International Journal of Medical Discoveries
Volume 2, Issue 1
ISSN: 3067-7912

Altitude-Induced Oral and Sinus Complaints: Prevalence of Barodontalgia in Hot Air Balloon Operators: A Cross-sectional Study

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Abstract

Background: Barodontalgia is a clinical condition characterized by intraoral pain that develops due to changes in atmospheric pressure and can be of odontogenic or non-odontogenic origin.

Purpose: The study aimed to assess the prevalence, severity, and potential risk factors of barodontalgia due to changes in atmospheric pressure among hot air balloon pilots and flight crew members operating hot air balloon flights in the Cappadocia region. The study highlighted the clinical consequences of barometric stress experienced by the dental occupational group and emphasized the need for preventive healthcare services.

Materials and Methods: A cross-sectional observational study was conducted using a structured questionnaire, including 36 active hot air balloon pilots and crew members working in the Cappadocia region. The duration of the study was approximately seven months, starting from the date of ethical approval. Toothache and symptoms related to barometric pressure changes were evaluated. The study included participants on duty and regular flights. Participants with a history of major maxillofacial surgery were excluded from the study. Data were analyzed using descriptive statistics and the chi-square test for correlations between categorical variables, with statistical significance set at $p < 0.05$.

Results: 72.22% of the participants underwent no dental examination for their flight permit; 41.67% had not seen a dentist in the last 6 months, and 27.78% for more than 1 year. 11.11% of the participants reported experiencing a toothache during the flight, 75% of this group stated that the pain was felt only in the air, and 25% said the pain continued on land. Gum bleeding was reported in 44.44% of the participants, 33.33% reported sinusitis, and 58.33% of these individuals stated that their symptoms increased during the flight. 36.11% of the participants experienced ear blockage or bleeding during the flight. Systemic symptoms included fatigue, reported in only 2 participants, while 2 reported shortness of breath, 1 reported headache, and 2 reported both headache and palpitations.

Conclusions: In individuals exposed to barometric pressure, which decreases with altitude, toothache symptoms were observed in 11.11% of cases during flight. The fact that the pain only occurs during flight and increases in intensity during this period suggests that the decreased pressure may cause clinically significant symptoms in the dentoalveolar tissues.

Keywords: Barodontalgia, Aerodontalgia, Hot air balloon, toothache.

Introduction

Barometric pressure fluctuations can cause various physiological problems in the human body, particularly in aviation and diving, where altitude and depth changes are frequently experienced [1]. These changes cause sudden changes in the volume of gases in body cavities, leading to tissue damage known as barotrauma [2]. For barotrauma to occur, a change in ambient pressure must be transmitted to a gas-filled space that is either non-collapsed or partially collapsible [3]. Gas expansion can cause tissue rupture, while volume reduction can lead to vascular occlusion, mucosal swelling, and bleeding. This is particularly true in physiological or pathological gas spaces such as the middle ear, sinuses, lungs, intestines, teeth, and eyes, which contain air-filled spaces like face masks [4].

Barodontalgia is a clinical condition characterized by intraoral pain that develops due to changes in atmospheric pressure and can be of odontogenic or non-odontogenic origin [5]. The first systematic observations were made during World War II, when aircrew experienced toothaches in flight and were defined as “aerodontalgia” [6, 7]. Historically known as “aviators’ toothache,” barodontalgia is more frequently observed in individuals who have undergone restorative procedures, have pulpal

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Received: 22-Oct-2025 Revised: 13-Nov-2025 Accepted: 15-Dec-2025

International Journal of Medical Discoveries
Volume 2, Issue 1
ISSN: 3067-7912

disease, or have sinus pathology [8]. According to Boyle's Law, the volume of a gas at constant temperature is inversely proportional to the ambient pressure [9]. In line with this physical principle, decreasing atmospheric pressure with increasing altitude causes gases trapped in dental tissues to expand. The volumetric change of gases, particularly in spaces under restorations, root canal fillings, or sinus cavities, can exert pressure on surrounding tissues and cause pain [10].

Under normal conditions, intrapulpal pressure is around 25–30 mmHg, and this pressure is transferred to the dentinal fluid [11]. The higher pulp pressure than intraoral pressure facilitates fluid movement into the oral cavity via the dentinal tubules [12]. Decreased atmospheric pressure due to altitude can alter this fluid movement, leading to dentinal sensitivity and pain [13]. Furthermore, in pulpal tissue inflammation, increased vascular permeability and blood flow due to the lack of collateral circulation and rigid, expansion-resistant anatomical boundaries lead to increased pressure, resulting in oedema [14]. This, in turn, restricts tissue expansion and contributes to pain. Pain-causing barodontalgia is usually associated with predisposing dental pathologies such as caries, acute/chronic periapical infection, failed restorations, residual cysts, sinusitis or recent surgery [15].

While the prevalence of barodontalgia among military aviation personnel ranges from 0.3% to 2%, the majority of these studies have focused on extreme conditions such as high-altitude jet flights or diving [6, 16]. In civil aviation, hot air balloon flight personnel, particularly in the Cappadocia region, are exposed to chronic barometric stress, even though they fly at lower altitudes. Hot air balloon flights in Cappadocia generally range from 500–1500 meters [17]. The early morning flights, cold weather conditions, sudden altitude changes, and pressure fluctuations during flight predispose these personnel to the emergence of barodontalgia symptoms. Furthermore, the daily participation of these personnel in flights increases the repetitive and cumulative effects of barometric stress [18, 19].

Exposure to high altitude is associated with pathophysiological processes such as hypoxia, decreased oxygen saturation, and reduced barometric pressure, which adversely affect oral tissue health [20]. Studies have demonstrated a significant relationship between the severity of barodontalgia and the duration of barometric stress exposure, emphasizing that long-term pressure changes can lead to deterioration of dental health [21]. Regular dental checkups, oral hygiene maintenance, and timely restorative treatments are crucial to reduce the risk of barodontalgia in individuals experiencing frequent changes in ambient pressure [22]. Dentin exposure, caries, fractured teeth, the condition of restorations, and periapical pathologies should be carefully evaluated in at-risk individuals [23]. While numerous studies on barodontalgia among military pilots and divers exist in the literature, systematic studies examining this phenomenon in civilian hot air balloon pilots are pretty limited. This significant gap highlights the need for comprehensive research to better understand this group's oral and dental health, which has a unique risk profile both regionally and professionally.

This study evaluated the prevalence, character and etiological factors of barodontal symptoms in hot air balloon flight crew working in the Cappadocia region. The study also contributes to the development of preventive oral health services.

Methodology

Study Design and Setting

A cross-sectional observational study was executed using a structured questionnaire, involving 36 balloon pilots and crew members working in the Cappadocia region. This aimed to collect data from individuals regularly exposed to high altitudes and vulnerable to potential barometric stress. The study aimed to evaluate the toothache and related symptoms experienced by hot air balloon pilots and flight crew members due to barometric pressure changes. The duration of the study was

Eligibility Criteria

The selection of the participants was based on specific inclusion and exclusion criteria.

Inclusion Criteria

Participants currently on active duty in routine balloon flights. Participants with no history of oral and maxillofacial surgery, such as orthognathic surgery, post-traumatic reconstructive surgery, cyst or tumour excisions. However, relatively standard and low-risk procedures, such as implant surgery and impacted tooth extraction, were not considered exclusion criteria.

Exclusion Criteria

Participants with prior major maxillofacial surgery. This approach was adopted to minimize the potential impact of surgical history on barodontal symptoms and

increase the sample's homogeneity.

Procedure

A structured questionnaire was developed and pilot-tested for the study, which was used as the data collection tool. The survey included questions regarding participants' demographic information, such as gender, age, education level, oral and dental health history, and any toothache and related complaints experienced during flight and on land. The study was considered a "non-invasive clinical study" as it did not involve any interventional procedures and only collected data based on a questionnaire via email.

Ethical Consideration

This study was approved by the Cappadocia University Non-Interventional Clinical Research Ethics Committee (Decision No. 25.02, dated February 12, 2025). Written informed consent was obtained from all participants before their inclusion in the study. All procedures were conducted per the ethical standards of the institutional and national research committees and with the 1964 Helsinki Declaration and its later amendments.

Statistical Analysis

The obtained data were analyzed using descriptive statistics: frequency, percentage, mean, and standard deviation. The chi-square (χ^2) test assessed the relationship between categorical variables. This test examined the relationships between variables such as education level and routine dental examination habits, gum bleeding and pain type, sinusitis and toothache in the posterior maxilla, and increased pain in windy weather. Statistical analyses were performed using SPSS (IBM Corp., Released 2012. IBM SPSS Statistics for Windows, Version 21.0, Armonk, NY: IBM Corp.) program, and $p<0.05$ was considered statistically significant.

Results

A total of 36 participants were included in this study, as shown in Table 1. About 11.11% (4) of the participants were female, and 88.89% (32) were male. Their ages ranged from 22 to 58, with an average age of 32.7. Regarding their education level, 2.78% (1) had completed secondary school, 33.33% (12) had completed high school, 55.56% (20) had completed university, and 8.33% (3) had completed a postgraduate degree.

Table 1. Demographic Characteristics of Participants (n = 36)

Characteristic	**n**	**%**
Total Participants	36	100
Age (Mean ± SD)	32.7 ± 7.7	–
Gender		
• Female	4	11.1
• Male	32	88.9
Education Level		
• Secondary School	1	2.8
• High School	12	33.3
• University	20	55.6
• Postgraduate	3	8.3

Table 2 and Table 3 demonstrate that the % of those who underwent an oral and dental health examination for flight permits was 27.78% (10). In comparison, 72.22% (26) stated that they had not undergone any such examination. According to the timing of the participants' dental visits, 41.67% (15 people) reported visiting a dentist within the last 6 months, 30.56% (11 people) between the previous 6 months and 1 year, and 27.78% (10 people) more than 1 year ago. While 11.11% (4 people) of participants had routine dental checkups due to their profession, 88.89% (32) stated that they did not have this habit. No statistically significant relationship was found between education level and routine dental checkup habits ($\chi^2 = 1.74$, $p = 0.627$) as shown in Table 4.

Table 5 and Table 6 demonstrate that the proportion of participants who experienced a toothache during flight was 11.11% (4 people), and 88.89% (32 people) did not

International Journal of Medical Discoveries
Volume 2, Issue 1
ISSN: 3067-7912

Table 2. Clinical Characteristics (n = 36)

Variable	n	%
Routine Dental Examination		
• Yes	4	11.1
• No	32	88.9
Gum Bleeding		
• Present	16	44.4
• Absent	20	55.6
Nature of Toothache		
• Aching	22	61.1
• Throbbing	9	25.0
• Itching	2	5.6
• Sudden sensation like lightning	1	2.8
• Throbbing + Itching*	1	2.8
• No pain	1	2.8
Presence of Sinusitis		
• Present	12	33.3
• Absent	24	66.7
Pain in Posterior Maxilla		
• Present	7	19.4
• Absent	29	80.6
Increased Pain in Windy Weather		
• Yes	24	66.7
• No	12	33.3

**One participant reported both throbbing and itching sensations.*

Table 3. Relationship between Dental Examination for Flight Permit and Time since Last Dental Visit

Time Since Last Dental Visit	Examined (0)	Not Examined (1)	Total
0–6 months	2	12	14
6–12 months	2	3	5
≥1 year	0	17	17
Total	4	32	36

Table 4. Relationship between Education Level and Time since Last Dental Visit

Education Level	Last 6 Months (n, %)	6–12 Months (n, %)	≥1 Year (n, %)	Total (n, %)
Primary School	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Secondary School	1 (100)	0 (0.0)	0 (0.0)	1 (100)
High School	5 (41.7)	2 (16.7)	5 (41.7)	12 (100)
University	8 (42.1)	1 (5.3)	10 (52.6)	19 (100)
Postgraduate	2 (50.0)	2 (50.0)	0 (0.0)	4 (100)
Total	16 (44.4)	5 (13.9)	15 (41.7)	36 (100)

Table 5. Toothache during Flight by Age Group

Age Group	Pain Present	No Pain	Total
22–39 years	4	25	29
40–58 years	1	6	7
Total	5	31	36

Table 6. Toothache in Air, Toothache on Land, and Increased Pain in Air

Toothache in the Air	Toothache on Land	Increased Pain in the Air	Number of Participants (n)
Yes (0)	Yes (0)	Yes (0)	1
Yes (0)	Yes (0)	No (1)	0
Yes (0)	No (1)	Yes (0)	3
Yes (0)	No (1)	No (1)	1
No (1)	Yes (0)	Yes (0)	0
No (1)	Yes (0)	No (1)	0
No (1)	No (1)	Yes (0)	0
No (1)	No (1)	No (1)	0

report such a problem. Of those experiencing pain, 25% (1 person) stated that it continued on land, and 75% (3 people) stated it was felt only in the air. In the same group, 75% (3 people) reported increased pain intensity in the air, while 25% (1) stated no such increase.

Tables 7 and 8 illustrate that 44.44% (16 people) of participants reported experiencing gum bleeding, while 55.56% (20 people) did not. No significant relationship was found between gum bleeding and pain type ($\chi^2 = 1.98$, $p = 0.739$). While 66.67% (24 people) reported increased toothache, pain, or sensitivity in windy weather, 33.33% (12) did not experience such a change, as shown in Table 9. No significant association was observed between increased pain in windy weather and a history of sinusitis ($\chi^2 = 2.25$, $p = 0.13$), as shown in Table 10. According to the nature of the toothache, 61.11% (22 people) of the participants described the pain as "aching," 25% (9 people) described

Table 7. Cross Table: Gum Bleeding and Type of Pain

Gum Bleeding	Aching (0)	Throbbing (1)	Itching (2)	Sudden Sensation (3)	No Pain (4)	Throbbing + itching (5)	Total
Present (0)	10	4	1	1	0	1	17
Absent (1)	7	7	1	1	0	1	17
Total	17	11	2	2	0	2	34

Table 8. Type of Pain and Gum Bleeding

Type of Pain	Gum Bleeding Present	Gum Bleeding Absent	Total
Aching	11	11	22
Throbbing	3	6	9
Itching	1	1	2
Sudden Sensation	1	0	1
No Pain	0	1	1
Throbbing + Itching	0	1	1
Total	16	20	36

International Journal of Medical Discoveries
Volume 2, Issue 1
ISSN: 3067-7912

it as "throbbing (like a pulse)," 5.56% (2 people) described it as "itching," and 2.78% (1 person) described it as "a sudden sensation like a lightning strike." In addition, 1 person reported both throbbing and itching, and another participant experienced no pain.

Table 9. Increase in Toothache/Pain/Sensitivity in Windy Weather (n = 36)

Increase in Windy Weather	n	%
Yes	24	66.7
No	12	33.3
Total	36	100

Table 10. History of Sinusitis and Increased Pain in Windy Weather

Sinusitis History	Pain in Windy Weather	No Pain in Windy Weather	Total
Present	10	2	12
Absent	14	10	24
Total	24	12	36

$\chi^2 = 2.25$; $p = 0.13$ (no significant relationship between history of sinusitis and increased pain in windy weather).

Tables 11 and 12 illustrate that 33.33% (12 people) of the participants reported suffering from sinusitis, 58.33% (7 people) of whom reported an increase in their symptoms during the flight, and 41.67% (5 people) reported no increase. No significant relationship was found between sinusitis and pain in the posterior maxillary region ($\chi^2 = 1.09$, $p = 0.297$). 19.44% (7 people) of individuals with sinusitis felt more pain in their upper jaw posterior teeth.

Table 11. Sinusitis and Posterior Maxillary Pain

Sinusitis	No Posterior Maxillary Pain	Posterior Maxillary Pain	Total
Absent (0)	4	8	12
Present (1)	3	21	24
Total	7	29	36

Table 12. Increase in Symptoms During Flight Among Participants with Sinusitis (n = 12)

Symptom Increase	n	%
Present	7	58.3
Absent	5	41.7
Total	12	100

Table 13. Relationship between Gender and Time since Last Dental Visit

Gender	Within Last 6 Months (n, %)	6–12 Months Ago (n, %)	≥1 Year Ago (n, %)	Total (n, %)
Female	4 (26.7)	1 (9.1)	0 (0.0)	5 (13.9)
Male	11 (73.3)	10 (90.9)	10 (100)	31 (86.1)
Total	15 (100)	11 (100)	10 (100)	36 (100)

No statistically significant relationship was found between gender and time to see a dentist ($\chi^2 = 5.38$, df

= 2, p = 0.0677). 36.11% (13 people) of the participants reported experiencing ear blockage or bleeding during the flight, while 63.89% (23) did not report such a problem, as shown in Table 13.

Chi-square test: $\chi^2 = 5.38$, df = 2, p = 0.0677

Systemic symptoms due to hypoxia were rarely observed; fatigue was noted in 2 participants, shortness of breath in 2, headache in 1, and both headache and palpitations in 2. When toothache experienced during the flight was evaluated according to age groups, 13.8% (4 people) of participants between the ages of 22–39 and 14.3% (1 person) of those between the ages of 40–58 reported pain, and no significant relationship was found between these two variables ($\chi^2 = 0.08$, p = 0.77) as shown in Table 14.

Table 14. Findings of Hypoxia

Symptom	**n**	**%**
Fatigue	2	5.6
Shortness of breath	2	5.6
Headache	1	2.8
Headache + Palpitations	2	5.6
Palpitations	0	0
Confusion	0	0
Cough	0	0
Cyanosis	0	0
None	29	80.6
Total	36	100

Discussion

Barodontalgia is a clinical symptom caused by altered altitude and atmospheric pressure, significantly affecting flight members, airline passengers, and pilots [10]. The current study assessed the toothache and related symptoms in hot air balloon flights due to decreasing barometric pressure. It provides essential preliminary findings regarding barodontalgia in this specific civil aviation branch. In the literature, barodontalgia has been studied primarily in individuals operating in extreme environments, such as military pilots, jet crews, and divers, while civilian personnel perform low-altitude operations. Still, frequent flights have been overlooked [21, 24]. This study highlights the importance of evaluating dental health, particularly in groups exposed to repetitive barometric stress [25].

The fact that 11.11% of participants reported experiencing a toothache during flight demonstrates that even low-altitude flights can significantly affect oral and dental health [26]. Furthermore, the fact that 75% of pains occurred solely during flight suggests a direct effect of barometric pressure changes on dental tissues. This finding is consistent with the classical mechanism describing barodontal symptoms, which may occur due to intradental gas volume expansion in individuals undergoing restorative treatment or with pulpal pathology [27]. Considering that only 27.78% of participants received a pre-flight dental examination, and 88.89% did not have a routine dental checkup, this occupational group appears to be excluded from systematic dental health monitoring. This demonstrates a lack of awareness of individual and occupational risks and points to a lack of preventative oral health protocols in civil aviation [5].

The findings showed that pulp-related pain and periodontal and sinus complaints were prominent. Gum bleeding was reported in 44.44% of participants, sinusitis in 33.33%, and ear blockage or bleeding in 36.11%. These rates demonstrate that intradental tissues and all pressure-sensitive oral and head-neck structures are under stress during flight [26]. Indeed, 58.33% of individuals with sinusitis experienced increased symptoms during flight, confirming the phenomenon of barosinusitis described in the literature [28].

Boyle's Law and pulp physiology are key determinants in understanding the effects of barometric trauma. Under normal conditions, intrapulpal pressure is around 25–30 mmHg; this balance is disrupted by a decrease in atmospheric pressure, resulting in oedema in the pulp

International Journal of Medical Discoveries
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microvasculature[29]. The inability of the oedema to expand due to the rigid dentinal boundaries exacerbates pain (Berman et al., 2021). This effect is particularly acute in under-restoration cavities, unsuccessful root canal treatments, and fillings that produce microleakage [30, 31]. Even in self-report-based assessments, participants described pain in various ways, such as "throbbing," "aching," and "lightning," demonstrating that barodontalgia can manifest not with a single symptom, but with a variable clinical presentation [32]. This suggests that during dental examinations, flight personnel should carefully assess restoration quality, the sinus-tooth relationship, and pain history based on the timing of the flight, not just for classic caries or abscesses [33].

Additionally, the study found no statistically significant differences between demographic variables such as age group, gender, education level, dental pain, or dental examination habits. This suggests that the risk of barodontalgia is more closely tied to flight-specific environmental conditions than to age or socioeconomic status. Therefore, it would be more appropriate to develop occupation-based preventive programs rather than individual-based ones [34]. The low rate of reporting of hypoxia-related symptoms (fatigue, headache, palpitations) in our study may be explained by the relatively low altitudes of hot air balloon flights and the limited changes in oxygen saturation. However, observing systemic symptoms in some participants should not suggest that this type of flight is entirely physiologically harmless. Hypoxic symptoms may be more pronounced, particularly in personnel with cardiorespiratory comorbidities[35].

Strengths and Limitations of the Study

This original, regional field study evaluates the oral and dental health problems experienced by hot air balloon flight personnel due to barometric pressure changes.

The most important limitation of the study is the relatively small sample size. However, the assessment of a homogeneous population and the fact that the data reflect region-specific flight conditions increase the internal validity of the results. Furthermore, the reliance on self-administered data, based on a questionnaire, is susceptible to subjective bias.

Therefore, it is recommended that future studies enhance the data with objective measurements, including clinical examination and radiographic examinations. Repetition of this study with a larger sample size and multicenter designs would contribute to a clearer understanding of the effects of barometric stress on oral health.

Conclusion

Despite low-altitude flights, some participants experienced significant toothaches, bleeding gums, ear congestion, and sinusitis-related symptoms during flight. The rarity of systemic symptoms due to hypoxia also suggests that hot air balloon flights differ from other high-altitude flights in terms of general physiological effects. Personnel who regularly participate in hot air balloon flights may be at risk for their oral and dental health. Therefore, regular dental checkups should be encouraged, flight-specific preventive health protocols should be established, and pre-flight examinations should be standardized.

Statements and Declarations

Author Contribution

S.N.Ç (Sabiha Nisa Çandır): Conceptualization
H.G.A (Hasan Gökhan Açıkgöz): Writing – original draft
A.A (Aydan Açıkgöz): Methodology
F.B.E (Fatma Bilgesu Erden): Validation

Funding

No funding was received for this study

Conflict of Interest

None disclosed

Data Availability Statement

Data available upon reasonable request from the corresponding author

References

1. Ritter, P.D.J., The Effect of Barometric Pressure on the Behavior of Middle and High School Students. 2022, Concordia University Chicago.
2. Nasution, I.S., A review of barotrauma from diving: a narrative literature review. Sriwijaya journal of forensic and medicolegal, 2023. 1(1): p. 8-10.
3. Beatty, P., et al., Physiological monitoring to prevent diving disorders. Frontiers in Physiology, 2024. 15: p. 1517361.
4. Roque, F. and A. Simão, Barotraumatism, in Handbook on Hyperbaric Medicine. 2006, Springer. p. 715-729.
5. Felkai, P.P., et al., Dental tourism and the risk of barotrauma and barodontalgia. British Dental Journal, 2023. 234(2): p. 115-117.
6. Holowatyj, R.E., Barodontalgia among flyers: a review

of seven cases. Journal (Canadian Dental Association), 1996. 62(7): p. 578-584.
7. Robichaud, R. and M.E. McNally, Barodontalgia as a differential diagnosis: symptoms and findings. J Can Dent Assoc, 2005. 71(1): p. 39-42.
8. García-Torres, J. and J.J. Segura-Egea, Barodontalgia and its implications for Navy divers and dentists: A narrative review. Journal of Clinical and Experimental Dentistry, 2024. 16(5): p. e634.
9. Jeong, N.-J. and S.-H. Paik, Analysis of the Pre-service Chemistry Teachers' Cognition of the Nature of Model in the Design and Development Process of Models Using Technology: Focusing on Boyle's Law. Journal of the Korean Chemical Society, 2023. 67(5): p. 378-392.
10. Topbaş, C., et al., Relationships among barodontalgia prevalence, altitude, stress, dental care frequency, and barodontalgia awareness: a survey of Turkish pilots. PeerJ, 2024. 12: p. e17290.
11. Wyatt, T. and H. Roberts, Simulated Hydrostatic Pulpal Pressure Effect on Microleakage—An Initial Study. Operative Dentistry, 2024. 49(3): p. 290-299.
12. Lau, X.E., et al., Heat generated during dental treatments affecting intrapulpal temperature: a review. Clinical oral investigations, 2023. 27(5): p. 2277-2297.
13. Samir, P., et al., A correlation between clinical classification of dental pulp and periapical diseases with its patho physiology and pain pathway. International Journal of Clinical Pediatric Dentistry, 2023. 16(4): p. 639.
14. Kawashima, N. and T. Okiji, Characteristics of inflammatory mediators in dental pulp inflammation and the potential for their control. Frontiers in Dental Medicine, 2024. 5: p. 1426887.
15. Hugar[1], S., D. Sakhare, and H.S. Chandra, Diseases of Pulp and Periradicular Tissues. Illustrated Pediatric Dentistry-Part 3, 2023: p. 56.
16. Sipahi, C., et al., prevalence of barodontalgia in Turkish Air Force flight crew. Gulhane Medical Journal, 2007.
17. Sahin Ceylan, D., et al., Do Flights Affect Hearing in Hot Air Balloon Pilots? American Journal of Audiology, 2024. 33(1): p. 112-121.
18. Del Fabbro, M., et al., Oral Health of Astronauts in Short-and Long-Term Missions in Space. Aerospace medicine and human performance, 2025. 96(2): p. 168-179.
19. Singhal, I., The Convergence of Diving and Dentistry: A Deep Dive into Underwater Dental Care-A Review.
20. Ashour, A.A., High altitude and its effects on oral health: a review of literature. Journal of Advanced Oral Research, 2020. 11(2): p. 143-147.
21. Doshi, D.J. and S. Tamgadge, Aeronautics in dentistry: Navigating oral health challenges in zero gravity. Journal of Academy of Dental Education, 2024: p. 1-7.
22. Allende, A.L.B., Futuristic dentistry: Towards medical–dental integration and minimalistic approaches, in Innovations in Healthcare and Outcome Measurement: New Approaches for a Healthy Lifestyle. 2025, Springer. p. 105-124.
23. Lado, E. and R. Caudle, Pathway to Diagnosis and Management of Toothaches. 2024: Springer.
24. Zadik, Y., Barodontalgia: what have we learned in the past decade? Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 2010. 109(4): p. e65-e69.
25. Oudman, R., et al., Barodontalgia–Painevaihteluiden aiheuttamahammaskipu. Suomen hammaslääkärilehti, 2024. 31(6-7): p. 26-31.
26. van Veelen, M.J., et al., Emergency care for high-altitude trekking and climbing. High Altitude Medicine & Biology, 2025. 26(1): p. 70-86.
27. Pallarés-Serrano, A., et al., study of the intra-coronal pressure generated by internal bleaching agents and its influence on temporary restoration. Applied sciences, 2022. 12(6): p. 2799.
28. Dąbrowska, J., et al., The impact of barometric pressure changes on oral health in light aircraft pilots: literature review. Quality in Sport, 2025. 44: p. 62994-62994.
29. Bayar, G.R., et al., The Importance of Periodic Oral and Dental Health Examination of Aircrew. Journal of Aviation, 2023. 7(2): p. 310-316.
30. El-Hoshy, A., Teeth Hypersensitivity.
31. Mangat, P., et al., comparison between biodentine and light-cured mineral trioxide aggregate as an indirect pulp capping agent–A randomized controlled trial. Journal of Conservative Dentistry and Endodontics, 2025. 28(1): p. 78-83.
32. Sajib, S.M.R., et al., Oro-Facial and Dental Problems in High Altitude: a Study on Aircrew of Bangladesh Air Force. Bangladesh Armed Forces Medical Journal, 2024. 57(2): p. 36-43.
33. Ahuja, R.S., B.J. George, and M. Panwar, Dental considerations in flight safety. Journal of Dentistry Defense Section, 2023. 17(2): p. 79-83.
34. Thomas, D.C., et al., Toothaches of Non-odontogenic Origin. Dental Clinics, 2025.

International Journal of Medical Discoveries
Volume 2, Issue 1
ISSN: 3067-7912

35. Kelly, C., S. Saxena, and K. Kelly, Degree of Hypoxia and Physiological Differences Between Fast and Slow Ascents to Very High Altitude. Oxygen, 2025. 5(3): p. 13.