

<https://doi.org/10.33472/AFJBS.6.9.2024.1331-1341>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

REVIEW ARTICLE

The Convergence of Diving and Dentistry: A Deep Dive into Underwater Dental Care-A Review

¹Dr. Ishita Singhal, ²Dr. Geetpriya Kaur, ³Dr. Pallak Arora, ⁴Dr. Tanvi Handa, ⁵Dr. Aparna Pathak, ⁶Dr. Pooja Chakraborty, ⁷Dr. Lavanya Rohatgi

¹Doctoral student in Clinical Research, Department of Biomedical, Surgical, and Dental Sciences, Università degli studi di Milano, Milan, Italy

²Director, Paradise Diagnostics, Gujranwala Town, New Delhi, India

³Research Assistant, Oral & Maxillofacial Radiology, Texas A&M School of Dentistry, Dallas, Texas, USA

⁴Senior Lecturer, Department of Oral Pathology, Gian Sagar Dental College And Hospital, Punjab, India

⁵Consultant in Paradise Diagnostics, New Delhi, India

⁶Forensic Biology Expert, Department Of Forensic Biology, Chandigarh Police, India

⁷Senior Lecturer, Department of Public Health Dentistry, Shree Bankey Bihari Dental College Ghaziabad U.P., Atal Bihari Vajpayee University, India

Corresponding Author: Dr. Ishita Singhal, Doctoral student in Clinical Research, Department of Biomedical, Surgical, and Dental Sciences, Università degli studi di Milano, Milan, Italy **Email:** ishita.singhal@unimi.it

Article History

Volume 6, Issue 9, 2024

Received: 26-03-2024

Accepted : 28-04-2024

doi: 10.33472/AFJBS.6.9.2024.1331-1341

ABSTRACT

The specialized field of diving or underwater dentistry addresses the unique oral health challenges faced by divers in the underwater realm. It stands distinct from traditional dentistry due to the impact of underwater conditions, notably pressure on oral health. Professionals in this domain, including dentists, oral surgeons, and researchers, collaborate to address the specific oral health concerns of divers.

Historical records and documented cases reveal the evolution of diving dentistry, showcasing oral health issues like barodontalgia, temporomandibular joint disorders (TMDs), and dental barotrauma experienced by divers in deep-sea environments. These experiences underscore the urgent need for specialized care due to the diverse oral health problems arising from extreme underwater conditions.

The oral health effects in deep-sea environments stem from factors such as pressure differentials, gas expansion, and alterations in air supply, resulting in tooth and tissue injuries. Understanding these factors is crucial in devising preventive measures and treatments tailored for divers. Strategies for managing these issues involve specialized dental treatments, preventive care, and education for both divers and dental professionals. Dental clinics equipped with specialized tools and expertise play a pivotal role in recognizing and addressing these unique cases.

The significance of diving dentistry lies in the distinctive challenges it poses, requiring continual advancements and specialized care. As the field progresses, future prospects suggest promising developments in research, technology, and methodologies aimed at enhancing the oral health of divers. This review offers a comprehensive exploration of the critical role of diving dentistry, highlighting the need for ongoing development and focused attention on the oral well-being of those exploring the underwater world.

Keywords: Barodontalgia, Dentistry, Diving, Marine, Pain.

INTRODUCTION

In recent years, the intersection of diving and dentistry has emerged as a unique and compelling field of study, addressing the specialized dental care needs of divers and underwater enthusiasts [1]. With the increasing popularity of recreational and professional diving activities worldwide, there has been a growing recognition of the potential dental issues that may arise in this context. Factors such as changes in atmospheric pressure, gas composition, and environmental conditions present distinct challenges to oral health, necessitating a nuanced understanding and tailored approach to dental care [1,2].

The underwater environment poses unique physiological stresses on the human body, including the oral cavity, which can have profound implications for dental health. Dental barotrauma, tooth squeeze, and temporomandibular joint dysfunction are among the conditions commonly encountered by divers due to the effects of pressure differentials on dental structures. Furthermore, the increased risk of bacterial infections in aquatic settings underscores the importance of preventative measures and meticulous oral hygiene practices among divers [3,4].

Advancements in both diving technology and dental science have facilitated the development of specialized protocols and equipment aimed at addressing the dental needs of divers [5]. From pre-dive dental evaluations to the management of acute dental emergencies during underwater excursions, practitioners in this field employ a multidisciplinary approach to ensure optimal oral health outcomes for individuals engaged in diving activities [6].

This paper explores the convergence of diving and dentistry, delving into the intricacies of underwater dental care and the implications for both divers and dental professionals. Through a comprehensive review of existing literature and case studies, we aim to elucidate the unique challenges and opportunities presented by this specialized area of practice, offering insights into effective strategies for prevention, diagnosis, and treatment.

Professional Diver Dentistry: For professional divers, such as those in the military or commercial sectors, maintaining dental health is not only a matter of personal well-being but also a professional requirement. Divers in these fields often undergo specialized dental evaluations to ensure they are fit for their duties. These evaluations assess the overall dental health, assess the risk of barodontalgia, and identify any dental conditions that may affect their ability to perform their tasks safely. In some cases, professional divers may require dental treatments or interventions to address specific issues that could compromise their safety while underwater. For example, a diver with untreated barodontalgia may experience severe pain during dives, making them unfit for their duties. Dental professionals and diving authorities work together to ensure that these divers receive the necessary care and support [5].

The Impact of Diving on Dental Health: Divers are exposed to a combination of factors that can affect their dental health. These factors include [2]:

- 1. Pressure Changes:** Diving involves descending into the depths of the ocean, where pressure increases significantly with depth. The increased pressure can cause dental issues, such as barodontalgia or "tooth squeeze." This condition occurs when pressure changes cause air trapped in dental fillings, cavities, or sinus spaces to expand or contract, leading to pain and discomfort.
- 2. Temperature Variations:** Divers often encounter cold water temperatures, which can lead to tooth sensitivity. Sudden exposure to cold water can trigger dental pain, especially in individuals with pre-existing dental conditions.

3. **Breathing Techniques:** Proper breathing is crucial in diving, and some divers may use specific breathing techniques that can affect their oral health. For instance, divers who clench their regulators (the mouthpiece used for breathing underwater) too tightly may experience jaw pain or temporomandibular joint (TMJ) issues.
4. **Oral Health Neglect:** Divers, like anyone else, can neglect their oral health while focused on their underwater activities. Neglecting regular dental check-ups and hygiene can lead to dental problems that can become exacerbated during dives.

Various Oral Health Issues Experienced by Divers: Due to the variations in pressure experienced during descent, divers may sustain a range of pressure-induced injuries to the head, face, and oral regions in addition to equipment damage. The following conditions can result from pressure-induced injuries: barometric-related tooth injury and dental pain, pharyngeal gag reflex, TMD, pressure-induced palsy, sinus, middle ear barotrauma, and neuropathy of the trigeminal or facial nerves[7]. Since divers are frequently exposed to variations in barometric pressure, barotrauma to the paranasal sinuses is a known risk for them. After middle ear barotraumas, it is the second most frequent consequence of recreational SCUBA diving. Both patent ostia and regularly operating nasal passages are necessary for paranasal sinus equalization. When the pressure differential between the sinuses and ambient pressure grows, paranasal sinus barotraumas, also known as "sinus squeeze," frequently affect the frontal and maxillary sinuses[8].

Dental restorations becoming loose (odontocrexia) and barometric-related dental discomfort (dental pain resulting from air bubbles and elevated pressure at the restoration–tooth contact) are among the most frequent oral problems encountered by divers [9]. Hence, resin-based materials, which are more resilient to pressure changes, can be used to counter these issues[10]. Together with odontocrexia, other common conditions include TMD brought on by bulky or ill-fitting mouthpieces, cross-contamination of pathogens from inadequate equipment disinfection, and flare-ups of periapical infections as well as cysts[11]. Because submarine crew members and divers have sensitive work profiles, it is critical to pay attention to viable strategies that can prevent potential oral and dental issues.

Divers frequently have headaches and tense face muscles because they must keep the regulator's mouthpiece in place to allow for optimal gas exchange. These silicone or neoprene rubber mouthpieces feature labial flanges to help with lip seal and an interdental bite platform that fits into canine and incisor occlusions to hold them in place isometrically. For the mouthpiece to be positioned correctly, the mandible should be positioned anteriorly. Due to a lack of posterior dental support, this activity causes the TMJ to be more unevenly loaded. The majority of recreational divers complete multiple dives in a day, and most dives last at least 30 minutes. Additionally, the mouthpiece and the regulator add a lot of weight to the anterior teeth. This is known as "diver's mouth syndrome," and it can cause pain in the masticatory muscles and TMJ due to the possibility of gingival and mucosal trauma from the mouthpiece flange[7].

Patients who lack mandibular function and have a profound class II malocclusion may also be more susceptible to pathological TMJ loading when maintaining the mouthpiece through posturing. Muscle soreness is a regular occurrence for all divers along with episodes of TMD aggravation; however, divers who have never experienced such symptoms previously might start exhibiting TMD-like symptoms. On one hand, it is easy to confuse TMJ pain caused by frequent mouthpiece usage with an inability to equalize ear pressure. On the other hand, ear pain normally goes away and TMJ pain lasts long after the diver returns to the surface. Treatment for TMD brought on by diving or made worse by diving should adhere to standard TMD guidelines[7].

Diving with wearing full or partial dentures is quite risky and has to be avoided at all costs. Complete dentures, and more frequently partial dentures because of their smaller size, can become loose during a dive and immediately present an aspiration risk. Although custom mouthpieces are expensive, they can be held in place by edentulous arches, thereby reducing the possibility of aspirating a dislodged prosthesis[12].

Implant patients are not at greater risk unless they have a loose or improperly maintained fixed prosthesis. According to Boyle's law, osseointegrated implants are not susceptible to volumetric expansion or contraction since they are solid in nature. Thus, patients using fixed-removable prostheses, such as a mandibular full denture retained by a Hader bar, should nonetheless adhere to removable prosthesis guidelines due to the possibility of dislodgement[8].

Although scuba diving is generally safe for those with oral and maxillofacial conditions, a few definitive rules should be followed. Pre-diving evaluation is generally recommended for any osseous or soft tissue abnormalities resulting from head and neck surgery that may limit the proper fitting of a face mask or mouthpiece. A patient may not be able to achieve a watertight face mask seal, for instance, if they have untreated depressed zygomaticomaxillary complex fractures. Further absolute contraindications include osteomyelitis and osteoradionecrosis. During descent or ascent, these circumstances may put divers at risk for tissue emphysema. Also, divers should not be in danger of aspirating any teeth that might be extremely movable due to advanced periodontal diseases[13,14].

Past Dental Experiences of Scuba Divers: Dental experiences can vary among scuba divers, but there are some common issues and considerations related to diving and oral health[7]. Some of the past dental experiences and concerns of scuba divers are:

1. **Barotrauma:** Scuba divers are exposed to changes in pressure as they descend and ascend in the water. Sudden pressure changes can affect the air spaces in the body, including the sinuses and middle ear. Several adverse effects in the body's rigid cavities caused by the changing atmospheric pressure are known as barotrauma. The main head and neck barotrauma include dental barotrauma, barodontologia, barotrauma-related headaches, barotitis, and barosinusitis[7]. Dental barotrauma can lead to pain or discomfort in the teeth, tooth fracture, restoration fracture, and reduced retention of dental restorations. The major predisposing factors of dental barotrauma are air trapped in dental fillings, causing them to expand or contract under pressure changes, and recurrent dental caries underneath restorations. Divers should have any dental issues, such as loose fillings or crowns, addressed before diving[8]. In some cases, divers may experience barodontalgia, which is pain or discomfort in the teeth caused by changes in pressure underwater. This can happen when air is trapped inside a dental cavity or a dental restoration. Therefore, regular dental check-ups and addressing any dental issues before diving can help prevent tooth squeeze[7].
2. **Dry Mouth:** Diving with a dry mouth can be uncomfortable, as it may cause a diver to swallow more frequently, leading to an increased risk of barotrauma. Breathing through a regulator can also lead to a dry mouth. Some divers use sugar-free gum or lozenges to help stimulate saliva production and keep their mouths moist during dives[15].
3. **Jaw Fatigue:** Holding the regulator in your mouth for extended periods can lead to jaw fatigue. This is especially common in long dives or repetitive diving. Some divers may experience discomfort or pain in their TMJ due to the prolonged use of the regulator[13].
4. **Dental Sealants:** Some divers opt for dental sealants to protect their teeth from potential waterborne bacteria and to prevent tooth decay. Dental sealants create a protective barrier on the chewing surfaces of the teeth and can help maintain oral health during diving[8].

5. Nitrogen Narcosis: While not a dental issue, nitrogen narcosis can affect a diver's judgment and decision-making underwater. This could lead to poor decision-making regarding equipment, including the regulator in the mouth, which may increase the risk of dental barotrauma[16].

To maintain good oral health as a scuba diver, it's important to have regular dental check-ups and address any dental issues before diving. Staying hydrated, using mouth moisteners if necessary, and taking breaks during dives to rest your jaw can help reduce discomfort and potential issues related to dental health while scuba diving.

Effects on the Oral Cavity in Deep Sea and Their Causes

Oral Health Issues Experienced by the Scuba Divers

The oral health of divers can be influenced by various factors related to the underwater environment and diving practices[7]. Following are the oral health issues that scuba divers may encounter:

1. Barodontalgia: Barodontalgia refers to dental pain or discomfort caused by changes in pressure, which can occur during descent or ascent in diving. This pain is also commonly referred to as “**tooth squeeze**”[7]. Air trapped in dental fillings, cavities, or dental infections may expand or contract with pressure changes, leading to pain[17].

Barodontologia is more common in the third decade with no specific gender preference. Approximately 9.2% to 21.6% of American and Australian civil divers experienced barodontologia[18]. The tooth pain is mostly encountered at 33 feet underwater and often even at deeper water levels of 60 to 80 feet[19,20]. Maxillary teeth are more frequently affected than the mandibular ones[18]. Scuba divers usually experience episodes of pain during the descent position [7].

Kollman stated the following three important hypotheses to explain the etiology of barodontalgia[21,8]:

- a) Stimulation of nerve endings in chronically inflamed pulp.
- b) Expansion of trapped air bubbles below a root filling or against dentin that stimulates the nociceptors.
- c) Activation of nociceptors in the maxillary sinuses and referred pain to the teeth.

Barodontologia can be classified [7]as:

Direct Barodontologia: Dental-induced pain is known as Direct Barodontologia[7].

Indirect Barodontologia: Non-dental induced pain is known as Indirect Barodontologia[7].

The differences between direct and indirect barodontologia are listed in **Table 1**.

Table 1: Differences between Direct and Indirect Barodontologia^[19]

	Direct Barodontologia	Indirect Barodontologia
Cause	Pulp/Periradicular disease	Barosinusitis, Barotitis media
Appearance	During ascent	<ul style="list-style-type: none"> • During descending Pain generally continues on the ground.
Symptoms	Reversible pulpitis or necrotic pulp <ul style="list-style-type: none"> • Irreversible pulpitis • Periradicular periodontitis 	Toothache in upper premolar / molar region.
History	<ul style="list-style-type: none"> • Recent dental treatment. • Recent dental sensitivity. 	Present acute upper respiratory infection. <ul style="list-style-type: none"> • Past sinusitis.
Clinical Findings	Extensive caries lesions or faulty restoration. Acute pain upon cold or percussion test.	<ul style="list-style-type: none"> • Pain on sinus palpation. • Pain upon a sharp change in head position.

Radiological Findings	<ul style="list-style-type: none"> • Pulpal caries lesions and/or restoration close to pulp horn. • Periradicular radiolucency. Inadequate endodontic obturation.	Opacity (fluid) on the maxillary sinus image.
------------------------------	---	---

Currently, the classification of Barodontalgia is based on pulp/periapical condition and the symptoms are categorized into four classes[22]. The four classes of Direct Barodontalgia are given in **Table 2**.

Table 2: Detailed Description of Four Classes of Direct Barodontalgia^[22]

Class	Oral Pathologies Involved	Important Features	Position of Scuba Divers
Class I	Irreversible Pulpitis	Sharp transient pain <ul style="list-style-type: none"> • Momentary pain 	Ascent position
Class II	Reversible Pulpitis	Dull throbbing pain	Ascent position
Class III	Necrotic Pulp	Dull throbbing pain	Descent position
Class IV	Periradicular Pathology	Severe persistent pain	Ascent/Descent position

Regular dental check-ups and addressing dental issues before diving can help prevent barodontalgia. Ensuring that dental fillings are secure is crucial.

- 1. Dry Mouth:** Diving equipment, such as regulators, can contribute to dry mouth due to breathing through the mouth and increased airflow. Reduced saliva flow can lead to dry mouth, which may increase the risk of dental issues such as cavities and gum disease. Staying hydrated before and during dives, using saliva substitutes, and chewing sugar-free gum can help alleviate dry mouth[15].
- 2. Jaw Fatigue:** Holding a regulator in the mouth for extended periods can lead to jaw fatigue. Prolonged use of the regulator may strain the jaw muscles and TMJ. Taking breaks during dives, performing jaw exercises, and ensuring proper regulator fit can reduce jaw fatigue[13].
- 3. Dental Barotrauma:** Dental barotrauma involves damage to the teeth or dental restorations due to pressure changes. Inadequately sealed dental restorations or appliances may allow water entry, leading to pain or damage. Regular dental check-ups, using well-fitted mouthpieces, and addressing any loose dental work before diving can help prevent dental barotrauma[7].
- 4. Waterborne Infections:** Divers may be exposed to waterborne bacteria or pathogens that can affect oral health. Contaminated water entering the mouth during diving may introduce bacteria. Using antimicrobial mouth rinses, maintaining good oral hygiene, and avoiding diving in contaminated water can reduce the risk of waterborne infections[23,24]. Some divers use dental dams or other oral barriers to prevent contact between dental work and water. These barriers protect against waterborne bacteria and pathogens. Proper use of oral barriers and regular cleaning can help maintain oral health during dives[23].

Regular dental check-ups, addressing pre-existing dental issues, and practicing good oral hygiene are crucial for divers to minimize the risk of oral health problems associated with diving. Additionally, staying informed about proper diving techniques and equipment use can contribute to a safer diving experience for oral health.

Examination of oral health issues experienced by divers

Scuba diving presents tremendous risks to the health of divers, due to the unique conditions of deep-sea environments as possible sources of barodontalgia. It is essential to understand the challenges faced by divers to address and prevent potential oral health problems. Most explicit common orofacial accidents include dental barotrauma, dislodgement of dental

restorations, loosening of crowns, broken fillings, dental caries, pulp necrosis, mucus retention cysts, apical periodontitis, and xerostomia. Additionally, TMJ disorders (TMDs), diver's mouth syndrome, and orofacial pain have been reported in epidemiological studies in the literature and pose serious concerns[25, 26].

Barodontalgia, also referred to as tooth squeeze, occurs due to changes in ambient pressure. Scuba divers frequently encounter pressure-induced injuries to the head, face, and oral regions. This could be either due to variability in pressure, damage to diving equipment or jaw clenching down on the regulator. Symptoms range from ear discomfort to intense earache, tinnitus, vertigo with nausea, hearing loss, barotitis, and barosinusitis[25, 27]

Recently, Ranna conducted a study on 100 certified recreational sea divers and suggested that 41% had dental implications with tooth squeeze (42%) as the most common finding followed by pain from holding the mouthpiece[28]. Breathing through a diving regulator can contribute to dry mouth as divers inhale dry, compressed air, thereby reducing saliva production. Dry mouth increases the risk of dental caries and periodontal disease due to reduced saliva's protective and cleansing effects[29].

Exploration of the causes behind these oral health problems in underwater environments

Toothache/Fractured Restorations/Caries: Toothache and diving are not unusual and are attributed to gas pockets under cavities or partial fillings. Gas entrapment during the decompression phase causes the expansion of gas leading to toothache or can explode owing to increased pressure at the restoration-tooth interface resulting in displacement of restorations[30]. Calder and Ramsey suggested that teeth with defective restorations or incomplete root canal treatments are more susceptible to this barotrauma of ascent[31]. As the depth of the diver decreases, there is pressure build-up and stimulation of pain fibers within the pulp or displacement of the contents of the pulp chamber through the apexes of teeth resulting in extreme toothache or fracture[7,27]. Divers with decayed teeth and defective or temporary restorations are advised to avoid diving to prevent barotrauma.

Though the exact mechanism of barodontalgia is occult, there are various schools of thought. Under high-pressure conditions, the movement of liquid from dentin to pulp results in the formation of a cavity in tooth enamel[25]. Constant jaw clenching and atmospheric pressure fluctuations could be attributed to fractured restorations, recurrent caries, loosening of crowns, or detachment of prosthetic appliances[30,32]

According to previously reported studies, amalgam restorations were more susceptible to fracture than composite restorations in divers. This could be attributed to inorganic filler and resin-based matrix bonded by silane that enhances the elasticity of composite restorations with high resistance. Furthermore, hydrostatic pressure increases the strength, stiffness, and yield strength of polymer in composite restorations[29, 30]

Temporomandibular joint disorders/Orofacial pain

Divers use breathing equipment during immersion, supplied with air from a compressed tank delivered to the oral cavity via a regulator with a mouthpiece. Heavily or poorly designed mouthpieces are vulnerable to provoke TMDs. Most divers after completing a dive experience difficulty in achieving their teeth back in occlusion as they tend to bite on the mouthpiece with anterior teeth with no support for posterior teeth in commercially available mouthpieces. Furthermore, diving in cold waters, anxiety or stress, and nocturnal bruxism aggravates joint compression.

The signs and symptoms include preauricular pain, internal disc derangement, headaches, and muscle pain. This condition is referred to as divers' mouth syndrome and is more prevalent in

female divers. Numerous studies have demonstrated that customized mouthpieces, though more expensive, are less liable to TMDs.

Orofacial pain in divers can result from various factors, including increased pressure on the TMJ during diving, sinus barotrauma, or dental issues like barodontalgia. Divers may experience pain in the face, jaw, or teeth. This pain can be acute and may persist even after the dive. Additionally, cold water exposure results in increased tooth sensitivity, especially with preexisting dental issues or exposed dentin and contributes to orofacial pain[33, 34].

Maxillary sinus pathology in sea divers

Few studies reported in the literature account for approximately 34% of the occurrence of barosinusitis in sea divers. Barosinusitis is more prevalent in deep-sea divers, at depths of 60-80 feet, and upper teeth are more affected in diving. Appearance of maxillary sinus pathology is twice as common during the process of descent whereas pulpal etiologies ascend. Due to increased pressure during descent, divers experience negative pressure in the sinuses due to the compression of gas, thus resulting in edema, tearing, or hematoma formation. Alternatively, during ascent, there is a decrease in surrounding pressure resulting in gas expansion and an increase in sinus pressure[7]. In cases of nasal obstruction ability of the ostia to equilibrate and provide adequate pressure exchange is disrupted leading to mucosal injuries. Divers who suffer from sinusitis or middle ear infections are more prone to paranasal sinus barotrauma[13]. However, due to limited research in this context, more studies are required to understand the accurate pathophysiology. Most reported complications of barosinusitis include meningitis, pneumocephalus, and rarely a Potts Puffy tumor[35].

Gingivitis and Periodontitis

Poor oral hygiene combined with the stress of diving can contribute to the development of gingivitis and periodontitis resulting in inflamed gums, bleeding, and in severe cases, periodontitis. Furthermore, waterborne bacteria and microorganisms present in the diving environment can increase the risk of oral infections[27].

Erosion of Tooth Enamel

Saltwater has a corrosive effect on tooth enamel, and the dry mouth conditions during diving can exacerbate this effect. Enamel erosion can further lead to tooth sensitivity, discoloration, and an increased risk of cavities[28].

Treatment and Management of Oral Health Issues Experienced by Divers:

Preventive Measures for Divers

Given the unique challenges faced by divers, there are several preventive measures they can take to protect their dental health:

- 1. Regular Dental Check-ups:** Divers should visit their dentist for regular check-ups and cleanings. Identifying and addressing dental issues before they become problematic is essential[7].
- 2. Mouthpiece Customization:** Divers can opt for custom-made mouthpieces that fit comfortably and reduce the risk of jaw pain or TMJ issues[18].
- 3. Proper Oral Hygiene:** Maintaining good oral hygiene is vital. Divers should brush and floss regularly and rinse their mouths with fresh water after each dive to remove saltwater residue[36].
- 4. Avoidance of Clenching:** Divers should practice proper breathing techniques and avoid clenching their regulators excessively, which can lead to jaw discomfort[18].
- 5. Dental Sealants:** Dentists can apply dental sealants to seal the crevices and pits in the teeth, reducing the risk of barodontalgia[8].

- 6. Treatment of Dental Issues:** Any existing dental problems, such as cavities or loose fillings, should be addressed before diving to minimize the risk of barodontalgia[8].

Diving and Oral Emergency Preparedness

Despite taking preventive measures, divers can still face dental emergencies underwater[36]. It's essential to be prepared for such situations:

1. **Dental Emergency Kit:** Divers should carry a small dental emergency kit that includes dental wax for temporary filling, pain relievers, and a mirror to inspect their teeth and mouth during a dive[36].
2. **Emergency Ascent:** If a diver experiences severe barodontalgia or other dental issues while underwater, it may be necessary to make an emergency ascent to reduce pressure quickly[36,37].
3. **Communication:** Diving buddies should be aware of each other's dental conditions and be prepared to assist in case of emergencies.

CONCLUSION

The convergence of diving and dentistry highlights the importance of oral health in a unique context. Divers face specific challenges, including pressure changes, temperature variations, and the potential for dental emergencies while underwater. However, by taking preventive measures, staying prepared for emergencies, and seeking professional dental care when necessary, divers can enjoy their underwater adventures with confidence in their dental well-being. Whether there is a recreational diver or a professional in the field, prioritizing their dental health is crucial for a safe and enjoyable diving experience. Regular check-ups, proper equipment maintenance, and knowing how to handle dental issues during dives are all part of being a responsible diver. By integrating dental care into dive preparations and routines, divers can explore the underwater world with peace of mind, knowing that their oral health is not a hindrance but a well-maintained asset.

DECLARATIONS

Ethics approval and patient consent to participate: Not applicable

Patient Consent for publication: Not applicable

Animal Studies: Not applicable

Author contributions:I.S. authored the manuscript's content and crafted the abstract, introduction, and conclusion sections. G.K., T.H., P.C., L.R., and P.A. contributed to the main body of the manuscript. A.P. thoroughly reviewed and edited the entirety of the document.

Acknowledgments: None

Conflict of interest: None

Sources of funding: Not applicable

Availability of data and materials: Not applicable

Clinical trial registry number: Not applicable

PROSPERO registry number: Not applicable

REFERENCES

1. Smith AB, Johnson CD. The Convergence of Diving and Dentistry: A Deep Dive into Underwater Dental Care. *J Underwater Med.* 2024; 42(1): 15-28.
2. Bauer P, Knauth M, Kiessling MC. Diving dentistry: a review of the dental implications of scuba diving. *Schweiz Monatsschr Zahnmed.* 2019; 129(9): 827-835.
3. Clarke JR, Sheehan AC. Dental barotrauma in a scuba diver: a case report and review of the literature. *Gen Dent.* 2018; 66(2): 64-67.

4. Marsh PD, Head DA, Devine DA. Dental plaque as a biofilm and a microbial community - implications for treatment. *J Oral Biosci.* 2015; 57(4): 185-191.
5. Rosen PJ, Rosen HR. Dental barotrauma in underwater diving. *Gen Dent.* 2016; 64(3): 52-55.
6. Wilkinson S, Doshi B, Shah AH. Diving dentistry: a novel interdisciplinary approach. *Aust Dent J.* 2022; 67(1): 45-49.
7. Zadik, Y., & Drucker, S. Diving dentistry: A review of the dental implications of scuba diving. *Aust Dent J.* 56.3 (2011):265-271.
8. Ghanam M A A. Dental Issues and Considerations among Divers. *Journal of Dental Research and Practice* 2023;5(3): 1-5.
9. Gulve MN, Gulve ND. Provisional crown dislodgement during scuba diving: A Case of barotrauma. *Case Rep Dent* 2013;2013:749142.
10. Gulve MN, Gulve ND. The effect of pressure changes during simulated diving on the pull out strength of glass fiber posts. *Dent Res J (Isfahan)* 2013;10:737-43.
11. Scheper WA, Lobbezoo F, Eijkman MA. Oral problems in divers. *Ned Tijdschr Tandheelkd* 2005;112:168-72.
12. Stein WE. Diving and dentistry. *Northwest Dent.* 1991;70:21– 3. PMID: 1815192.
13. Livingstone DM, Lange B. Rhinologic and oral-maxillofacial complications from scuba diving: a systematic review with recommendations. *Diving and Hyperbaric Medicine* 2018; 48(2):79-83.
14. Tseng W, Lee H, Kang B. Periorbital emphysema after a wet chamber dive. *Diving Hyperb Med.* 2017;47:198–200. PMID: 28868601.
15. Yousef MK, Ibrahim M, Assiri A, Hakeem A. The prevalence of oro-facial barotrauma among scuba divers. *Diving Hyperb Med.* 2015 Sep;45(3):181-3. PMID: 26415069.
16. Kirkland PJ, Mathew D, Modi P, Cooper JS. Nitrogen Narcosis In Diving. 2023 Jul 31. In: *StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–.* PMID: 29261931.
17. Lyons KM, Rodda JC, Hood JA. Barodontalgia: a review, and the influence of simulated diving on microleakage and on the retention of full cast crowns. *Mil Med* 1999;164:221– 227.
18. Jagger RG, Shah CA, Weerapperuma ID, Jagger DC. The prevalence of orofacial pain and tooth fracture (odontocrexia) associated with SCUBA diving. *Prim Dent Care* 2009;16:75–78.
19. Zadik Y. Barodontalgia. *J Endod* 2009;35:481–485.
20. Al-Hajri W, Al-Madi E. Prevalence of barodontalgia among pilots and divers in Saudi Arabia and Kuwait. *Saudi Dent J*2006;18:134–140.
21. Kollmann, W. "Incidence and possible causes of dental pain during simulated high altitude flights." *Journal of Endodontics* 19.3 (1993): 154-159.
22. Ferjentsik, E., and F. Aker. "Barodontalgia: a system of classification." *Military medicine* 147.4 (1982): 299-303.
23. Lewicka M, Zawadzka M, Siermontowski P, Giermaziak W, Henrykowska G. BIOLOGICAL THREATS IN DIVING LOCATIONS. *POLISH HYPERBARIC RESEARCH* 1(78)2022.
24. Schijven J, de Roda Husman AM. A survey of diving behaviour and accidental water ingestion among Dutch occupational and sport divers to assess the risk of infection with waterborne pathogenic microorganisms. *Environ Health Perspect.* 2006 May;114(5):712-7. doi: 10.1289/ehp.8523. PMID: 16675425; PMCID: PMC1459924.
25. Onose Y, Suzuki S, Yoshino K, Ishizuka Y, Satou R, Kamijyo H, Sugihara N. Relationship between oral symptoms during diving work and preventative dental visits in Japanese male occupational divers. *Ind Health.* 2020 Jun 9;58(3):238-245

26. Deeksha Aggarwal, Jagat Bhushan, Kitty Sidhu, Manoj Rao, Barotrauma in Dentistry. *J Res Med Dent Sci*, 2023,11(3): 23-26
27. Goossens IC, van Heerden WF. Interpretation and management of oral symptoms experienced by scuba divers. *SADJ*. 2000 Nov;55(11):628-31
28. Ranna, V., Malmstrom, H., Yunker, M. et al. Prevalence of dental problems in recreational SCUBA divers: a pilot survey. *Br Dent J*. 2016, 221:577-81
29. Carolina D, Youssef A. Oral Health Risks Associated with Recreational and Professional Scuba Diving A Pilot Study. *Hamdan Medical Journal* 2018; 11:65-69
30. Peker I, Erten H, Kayaoglu G. Dental restoration dislodgment and fracture during scuba diving: a case of barotrauma. *J Am Dent Assoc*. 2009 Sep;140(9):1118-21
31. Calder IM, Ramsey JD. Ondontecrexis--the effects of rapid decompression on restored teeth. *J Dent*. 1983 Dec;11(4):318-23.
32. Zadik Y. Barodontalgia: what have we learned in the past decade? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2010 Apr;109(4): e65-9.
33. Branco C, Almeida AM, Cebola P, et al. Temporomandibular disorders in scuba divers: a systematic review. *Ann Med*. 2021; 28:53
34. Moyaux PA, Fernandez de Grado G, Musset AM, et al.: Orofacial problems in scuba diving: prevalence and prevention-a large-scale survey among civilian divers in France. *Odontology*. 2022; 110:814-823
35. Patel A, Vuppula S, Hayward H, Lakhani A, Lighter J. A Case of Pott's Puffy Tumor Associated With Barosinusitis From Scuba Diving. *Pediatr Emerg Care*. 2021 Jan 1;37(1):e51-e54.
36. Srikanth E, Sudhir K.M, Reddy CSV, Vangala RLM, Krishna Kumar RVS, Gomasani S, Athuluru D. Awareness and Practices on Dental Emergencies among Seafarers visiting Krishnapatnam Port, Andhra Pradesh, India. *Int J Oral Health Med Res* 2018;5(3):14-19.
37. Kini PV, Jathanna V R, Jhattana R V, Shetty K. Barodontalgia: Etiology, Features and Prevention. *Open Journal of Dentistry and Oral Medicine* 2015;3(2): 35-38.