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Barodontalgia and Flight Safety: A Critical Narrative Review of Pressure Physiology, Acute Pain, and Human Factors

Barodontalji ve Uçuş Emniyeti: Basınç Fizyolojisi, Akut Ağrı ve İnsan Faktörleri
Açısından Eleştirel Anlatısal Derleme



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Abstract

Barodontalgia is dental or orofacial pain brought on by a change in barometric pressure, and it usually points to an underlying dental or maxillofacial problem rather than standing as a disease on its own. This narrative review looks at the condition through five lenses: pressure physiology, clinical presentation, epidemiology, occupational stress, and human factors relevant to flight safety. A literature search was conducted using PubMed/MEDLINE, Web of Science, Scopus, Google Scholar, and DergiPark between 22 April and 7 June 2026. One systematic review covering 4,894 aircrew members and divers reported an overall experience rate of 8.2%, with divers at 9.8% and aircrew at 5.8%. Divers may be more exposed simply because pressure changes more rapidly over a short vertical distance underwater and because descent-ascent cycles occur more often, though differences in study design across the diving and aviation literature make a direct comparison difficult. A Turkish pilot survey found that 81% of those who had experienced barodontalgia placed the pain below 2,000 ft. That is a striking figure, but it comes from self-report: it points to a plausible overlap with low-altitude, pressure-changing flight segments without actually confirming the flight phase or an operational safety effect. Bruxism, occupational stress, and barodontalgia appear together in the literature, but the association is observational and says nothing about causality. General pain research backs the idea that pain can pull attention away from a task, yet no study has measured pilot performance during an actual barodontalgia episode. Taken as a whole, the evidence makes barodontalgia a biologically credible and operationally worth-watching problem, potentially preventable in principle, even if its real performance cost has not yet been quantified.

Öz

Barodontalji, barometrik basınç değişimiyle ortaya çıkan ve çoğunlukla altta yatan bir dental ya da maksillofasial patolojiyi işaret eden dental veya orofasiyal ağrı tablosudur. Bu anlatısal derleme, konuyu basınç fizyolojisi, klinik özellikler, epidemiyoloji, mesleki stres ve insan faktörleri başlıkları altında ele almaktadır. Literatür taraması, 22 Nisan-7 Haziran 2026 tarihleri arasında PubMed/MEDLINE, Web of Science, Scopus, Google Scholar ve DergiPark veritabanları kullanılarak gerçekleştirilmiştir. Geniş kapsamlı bir sistematik derlemeye göre 4.894 uçuş personeli ve dalgıcın yüzde 8,2'si barodontalji bildirmiş; bu oran dalgıcılarda yüzde 9,8, uçuş personelindeyse yüzde 5,8 olarak saptanmıştır. Dalgıcılardaki bu görece yüksek oran, kısa dikey mesafelerde yaşanan büyük basınç değişimleri ve tekrarlayan iniş-çıkışlarla ilişkilendirilebilir; ancak çalışmalar arası maruziyet ve yöntem farklılıkları doğrudan kıyaslamayı güçleştirmektedir. Türk pilotları üzerinde yapılan bir ankette, ağrı bildiren pilotların yüzde 81'i bu ağrıyı 2.000 feet altında tecrübe ettiklerini belirtmiştir. Bulgu, basıncın değiştiği düşük irtifa segmentleriyle zamansal bir örtüşmeye işaret etmektedir; ancak öz bildirime dayandığından uçuş fazını ya da operasyonel riski doğrulayan bir kanıt olarak kabul edilmemelidir. Bruksizm, mesleki stres ve barodontalji arasındaki ilişkiler gözlemseldir; nedensellik göstermez. Ağrı literatüründeki genel bulgular, ağrının dikkati bölmeleceğini düşündürmekle birlikte, barodontalji sırasında pilot performansını doğrudan ölçen bir çalışma bulunmamaktadır. Barodontalji, bu haliyle; biyolojik olarak makul, operasyonel açıdan dikkate değer, fakat nicel kanıtı henüz kısıtlı olan, büyük ölçüde önlenabilir bir uçuş emniyeti konusu olarak değerlendirilmelidir.



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Barodontalgia and Flight Safety: A Critical Narrative Review of Pressure Physiology, Acute Pain, and Human Factors

Introduction

Dental pain associated with pressure change has been reported since the early years of aviation. It was first observed among military aircrew during the Second World War and was initially termed aerodontalgia. As similar clinical presentations were later identified in divers, the term barodontalgia, which more clearly emphasizes pressure change, entered the literature (Zadik et al., 2007). Barodontalgia is defined most simply as oral or dental pain triggered by barometric pressure changes. It is not a primary disease in itself; rather, it is usually the clinical manifestation of an existing dental or maxillofacial pathology under pressure stress (Nakdimon & Zadik, 2019; Zadik, 2009).

In this review, barodontalgia is considered not only as a localized dental complaint but also as a potential human-factors concern. The argument is a cautious one: sudden, severe pain could conceivably draw attention away from safety-critical tasks, yet no experimental study has actually linked barodontalgia to worse cockpit performance. Throughout this review, three types of evidence are kept distinct - what has been observed directly in aviation settings, what dental research supports indirectly, and what is inferred from the wider pain-and-cognition literature.

The aim of this review is to bring together what is currently known about barodontalgia's pressure physiology, clinical classification, epidemiology, occupational correlates, and possible relevance to human factors. The question guiding the review is a simple one: does the evidence support treating pressure-provoked dental pain as a preventable aviation health and safety issue, without stretching indirect findings into proof of operational harm?

Methods

This study was designed as a narrative review rather than a systematic review or meta-analysis. The literature search was conducted between 22 April and 7 June 2026 using PubMed/MEDLINE, Web of Science Core Collection, Scopus, Google Scholar, and DergiPark. Search strings combined the terms "barodontalgia," "aerodontalgia," "dental barotrauma," and "odontocrexia" with "aviation," "pilot," "aircrew," "flight," or "diving"; additional searches used "orofacial pain AND aviation," "bruxism AND pilot," "bruxism AND occupational stress," "acute pain AND attention," "acute pain AND working memory," "flight safety AND pain," "cabin pressure AND dental," and "hypobaric pressure AND dental," together with Turkish equivalents. Reference lists of key reviews and included articles were also screened.

No publication date or formal language restriction was applied. Publications were included if they addressed at least one of the following: barodontalgia or dental barotrauma in aviation or diving populations; pressure-related dental mechanisms; clinical classification or differential diagnosis; epidemiology among aircrew or divers; occupational stress or bruxism in pilots; pain-related attention or cognitive performance; or prevention and operational management. General dental-pain publications with no pressure or aviation/diving link, duplicate reports, non-scholarly webpages, and sources lacking methodological or clinical detail



were left out of the evidentiary core. Selected regulatory and aeromedical documents from ICAO, EASA, and the Turkish Directorate General of Civil Aviation were consulted only to give context on operational fitness and reporting concepts, not as evidence of clinical effectiveness (International Civil Aviation Organization, 2012; European Union Aviation Safety Agency, 2025; Sivil Havacılık Genel Müdürlüğü, 2021).

After screening titles and abstracts for relevance, the full texts of potentially eligible sources were reviewed. The evidence was classified into three tiers: direct evidence, coming from aviation or diving populations and documented barodontalgia cases; supporting evidence, from experimental dental or pressure-simulation studies; and indirect evidence, drawn from the broader pain, stress, and cognition literature. Reported prevalence figures and operational events are described here only where direct evidence exists; indirect findings are flagged as hypothesis-generating rather than confirmatory. The search process was iterative rather than prospectively logged, so record-level screening counts and a PRISMA flow diagram cannot be provided. Twenty-seven sources make up the final synthesis. No formal risk-of-bias tool was applied, and selection bias remains a possibility that is addressed in the Limitations section.

Pressure Physiology and Dental Pain Mechanisms

The physical basis of barodontalgia is the Boyle-Mariotte law: at a constant temperature, the volume of a given amount of gas is inversely proportional to ambient pressure. As altitude increases, atmospheric pressure decreases. Consequently, gas trapped beneath restorations, within carious cavities, in a necrotic pulp chamber, in periapical lesions, or in maxillofacial sinuses expands. In enclosed or poorly compliant dental and maxillofacial spaces, such expansion may alter local tissue pressure and contribute pain. (Bayar et al., 2023; Robichaud & McNally, 2005).

Nociceptive signals from the dental pulp travel to the central nervous system along the maxillary and mandibular branches of the trigeminal nerve. The pulp's enclosed setting, its limited volume, and its dense innervation explain why inflammatory dental pain is so often felt as sharp, severe, and sharply localized. Mechanical gas expansion alone does not account for it; the pain reflects the interplay of pulpal inflammation, vascular pressure swings, local ischemia, and trigeminal nociceptive transmission (Stoetzer et al., 2012; Zadik, 2010).

Several theories have been advanced over the years to explain barodontalgia associated with pulpitis, among them intrapulpal gas expansion, reduced gas solubility, direct ischemia, and indirect ischemia from vasodilation. No single explanation covers every clinical presentation, and current thinking treats barodontalgia less as a single-mechanism event than as an integrated pulpal and periapical stress response set off by changes in barometric pressure (Bayar et al., 2023; Zadik, 2009).

From a diagnostic standpoint, the phase of flight in which pain appears is a useful pointer. Pain on ascent tends to accompany vital pulp inflammation, whereas pain on descent points more often to a necrotic pulp, periapical pathology, or barotrauma of the adjacent sinus cavities. The distinction is far from absolute, however. Barotrauma arising in the maxillary sinus or middle ear can refer pain to the upper posterior teeth and be mistaken for true dental barodontalgia (Garges, 1985; Robichaud & McNally, 2005).

Clinical Classification and Differential Diagnosis

The classification most often cited is the four-class system proposed by Ferjentsik and Aker in 1982, which links the presumed pulpal or periapical diagnosis to pain quality and the phase of pressure change (Ferjentsik & Aker, 1982; Zadik, 2009). It works as a clinical heuristic, not an infallible rule - individual cases vary, and the timing of pain cannot substitute for examination, pulp testing, and imaging where these are indicated. Table 1 summarizes the typical associations.

Table 1

Typical barodontalgia patterns according to the Ferjentsik-Aker classification. These associations are clinically useful but are not diagnostic rules.

Class	Underlying pathology	Pain quality	Typical flight phase
I	Irreversible pulpitis	Sharp, sudden pain	Ascent
II	Reversible pulpitis	Dull or throbbing pain	Ascent
III	Necrotic pulp	Dull or throbbing pain	Descent
IV	Periapical pathology	Severe and persistent pain	Both phases

Differential diagnosis turns on distinguishing pain of direct dental origin from referred pain due to sinus or middle-ear barotrauma. Pain confined to a single tooth and backed by percussion or vitality-test abnormalities fits a dental origin. Dull, diffuse pain across several upper posterior teeth, particularly when vitality tests are normal, should instead raise early suspicion of sinus barotrauma (Garges, 1985; Robichaud & McNally, 2005). One practical obstacle is that the pressure changes that provoke symptoms cannot usually be reproduced in a standard dental clinic operating at 1 atm.

Dental barotrauma and odontocrexia also belong in the differential. Defective restorations, secondary caries, and heavily restored teeth can develop microfractures during pressure changes due to trapped air (Zadik et al., 2006). Even clinically sound teeth have been reported to fracture under hypobaric conditions, which shows that, in aviation populations, calling a tooth "sound" on visual inspection alone may not be enough (Gunepin et al., 2010).

Epidemiology and Exposure Context

Frequency figures for barodontalgia call for care in how the metric is read. Event rates per flight, incidence per flight-year, and person-based lifetime experience rates are conceptually distinct, and losing that distinction can make published percentages look contradictory. The 0.3% rate reported among Turkish Air Force personnel, for instance, is closer to an event-per-flight measure, whereas the figures in the systematic review by Nakdimon and Zadik reflect person-based lifetime experience of barodontalgia (Sipahi et al., 2007; Nakdimon & Zadik, 2019).

The largest pooled dataset comes from Nakdimon and Zadik's 2019 systematic review of 4,894 aircrew members and divers, which reported overall experience rates of 8.2%, with 9.8% among divers and 5.8% among aircrew. Why divers report more may have a fairly straightforward physical explanation: ambient pressure rises by roughly one atmosphere in just the first 10 m of descent, a large change packed into a short vertical distance, and repeated descents, depth, and regulator-related clenching could add further orofacial loading (Robichaud & McNally, 2005; Moyaux et al., 2022). These remain plausible explanations rather than proven causes of the pooled gap, since diving and aviation studies differ in exposure frequency, surveillance intensity, participant selection, and outcome definitions.

Barodontalgia is not confined to one aviation population. French military and civilian pilots and aircrew reported it at 6.6%, and 13.5% of those affected described an event they considered relevant to flight safety (Laval-Meunier et al., 2013). Jordanian and Malaysian military-pilot surveys found prevalences of 10.49% and 12.1% respectively, with headache or concentration problems reported by some affected participants (Al Khawalde et al., 2016; Abidin et al., 2025). All of these figures rest mainly on retrospective self-report and should not be read as objectively verified performance loss.



Table 2*Selected epidemiological findings and the strength of their operational interpretation.*

Source	Population and n	Frequency/key finding	Interpretation and limitations
Nakdimon & Zadik, 2019	Aircrew and divers; n = 4,894	Overall 8.2%; aircrew 5.8%; divers 9.8%	Higher pooled proportions in divers and civilian groups; heterogeneous exposure and surveillance limit causal interpretation.
Laval-Meunier et al., 2013	French military/civilian pilots and aircrew; n = 1,184	Barodontalgia 6.6%; 13.5% of affected respondents reported flight-safety relevance	Retrospective self-report; operational effect was not verified by flight-data records.
Al Khawalde et al., 2016	Jordanian military pilots; n = 305	Prevalence 10.49%; headache and concentration-related symptoms reported	Cross-sectional self-report; symptoms do not quantify objective performance loss.
Topbaş et al., 2024	Turkish civilian and military pilots; n = 526	81% of affected pilots reported pain below 2,000 ft	Possible overlap with changing-pressure/high-workload segments is inferred, not confirmed by cabin-pressure or flight-data records.
Abidin et al., 2025	Malaysian military pilots; n = 190	Prevalence 12.1%; concentration difficulty reported by some affected pilots	Cross-sectional self-report; causality and operational magnitude remain uncertain.

The most directly relevant Turkish data come from Topbaş et al. (2024), who surveyed 526 pilots from Turkish Airlines and the Turkish Air Force. Among those who reported barodontalgia, 81% placed the pain below 2,000 ft. One plausible reason is fairly straightforward: cabin pressure changes during climb and descent but remains comparatively stable at cruise, and a given vertical interval produces a larger absolute pressure change near sea level. Still, the survey relied on participant recall rather than cabin-pressure traces, flight-data records, or verified phase-of-flight timing. What the result suggests, then, is a possible temporal overlap with take-off, initial climb, approach, landing, or go-around - not confirmation that pain occurred in a specific phase, and certainly not evidence that it caused an operational safety event.

Bruxism and Occupational Stress

Pilots face a cluster of occupational stressors - heavy responsibility, time pressure, circadian disruption, noise, vibration, and, in some roles, high acceleration. Some military pilot groups show greater tooth wear or bruxism indicators than comparison groups in observational studies (Lurie et al., 2007; Al-Khalifa, 2022). That is reason enough to pay clinical attention to parafunction, though it does not mean aviation stress causes bruxism in every pilot.

A link between bruxism and barodontalgia makes clinical sense: parafunctional loading could plausibly wear teeth, weaken restoration margins, open cracks, expose dentin, and produce muscular or temporomandibular pain. Topbaş et al. (2024) found bruxism more often among pilots who reported barodontalgia. What a cross-sectional design cannot tell us is which way the arrow points - bruxism could be a contributing factor, a marker of shared occupational or behavioral exposures, or simply an associated condition with no causal role at all.

A reasonable middle ground is to fold bruxism assessment into the broader dental history for aircrew, particularly where tooth wear, restoration failure, muscle tenderness, or temporomandibular symptoms are

already present - treating it as sensible risk-oriented practice rather than a proven way to prevent in-flight barodontalgia.

Human Factors and Flight Safety

Aeromedical practice exists largely to keep aircrew from losing functional capacity mid-duty. Severe dental pain could distract a crew member or impede communication, monitoring, and task sharing. The direct aviation evidence for this, though, consists mainly of self-reported concentration problems, case reports, and retrospective accounts; no controlled study has measured pilot performance during a barodontalgia episode.

The wider pain literature lends indirect support to an attentional mechanism - pain is well documented to interrupt ongoing activity and compete for attentional resources (Eccleston & Crombez, 1999; Moriarty et al., 2011). A meta-analysis of experimentally induced pain found moderate evidence of effects on orienting and alerting attention but not on executive attention (Gong et al., 2019), suggesting that the cognitive effects depend on the task rather than uniformly impairing everything. Since most of this work is not aviation-specific and comes from experimental or chronic-pain settings, it speaks to biological plausibility more than to any measured cockpit-performance effect.

Where barodontalgia might matter operationally is in the combination of sudden pain, the limited scope for definitive treatment mid-flight, and its possible timing during periods of changing pressure. The self-reported low-altitude finding among Turkish pilots makes overlap with high-workload segments conceivable - but that remains an inference, not a measurement. Barodontalgia is better described as a plausible, preventable human-factors concern than as a demonstrated cause of pilot error or accident risk.

Prevention and Clinical/Operational Implications

Prevention comes down mainly to identifying and treating the underlying dental or maxillofacial problem before exposure to pressure. Clinical aviation-dentistry reviews call for careful assessment of active caries, pulpal and periapical disease, defective restorations, open dentin, fractures, and sinus-related symptoms, reserving vitality testing and imaging for cases where they are clinically indicated rather than applying them indiscriminately (Zadik, 2009; Robichaud & McNally, 2005; Gunepin et al., 2012).

For patients with aviation duties, their specific occupation and any recent pressure-related symptoms are worth documenting, as they inform the differential diagnosis, the timing of definitive treatment, and whether aeromedical communication is needed. Post-treatment advice should be tailored to the procedure, symptoms, healing, infection, and sinus involvement rather than following a fixed rule - this review does not set out procedure-specific waiting periods. Table 3 lays out a proposed risk-screening framework and, for each element, states plainly whether it is based on clinical literature, observational associations, or the author's own judgment.

Table 3*Proposed risk-oriented dental assessment for aviation personnel, with the basis of each recommendation.*

Assessment domain	Clinical question or procedure	Operational purpose	Evidence basis/status
Occupation and exposure	Is the patient a pilot, cabin crew member, air traffic controller, technician, diver, or frequent flyer?	Identify relevant pressure exposure and safety-critical duties.	Author-proposed screening question informed by aviation-dentistry literature.
Pain history	During which phase of flight or diving did pain begin, and how long did it last?	Support differential diagnosis and identify recurrent pressure-related symptoms.	Clinical aviation-dentistry evidence: timing is suggestive, not diagnostic.
Active dental pathology	Are caries, pulpitis, periapical lesions, periodontal disease, or pericoronitis present?	Treat underlying disease before pressure exposure when feasible.	Established clinical principle supported by aviation-dentistry reviews.
Restorations and structural integrity	Are there defective restorations, secondary caries, cracks, or microleakage?	Identify potential sources of pain or structural failure under pressure change.	Case reports, clinical reviews, and laboratory evidence.
Bruxism/TMD	Is there tooth clenching, tooth wear, muscle tenderness, or temporomandibular dysfunction?	Identify associated parafunction and orofacial symptoms.	Observational association; a causal link with barodontalgia is unproven.
Imaging	Is periapical or panoramic imaging clinically indicated?	Detect pathology not evident on clinical examination.	Indication-based clinical recommendation; not universal routine screening.
Post-treatment plan	Have symptom review, follow-up, and individualized duty/flight advice been provided?	Avoid return to pressure exposure with unstable symptoms or incomplete healing.	Existing clinical guidance plus expert judgment; no fixed waiting period is proposed in this review.

Periodic dental assessment has been proposed for aircrew, particularly where asymptomatic disease could become relevant under pressure change (Bayar et al., 2023). Historical airline radiographic archives show the value of keeping longitudinal records, though present-day imaging should stay indication-based and follow radiation-protection principles rather than becoming routine for every crew member (Keiser-Nielsen et al., 1981). At the institutional level, this review proposes that significant in-flight dental-pain events be reported through existing non-punitive safety or occupational-health channels and followed by dental evaluation where appropriate - a suggestion that has not been prospectively validated and should not be mistaken for a regulatory requirement.

Limitations

Several limitations apply to this narrative review. The search and selection process was iterative rather than prospectively logged as a systematic review, so record-level screening counts and a formal risk-of-bias assessment are unavailable, and author judgment may have influenced which sources were included. Much of the epidemiological evidence comes from cross-sectional surveys and military populations, and the literature mixes heterogeneous measures - events per flight, period prevalence, career-long experience - that do not translate neatly into one another. The 81% low-altitude finding is self-reported and cannot pin down the exact flight phase, cabin-pressure profile, or operational consequence.

Much of the human-factors interpretation here is extrapolated from general pain and attention research rather than drawn from barodontalgia-specific studies. No simulator or flight-performance study of

barodontalgia was identified in this review and self-reported difficulty concentrating is not the same as objectively measured performance loss. The links among occupational stress, bruxism, dental wear, and barodontalgia remain observational, not causal. Finally, the screening and reporting framework proposed in this review combines published clinical recommendations with author-proposed suggestions and has not been validated as a safety intervention.

Future Research

Prospective aircrew cohorts would be valuable, as would standardized reporting of altitude and flight phase and registries that distinguish barodontalgia from ordinary dental or sinus pain. Given the ethical and safety concerns associated with intentionally exposing individuals with active dental pathology to hypobaric conditions, normobaric simulator studies may offer a safer alternative. Such studies could use ethically acceptable, reversible, non-nociceptive paradigms to examine whether dental pain expectancy affects attention, reaction time, mental workload, and crew resource management performance in dentally healthy volunteers. The author is currently developing a normobaric, nocebo-based simulator study to investigate these effects in active pilots without administering a painful stimulus. Any future hypobaric research should be restricted to dentally healthy participants and include dental screening, medical oversight, predefined stopping criteria, and formal ethics approval. Longitudinal studies are also needed to determine whether occupational stress, bruxism, restoration quality, or preventive dental programs predict subsequent barodontalgia.

Conclusion

Barodontalgia is a pressure-provoked symptom of dental or maxillofacial disease that matters to aviation because it can appear suddenly, at a moment when definitive treatment is not an option. Case reports and surveys show it can be severe and is sometimes accompanied by self-reported difficulty concentrating, but no study identified in this review has directly measured its effect on cockpit performance. The broader pain literature offers a plausible mechanism - pain interrupting attention - though this remains indirect evidence, not proof that flight safety has actually been compromised.

Pooled figures show that a meaningful minority of exposed populations experience barodontalgia, with divers reporting it more often than aircrew. The Turkish low-altitude finding and the association with bruxism are worth testing further, but neither establishes that the flight phase causes the pain or that a stress-bruxism-barodontalgia pathway actually exists. Risk-oriented dental assessment, prompt treatment of underlying disease, symptom awareness, and clear communication with aeromedical services all seem like reasonable precautions in the meantime - though whether they actually work should be tested prospectively before anyone turns them into formal safety standards.



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