have shown that dental pulp extraction can induce functional and morphologic changes in the spinal trigeminal nucleus, triggering neuronal hyperactivity and prolonging nerve discharges after stimulating the face on the same side. These observations are also supported by the established relationship between myelinated trigeminal fiber alterations and primary or essential trigeminal neuralgia.

The relationship between prior dental extractions and endodontics in the quadrant initially affected by pain was significantly greater than in the case of the contralateral quadrant. Although a search of the literature yielded no reference to this subject, our findings suggest a possible relationship between oral surgical and endodontic procedures and the appearance of CH. In this context, the trigeminal myelinated fibers mediate vascular orofacial pain; consequently, teeth extractions could alter normal perception and transmission of the sensory afferents by altering the peripheral nerves as a result of sectioning or amputation of their terminal branches—as explained earlier. On the other hand, dental extractions performed before the diagnosis of CH could reflect attempts to provide relief from pain mistakenly thought to be of dental origin in areas presenting caries or in teeth in poor conditions. Similar considerations apply to the appearance of pain shortly after dental extraction, seen in 4 of our patients.

The teeth possess a potent nociceptive capacity that serves to warn of possible structural damage. In this sense, the teeth are “visceral structures” that function as part of the musculoskeletal system. Pain of dental origin is highly versatile in that it can simulate any painful syndrome; in this sense, a good approach is to regard all oral and facial pain as being of dental origin until confirmed otherwise. In many patients (44%), extractions were performed after the onset of pain in an attempt to afford relief. This situation may be a consequence of the diagnostic difficulties involved, because any pathologic process causing orofacial pain can mimic acute pulp pain. The teeth and oral structures are frequently implicated in vascular orofacial headaches; many such patients believe their pain to be of dental origin, and pulpitis is often erroneously diagnosed as a result.

Bittar and Graff-Radford, in a study of 33 patients with CH, found 50% had undergone inadequate dental treatment to resolve the pain. Benoliel et al. in turn described a large group of patients with facial pain, including vascular-type oral pain symptoms. The patients suffered from episodic, severe pain that was usually unilateral and was accompanied by autonomic or systemic manifestations (55% of cases). A large
number of these patients (38%) reported unsuccessful attempts at pain relief by dental treatment, although antimigraine-type therapies were reported to be effective.4

The appearance of pain after dental extraction could suggest a relationship between damage to the nerve supply and the development of CH; the possibility that dental extraction and endodontics may have been performed in response to CH-related pain must also be taken into account. Therefore, a correct diagnosis of such patients in the dental clinic is essential, because misinterpretation can lead to inappropriate treatments such as extractions and endodontic procedures in an attempt to solve the orofacial pain—thereby producing iatrogenic problems that only further worsen the condition of the patient.

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