

The prevalence of oro-facial barotrauma among scuba divers

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Abstract

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Introduction: Barotrauma is a physical injury that results from ambient pressure changes during flying, diving or hyperbaric oxygen therapy. The aim of this study was to assess the prevalence of oro-facial barotrauma among a sample of scuba divers in Jeddah, Saudi Arabia.

Materials and methods: Data for the study were collected through a self-reported questionnaire that was distributed to 166 divers. The questionnaire was divided into two parts, in which the first part contained demographic data and the second part consists of multiple choices questions and a few open-ended questions discussing the different signs and symptoms of orofacial barotraumas.

Results: One-hundred-and-sixty-three divers responded. The most frequent symptoms during diving were dry mouth (51.9%), followed by clenching (32.5%) and temporomandibular joint (TMJ) pain (19.5%), while the most frequent symptoms after diving were dry mouth (22.7%) followed by clenching and facial pain (16.9%).

Conclusion: Clenching and dry mouth were common findings but are temporary in nature and do not warrant any dental intervention. TMJ and facial pain were also reported but were temporary. The use of commercial mouthpieces during diving may be related to more symptoms when compared with customized types.

Key words

Barotrauma; dental; scuba diving; pain; underwater medicine

Introduction

Scuba diving continues to be a popular sport. However, research conducted in the field of barotrauma and oro-facial problems associated with diving is relatively scarce.¹ Barotrauma, which is defined as a physical injury resulting from ambient pressure changes during flying, diving or hyperbaric oxygen therapy,^{1,2} may be associated with different oro-facial complications, including barodontalgia (barotraumatic toothache),³⁻⁶ sinus, myofacial and temporomandibular joint (TMJ) pain^{5,7,8} and odontocrexia,⁵ which is the loosening or fracture of restorations. The aim of this study was to assess the prevalence of oro-facial barotrauma among a sample of scuba divers in Saudi Arabia.

Materials and methods

The study is a descriptive, non-experimental, retrospective survey that was conducted in Jeddah, Saudi Arabia. Ethical approval was obtained from the Research and Ethical Committee of the Dental College at King Abdulaziz University, Jeddah.

Data for the study were collected using a self-reported questionnaire* that was distributed to 166 divers. Recruitment of participants was through the local scuba diving association. Also, divers who agreed to participate were encouraged to invite their fellow divers to participate. Before distribution, the questionnaire was initially surveyed as a pilot study to ensure clarity of questions asked. Before participation, each

participant signed a consent form. The questionnaire was divided into two sections, the first contained demographic data and the second consisted of multiple choice questions and a few open-ended questions discussing the different symptoms and signs of orofacial barotrauma. The survey included questions about the presence of dental pain during or after dives, its location (upper or lower jaw), any facial pain or limited mouth opening, TMJ pain or clicking, dry mouth, and any problems with dental restorations or appliances, such as aspiration, loss or fracture. Participants reporting previous head and neck surgery or symptoms were excluded. Two authors surveyed the questionnaires and one entered the data for statistical analysis.

STATISTICAL ANALYSIS

Data were tabulated and analyzed using the Statistical Package for Social Science (IBM SPSS Statistics for Windows, Version 20, Armonk, NY: IBM Corp, USA). Frequencies for each answer to the questionnaires were calculated or the number of subjects responding to each question. The statistical differences between the prevalence of different oral barotrauma symptoms and signs were determined using chi-square tests for nominal data. The level of statistical significance was considered at $P < 0.05$.

Results

Questionnaires were distributed to 166 scuba divers of whom 163 responded (98%). Among the 163 divers, nine were excluded from the study because of previous injury

* **Footnote:** A copy of the questionnaire (in English) is available from the authors on request.

Table 1

The prevalence of odontocrexia *n* (%) among 151 scuba divers

	Divers	Fracture	Loss
Dental filling	107 (70)	19 (12)	23 (15)
Fixed prosthesis	34 (22)	27 (18)	5 (3)
Removable prosthesis	2 (1.3)	0	0

or surgery in the head and neck area. Responders were 15 females and 139 males. Mean age was 38.5 years (40.5 years for men and 32 years for women, range 14–63 years); the majority were in their twenties and thirties (70%).

The prevalence of oro-facial problems the divers had faced at least once during or after their diving activities is shown Figure 1. The most frequent symptom during diving was dry mouth (80 of the 154 scuba divers investigated, 52%), while the least was limited mouth opening (six divers, 4%) during dives. Jaw clenching occurred in 50 divers (33%) during diving.

Table 1 reports the prevalence of odontocrexia in divers who had dental fillings or fixed or removable prosthesis. Twenty-nine divers (19%) of the sample reported dental pain: six in the upper jaw; 11 in the lower jaw and 12 reported dental pain in both upper and lower jaws at the same time.

There was a highly significant association between TMJ pain and limited mouth opening ($P < 0.001$) and clicking ($P = 0.001$) (Table 2). When evaluating the relationship between the type of mouthpiece used and reported symptoms, TMJ and facial pain occurred more in divers using commercial mouthpieces compared to customized ones (Table 3).

Discussion

Barotrauma may lead to various effects on facial, oral or dental structures. Most symptoms in the present study occurred more often during than after diving. The high percentage of clenching and mouth dryness may be related to emotional stress or the cold environment during diving,⁷ whilst breathing dry, compressed gases may contribute to mouth dryness. Other symptoms, such as TMJ clicking, pain and limited mouth opening, may be the result of the downwards and backwards displacement of the mandible to varying degrees depending on the type of mouthpiece. Using commercial-type mouthpieces showed the largest difference in the position of the mandible from normal, while the customized-type displaces the mandible the least.⁷

Barodontalgia has been reported at a rate (21%) similar to that of this study.⁵⁻⁷ It is related to various causes, such as trapped gases, low temperature, pulpal embolism, prolonged vasoconstriction, dentinal tubule permeability, impacted teeth, recent extraction, recent restoration, recurrent caries or periodontal disease.⁵⁻⁷ In contrast to our findings, previous

Table 2

The association between temporomandibular joint (TMJ) pain and limited mouth opening and TMJ clicking ($P \leq 0.001$; $n = 154$)

TMJ Pain	Limited mouth opening		Clicking	
	Yes	No	Yes	No
Yes	4	18	7	15
No	1	131	10	122

Table 3

The type of mouthpiece and TMJ and facial pain ($n = 154$)

Mouthpiece	TMJ pain (during diving)		TMJ pain (after diving)		Facial pain	
	Yes	No	Yes	No	Yes	No
Customized (<i>n</i>)	1	10	1	10	2	9
Commercial (<i>n</i>)	26	116	21	121	15	127

studies of barodontalgia during diving have reported pain more commonly in the upper jaw.⁵⁻⁷ This difference however, could be explained by the differences in existing dental restorations or dental appliances in upper and lower jaws which were not recorded in previous studies. One study reported that some divers may experience headaches related to TMJ stress following their dives,⁸ but this was not supported in the present study.

Dental barotrauma may result in restoration fractures or displacement by reducing the retention of the restoration.⁷ It has been hypothesized that, with the pressure changes during diving, changes in the volume of air bubbles in the cement layer underneath prostheses can reduce the retention, and this may lead to displacement of the fixed prosthesis or of restorations.⁷ Also micro-leakage may increase and retention may decrease in fixed prostheses that are cemented with zinc phosphate and glass ionomer cements.

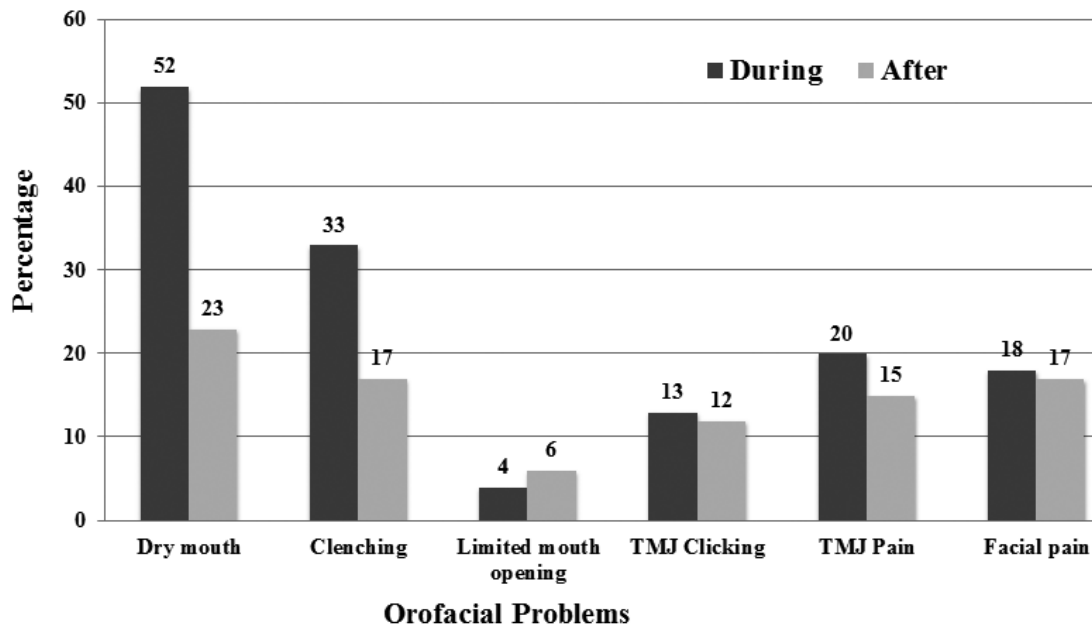
Because of the method of recruitment of subjects, the study may have suffered from selection bias. Therefore, firm conclusions regarding prevalence cannot be drawn. Further studies are needed in this field since the literature is scarce in reporting oral and facial problems amongst divers. A similar study among professional divers is also encouraged.

Conclusion

Scuba diving can be considered as a safe sport with regard to orofacial barotrauma, but divers should undergo regular dental checkups and inform their dentists of their diving activities. Clenching and dry mouth were common findings but were temporary in nature and did not warrant dental intervention. Reported TMJ and facial pain was also temporary in nature. The use of commercial mouthpieces during diving may be associated with more symptoms when compared with customized types.

Figure 1

The prevalence of some oro-facial problems among scuba divers during and after dives; number of subjects shown



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