

# Dental and Orofacial Barotraumas among Saudi Military Naval Divers in King Abdul Aziz Naval Base Armed Forces in Jubail, Saudi Arabia: A Cross-sectional Study

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ABSTRACT

**Background:** The aim of this study was to assess dental as well as orofacial pain under atmospheric pressure in military divers. **Materials and Methods:** Cross-sectional study was conducted in King Abdulaziz Naval Base Armed Forces (KANB) in Jubail, Saudi Arabia involving 216 Saudi military divers. Questionnaire was formulated to assess the prevalence and factors associated with dental as well as orofacial pain among divers. **Results:** Of total 216 participants, 35.6% participants dive 10-50times/year; whereas 52.8% dive in more than 20 m depth and 67.2% dive in the atmospheric pressure of >1.5bar. Majority (81.9%) used compressed air when diving. Sudden pain during or after diving was experienced by 67.1% in head or facial area, 69.2% in nose and paranasal sinuses, and 52.3% have experienced dental injury. Statistically significant associations were found between pain during diving with a frequency of diving, diving depth, and atmospheric pressure with  $P < 0.001$ , 0.001, and 0.011, respectively. **Conclusion:** Through this study, we concluded that dental and orofacial pain were experienced by more than half of the military divers at least once during their dive. Factors like increased frequency of diving, deep divers, and increased atmospheric pressure increases the extent of pain. Findings of this study suggested that more studies focusing on diving centers should be performed to realize the complete range of the issue.

**KEYWORDS:** Barodontalgia, barotrauma, military, Saudi Arabia, scuba diving

## INTRODUCTION

From the time of the advent of professional and leisure self-contained underwater breathing apparatus (SCUBA) diving, that is, in the middle of the twentieth century, various known phenomena associated with diving were described pertaining to the changes in the atmospheric pressure.<sup>[1]</sup> The pressure that is exerted by water on the diver when an individual descends deeper, underneath the surface of water, is said to increase and decrease the volume of gases in teeth and sinuses.<sup>[2]</sup> A problem appears when these enclosed gases are unable to contract or expand; for adjusting the internal pressure so that it corresponds

to the outside pressure.<sup>[3,4]</sup> This may create pain in various regions of body specifically facial muscles. Underwater diving pain has been related to appear at depths ranging from thirty-three feet to eight feet. Such variations are significantly greater during diving as every descent of 10 m raises the pressure by another one atmosphere.<sup>[5-7]</sup>

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Dentists can face certain oral conditions related to it that require immediate treatment one of which is barodontalgia.<sup>[8,9]</sup> It is an oral pain; dental or nondental that is produced by the alteration in barometric pressure in otherwise asymptomatic structure.<sup>[6,10]</sup> According to the Boyle's Law, "At a given temperature, the volume of gas is inversely proportional to the ambient pressure"<sup>[10]</sup> which explains barodontalgia. In an environment of diving, this type of pain is generally termed as tooth squeeze.<sup>[9,11,12]</sup> It affects the upper teeth than the lower teeth more commonly and many of the episodes appear on descent.<sup>[7,8]</sup>

Head and face barotrauma comprise of the entities of barotrauma-related headache, baro-sinusitis, barotitis, barodontalgia, and dental barotrauma.<sup>[8,9]</sup> In addition to pressure fluctuations, traumatic injuries may occur in divers; particularly to the orofacial structures because of continuous jaw clenching. The effect was referred as divers' mouth syndrome ranging from dry mouth to tooth fracture or odontocrexia.<sup>[8,13]</sup> Other symptoms related to barodontalgia or tooth squeeze included injury or pain to teeth as a result of the fluctuations in the pressure gradient, pain and discomfort in the temporomandibular joint (TMJ), oral soft tissue injury owing to inappropriate design of the mouthpiece and loosening of dental fillings as well as restorations.<sup>[14-16]</sup>

Co-factors that aggravate such conditions include odontogenic infections, apical periodontitis, secondary caries, pulp necrosis, sinusitides, recently performed dental treatments and insufficient fillings extending into dentin.<sup>[6,9]</sup> Pain associated with these conditions is usually localized, severe and sharp; often emerging upon a rise in pressure while sometimes can become so severe that the diving safety is jeopardized by the individuals affected; due to the misconduct related to this pain.<sup>[1,6,9]</sup> A possibility of the exacerbation of pre-existing sub-clinical symptoms can also be taken into account while labeling a person with barodontalgia.<sup>[9]</sup>

Few studies those have assessed the dental symptoms prevalence among divers have involved professional divers such as military divers or those having long diving experience and extensive training.<sup>[4]</sup> For instance, a study done by Gunepin *et al.*<sup>[17]</sup> involved 1,317 French military divers where 7.3% of them suffered from barodontalgia. Another study conducted by Zanotta *et al.*<sup>[4]</sup> found that 15% of 520 caisson workers as well as professional divers experienced pressure-related dental symptoms. Other studies including recreational divers also showed somewhat higher prevalence of barodontalgia.<sup>[16,18]</sup> Similarly, Yousef *et al.*<sup>[18]</sup> noticed the occurrence of orofacial pain and TMJ symptoms in 163 divers from Saudi Arabia ranging from 4% to 52%.

However, the recent study conducted in Saudi Arabia reported 46.7% divers reported facial pain.<sup>[19]</sup>

More than 60 years have passed since the introduction of the concept of barodontalgia, still limited information is present in the published literature regarding it. Besides, this lack of knowledge and paucity in recent data regarding diving-related conditions, several agreements have derived concerning to the barometric effects on oral tissues; from in-flight observations and most commonly from the military settings.<sup>[7,8]</sup> Therefore, we aim to study and assess dental and orofacial pain under atmospheric pressure using questionnaires taking into consideration the current literature, so as to elaborate recommendations to reduce barotraumas in Saudi Arabia.

## MATERIALS AND METHODS:

### STUDY DESIGN AND STUDY SETTING

This was a cross-sectional study that was conducted in December 2016 in King Abdulaziz Naval Base Armed Forces (KANB) in Jubail, Saudi Arabia. King Abdul-Aziz Naval Base (KANB) is located just south of the steadily growing Jubail commercial port and industrial complex. It is about 100 km (60 miles) northwest of Dhahran; about one hour driving time over a heavily-traveled, divided, and limited access highway.<sup>[20]</sup>

### SAMPLING AND SAMPLE SIZE

This study involved Saudi military divers a total of 280 to study the effect of barodontalgia and orofacial trauma. We requested the list of total Military naval individuals from the authorities of King Abdulaziz Naval Base Armed Forces (KANB) in Jubail, Saudi Arabia. Because of confidentiality issues we got the unique identification instead of the actual names of military naval. By using that list we randomly selected 300 militants. From those total 300 militants, we included those only who were medically fit military divers having no dental caries ( $n = 280$ ). Militants with oral and dental problems or those who have medical illnesses were excluded from the study.

### STUDY TOOL

A questionnaire was designed in English and was translated to Arabic and then was distributed to 280 selected divers according to "diving medical standards for military divers concerning dental department".<sup>[21,22]</sup> Questionnaire was designed by using variables from different studies and modified as per the Saudi context.<sup>[4,17-19]</sup> We also included the expert advice on formulating the content of questionnaire. Content and face validity of questionnaire were assessed by piloting the questionnaire on 20 military naval. The

results of the pilot study showed considerable face and content validity of the questionnaire. Questionnaire comprises of three sections. The first section was about the demographic and general data, the second section about the dental pain, whereas the third was about head and orofacial pain. The first section represented general data about gender, age, medical condition, last dental visit, smoking, frequency of diving per year, usual diving depth, usual atmospheric pressure, do use breathing gas, breathing gas used. The second section was regarding dental pain such as do you feel pain in your teeth during or after diving, type of pain, level of pain (represented in a scale from 0 to 10), when did the pain happen (during rise or decrease in pressure), once or several times, did pain persist, have you experienced any dental injury while diving, type of injury (in teeth, dental restoration or dental crown), where did the injury happen (in back or front teeth), have you treated your teeth during annual examination, and what was the reason for past dental treatment. The third section was about pain in head and orofacial area and this section included following variables; barotrauma or any other pain in the head and orofacial area except teeth, did you feel pain in head or orofacial area during diving, the area of pain, the level of pain (represented in a scale from 0 to 10), type of pain (sudden pain, pulsating pain, pressure), is there an effort required to hold the mouthpiece in place, is there any facial muscle pain, the level of pain (represented in a scale from 0–10), muscle fatigue, change in lip sensation (numbness), any incomplete mouth opening, TMJ clicking or pain, dry mouth after diving.

#### STATISTICAL ANALYSIS

One author surveyed the questionnaires and one entered the data for statistical analysis which were then analyzed using a statistical software, that is, SPSS version 21.0. Descriptive statistics (frequencies, percentages, median and interquartile range) were used to describe the categorical study variables and skewed observations of pain level. Normality test (Kolmogorov–Smirnov) was used to assess the normality of scores of pain levels. Nonparametric statistical test (Kruskal–Wallis) was used to compare the mean ranks of pain levels in relation the study variables (age groups, number of times diver per year, diving depth levels, and atmospheric pressure) which were having more than two categories to report the statistical significance of results, a  $P < 0.05$  was used.

#### ETHICAL APPROVAL

Ethical approval was attained from the Research and Ethical Committee at Riyadh Colleges of Dentistry and Pharmacy, Riyadh, Saudi Arabia. The research registration number is FIRP/2016/62.

## RESULTS

Of 280 Saudi military naval divers, 77% have responded to this study. Most of them (65.3%) belonged to 25–35 years age group and 32% of them were smokers. The 10–50 time's frequency of dive per year among these divers was found to be 35.6%, and a >50 time per year was 25%. The depth of diving was 20–50 m for 43.1% of divers, whereas >50 m depth for 9.7% of divers. Most of the divers (81.9%) were using breathing gas when they dive, in which 76.8% were using compressed air [Table 1].

Pain during diving was felt by 61.1% of divers, in which 62.9% were feeling sudden pain during or after diving. The median pain on 10-point scale was 5. And 56.1% had expressed pain in their teeth upon rise in pressure during diving, only 18.5% of them reported of having pain in their teeth at every dive. Whereas 65% felt the continuation of pain after diving [Table 2].

The prevalence of dental injury was 52.3% while diving, of which 63.7% of them had injury in dental restorations, and 22.1% of them had injury in dental crowns. Most of the tooth injuries (87.6%) happened in Back teeth. The treatment of diver's teeth during their annual examination was carried out in 63.6% of divers, in which 75.7% for broken restoration or dental crown [Table 3].

Of 216 Saudi divers, 67.1% felt pain in their head and facial area during diving, and most of them 69.2% had pain in their nose (paranasal sinuses). The median value of their pain on 10-point scale was 5. The sudden pain was reported by 53.8 divers. And 54.4% of divers felt pain in their facial muscles during diving. Their median value of pain was 5. Among the symptoms, muscle fatigue was reported by 30%, lip numbness by 6.9%, limited mouth opening by 13.4%, TMJ pain or clicking by 13.9%, and mouth dryness by 48.6% of divers [Table 4].

The comparison means ranks of observations of pain during diving in relation to the age groups of divers indicate no statistically significant difference ( $P = 0.356$ ). Whereas a statistically significant difference was present in the mean ranks of pain observations, in relation to the number of times divers dive per year, depth of diving and the levels of atmospheric pressure during diving. That is the pain level is statistically significantly higher among the divers who dive 10–50 times and >50 times per year when compared with divers who dive <10 per year ( $P < 0.001$ ). Also, the statistical significance was also found in pain level during diving, among the divers who dive at depth of 20–50 m and >50 m when compared with divers

**Table 1: Distribution to sociodemographic characteristics and work-related variables of Saudi Military Naval Divers (n = 216)**

Characteristics	No. (%)
Age (in years)	
<25	8(3.7)
25–35	141(65.3)
35–45	56(25.9)
45–50	11(5.1)
Are you medically fit to dive?	
Yes	183(84.7)
No	18(8.3)
I don't know	15(7.0)
When was your last dental visit?	
Before 1 month	52(24.1)
From 1 to 6 months	59(27.3)
From 6 months to 1 year	56(25.9)
More than 1 year	28(13.0)
I don't know	21(9.7)
Do you smoke	
Yes	69(32.0)
No	147(68.0)
How many times do you dive per year?	
< 10 times per year	61(28.2)
10–50 times per year	77(35.6)
> 50 times per year	54(25.0)
I don't know	24(11.1)
What is your usual diving depth?	
< 10 m	37(17.1)
1–20 m	49(22.7)
20–50 m	93(43.1)
> 50 m	21(9.7)
I don't know	16(7.4)
What is the usual atmospheric pressure when you dive?	
< 1 bar	16(7.4)
1–1.5	23(10.6)
1.5–2	47(21.8)
2.1–3	63(29.2)
> 3	35(16.2)
I don't know	32(14.8)
Do you use the breathing gas when you dive?	
Yes	177(81.9)
No	39(18.1)
What type of breathing gas do you use?	
Compressed air	136(76.8)
Nitrox	28(15.8)
Mixture of gasses (heliox/trimix)	13(7.3)

who dive at depth of <10 m and 10–20 m of depth ( $P < 0.001$ ). The pain during diving was higher among divers who dive with atmospheric pressure of 1.5–2 bars, 2.1–3 bars and >3 bars, when compared with divers who dive with atmospheric pressure of <1 bar and 1–1.5 bars ( $P = 0.011$ ) [Table 5]

Likewise, the levels of pain in head or facial area in relation to the age groups of divers indicates no statistically significant difference ( $P = 0.350$ ). Whereas

there was a significant difference in the mean ranks of pain observations, in relation to the number of times divers, dive per year, depth of diving and the levels of atmospheric pressure during diving with  $P = 0.001$ , 0.004, and 0.025, respectively.

The levels of pain in facial muscle area in relation to the age groups of divers indicate statistically significant difference ( $P = 0.036$ ). That is the pain in facial muscle area is significantly higher in divers who were in age

**Table 2: Distribution of responses of Saudi Military Naval Divers towards their pain during diving**

Pain and its variables	No. (%)
Do you feel pain during or after diving?	
Yes	132(61.1)
No	80(37.0)
I don't know	4(1.9)
What type of pain do you feel?	
Sudden pain during diving or after diving	83(62.9)
Pulsating pain during diving or after diving	35(26.5)
Pressure pain during diving or after diving	14(10.6)
Level of pain (Median & Inter Quartile range)	5(2)
When did you feel pain in your teeth during diving? ( <i>n</i> = 157)	
Upon rise in pressure during diving	88(56.1)
Upon decrease in pressure during diving	9(5.7)
After diving directly	29(18.5)
I don't know	31(19.7)
How many times the pain did occur in your teeth? ( <i>n</i> = 157)	
No pain during diving	5(3.2)
Once	12(7.6)
More than once	80(51.0)
At every dive	29(18.5)
I don't know	31(19.7)
Did the pain continue for a while after diving? ( <i>n</i> = 157)	
Yes	102(65.0)
No	44(28.0)
I don't know	11(7.0)

**Table 3: Distribution of responses of Saudi Military Naval Divers towards their dental injury during diving**

Dental injury and its variables	No. (%)
Have you ever experienced any dental injury while diving?	
Yes	113(52.3)
No	99(45.8)
I don't know	4(1.9)
Type of injury( <i>n</i> = 113)	
Injury in teeth	16(14.2)
Injury in dental restorations	72(63.7)
Injury in dental crowns	25(22.1)
Where did the tooth injury happen? ( <i>n</i> = 113)	
In frontal teeth	14(12.4)
In back teeth	99(87.6)
Have you treated your teeth during annual examination? ( <i>n</i> = 214)	
Yes	136(63.6)
No	70(32.7)
I don't know	8(3.7)
What was the reason for treatment? ( <i>n</i> = 136)	
Broken restoration or dental crown	103(75.7)
Recurrent caries	33(24.3)

group of 25–35 years and 35–45 years. Also, there is highly statistically significant difference in the mean ranks of facial muscle pain observations, in relation to the depth of diving and the levels of atmospheric pressure during diving with  $P = 0.007$  and  $0.005$ , respectively [Table 5].

## DISCUSSION

This study showed that majority of the participants were between 25 and 35 years of age and were medically fit to dive. Dental problems increased with growing experience of the divers. More than a quarter of individuals dive 10–50 times per year whereas the usual diving depth

**Table 4: Distribution of responses of Saudi Military Naval Divers towards their pain in head and facial area during diving**

Pain in head and facial area and its variables	No. (%)
Did you ever feel any pain in your head or facial area during diving? ( <i>n</i> = 213)	
Yes	143(67.1)
No	66(31.0)
Don't know	4(1.9)
Area of pain( <i>n</i> = 143)	
Mouth	12(8.4)
Nose (paranasal sinuses)	99(69.2)
Ear	32(22.4)
Level of pain (Median & Inter Quartile range)	5(2)
Type of pain ( <i>n</i> = 143)	
Sudden pain	77(53.8)
Pulsating pain	20(14.0)
Pressure pain	45(31.5)
Don't know	1(0.7)
Is there an effort required to hold the mouth piece in place? ( <i>n</i> = 206)	
Yes	128(62.1)
No	78(37.9)
Do you feel pain in your facial muscle during diving? ( <i>n</i> = 206)	
Yes	112(54.4)
No	88(42.7)
Don't know	6(2.9)
Level of pain (Median & Inter Quartile range)	5(2)
Muscle fatigue while the dive or after diving ( <i>n</i> = 203)	
Yes	61(30.0)
No	111(54.7)
Don't know	31(15.3)
Lip numbness while the dive or after diving( <i>n</i> = 202)	
Yes	14(6.9)
No	152(75.2)
Don't know	36(17.8)
Limited mouth opening while the dive or after diving ( <i>n</i> = 202)	
Yes	27(13.4)
No	136(67.3)
Don't know	39(19.3)
Any TMJ pain or clicking while the dive or after diving( <i>n</i> = 201)	
Yes	28(13.9)
No	128(63.7)
Don't know	45(22.4)
Mouth dryness while the dive or after diving ( <i>n</i> = 208)	
Yes	101(48.6)
No	89(42.8)
Don't know	18(8.7)

of many of them was 20–50 m on average atmospheric pressure of 2.1–3 during which vast majority used breathing gas, that is, compressed air when diving. Sudden pain during or after diving was experienced by more than half in head or facial area and in nose (paranasal sinuses) whereas about half of them reported dental injury upon rise in pressure during diving; pertaining to injury in dental restorations of back teeth. Statistically significant associations were found between pain in head or facial during diving and frequency of diving, depth, and atmospheric pressure during diving.

Barodontalgia was also experienced by 9.2% of American<sup>[23]</sup> and 17.3% Australian<sup>[16]</sup> civilian divers on one or more occasions whereas its incidence was 21.6% in Saudi-Arabian and 11.9% in Kuwaiti military divers<sup>[5]</sup> which were lesser then reported by our study participants that is 67.1%. In these studies, Barodontalgia was predominant in thirties (30–39 years of age) which was similar to the present study. Similar to the findings of our study, study conducted among Australian divers reported jaw pain and pain in sinuses;<sup>[16]</sup> however, the prevalence is much frequent

**Table 5: Comparison of mean values of pain of Saud military naval divers in relation to age, fitness, frequency, and depth of diving**

Variables	Pain during diving		Pain in head or facial area		Pain in fascial muscle	
	Mean Ranks	P Value	Mean ranks	P Value	Mean ranks	P Value
Age (in years)						
<25	74.63	0.356	47.90	0.350	9.75	0.036*
25–35	66.73		73.01		60.33	
35–45	77.32		77.97		72.36	
Frequency of dive per year						
<10	54.73	<0.001*	47.35	0.001*	55.07	0.083
10–50	79.25		78.25		63.39	
> 50	77.94		84.26		69.57	
Don't know	19.78		62.19		34.92	
Diving depth						
< 10 m	43.80	0.001*	40.36	0.004*	46.80	0.007*
10–20 m	58.67		64.06		44.26	
20–50 m	78.76		75.34		63.88	
> 50 m	84.73		90.55		84.16	
Don't know	43.23		86.55		64.89	
Atmospheric pressure						
< 1 bar	43.38	0.011*	40.75	0.025*	52.40	0.005*
1–1.5	60.88		55.69		18.71	
1.5–2	81.37		82.93		76.48	
2.1–3	72.56		74.52		60.83	
>3	73.46		81.07		66.00	
Don't know	34.56		57.04		59.21	

\*Statistically significant

in our study population compared to this study. Like our study, study conducted among Kuwaiti military divers reported the relation between pain and depth of diving.<sup>[5]</sup>

Long back in 80's Calder *et al.*<sup>[24]</sup> also documented the negative consequence of pressure change on teeth having damaged fillings. They also supported the explanation of the possibility that air trapped within decayed teeth or beneath damaged restorations could contract and expand abnormally during the progression of a dive, producing dental pain. Historically a 10-year longitudinal prospective study was conducted, incorporating the German navy, a 4-fold escalation was detected in missing teeth, whereas a 10-fold increase was noted in crown placement in those navy divers who regularly had exposure to barometric changes, that is, approximately 200–300 hours of underwater diving per annum, as compared to almost three to five-fold increase in missing teeth crown settlement, respectively, among submariners who often worked in normal pressure conditions.<sup>[25]</sup> However, survey among Australian divers by Jagger *et al.*<sup>[16]</sup> showed that only one diver experienced tooth shattering whereas two of them suffered restoration displacement when diving. A recent study conducted in the United Arab Emirates reported that frequent divers and deep divers experience

periodontal damage, enamel fissures and odontocrexia of metal and composite restorations.<sup>[26]</sup>

Likewise the findings of our study, prevalence of dental problems was also studied by Ranna *et al.*<sup>[27]</sup> in recreational SCUBA divers where 41% of the respondents experienced dental signs during diving and the most commonly experienced symptom was Barodontalgia, that is, 42%, 24% suffered discomfort from when they had to hold the regulator very tightly, 22% experienced jaw pain, 5% noticed loosening of crowns that were placed on teeth and 5% had pain in the gums, whereas 2% developed a broken dental filling. Likewise, our study findings also highlighted increased prevalence of injury in restoration and crown, and pain in molar teeth pertaining to negative consequence of pressure change on teeth and possibility of air trapped. Therefore, it is suggested that since Scuba diving is nowadays among the fastest growing sports all around the world, it is hence imperative for dentists to remain attentive towards dental problems that can occur for scuba divers.<sup>[28]</sup>

Another study conducted by Yousef *et al.*<sup>[18]</sup> assessed the frequency of orofacial barotrauma in 166 scuba divers from Jeddah in which the most frequently occurring symptoms during diving included dry mouth, that is, 51.9%, then clenching, that is, 32.5%, followed by TMJ

pain, that is, 19.5%, whereas after diving, the most prevalent issues were dry mouth, that is, 22.7% after which facial pain and clenching (16.9%) were other most prominent symptoms. However, in our study the most frequently occurring symptoms during and after diving were dry mouth followed by muscle fatigue, pain in TMJ, limited mouth opening and numbness of lips. As reported in previous study dry mouth was also the most common symptom in the present study.

We should conclude the findings of this study by keeping into consideration following limitations which are as follows; firstly, the sample size was not that huge thus we cannot generalize the findings of our study however; even with this sample size our findings are consistent with the findings of previous studies. Second, the information received from the participants on dental status was self-reported. Therefore, reporting bias can be considered. Thirdly, gender distribution was also not considered as all the participants belonged to military and so were males. Moreover, racial and ethnic information was not recorded, and this might lead to underestimation of few findings are few problems are specific with certain ethnicity. Finally, any difference that existed between the symptoms experienced by military divers and those who perform diving for recreational purposes could not be assessed. There might be some alteration depending upon the level of training of the divers. However, pertaining to the limited data in Saudi Arabia on this topic, this study will add into the existing pool of literature and has proved to have significant results that can be of help in designing health-related strategies and oral examinations for military divers.

## CONCLUSION

Pain in head or facial muscles during diving specifically in paranasal sinuses and back teeth were the most prevalent problems faced by the divers which were found dependent on the number of times they dived per year, depth of diving, and the atmospheric pressure. Findings of this study suggested that more studies with focus to diving centers should be performed to realize the complete range of the issue. Barotrauma is a process, which does not need to be dismissed as insignificant, as it can create serious safety risks to the divers. Dentists as well as patients should be aware of the significance of routine dental checkup and screening so as to avoid any barotrauma-associated dental problems.

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## CONFLICTS OF INTEREST

There are no conflicts of interest.

## AUTHORS CONTRIBUTIONS

Not applicable.

## ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

Not applicable.

## PATIENT DECLARATION OF CONSENT

Not applicable.

## DATA AVAILABILITY STATEMENT

Not applicable.

## REFERENCES

- Zadik Y, Drucker S. Diving dentistry: A review of the dental implications of scuba diving. *Aust Dent J* 2011;56:265-71.
- Livingstone DM, Lange B. Rhinologic and oral-maxillofacial complications from scuba diving: A systematic review with recommendations. *Diving Hyperb Med* 2018;48:79-83.
- Rusoke-Dierich O, editor Barotrauma. In: *Diving Medicine*. Cham: Springer; 2018. p. 167-201.
- Zanotta C, Dagassan-Berndt D, Nussberger P, Waltimo T, Filippi A. Barodontalgias, dental and orofacial barotraumas: A survey in swiss divers and caisson workers. *Swiss Dent J* 2014;124:510-9.
- Al-Hajri W, Al-Madi E. Prevalence of barodontalgia among pilots and divers in Saudi Arabia and Kuwait. *Saudi Dent J* 2006;18:134-40.
- Stoetzer M, Kuehlhorn C, Ruecker M, Ziebolz D, Gellrich NC, von See C. Pathophysiology of barodontalgia: A case report and review of the literature. *Case Rep Dent* 2012;2012:453415.
- Gaur TK, Shrivastava TV. Barodontalgia: A clinical entity. *J Oral Health Comm Dent* 2012;6:18-20.
- Zadik Y. Aviation dentistry: Current concepts and practice. *Br Dent J* 2009;206:11-6.
- Zadik Y. Barodontalgia. *J Endod* 2009;35:481-5.
- Robichaud R, McNally ME. Barodontalgia as a differential diagnosis: Symptoms and findings. *J Can Dent Assoc* 2005;71:39-42.
- Gulve MN, Gulve ND. Provisional crown dislodgement during scuba diving: A case of barotrauma. *Case Rep Dent* 2013;2013:749142.
- Shetty KP, Satish SV, Rao K, Bhargavi PA. Barodontalgia: A review. *Endodontology* 2013;25:156-60.
- Nakdimon I, Zadik Y. Barodontalgia among aircrew and divers. *Aerosp Med Hum Perform* 2019;90:128-31.
- Marinides Z, Virgilio GVR. Recurrent facial nerve baroparesis in a military diver: A case report. *Undersea Hyperb Med* 2019;46:87-90.
- McDonnell JP, Needleman HL, Charchut S, Allred EN, Roberson DW, Kenna MA, *et al.* The relationship between dental overbite and eustachian tube dysfunction. *Laryngoscope* 2001;111:310-6.
- 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;16:75-8.



17. Gunepin M, Derache F, Dychter L, Blatteau JE, Nakdimon I, Zadik Y. Dental barotrauma in French military divers: Results of the POP study. *Aerosp Med Hum Perform* 2015;86:652-5.
18. Yousef MK, Ibrahim M, Assiri A, Hakeem A. The prevalence of oro-facial barotrauma among scuba divers. *Diving Hyperb Med* 2015;45:181-3.
19. Aldakhil AM, Alshammari AF, Alshammari SS. Dental and temporomandibular joint problems among SCUBA divers in Jeddah, KSA. *Am J Sports Sci Med* 2018;6:67-71.
20. Available from: <https://www.globalsecurity.org/military/facility/jubail.htm>. [Last accessed on 2019 Apr 24].
21. Weiss M. Standards on medical fitness examinations for navy divers. *Int Marit Health* 2003;54:135-43.
22. Koob A, Ohlmann B, Gabbert O, Klingmann C, Rammelsberg P, Schmitter M. Temporomandibular disorders in association with scuba diving. *Clin J Sport Med* 2005;15:359-63.
23. Taylor DM, O'Toole KS, Ryan CM. Experienced scuba divers in Australia and the united states suffer considerable injury and morbidity. *Wilderness Environ Med* 2003;14:83-8.
24. Calder IM, Ramsey JD. Ondontecrexis—the effects of rapid decompression on restored teeth. *J Dent* 1983;11:318-23.
25. Goethe WH, Bäter H, Laban C. Barodontalgia and barotrauma in the human teeth: Findings in navy divers, frogmen, and submariners of the federal republic of Germany. *Mil Med* 1989;154:491-5.
26. Duarte C, Abu-Youssef A. Oral health risks associated with recreational and professional scuba diving: A pilot study. *Hamdan Med J* 2018;11:65.
27. Ranna V, Malmstrom H, Yunker M, Feng C, Gajendra S. Prevalence of dental problems in recreational SCUBA divers: A pilot survey. *Br Dent J* 2016;221:577-81.
28. Kamran B, Nakdimon I, Zadik Y. [Military aviation dentistry]. *Refuat Hapeh Vehashinayim* (1993) 2017;34:42-7, 88.