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## Journal of Oral Medicine, Oral Surgery, Oral Pathology and Oral Radiology

Journal homepage: <http://www.joooo.org>

## Review Article

## Aeronautics dentistry: An emerging field

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## Abstract

Aeronautic dentistry is an emerging field that investigates the effects of aviation and space environments on oral health. With the increasing number of individuals involved in air and space travel—including pilots, cabin crew, and astronauts—the need to understand the impact of altered atmospheric pressure and microgravity on the oral cavity has become crucial.

During flight, closed cabin conditions and rapid changes in barometric pressure can lead to barodontalgia (tooth pain due to pressure changes), sinus-related dental pain, and discomfort in previously treated or compromised teeth. These conditions may impair crew performance and mission readiness. Additionally, in spaceflight, microgravity has been linked to increased risks of periodontitis, dental caries, bone demineralization, and impaired wound healing.

Early and accurate diagnosis, combined with preventive and responsive dental care, is essential to manage these complications. Therefore, dentists must be educated about these unique challenges to provide tailored treatment and support the oral health needs of individuals in aeronautic and aerospace environments. Continued research is vital to establish effective protocols and ensure long-term oral health in aviation and space travel.

**Keywords:** Aeronautic dentistry, Barodontalgia, Microgravity, Space.**Received:** 25-07-2025; **Accepted:** 11-08-2025; **Available Online:** 29-09-2025

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## 1. Introduction

It is a well-established fact that at higher altitudes, both air density and air pressure decrease significantly. At 18,000 feet, the air pressure is approximately half of what it is at sea level, and at 33,000 feet, it drops to about one-quarter of sea-level pressure. This reduction in atmospheric pressure can have several negative effects on aviators, impacting both physiological function and overall flight performance.<sup>1</sup> Space travel presents special health problems because of the harsh circumstances outside of Earth's atmosphere, particularly in the field of dentistry. The human body is significantly impacted by microgravity, which changes the musculoskeletal system, fluid distribution, vestibular and sensorimotor systems, and calls for particular medical attention. Dental health is greatly impacted by these physiological changes, which are exacerbated by immunodeficiency and changed microbial flora.<sup>2</sup> Space

exploration also impacts oral and maxillofacial health, leading to issues such as dental caries, periodontal diseases, jaw dysfunctions, and oral cancers. Addressing these orofacial issues is crucial for astronaut well-being.<sup>3</sup> The closed cabin conditions and exposure to high altitudes are the main factors contributing to these changes.

Aeronautic dentistry is a specialized branch of dentistry that focuses on the study of dental health in the context of the aeronautic environment. It has gained increased attention in recent years, particularly among frequent flyers, flight crew members, and pilots.<sup>4</sup> Aeronautic dentistry focuses on preventing, diagnosing, and treating oral and dental problems that may arise due to barometric pressure changes, G-forces, and microgravity during flight or space missions. In recent years, dental practice has increasingly emphasized preventive care. Aviation dentistry specifically addresses the oral and dental health of aircrew members and frequent flyers. Studies

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have shown that the prevalence of dental caries increases in microgravity conditions. Individuals who frequently take to the skies—such as pilots, flight crews, and frequent business travellers—are particularly susceptible to flight-related oral health issues. With the growing number of air passengers, flight attendants, leisure pilots, and both military and commercial pilots, dentists are more likely to encounter oral conditions related to air travel. It is therefore essential for dental professionals not only to treat these conditions but also to prevent the creation of in-flight hazards when providing care to air crew members.<sup>5</sup>

## 2. Discussion

Pressure changes—such as those experienced during air travel, scuba diving, or hyperbaric oxygen therapy—can have a direct impact on the paranasal sinuses and, in some cases, may present as dental pain. This is because the roots of the upper posterior teeth are often in close anatomical proximity to the maxillary sinuses, and any alteration in sinus pressure can be perceived as discomfort in these teeth. The phenomenon, commonly known as barodontalgia, occurs when a pressure mismatch develops between the air-filled spaces inside the body and the surrounding environment. This commonly occurs when rapid ambient pressure shifts outpace the body's ability to equalize.

1. Sinus barotrauma (also called barosinusitis or aerosol-barotrauma) arises when inflammation, blockages, or anatomical variations prevent pressure equilibration, particularly affecting the frontal and maxillary sinuses. Symptoms include severe facial pain or headache, nosebleeds, and a feeling of fullness, often radiating to the upper teeth or gums.
2. Barodontalgia refers to tooth pain triggered by pressure changes—often in teeth with existing pathology or poor restorations—or as referred pain from sinus barotrauma.

Prevention centers on pre-travel dental and ENT evaluations, especially for professions such as pilots, divers, and military personnel. These assessments help identify potential sources of barotrauma like defective restorations, pulpal or periapical disease, or recent dental work. To minimize risk:

1. Delay travel after dental treatment
  - a. After certain dental procedures—especially extractions, root canals, or surgeries—there can be swelling, bleeding risk, or discomfort.
  - b. If you travel too soon (especially by air), changes in air pressure or lack of access to immediate dental care can worsen pain or cause complications.
  - c. Waiting 24–72 hours gives time for the initial healing to start, reduces swelling, and ensures you can return to your dentist if any early problems arise
2. Use decongestants or nasal sprays when appropriate.

- a. If you have sinus congestion before traveling—especially after upper jaw (maxillary) dental procedures—it can cause sinus pressure pain during flight due to changes in cabin pressure.
- b. Decongestants (oral or nasal spray) help open the sinus passages and equalize pressure, reducing discomfort and lowering the risk of sinus barotrauma.
- c. They should be used as recommended and only, when necessary, particularly if your dentist or physician advises it.

3. Teach patients to recognize symptoms early and seek prompt care

Patients should know warning signs after dental treatment, such as:

- a. Persistent or severe pain not relieved by medication
- b. Excessive swelling or redness
- c. Bleeding that doesn't stop
- d. Fever or signs of infection
- e. Numbness or tingling that persist

## 3. Odontocrexism

Odontocrexism is a specific type of dental barotrauma in which a tooth fractures or cracks due to barometric stress. It occurs when air becomes trapped inside the tooth structure or within a dental restoration. When external pressure changes—such as during flying, scuba diving, or hyperbaric oxygen therapy—this trapped air expands or contracts, creating internal stress that the tooth structure cannot withstand. Clinically, patients often report a sudden, sharp, and intense pain, sometimes describing it as if the tooth is “exploding”. The pain can worsen when biting or chewing. In more severe cases, dentists may observe visible fractures, loss of the restoration, or tooth fragments.<sup>8</sup>

Prevention includes ensuring tight seals in restorations to avoid air entrapment, using suitable restorative materials, delaying exposure to pressure changes after dental work, and conducting pre-travel assessments for individuals like pilots and divers. Management involves prompt pain relief to restore function and comfort, followed by radiographic evaluation to assess structural damage. Depending on the findings, treatment may include repairing or replacing faulty restorations, performing endodontic therapy if the pulp is affected, or extracting the tooth if it is beyond repair. Subsequent restorative procedures ensure long-term function and prevent recurrence.<sup>9,10</sup>

## 4. Increased Risk of Dental Infections

Long-duration space missions or military deployments in isolated environments significantly increase the risk of dental infections due to a combination of factors such as limited access to dental care in space or remote deployments, immediate dental treatment is often unavailable, allowing minor dental issues to progress into infections. Microgravity

and stress can weaken the immune system, reducing the body's ability to fight oral pathogens. Spaceflight has been shown to reduce salivary flow, which is essential for maintaining oral hygiene and neutralizing bacteria. Daily oral care routines may be compromised due to time constraints, equipment limitations, or environmental factors. Undiagnosed or untreated caries, periodontal disease, or failed restorations can become problematic over time.<sup>11</sup>

All crew members should undergo thorough dental assessments prior to the mission, with treatment of any existing or potential issues (e.g., caries, faulty restorations, or periodontal problems) to ensure dental fitness for flight. Tailored oral care routines suitable for the space environment should be implemented. This includes the use of space-adapted toothbrushes, fluoride toothpaste, and scheduled brushing/flossing to maintain optimal oral hygiene.

When access to water is limited, antimicrobial mouthrinses (e.g., chlorhexidine-based) can serve as an effective substitute to reduce bacterial load and maintain oral health.

Crew members and onboard medical personnel should be trained in basic dental emergency management, including handling toothaches, dislodged fillings, and minor infections.

Specialized dental kits should be available onboard, containing essential tools and materials for emergency dental care (e.g., temporary filling material, dental mirror, analgesics, and antiseptics). Establishing tele-dentistry links with ground-based dental professionals allows remote consultation, diagnosis, and guidance during in-flight dental emergencies.<sup>12</sup>

## 5. Challenges in Microgravity

In space missions, normal dental procedures are difficult due to fluid management and lack of gravity. Microgravity, or near-zero gravity, presents several unique physiological and logistical challenges for astronauts during space travel, significantly impacting various aspects of health and routine activities — including oral health and dental care. Body fluids shift toward the head and upper body, leading to facial puffiness, nasal congestion, and increased intracranial pressure. This can affect oral tissues, salivary flow, and complicate dental procedures. Saliva plays a crucial role in neutralizing acids and cleansing the mouth. Decreased salivary production in microgravity may increase the risk of dental caries and oral infections. The immune system is weakened in space, making astronauts more vulnerable to infections, including oral infections. Lack of gravity makes it difficult to manage instruments, fluids, and patient positioning during dental emergencies. Suction and isolation of the oral cavity are challenging without gravity, increasing the risk of aspiration or contamination. Brushing, flossing, and rinsing become more difficult in a weightless

environment. Special waterless oral hygiene products may be required. Spacecraft carry only minimal dental equipment, usually limited to emergency kits. Complex procedures like restorations or extractions cannot be performed in-flight.<sup>13-15</sup>

## 6. Role of an Aeronautic Dentist

An aeronautic dentist is a dental professional specialized in managing and preventing oral health issues that may arise due to changes in atmospheric pressure and other environmental factors associated with aviation, space travel, and related high-altitude activities.

Key responsibilities:

1. Pre-flight dental screening
  - a. Conduct thorough dental evaluations for pilots, astronauts, aircrew, and divers before missions.
  - b. Identify and treat conditions that could lead to barotrauma, such as caries, defective restorations, or pulpitis.
2. Management of barodontalgia and barotrauma
  - a. Diagnose and manage pain related to pressure changes (barodontalgia).
  - b. Prevent and treat issues like odontocrexia (tooth fracture due to pressure) or sinus-related dental pain.
3. Emergency preparedness and training
  - a. Equip flight crews with knowledge and resources for handling dental emergencies mid-flight or in remote environments.
  - b. Provide training in the use of onboard dental emergency kits.
4. Space and aviation-specific oral health advice
  - a. Educate aircrew and astronauts on maintaining oral hygiene in restricted environments, including microgravity.
  - b. Recommend preventive measures like the use of fluoride products and antibacterial rinses.
5. Post-mission evaluation
  - a. Assess and treat any oral health issues arising after long flights, high-altitude missions, or space travel.
  - b. Monitor long-term oral health effects of exposure to microgravity or high-altitude conditions.
6. Research and development
  - a. Contribute to ongoing research on the effects of flight and space conditions on oral and craniofacial health.
  - b. Help design oral care protocols and equipment adapted for aviation and aerospace environments.<sup>16,17</sup>

## 7. Conclusion

Aeronautic dentistry is also known as aerospace or aviation dentistry is a specialized branch of aerospace medicine

dedicated to maintaining oral health in extreme environments such as high altitudes, rapid pressure changes, and microgravity. In these settings, unique challenges arise, including barodontalgia (tooth pain from pressure changes), sinus-related dental discomfort, delayed healing, and an increased risk of oral infections.

With modern aviation reaching higher speeds and altitudes, and space travel becoming more frequent, the demand for dental professionals trained in this niche is growing. These specialists play a crucial role in screening crew members before missions, providing preventive care to minimize in-flight problems, and ensuring emergency readiness for unexpected dental issues.

As human space exploration advances, continued research, specialized training, and international collaboration in aerospace dentistry are essential. The goal is to ensure that oral health never becomes a limiting factor for crew performance, safety, or mission success—whether in the cockpit, aboard the International Space Station, or on future missions to the Moon and Mars.

## 8. Source of Funding

None.

## 9. Conflict of Interest

None.

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**Cite this article:** Khan SA, Agrawal N, Saxena VS, Zehra C, Chandel M. Aeronautics dentistry: An emerging field. *J Oral Med Oral Surg Oral Pathol Oral Radiol*. 2025;11(3):105–108.