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Dental Barotrauma and Barodontalgia

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ABSTRACT

Barodonatalgia is defined as a pressure induced dental pain that can occur both at high and low pressures. In the orofacial region, barotrauma is manifested either as facial barotraumas (eg, barosinusitis and barotitis-media) or dental barotrauma This review outlines the etiology, clinical manifestations, differential diagnosis and recommendations for prevention and management of barodontalgia and barotrauma. When treating patients associated with aviation or diving, clinicians should cautiously examine and treat fractured cusps, caries, areas of dentin exposure and integrity of restorations and prosthesis to prevent barometric-related dental problems.

Keywords- *Aerodontalgia, Barotrauma, Odontecrexis, Barodontalgia, In-flight toothache*

INTRODUCTION

Barodontalgia is also defined as an oral (dental or nondental) pain caused by a change in barometric pressure in an otherwise asymptomatic organ[1].This phenomenon was first observed in air crews during World War II era, during a period before airplane compression and was given the name "aerodontalgia"[2] Later it was also observed in

divers, at high altitudes and in patients receiving hyperbaric oxygen therapy [3] . The incidence of this type of tooth pain is 0.26–2.8% in aircraft personnel, air passengers, and divers[4,5,6]. Barodontalgia was reported to occur during flying at altitudes of 600–1500m and during diving at depths of 10–25m [7], [8] and upper teeth are more affected than lower teeth whereas in flight conditions, upper and lower teeth are affected equally [9]

In the orofacial region, barotrauma is manifested either as facial barotraumas (eg, barosinusitis and barotitis-media) or dental barotrauma. Dental barotrauma can manifest itself as tooth fracture, restoration fracture or reduced retention of the restoration [10].

Boyle's Law which states that "at a given temperature, the volume of a gas is inversely proportional to the ambient pressure," may be used to explain the phenomenon of barodontalgia [11]. As ambient pressure increases, the volume of a confined gas decreases. This occurs during underwater diving conditions. Vice versa during flight, volume of the gas increases as surrounding atmospheric pressure decreases. Aircraft personnel and passengers travelling in non-pressurized cabins are especially at risk [7] . Pressure differences occur in the human body when a gas-filled cavity cannot communicate with the exterior and pressure cannot be equalized. Clinically, the resulting pressure difference between the gas-filled cavity and the exterior environment can lead to pain, oedema, or vascular gas embolism 12]

ETIOLOGY OF BARODONTALGIA

Barodontalgia is generally experienced in teeth which have pre-existing pathosis, making it more of a symptom rather than a pathological condition[7].The common etiologic pathologies for pain were faulty dental restorations and dental caries without pulp involvement (29.2%), necrotic pulp/periapical inflammation (27.8%), vital pulp pathology (13.9%) and recent dental treatment ("postoperative barodontalgia"; 11.1%). Barosinusitis was the main cause of pain origin in 9.7% of cases [9].

Authors [13], [14] have concluded that normal pulp tissue does not produce pain associated with change in ambient pressure regardless of whether restorations or caries were present. However in 1965 it was stated by Shiller[15] that pain could be produced by healthy pup tissue when atmospheric pressure increased to a level corresponding to a depth of 100 fsw.

Carlson et al [16] carried out animal experiments and showed that fluid movement occurred within the dentinal tubules, from the dentin towards the pulp after cavity preparation in enamel under increased atmospheric pressure. This fluid movement could produce the sharp localized pain that disappears after return to ambient pressure. A dull and non localized pain would be suggestive of a pathological condition.

Kollman[4] has reported three important hypotheses to explain this phenomenon: 1)expansion of trapped air bubbles under a root filling or against dentin that activates nociceptors; 2) stimulation of nociceptors in the maxillary sinuses, with pain referred to the

teeth; and 3) stimulation of nerve endings in a chronically inflamed pulp.

Several other hypotheses regarding pathogenesis of barodontalgia include direct ischemia resulting from the inflammation [17], indirect ischemia resulting from intrapulpal increased pressure as a result of the vasodilatation and fluid diffusion[18], the result of intrapulpal gas expansion. The gas is a by-product of acids, bases, and enzymes in the inflamed tissue.

Calder and Ramsey [19] stated that the physical properties of the gas mixture used during deep sea diving may contribute to barodontalgia. In self contained underwater breathing apparatus (scuba) tanks, oxygen's natural diluent gas, nitrogen, is replaced by helium, resulting in a gas of lower viscosity. This gas can enter tissues, including teeth, and can sometimes become trapped in closed spaces, such as the pulp chamber and root canal.

CLASSIFICATION OF BARODONTALGIA

A classification of barodontalgia was developed by Ferjentsik and Aker[20] and is primarily based on the underlying causes and clinical symptoms (Table 1)

Table 1: Classification of Barodontalgia[20]

Class	Cause	Symptoms
Class I	Irreversible pulpitis	Sharp pain on ascent
Class II	Reversible pulpitis	Dull pain on ascent
Class III	Necrotic pulp	Dull pain on descent
Class IV	Periapical pathology	Severe persistent pain on ascent or descent

BAROTRAUMA

Barotraumas can be further divided into facial barotrauma and dental barotrauma.The term facial barotraumas generally refers to barometric-related trauma to facial cavities, including barotitis media (middle ear barotrauma), external otitic barotrauma, barosinusitis (sinus barotrauma), and dental barotrauma. Barotitis media is a traumatic inflammation in the middle ear space produced by a pressure differential between the air in the tympanic cavity and that of the surrounding atmosphere. External otitic barotraumas is caused by injury to the lining mucosa of the external ear canal because of the airtight space between an object in the outer ear canal and the eardrum. Barosinusitis is an inflammation of one or more of the paranasal sinuses produced by the development of a pressure difference (usually negative) between the air in the sinus cavity and that of the surrounding atmosphere. Referred pain from extraoral facial barotrauma (barotitis media,external otitic barotraumas, and barosinusitis) can be manifested as a toothache and should therefore appear in the differential diagnosis list of barodontalgia. Barosinusitis is distinguishable from barodontalgia, as the former will always occur on descent, whereas the latter always begins on ascent [7] . Table 2 compares pulp/periapical-related (direct) barodontalgia and barotitis/barosinusitis-induced (indirect) barodontalgia.

Dental barotrauma includes all barometric-related dental mechanical phenomena such as tooth fracture, failure of dental restoration or dislodgment of prosthesis these are associated with a leaking restoration or secondary caries lesion. Calder and Ramsey[19] studied tooth fractures caused by a high-

altitude environment and they coined the term, "Odontecrexis" (Greek for tooth explosion), to describe this physical disruption of teeth with leaking restorations caused by barometric pressure changes. Authors[19], [21] have concluded that pressure induced breakage of teeth occurs only in cases of teeth with defective restorations and latent caries prior to exposure to the barometric changes. In crowns, pressure changes occur in microtubules of the cement layer, which resulted in a reduced retention of the crown [22]. Mostly, the cement layers beneath the crowns become weak due to microleakage[23].

DIVERS' MOUTH SYNDROME

This term describes the pain in the temporomandibular joints and orofacial muscles experienced after diving[24]. Diving can cause TMJ symptoms in previously symptom-free divers, or aggravate existing problems[25].This is caused by biting onto the mouthpiece with the anterior teeth only, since most commercial mouthpieces do not provide support for the posterior teeth. To keep the mouthpiece in place, the mandible has to be forced in a forward position. Holding this position often and for long periods of time, may develop or aggravate temporomandibular dysfunction[26]. A custom-fitted mouthpiece could help alleviate the problem.

PREVENTION AND MANAGEMENT

Fédération dentaire international (FDI) recommends an annual oral examination for divers, submariners and pilots. In addition, patients should not dive or fly in non-pressurized cabins within 24 hours of a dental treatment requiring anaesthetic or 7 days following a surgical treatment[11], [27]. The placement of a zinc oxide eugenol (ZOE) base was found to prevent barodontalgia when reversible pulpitis was the underlying cause which is attributed to its well-known sedative affects of ZOE [27]. Indirect pulp capping is currently not recommended in patients exposed to pressure changes. Variations in pressure are believed to adversely affect the regeneration of pulp tissue. In order to avoid possible complications, endodontic treatment or extraction should therefore be performed in cases in which direct pulp capping would be indicated[2].

Based on the results from their study, Lyons and co-workers suggest that dentists should consider using resin cement when luting fixed prostheses in patients who will be exposed to significant variations in pressure[23], [28]. Resin is indicated as a luting agent of choice for cementing fixed prostheses in populations at risk for barodontalgia. Under the influence of pressure gradients, resin cements maintain original bond strength and demonstrate the least amount of microleakage compared with other cements.

Table 2: Dental-related (Direct) versus Non–Dental-related Indirect) Barodontalgia[7]

Characteristic	**Pulp disease-induced(direct) barodontalgia**	**Periapical disease-induced (direct) barodontalgia**	**Facial barotrauma-induced (indirect) barodontalgia**
Cause	Pulp disease	Periapical disease	Barosinusitis, barotitis media
Appearance	During ascent, Pain usually ceases during descent At the appearance-level	Periapical periodontitis: Usually at high altitude (38,000 ft) during ascent or descent	During descent
Symptoms	Irreversible pulpitis: Sudden sharp penetrating pain , Reversible pulpitis or necrotic pulp: dull beating pain	Continuous intense or dull beating, Pain, swelling	Dental pain in maxillary molar or premolar region
Dental history	Recent dental work Recent dental thermal sensitivity	Recent dental percussion, Sensitivity	Present upper respiratory infection, past sinusitis illness
Clinical findings	Extensive dental caries lesion or defective restoration.Acute pain upon cold test	Extensive caries lesions or defective restoration, Acute pain upon percussion test.	Pain on sinus palpation,Pain upon an acute change in the head position
Radiological findings	Pulpal caries lesions Restoration close to pulp chamber	Pulpal caries lesions Restoration close to pulp chamber, Periapical radiolucency,Inadequate endodontic obturation	Opacity in maxillary sinus

CONCLUSIONS

Treatment must include the restoration of all carious lesions, the removal of all defective restorations, and the management of inflammation. Vitality testing of all teeth is required for the detection and treatment of asymptomatic pulp necrosis[9], [29]. Dentists should advise patients to avoid exposure to pressure changes until all necessary surgical, conservative, and prosthetic procedures have been completed[2]. These barometric-related clinical manifestations can cause a decrease in life quality and jeopardize the safety of flight or diving[9]. Therefore an in depth understanding of the pathological conditions that may occur in aircraft personnel, passengers and scuba divers and the clinical recommendations for management of these conditions are essential to the oral physician. Dentists and patients should be cognizant of the importance of routine dental screening to avoid barotrauma-related dental problems.

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