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Review Article

The Flying Tooth: Aerospace dentistry & implications

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Abstract

The airline sector has grown in popularity recently, yet little is known about the dental issues brought on by flying at a high altitude. It most frequently affects regular travellers, crew members, pilots, etc. Numerous organs in the human body, including the middle ear, lungs, stomach, and sinuses on the face, contain gases that tend to expand when the air pressure is low. The accumulating pressure in these organs because of the closed chamber causes pain, discomfort, and organ malfunction. Due to the drastic variations in altitude, dental abscesses, periodontitis, deep carious lesions, and deep unlined restorations in the oral cavity may cause considerable pain. Due to the airline industry's rapid expansion in all areas, dental surgeons should pay special attention to crew members and regular travellers as a result of pressure changes in flight that can result in a variety of orofacial pains. Aviation dentistry focuses on diagnosing, preventing, and treating diseases, disorders, and conditions that affect the oral cavity, the maxillofacial region, or adjacent and connected structures, as well as their effects on passengers, aircrew members, and flight restrictions. Different complications can be prevented with an accurate diagnosis. When treating frequent fliers and members of the aircrew, dental surgeons should take precautions to avoid the development of in-flight risks. Therefore, a dental surgeon should offer a thorough treatment and be well-versed in these facts. The purpose of this article is to teach the various principles of aviation dentistry, with a particular emphasis on the oral symptoms of barometric pressure variations that passengers and pilots may encounter.

Keywords: aerospace medicine, aviation dentistry, barodontalgia, barotrauma, dentistry, high altitude, odontocrexis

INTRODUCTION

Dental care is an essential component of an aircrew's operational fitness and could be compromised by lower air pressure and density at higher altitudes [1]. Despite the low atmospheric pressure outside, aircraft pressure is kept at high altitude for the comfort of the crew and passengers using aircycle machines and outflow valves [2]. The practise of dentistry has evolved in recent years, with a strong emphasis on preventive. Aviation dentistry focuses on the oral and dental health of pilots and frequent travellers. Aviation dentistry places a focus on the aviators' oral and dental health, with a particular focus on the prevention of conditions linked to changes in atmospheric pressure [3]. In microgravity, caries are more prevalent. People who frequently "raise from the earth" include pilots, flight attendants, and individuals who travel for employment. Dental surgeons may see more aviation-related oral disorders that need treatment as there are more passengers, flight attendants, leisure pilots, military pilots, and airline pilots. In addition, when treating aircrew members, dental surgeons should avoid creating in-flight dangers [4].

There have been numerous reports of dental restorations fracturing, teeth breaking, and severe or sporadic discomfort. Pressure placed on numerous nerves and their branches is what causes the pain that is experienced. The air pressure changes as one travels at high altitude, or at altitudes of at least 18,000 feet [5]. Military soldiers are more likely to experience dental barotrauma than civilian fliers or passengers. Numerous dental investigations were carried out in altitude chamber stimulations and during in-flight observations during World War II, and the US even provided a specialised programme in aviation dentistry [6]. To treat barodontalgia earlier, a correct diagnosis of the pain must be made. Barodontalgia frequently goes unnoticed as a result of carelessness. Therefore, both dental surgeons and aviators need have more information about aviation dentistry.

DISCUSSION

Dental surgeons may frequently meet flight-related oral disorders requiring prompt treatment due to the rising number of people travelling by air as well as airline and leisure pilots and their staff. Since most aircrew members are generally in good health, dental problems were discovered to be a significant contributor to aircrew indisposition [7]. The purpose of this article is to familiarise the dental professional with the principles of aviation dentistry and medicine and to provide the dental surgeon with some diagnostic equipment and treatment options.

Head and face barotrauma

A disease known as barotrauma, which affects tissues, is brought on by a difference in pressure between a gas pocket inside the body and the fluid around it. Flying, scuba diving, or receiving hyperbaric oxygen therapy can all result in barotrauma. As a result, in this instance, flying at great altitudes lowers air pressure. It includes ailments include dent al barotrauma, external otitic barotrauma, barosinusitis, headaches associated to barotrauma, and barodontalgia [8]. Ascents from high heights can cause barotitis and barosinusitis. A partially vacuum forms, and the retracted tympanic membrane is one of its symptoms. The suction may result in haemorrhages. Barotrauma, also known as acute inflammation of the sinus and middle ear cavities, is caused by pressure-volume fluctuations that are linked to changing atmospheric pressure [9]. Barosinusitis is an inflammation of the paranasal air sinuses, whereas barotrauma is an abrupt inflammation of the sinus and middle ear cavities. An infection of the paranasal air sinuses is known as barosinusitis. A vacuum is produced as a result of the difference in air pressure. This vacuum causes submucosal haemorrhage, mucosal oedema, and other conditions that can cause anoxia, headaches, and vertigo [8]. The sinus mucosal linings experience stress due to the vacuum that is produced. Trigeminal nerve branches may be compressed, causing subsequent pain and numbness [10].

Barodontalgia

Dental discomfort might result from a condition when barometric pressure fluctuates in the outside environment. This issue could arise as a result of a tiny gap left behind after a tooth has been filled or had a root canal. An indication is barodontalgia. Dental caries, flawed dental fillings, pulpitis, pulp necrosis, apical periodontitis, periodontal pockets, impacted teeth, and mucus retention cysts are common oral conditions that result in barodontalgia [11]. It can be brought on in one of two ways: either by pressure changes in the tooth produced by carious activities, or by flaws in the tooth itself. It can also happen during ascent when the pressure drops and causes the blood vessels to dissolve in gas, which causes bubbles to enter the pulp. When pain is felt ascending, it is caused by vital pulp tissue, and when it is felt descending, it is caused by pulp necrosis or facial barotrauma. The periapical illness is associated with pain that occurs during both ascent and descent [12]. The affected restoration must be carefully replaced, the endodontic procedure must be repeated, or the tooth must be extracted as part of the treatment.

Strohaver provided an explanation for the pathophysiology of barodontalgia in 1972, arguing for the distinction between direct and indirect forms. In the case of direct barodontalgia, the affected tooth is directly impacted by the reduced air pressure, whereas in the case of indirect barodontalgia, pain is caused by stimulation of the superior alveolar nerves during maxillary barosinusitis. In the direct kind, the pain is mild to severe, localised during takeoff, and the patient may recognise the affected tooth. In the indirect variety, the posterior teeth are involved, and the pain is dull, poorly defined, and develops upon landing [13].

Although Hodges noted that dental pain can sometimes develop in healthy teeth during the changing atmospheric pressure, pulp disease is the most likely source of the pain in barodontalgia. The growth of trapped bubbles under a restoration may potentially result in barodontalgia by activating pain receptors. When nociceptors in the maxillary sinus are stimulated, it may result in referred pain to the teeth.

The classification of barodontalgia is based on pulp / periapical condition and symptoms: pulp/ periapical-related ‘direct’ barodontalgia and barotitis/ barosinusitis-induced ‘indirect’ barodontalgia [14].

Pulpitis and barotrauma

According to the scientific literature, the principal pathology responsible for barodontalgia's causation is pulpal disease [15]. They may also appear in teeth that have pulpitis following restorative therapy, in newly formed caries, in recurrent endodontic complaints, in dental and periodontal cysts, or in abscesses [16]. They may also coexist with sinusitis. Holowatyj RE's analysis of seven instances came to the same conclusion that pulpal hyperaemia might be the cause of barodontalgia [17].

Barodontalgia has a clinical advantage in that it can assist dental surgeons in identifying early caries, leaky restorations, and periodontal problems. When reversible pulpitis was the underlying reason, implantation of a zinc oxide eugenol (ZOE) base was found to prevent barodontalgia. The well-known sedative effects of ZOE were blamed for this. Additionally, it was indicated that it would be advisable to refrain from practises such capping exposed pulp when treating patients who had seen significant pressure fluctuations. An endodontic procedure might be recommended instead. Parafunction (bruxism), low temperatures, lower oxygen content, acceleration, and dryness are additional risk factors [18].

Odontocrexis

Barometric tooth explosion is another name for this ailment. The term "odontecrexis," which means "tooth explosion" in Greek, was created by Calder and Ramsey to characterise the physical destruction of teeth with leaking restorations brought on by changes in barometric pressure [19]. They researched tooth fractures brought on by high-altitude environments. When there were unrestored teeth with and without cavities and low-quality restorations, tooth damage occurred. Gas that was trapped beneath the restorations expanded accidentally, causing the damage. Some of the causes included cracks in porcelain fused metal restorations and pressure shifts in the dental cements' microtubules, which might cause crowns to come loose.

Mesio-occluso-distal restorations were found to be a significant risk factor for tooth fractures in a study on fractures of posterior teeth. This study identified the mandibular first molar teeth as being at risk; cuspal covering restorations may be thought of as a justified preventive treatment [20].

Prosthesis

Denture retention is entirely governed by the laws of adhesion, gravity, and air pressure. This applies to both mandibular and maxillary dentures, the latter of which is entirely dependent on them. Complete dentures may be more difficult to keep in place when barometric pressure is lower. Pressure alterations in the cement layer's microtubules in crowns cause a decreased retention of the crown [21]. Most frequently, microleakage causes the cement layers beneath the crowns to weaken. A study found that using either zinc phosphate cement or glass ionomer cement for the crown's cementation impaired the retention of full cast crowns to excised teeth during pressure cycling.

Lyons et al. argued that whereas crowns bonded with glass-ionomer cement or zinc phosphate cement had lower retention with the teeth during environmental pressure changes, those cemented with resin cement did not.

When cementing crowns and permanent partial dentures for patients, such as divers, who are likely to be, exposed to pressure cycling, dental, surgeons should think about employing resin cement [22].

Periodontal defects

Decreased oxygen levels can harm teeth, fillings, gums, and the mouth in pilots who fly at high altitudes. The condition of xerostomia is typical. Periodontal problems are more likely to develop as salivary volume decreases. Poor dental hygiene, anxiety, and weariness from flying are risk factors for flying personnel. Aircraft passengers who breathe dry compressed gases may experience mouth dryness [23].

Endodontic considerations

In order to avoid subacute pulpitis or silent pulp necrosis and any potential repercussions associated to barometric pressure, Rossi advised against direct pulp capping in aircrew patients and recommended endodontic treatment in suspected cases of pulp chamber invasion [24]. If left untreated, root canal infection can result in subcutaneous emphysema and leaking of the intracanal infected substance to the periradicular tissues.

Oral surgery

Following the extraction of maxillary teeth, dental surgeons should always rule out the presence of an oroantral communication since it can result in sinusitis when exposed to a pressure-changing environment [25].

Restorative dentistry

In contrast to tooth hard tissue, amalgam restorations exhibit differential thermal shrinkage when exposed to low temperatures and high altitudes. Harvey argued that dental fracture is primarily caused by cold temperatures [26]. According to Sognnaes, teeth grinding was a contributing reason to the failure of restorative procedures.

Prevention

Prior to taking a flight, cavities should be excavated and restored. Restorations with leaks need to be replaced. To rule out any penetration into the pulp chamber, the cavity floor should be thoroughly examined during the repair of a carious tooth. In these circumstances, a protective cavity liner (such as glass-ionomer cement) should be used. The temporary repair must be properly positioned during multi-visit endodontic therapy. An oral surgeon should be consulted for closure when oroantral communication is diagnosed. Crowns with cuspal covering may also be used as a preventative strategy. Because they provide superior retention, resin cements are recommended for cementation. Chewing gum or candy will promote salivation and avoid mouth dryness while in flight [27].

Flight restriction

When there is an interference with the ability of the aircrew to fly, the patient must be grounded [28]. This may be brought on by taking drugs, which may result in headache, nauseous, or dizzy side effects. The blood clot that forms in the patient's mouth after surgery may break free due to the intra oral pressure, which may result in intra oral bleeding. Therefore, a flying restriction is required in this case until the symptoms pass. Restorations that have recently been completed have a higher chance of fracture than those that are older. Dental surgeons have a responsibility to inform their patients (aircrew members) of the limitations and side effects of post-operative flight [29].

Treatment

Only a correct diagnosis can result in a correct course of action. For those members of the aircrew, improper examination or cooperation can have major consequences in the future. Dental surgeons must rule out the possibility of an oroantral connection before extracting the maxillary premolars and molars. When exposed to an environment with variable pressure, this communication may result in sinusitis. An implant-supported prosthesis can be chosen to help with prosthesis retention [30].

Conclusion

There is a growth in the number of air travellers, including pilots, flight attendants, passengers, and leisure pilots. As a result, there are more members of the aircrew. In order to properly diagnose patients and treat them before their illnesses worsen, the field of aviation dentistry has expanded, and attention should be paid to it. When restorative, endodontic, prosthodontic, and surgical procedures are scheduled for aircrew patients, special precautions must be taken. To promote their wellness, dentists and aviators should take advantage of all opportunity to integrate oral and dental health into aviators' physical requirements. This article offers some diagnostic resources and treatment recommendations for dentists. There have also been descriptions of the principles of prevention, routine examination, dental-related flight limitation (grounding), and dental documentation (for forensic purposes).

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