AVIATION DENTISTRY

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ABSTRACT:

In Brief: A growing number of air passengers, flight attendants, leisure pilots as well as military and airline pilots may increasingly encounter flight-related oral disorders requiring treatment. Hence, dentists needs to treat the aircrew members in such a way that the in-flight hazards are prevented. The aim of this article is to introduce the various concepts of aviation dentistry. The article focuses on the oral manifestations of barometric pressure changes that might be experienced by air passengers and pilots. Also, it gives a brief about in-flight toothache, barodontalgia, etiology, its current epidemiology, diagnosis and management.

INTRODUCTION:

Airline industry has gained popularity of late but not much is known about the dental problems associated with the high altitude. Dental care is an essential part of flight crew's operative fitness which could be at risk by a reduction in air density and air pressure at higher altitudes.[1]
In the human body, various organs viz. facial sinuses, lungs, stomach, and middle ear contain gases which tend to expand at low atmospheric pressure. Due to a closed chamber, pressure gets accumulated in these organs causing pain, uneasiness and organ dysfunction.[2] The aircycle machines and outflow valves maintain the pressure in the airplane at high altitude regardless of the low atmospheric pressure outside in order to provide comfort to the crew and passengers.[3]
The presence of dental abscesses, deep carious lesions, deep unlined restorations and periodontitis in oral cavity can lead to severe pain because of the extreme altitude changes which usually can be prevented by a proper diagnosis. Hence, it is important for the dentist to identify as well as treat an aircrew patient with precision.

OBJECTIVES:

With the increasing number of air passengers as well as airline and leisure pilots and their aircrew, dentists may regularly encounter flight-related oral conditions requiring immediate treatment. Since the population of aircrews is usually healthy, dental conditions were found to be an integral part of aircrew's indisposition. [4] The objective of this article is to introduce the concepts of aviation dentistry and medicine to the dental practitioner, and to source the dentist with some diagnostic tools as well as treatment strategies.

HEAD AND FACE BAROTRAUMA:

Barotrauma refers to the physical damage or trauma to the body tissues caused by a difference in pressure between a gas space inside the body and the surrounding fluid.[5] It is usually seen in air travelers, scuba divers, hyperbaric oxygen therapy, or after the explosion due to the shock waves.[6]
Head and face barotrauma consist of external otitis barotrauma, barotitis-media, barosinusitis, barotrauma-related headache, dental barotrauma and barodontalgia.

Barotrauma refers to an acute inflammation of the sinus and middle ear cavities however *barosinusitis* is an inflammation of the paranasal air sinuses.
Stress to the sinus mucosal lining may be caused due to a vacuum effect resulting out of a pressure gradient created during an upper respiratory tract inflammation, when the normal sinus outflow may seem compromised.

The vacuum may cause mucosal edema, serosanguineous exudate, and submucosal haematoma, which may consequently cause pain that can be abrupt and severe, and may lead to epistaxis. During descent, the occurrence of barosinusitis is about *double* that during ascent. As pressure is exerted on branches of the fifth cranial nerve, pain and numbness can also be experienced. [5] Berilgen and Mungen testified barotrauma- related headache in a six-case series of 15-20-minute headache episodes during ascending and descending.

The dental significance of non-dental head and face barotraumas is as follows:

1. Either barotitismedia or barosinusitis can occur and be manifested as toothache i.e indirect barodontalgia.[7] Thus, they should be listed in the differential diagnosis of dental pain that is induced during changes in barometric pressure.

2. Several reports appealed that there is a relationship between dental malocclusion and eustachian tube dysfunction.[8]

Dental splint was offered as a therapeutic measure for barotitismedia.[9] However, at present, the use of dental splint for barotitis-media is not an indication.

DENTAL BAROTRAUMA:

Barodontalgia:

Dental pain occurring due to the changes in barometric pressure is called barodontalgia. It is a symptom and not a pathologic condition itself. Most often, it is an exacerbation of preexisting subclinical oral disease.[10]

Pulpitis is the main etiological factor of barodontalgia from the 1940s to date. Many suggestions have been presented to explain its mechanism:

1. Direct ischaemia resulting from inflammation.
2. Indirect ischaemia due to increase in the intra-pulpal pressure as a result of vasodilatation and fluid diffusion to the tissue.[11]
3. The effect of intra-pulpal gas expansion.[12] The gas is a by-product of acids, bases and enzymes which are present in the inflamed tissue.
4. Reduction in gas solubility lead to gas leakage through the vessels. This theory was based on a histological view of gas bubbles observed on sectioned teeth that were extracted after barodontalgia.[13]

Pain experienced on ascend is related to vital pulp tissue and that occurring on descend is related to facial barotrauma or pulp necrosis. Whereas, in periapical disease, pain occurs on both ascend and descend. [10]

Table 1 compares the pulp-related / direct barodontalgia and barotitis/ barosinusitis-induced / indirect barodontalgia.

Table 1 : Direct vs Indirect Barodontalgia		
	Direct barodontalgia owing to pulp disease with or without peri-apical involvement	**Indirect barodontalgia**
Cause	Pulp/peri-apical disease.	Barosinusitis, barotitis media.
Appearance	Pulpitis: during take-off/ascent. Pain usually appears during landing at the appearance-level. Peri-apical periodontitis: usually at high altitude (38,000 ft) during ascent or landing.40	During landing. Pain usually continues on ground.
Symptoms	Irreversible pulpitis: sudden sharp penetrating pain. Reversible pulpitis or necrotic pulp: beating dull pain. Peri-apical periodontitis: continuous strong pain, swelling.	Toothache in upper premolar/molar region.
History	Recent dental treatment. Recent dental sensitivity (eg to cold drinks, percussion/eating).	Present acute upper respiratory infection. Past sinusitis.
Clinical findings	Extensive caries lesions or (faulty) restoration. Acute pain upon cold or percussion test.	Pain on sinus palpation. Pain upon a sharp change in the head position.
Radiological findings	Pulpal caries lesions and/or restoration close to pulp-horn. Peri-apical radiolucency. Inadequate endodontic obturation.	Opacity (fluid) on the maxillary sinus image.

Odontocrexis:

Calder and Ramsey studied tooth fractures caused by a high-altitude environment and they coined the term, “odontocrexis”. [14,15] This condition is also known as *barometric tooth explosion.* Recurrent caries lesions or preexisting leaked restorations underneath restoration can cause odontocrexis when exposed to high altitude environment. Accidental expansion of gas trapped beneath the restorations is the common cause of such damage.[16]

Periodic Examination:

Early diagnosis of initial visible and occult oral disease is of importance for aircrew members. Currently there is no evidence- based guidelines or any consensus concerning the frequency and extent of periodic aircrews’ dental examinations.

However, based on both published studies and research reports,[17,18,19] special attention should be given to faulty (cracked or fractured) restorations, restorations with poor retention, and secondary carious lesions. Cold-test and/or peri-apical radiographs should be done in teeth with preexisting extensive restorations, in order to rule out occult pulp necrosis.[19]

DENTAL TREATMENT:

Lack of agreement regarding the dental treatment and grounding period of aircrews for dental reasons poses a major downside.

Table 2 summaries the principles of dental care for aircrew members.

Table 2 Summary of principles of dental care	
Discipline	**Principles**
Periodic Examination	• Vitality test in extensively restored teeth • Special attention to defective restorations, restorations with poor retention, and secondary caries lesions • Rule out bruxism • Panoramic radiograph (OPG)
Restorative treatment	• Removal of all carious tissue and placement of protective cavity liner before restoring
Endodontics	• Avoidance of direct pulp capping • Reinforced temporary restoration
Prosthodontics	• Enhanced retention • Clear speech • Resin cement
Oral Surgery	• Rule out oroantral communication

Restorative Dentistry:

In comparison to tooth hard tissue, differential thermal contraction is observed in amalgam restoration at low temperature of a high altitude environment. Harvey stated that cold temperature is the prominent causative factor underlying dental fracture.[20]

A protective cavity liner (eg glass ionomer cement) should be applied before the permanent restoration of a cavity.

Endodontic Considerations:

Rossi contraindicated the procedure of direct pulp capping in aircrew patients and recommended endodontic treatment in each case of even minor or pinpoint suspected invasion to the pulp chamber.
In a pressure-changing environment, open un-filled root canals can lead to facial emphysema as well as leakage of the intra-canal infected content into the peri-apical tissues.[21,22] Hence, root canals need to be obturated or closed to prevent the same.

Prosthetic Considerations:

Lyons et al. advocated that crowns cemented with resin cement had better retention than those cemented with glass-ionomer cement or zinc phosphate cement which had reduced retention with the tooth under a pressure changing environment.[23]
From a point of view of retention as well as other considerations (eg speech), implant -supported prosthesis is recommended over removable prosthesis.

Oral Surgery:

Oroantral communication can lead to sinusitis [24] and to adverse potential consequences on exposure to a pressure-changing environment.
The possibility of the existence of an oroantral communication should be ruled out after extraction of maxillary teeth.

SUMMARY:

With the increasing number of air travellers viz. pilots, aircrew personnel, air passengers, flight attendants and leisure pilots, it is important for the dental clinicians to raise awareness about these issues.
Prioritizing the promotion of diagnostic tools and treatment guidelines to the aviation industry for the wellness of the air-crew is of utmost importance.
Air passengers should undergo a dental check-up and get their restorative treatment completed before flying to prevent in-flight dental pain and barodontagia.
Aircrew personnel, pilots and flight attendants also need to mandatorily get their dental check-ups done at least once annually as a part of their complete medical fitness regimen to prevent dental pain and related disorders in-flight.

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