

# Prevalence of external auditory canal exostoses in Australian surfboard riders

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## Abstract

This paper assessed 300 surfboard riders, comprising 229 males and 71 females to determine the prevalence and rate of growth of exostoses in this population. A group of cold water swimmers and a control group were also examined.

Significant obstruction, defined as two thirds or more occlusion of the ear canal was noted in 90 of the male surfers and 10 female surfers. This degree of occlusion was found in seven of the 32 cold water swimmers.

A male surfer who has surfed regularly for 20 years or more has a one in two chance of developing significant obstruction of the external ear canal resulting from exostoses and this is a three in seven chance for females.

**Key words:** Ear, External; Swimming; Exostoses

## Introduction

Exostoses of the external ear canal have long been recognized as an important complication of surfing. This study aimed to determine the rate of growth of exostoses and also to clarify the susceptibility of female surfers in developing exostoses. To date female surfers have not been reviewed in significant numbers and there has been a suggestion that there may be some degree of gender protection reducing the risk of them developing exostoses.<sup>1</sup>

Surfboard riding in Australia is extremely popular as most of the population live on the extensive coastal fringe. Most surfers now wear a neoprene wetsuit that enables them to surf comfortably all year round, thereby increasing their ear exposure to wind and water. As a result Australia has a uniquely high incidence of exostoses of the ear canal.<sup>1,2,3</sup>

## Methods and materials

Competitors and surfboard riding spectators were examined at two professional surfing competitions in Victoria, Australia. A female competition, the Roxy Pro was conducted at Phillip Island. The male competition, the Rip Curl Pro was held at Bells Beach. Members of an all year round swimming club, 'The Brighton Icebergers', were also examined. Finally, this study included a control group comprising patients attending an ENT clinic for conditions unrelated to their ears.

All participants in the survey were asked to complete a questionnaire giving their relevant immediate details, such as age and sex. They were asked for their 'exposure history' which included both duration of surfing and the intensity of their exposure. They had to rate their exposure on a scale of 1–10, where '1' represented very occasional surfing, and '10' represented surfing almost every day of the year. They were asked to indicate the location where they did most of their surfing. They were also required to state whether they had experienced symptoms from their ears, such as recurrent ear infections; ear blockage after surfing; any degree of deafness or previous ear surgery for exostoses. Finally they were questioned as to whether they used any form of ear protection.

The participants were examined by an experienced otologist with a battery-powered otoscope. Wax and skin debris were removed when necessary so that complete visualization of the external ear canal could be achieved. The degree of obstruction was graded from '0' to '3', where '0' was no visible exostoses; '1' was zero to 33 per cent occlusion, '2' was 33–66 per cent occlusion and '3' was 66–100 per cent occlusion.

## Results

In total, there were 229 male surfers, 71 female surfers, 32 cold water swimmers and 60 controls. The mean age of male surfers was 32.6 (SD = 11.3) years

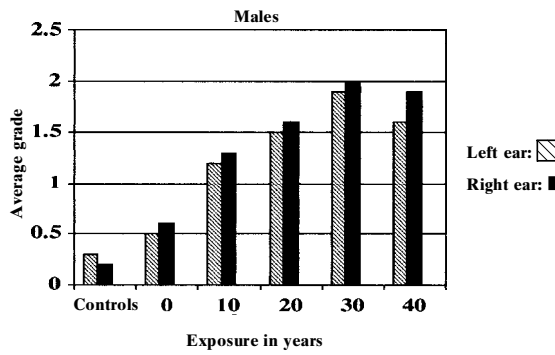


FIG. 1

The relationship between the severity of exostoses formation and exposure in males.

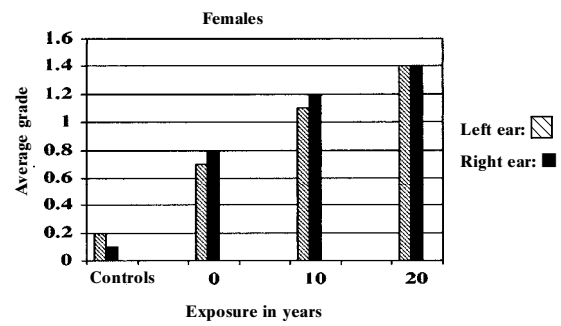


FIG. 2

The relationship between severity of exostoses formation and exposure in females.

while the mean exposure period was 20.4 years (SD = 11.0 years). The mean age for females was 24.5 years (9.4) and the mean exposure period was 10.4 (7.8) years. Some degree of exostoses formation was found in 179 males and 49 females. Severe occlusion (two thirds or more) was noted in 90 males and 10 females (Figures 1 and 2). The cold water swimmers had seven out of 32 with severe occlusion. Minor formation was found in 19 of the 60 controls.

The strongest predictor for severe exostoses was exposure, with each additional year of exposure increasing the risk of a grade 3 exostosis by 10 per cent (Table I). Initially, there was no apparent difference in the risk in developing severe exostoses between surfers and icebergers, but after adjustment for exposure, surfers were found to be 12 times more likely to develop severe exostoses. Although gender and self-reported grade were significant predictors at an univariate level, after adjustment for exposure, neither was found to be statistically significant. The level of exostoses in the right ear was found to be significantly greater than the left ear (mean 1.25 vs 1.15  $p = 0.005$ ).

**Discussion**

Both epidemiological and experimental studies have indicated that prolonged exposure of ears to cold water stimulates the formation of exostoses.<sup>4,5</sup> Surfers themselves however have suggested that wind in a wet ear could be an important cause; this is supported by the study from Fabiani *et al.*<sup>12</sup> who found exostoses in a group of athletes practising aquatic sports such as sailing. This may account for the prevalence of right ear exostoses in this survey. Surfers from Victoria typically face out to sea watching for the next wave such that their right ear

is facing the prevailing wind. There were 82 right ears with significant occlusion as opposed to 73 for the left in the total male and female sample. In the group from Victoria where the water temperature ranges from 13–19°C, there were 66 right and 57 left ears affected by exostoses.

It is interesting to note the male predominance in most reviews of exostoses surgery and epidemiological studies.<sup>1–3,7,12–17</sup> Exostoses do affect female surfers and although there appeared to be a large gender protection effect at univariate level with men 4.6 times more likely to develop severe exostoses than women, after adjusting for exposure, this result was no longer statistically significant [OR 1.8 95 per cent CI (0.81, 4.0)  $p = 0.15$ ]. The mean exposure time in the male group (20.4 years) was twice that of the females (10.4 years). Surfing has only recently become popular for females, so it can be expected that exostoses in this group will become increasingly more prevalent as their exposure increases and the incidence will approach that of males.

The symptoms produced by exostoses are a prolonged blocked feeling of the ears after water activities, deafness and recurrent otitis externa. When these symptoms cause sufficient distress, surgical removal is advised. The decision to operate should not be undertaken lightly, as the removal of exostoses is time consuming and exposes the patient to a number of possible complications. Common complications that have been reported are delayed healing, perforation of the tympanic membrane, sensorineural hearing loss, fistula into the temporomandibular joint or the mastoid air cells, facial nerve injury, infection, stenosis or recurrence.<sup>2,3,14–22</sup> Surgical emphysema in the neck is an unusual complication of a fistula into the temporomandibular joint.<sup>23</sup>

TABLE I  
UNIVARIATE AND MULTIVARIATE PREDICTORS OF SEVERE EXOSTOSES

Univariate analysis			Multivariate analysis*	
Variable	OR (95% CI)	<i>p</i> -value	OR(95% CI)	<i>p</i> -value
Sex (MvF)	4.6 (2.3, 9.3)	<.0001	1.8 (0.81, 4.0)	0.15
Surfer vs Iceberger	1.76 (0.74, 4.2)	0.20	12.2 (3.8, 40)	<.0001
Grade (1–10)	1.14 (1.05, 1.24)	0.001	1.02 (0.91, 1.15)	0.73
Exposure (yrs)	1.07 (1.05, 1.10)	<.0001	1.10 (1.07, 1.12)	<.0001

\*Multivariate analysis included all four variables, gender, type, grade and exposure

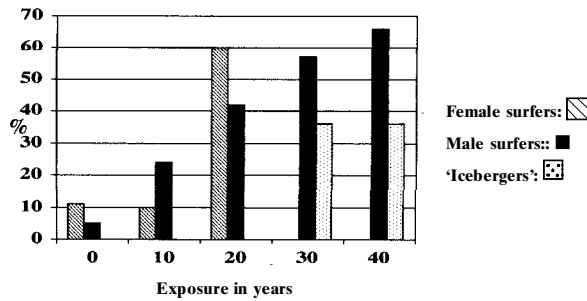


FIG. 3  
Probability of grade 3 or more exostoses.

- The development of exostoses in the external auditory meatus and their association with a repetitive cold water stimulus is well known
- This paper looks at the prevalence in 300 swimmers and in a control group attending an otolaryngology out-patient clinic with unrelated complaints
- The strongest predictor for severe exostoses was exposure, with each additional year increasing the risk by 10 per cent

It was attempted to determine the rate of growth of exostoses but this was particularly challenging due to the difficulty in standardizing exposure. This variable is especially hard to quantify as surfers may have surfed more intensely during their earlier years, but surfed less later on due to the pressures of employment. They may have graded themselves as '10' for their exposure history in their teens but now they would grade themselves as a '4' in answer to this question.

From Figure 3, it is apparent that a keen male surfer will have a one in two chance of developing severe exostoses with greater than 20 years of regular exposure (95 per cent CI = 42–58 per cent). In females the chances appear to be three in seven (95 per cent CI = five per cent to 71 per cent) after 20 years. However, the 95 per cent confidence interval for this figure suggests that the female cohort was too small for this to be an accurate prediction.

To reduce the observer error in determining the dimensions of the exostoses, the examination was carried out by one observer. It was difficult to grade early exostoses, thus any canal that had lost its circular pattern and exhibited an angle between the floor and the anterior wall creating a 'V'-sign as described by DiBartolomeo<sup>24</sup> was classified as Grade 1. In Australia there is widespread participation in water sports that may account for the high incidence of Grade 1 exostoses noted in the controls. The controls came from a coastal town and most were swimmers with differing degrees of exposure. It was much easier to classify Grade 2 and Grade 3 exostoses, which usually consist of single broad-based swellings anteriorly and posteriorly with a

single, multiple or lobulated exostosis arising from the roof. For the statistical analysis, each individual was classified according to the most obstructed ear as the growth of the exostoses was often unequal on both sides.

Symptoms of recurrent otitis externa, a blocked feeling in the ears after surfing and transient deafness were frequently reported throughout the whole group. On the other hand ear protection using plugs, a neoprene hood or a helmet were used infrequently. One of the benefits of this survey was to warn surfers of the risk they have of developing exostoses and to encourage them to start wearing protection as prevention is far better than cure.

Previous surgery to remove exostoses had been performed in 13 of the surfers with two having had both ears operated on, five of these had developed severe recurrences and six had minor recurrences. Two cold water swimmers had had their exostoses removed, one of whom had surgery performed on both ears twice. None of the female surfers recorded having had surgery.

The incidence of exostoses formation in females is not as great, as surfing has not been as historically popular in females and despite the increasing popularity of female surfing, the sport is still mostly dominated by their male counterparts. This is demonstrated by comparing the mean exposure in females (10 years) to males (20 years). The mean age of surveyed females (25 years) was younger than that for the males (33 years).

## Conclusion

Surfers who surf regularly for a prolonged period whether they be males or females have a high probability of developing symptomatic exostoses. This is supported by the analysis of the surfing history of 228 males and 71 females.

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