Barodontalgia: what have we learned in the past decade?

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This article reviews the current knowledge regarding barodontalgia, a barometric pressure–related oral (dental and other) pain. Contemporary classification, prevalence, and incidence, features, etiology, and diagnosis of this entity are presented regarding flight and diving conditions. Summarizing the past decade data, three-fourths of episodes were described as severe, sharp, and localized pain. Barodontalgia affects 11.9% of divers and 11.0% of military aircrews with a rate of 5 episodes/1,000 flight-years. Upper and lower dentitions were affected equally in flight, but more upper than lower dentition were affected in diving. The most prevalent etiologic pathologies for in-flight dental pain were faulty dental restorations (including dental barotrauma) and dental caries without pulp involvement (29.2%), necrotic pulp/periapical inflammation (27.8%), vital pulp pathology (13.9%), recent dental treatment (11.1%), and barosinusitis (9.7%). This review refutes 3 generally accepted conventions: According to the results, the current in-flight barodontalgia incidence is similar to the incidence in the first half of the 20th century, the weighted incidence of barodontalgia among aircrews are similar to the weighted incidence among divers, and the role of facial barotrauma in the etiology of in-flight barodontalgia is minor. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109:e65-e69)**

A considerable concern among aviation physicians and dentists during the 1940s and quite forgotten later, barodontalgia, a barometric pressure–related oral (dental or other) pain, was revisited in the past decade.[1] In the diving environment, this pain is commonly called "tooth squeeze," and the previous name "aerodontalgia," regarding its feature inflight, is still in use.

Although rare, in-diving or in-flight barodontalgia has been recognized as a potential cause of diver or aircrew-member vertigo and sudden incapacitation, which could jeopardize the safety of diving or flight.[2-4]

The aim of the present article is to review the current knowledge, from the past decade, regarding this pain entity.

CLASSIFICATION

Barodontalgia is subgrouped into direct (dental-induced) and indirect (nondental-induced) pain. The currently accepted classification of direct barodontalgia consists of 4 classes according to pulp/periapical condition and symptoms (Table I).[5,6]

PREVALENCE AND INCIDENCE

Diving conditions

Barodontalgia has been experienced on one or more occasions by 9.2%-21.6% of American and Australian self-contained underwater breathing apparatus (SCUBA) divers (Table II).[7,8] Barodontalgia was most prevalent in the third decade of life and without gender preference. An additional 16.8% and 27.2% of divers suffered from "jaw pain" and "sinus pain," respectively.[8] Among military divers (all male), an incidence of 17.3% was reported.[9]

Flight conditions

A distinction has to be made between real in-flight conditions and altitude-chamber simulations; barodontalgia is approximately tenfold more prevalent in the former than in the later conditions.[10] Table II presents the prevalence, incidence, and rate of barodontalgia in the past decade according to Spanish, Saudi-Arabian and Kuwaiti, Israeli, and Turkish Air Force reports.[9,11-13] All 4 reports are of male aircrews. Differences in the reported incidence are considerable and can be attributed to the relatively small groups, differences in oral health conditions, and frequency of flying, compression, and extreme conditions of flying (e.g., rapid maneuvering with the consequent rapid pressure changes).

In-flight barodontalgia affects 11.0% of military aircrews with a rate of 5 episodes/1,000 flight-years. The current weighted incidence of barodontalgia during flight is similar to the reported incidence (9.5%) from the first half of the 20th century,[1] despite current air compression inside airplane chambers, high-quality dental care, and enhancement of oral health in the second half of the 20th century.[1,14] Regarding the presumed effect of chamber air compression on barodontalgia, in the Israeli report no difference was found in incidence of barodontalgia between aircrews of uncompressed helicopters, semicompressed fighter aircraft,

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Table I. Classification of direct (dental induced) barodontalgia

Class	*Pathology*	*Features*
I	Irreversible pulpitis	Sharp transient (momentary) pain on ascent
II	Reversible pulpitis	Dull throbbing pain on ascent
III	Necrotic pulp	Dull throbbing pain on descent
IV	Periapical pathology	Severe persistent pain (on ascent/descent)

and compressed transport aircrafts (8.0%, 9.0%, and 7.0%, respectively).[12] Surprisingly, in the Spanish report, aircrews of compressed aircrafts (5.1%) were more affected than those of uncompressed aircrafts (0.7%).[11]

The weighted incidence of barodontalgia among aircrews (11.0%) is similar to divers (11.9%) despite requirement of oral health maintenance and lesser pressure changes among aircrews.[8] Generally, divers are subjected to more environment pressure than aircrews; whereas in flight the theoretically possible pressure changes range from 1 atmosphere at ground level to 0 atmosphere at outer space, in diving the changes are more significant since each 10 meters (32.8 feet) descent elevates the pressure by another 1 atmosphere.

FEATURES

Although barodontalgia was reported also in mountain climbing and hyperbaric chamber, research is available for diving and (military) flying conditions (Table III).

Diving conditions

Pain appears at a water depth of ≥33 feet,[10] mostly at depths of 60-80 feet.[9] In-diving, upper teeth are more affected than lower teeth,[8] and vast majority of episodes appeared upon descent.[9] Because appearance of barosinusitis is usually upon descent, whereas direct barodontalgia favors ascension (especially in vital pulp etiologies),[10] these 2 features (i.e., affecting upper teeth more and appearing upon descent) may indicate a greater role for maxillary sinus pathology in the etiology of in-diving barotrauma; more research is needed, however.

Flight conditions

Upper and lower teeth are affected equally. The most affected intraoral areas are posterior upper (50.0%) and lower (37.5%) dentitions,[13] with upper first molar (30.8%) and lower first molar (30.8%) the most affected teeth.[11] Pain intensity was rated as severe (75.0%) and moderate-severe (25.0%).[13] Most episodes were characterized as

Table II. Prevalence, incidence, and rate of barodontalgia*

	Taylor et al., 2003[7]	*Gonzalez Santiago Mdel et al., 2004*[11]	*Al-Hajri & Al-Madi, 2006*[9]	*Zadik et al., 2007*[12]	*Sipahi et al., 2007*[13]	*Jagger et al., 2009*[8]	*Weighted average*
In-flight							
Population	—	Spanish military aircrews	Saudi-Arabian & Kuwaiti military aircrews	Israeli military aircrews	Turkish military aircrews	—	
n	—	499	135	331	NR*	—	
Prevalence†	—	NR	NR	NR	0.3%	—	0.3%
Incidence‡	—	2.4%	49.6%	8.2%	NR	—	11.0%
Rate§	—	2	NR	10	NR	—	5
Altitude-chamber simulations							
Incidence‡	—	0.2%	NR	NR	NR	—	0.2%
In-diving							
Population	American and Australian civilian SCUBA divers	—	Saudi-Arabian & Kuwaiti military divers	—	—	Australian civilian SCUBA divers	
n	709	—	127	—	—	125	
Incidence‡	9.2%	—	17.3%	—	—	21.6%	11.9%

NR, not reported; *SCUBA*, self-contained underwater breathing apparatus.
*The authors analyzed 10,651 flights rather than aircrews-based analysis as other reports.
†Cases out of all flights.
‡Affected aircrews of ≥1 episode.
§Episodes per 1,000 flight-years.

Table III. Features of barodontalgia episodes

	Gonzalez Santiago Mdel et al., 2004[11]	*Al-Hajri & Al-Madi, 2006*[9]	*Sipahi et al., 2007*[13]	*Jagger et al., 2009*[8]	*Weighted average*
In-flight					
Population	Military aircrews	Military aircrews	Military aircrews	—	
n	13	67	32	—	
Affected teeth					
Upper	46.2%	NR	53.1%	—	51.1%
Lower	53.8%	NR	46.9%	—	48.9%
Appearance upon					
Ascent	46.2%	61.9%	NR	—	59.3%
Descent	23.1%	38.1%	NR	—	35.7%
Level, feet					
Appearance	9,846	NR	8,023	—	8,550
Disappearance*	5,800	NR	NR	—	5,800
In-diving					
Population	—	Military divers	—	Civilian SCUBA divers	
n	—	22	—	55	
Affected teeth					
Upper	—	NR	—	48.1%	48.1%
Lower	—	NR	—	29.6%†	29.6%
Appearance upon					
Descent	—	77.5%	—	NR	77.5%
Ascent (resurfacing)	—	22.5%	—	NR	22.5%
Level, feet					
Appearance	—	NR	—	NR	NR
Disappearance	—	NR	—	NR	NR

Abbreviations as in Table II.
*Regarding the cases in which the pain subsided during flight.
†22.2% suffered from dental pain in both upper and lower dentition.

sharp (76.9%) and localized (76.9%) rather than dull (23.1%) and diffuse (23.1%).[11]

Appearance of in-flight barodontalgia was reported at altitudes of 3,000-25,000 feet.[9,11] The pain may cease on returning to approximate onset level (3,000-10,000 feet)[11] or ground atmospheric level, but in many cases (61.5% in one report),[11] such as when pain is caused by periapical disease or by facial barotrauma, it lasts up to 3 days after landing.[15]

ETIOLOGY

Because barodontalgia is a symptom rather than a pathologic condition itself, and in most cases reflects a flare-up of preexisting subclinical oral disease, most of the common oral pathologies have been reported as possible sources of barodontalgia.[14,16] Table IV summarizes the most common conditions that were reported as causes of barodontalgia during flights.[9,11-13] The common etiologic pathologies for in-flight 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 pain origin in 9.7% of cases.

Cases of barodontalgia due to external otitic barotrauma (caused by expansion of air in earphone)[17] and to dental barotrauma (barometric pressure–related fracture of dental hard tissue and/or restoration)[18] have been reported. Together with barosinusitis, these examples of facial[19] and dental[20] barotrauma, respectively, are unique as barometric-related pathologic conditions that are generated during flight from pressure changes rather than pressure-related flare-up of preexisting conditions. Barodontalgia originated from referred pain of facial barotrauma is termed "indirect barodontalgia" (in contrast to dental-induced "direct barodontalgia"). The current data are proving that indirect barodontalgia is responsible for the minority (one-tenth) of cases, in contrast to some arguments that the vast majority or all barodontalgia cases are actually referred pain from barosinusitis.[21-23]

Robichaud and McNally[24] suggested that perforation in the oral tissue (e.g., after surgical procedure) may be prone to barodontalgia in aircrews and divers who wear oxygen mask, owing to air pushing into the tissues.

DIAGNOSIS

Barodontalgia is still known for the difficulty of obtaining on the ground a definitive diagnosis of the

Table IV. Etiologies of reported in-flight barodontalgia episodes

	Gonzalez Santiago Mdel et al., 2004[11]	*Al-Hajri & Al-Madi, 2006*[9]*	*Zadik et al., 2007*[12]†	*Sipahi et al., 2007*[13]	*Weighted average*‡
n	13	67	27	32	
Barosinusitis ("indirect barodontalgia")	0§	15.3%	18.5%	6.3%	9.7%
Recent dental treatment ("postoperative barodontalgia")	0	NR	29.6%	0	11.1%
Faulty restoration/dental caries without apparent pulp involvement	30.8%	NR	3.7%	50.0%	29.2%
Vital pulp pathology (i.e., exposure, pulpitis)	7.7%	NR	7.4%	21.9%	13.9%
Necrotic pulp/periapical pathology (including VRF)	53.8%	NR	22.2%	21.9%	27.8%
Impacted tooth	7.7%	NR	3.7%	0	2.8%

NR, not reported; *VRF,* vertical root fracture.
*Mixed population of military aircrews and divers.
†14.8% of this series remained undiagnosed.
‡Not including Al-Hajri and Al-Madi owing to incomplete available data.
§Although not diagnosed as barodontalgia origin, 30.8% and 7.7% concomitantly suffered from barosinusitis and barotitis, respectively.

causative pathology,[25,26] because even diagnostic altitude-chamber simulation[14] is not always effective nor practical.[10] According to one report, as many as 14.8% of cases eventually remained undiagnosed.[12]

In the diagnostic processing of a patient who suffered from barodontalgia, obtaining history of recent dental treatments, on-ground preceding symptoms, and pain onset/cessation (on ascent or descent) and nature provides invaluable data.[10] The clinician is advised to look for faulty restorations (including dislodged restorations over a vital pulp)[27] and secondary (remaining) caries lesion,[20] to perform vitality test and needed periapical radiographs, and to rule out sinusitis in episodes of pain in the upper posterior region[1] and pain originated from the temporomandibular joint or masticatory muscles in episodes of in-diving oral pain.[28]

According to one report, despite postepisode evaluation and treatment, recurrence of barodontalgia was reported in 16.4% of in-flight and 25.0% of in-diving cases.[9]

PATHOGENESIS

There was no published research regarding the pathogenesis of barodontalgia in the past decade. Despite some theories, most offered in the first half of the 20th century,[29] the pathogenesis of this unique dental pain remains occult.

PREVENTION

Periodic oral and dental examinations, including periapical radiographs and vitality tests, are recommended for the prevention of barodontalgia in high-risk populations (e.g., aircrews, divers). In addition, screening panoramic radiographs are recommended for these populations at 3-5-year intervals.[24,30] Special attention needs to be paid for periapical pathosis, faulty restorations, secondary caries lesions, and signs of teeth attrition.[1,31]

Temporary flight restriction (grounding) after dental and surgical procedures is still a powerful tool for prevention of postoperative barodontalgia.[1] Rossi[32] dictates the grounding of military aircrews from time of diagnosing the need for endodontic treatment until the completion of treatment. In addition, to prevent (subclinical) pulpitis or pulp necrosis and potential barometric pressure–related consequences, the same author contraindicates direct pulp capping in the military aircrew patient and indicates pulpectomy and endodontic treatment in all caries management in which invasion to the pulp chamber is evident or suspected.[32]

SUMMARY

The present article reviewed the updated knowledge regarding barodontalgia. Although it may seem that barodontalgia was almost neglected in dental education and research in the second half of the 20th century, during the past decade reports were gathered to draw an updated image of this pain entity.

This review refutes 3 generally accepted conventions: According to the results, the current weighted incidence of in-flight barodontalgia is similar to the incidence in the first half of the 20th century, the weighted incidence of barodontalgia among aircrews is similar to the weighted incidence among divers, and the role of facial barotrauma in the etiology of in-flight barodontalgia is minor.

More researchers', educators', and clinicians' efforts are needed for further enhancement of theoretic as well as practical knowledge of barodontalgia.

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