

Prevalence of ‘surfer’s ear’ in Cornish surfers

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Abstract

Objectives: To establish the prevalence of external auditory canal exostosis (‘surfer’s ear’) in Cornish surfers and investigate the potential impact on healthcare.

Method: A total of 105 surfers were interviewed and otologically assessed on popular Cornish beaches. The degree of exostosis was graded as mild, moderate or severe.

Results: The prevalence of external auditory canal exostosis was 63.81 per cent (33.33 per cent mild, 18.10 per cent moderate and 12.38 per cent severe). The degree of exostosis showed a significant correlation with absolute cold-water exposure time. However, there was individual variation in susceptibility to external auditory canal exostosis; 12 per cent of surfers with excessive cold-water exposure showed no exostosis. Regression analysis of surgical operations performed at the Royal Cornwall Hospital for exostosis over the last 13 years revealed an average increase of 1.23 operations per year, with an average of 13 cases per year over the last 9 years.

Conclusion: Exostosis of the external auditory canal is common in Cornish surfers. There appears to be individual variation in terms of susceptibility to this condition. The possible reasons for this are discussed. The increase in the technically difficult surgical operations performed for exostosis is likely to have implications for health resources in the future.

Key words: External Auditory Canal; Exostoses; Prevalence

Introduction

The development of external auditory canal exostosis (‘surfer’s ear’) is a recognised long-term complication of surfboard riding.¹ The exposure of the external auditory canal to cold water is thought to be the main precipitating factor in the development of external auditory canal exostosis. The prevalence of external auditory canal exostosis in cold-water areas published in the world literature ranges from 61 to 80 per cent.^{2–8} The water temperatures in these studies vary from 9.4°C to 19°C. The average water temperature in Cornwall ranges between 8°C and 16°C depending on the time of year.⁹

The Watersports and Leisure Participation Survey 2009,¹⁰ commissioned by the British Marine Federation amongst others, demonstrated that the number of people participating in surfing is increasing every year. According to this report, there are 113 668 surfers in South West England, with improvements in wetsuit technology increasing the numbers who enter the sea all year round.

The prevalence of external auditory canal exostosis in Cornish surfers is unknown. This study aimed to establish this prevalence and to investigate what

impact the treatment of this disease might have on healthcare systems in areas like the South West that have a significant surfing population.

Materials and methods

The study design was discussed with the local research and development department, and did not require the approval of the ethics committee.

The data were collected at the end of October 2010, over a period of two weeks, when two good swells were hitting the north Cornish coast. The beaches (South Fistral, St Agnes, Tolcarne, Perranporth and Porthtowan) were chosen to optimise the number of possible participants in the survey, bearing in mind wind direction, and the size and direction of the swell.

All surfers were seen and examined on the beach. All completed a questionnaire about their surfing habits and otological symptoms. Verbal consent for otoscopy was obtained. The otoscopic findings were graded according to the degree of stenosis of the external auditory canal, as follows: normal findings (no sign of exostosis), minimal stenosis (up to 30 per cent), moderate stenosis (up to 60 per cent) and severe stenosis (more than 60 per cent). Every participant received a leaflet

with general information about surfer's ear and exostosis. Only surfers residing and mainly surfing in Cornwall were included so that a more homogeneous cohort was obtained in terms of water temperature exposure.

An absolute cold-water exposure value in hours was calculated for each ear on the basis of years surfed, frequency of surfing per week and average duration of an individual surf session. The surfers were divided into three groups on the basis of these calculated values: group 1, less than 2500 hours of cold-water exposure; group 2, 2501–6000 hours; and group 3, more than 6000 hours.

The correlation between these groups and the degree of exostosis was explored with the Pearson chi-square test. To investigate the increase in surgical operations for external auditory canal exostosis performed at the Royal Cornwall Hospital between 1999 and 2011, the slope was calculated using linear regression. All statistical tests were performed with IBM SPSS® version 19.

Results

A total of 110 surfers were seen and surveyed on the beach. Of these, five were excluded: two were holiday-makers from abroad, two were body-boarders rather than surfers and in one case both external auditory canals were impacted with wax making evaluation of exostosis impossible.

Data analysis was performed for 105 surfers (86.7 per cent male and 13.3 per cent female), who had an average age of 30.08 years (range, 9–64 years; standard deviation (SD) = 11.28). The average age that participants started surfing was 14.58 years (range, 3–47 years; SD = 7.51). The participants had been surfing for an average of 14.89 years (range, 1–58 years; SD = 10.65). The participants surfed an average of 2.8 days per week (range, 0.07–6.02 days per week; SD = 1.49). Eighty-eight surfers (83.8 per cent) went in the water all year round, 12 surfers (11.5 per cent) surfed all seasons except winter, and 5 surfers (4.8 per cent) surfed summer and autumn only.

Otological examination of the external auditory canal revealed exostosis in 134 ears (63.81 per cent). The degree of exostosis was graded as mild (less than 30 per cent obstruction) in 33.33 per cent of surfers ($n = 70$), moderate (30–60 per cent obstruction) in 18.10 per cent ($n = 38$) and severe (more than 60 per cent obstruction) in 12.38 per cent ($n = 26$) (Figure 1). No statistical difference between the right and the left ears could be identified ($p = 0.415$).

All individual ears were grouped according to their calculated cold-water exposure (Figure 2). In group 1 (with less than 2500 hours of cold-water exposure, $n = 84$), 78.5 per cent of surfers were found to have normal or mild exostosis, with 21.4 per cent showing signs of moderate to severe exostosis. In group 2 (2500–6000 hours of cold-water exposure, $n = 76$), 76.3 per cent of surfers had normal or mild exostosis, with 23.7 per cent having moderate or severe exostosis.

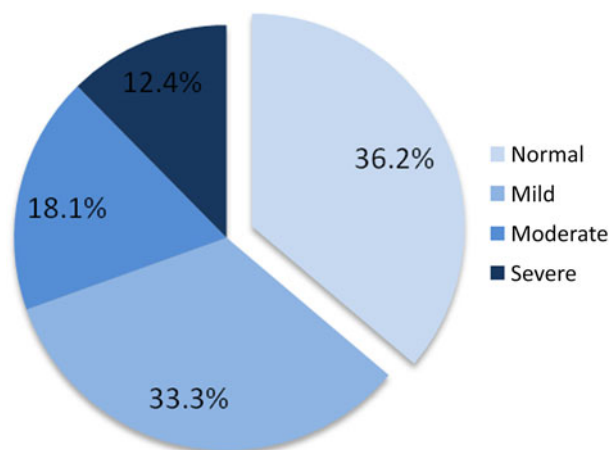


FIG. 1

Severity of external auditory canal exostosis (participants, $n = 105$).

In group 3 (more than 6000 hours of cold-water exposure, $n = 50$), 40.0 per cent of surfers had normal or minimal disease, with 60.0 per cent having moderate or severe exostosis.

A highly significant correlation was found between the total number of years of active surfing and the degree of exostosis in both ears for each individual ($n = 210$; $p < 0.001$). A similar relationship was found between the degree of exostosis and absolute cold-water exposure ($n = 210$; $p < 0.004$) (Figure 3). There was no significant association between the age at which an individual started surfing and the degree of exostosis ($n = 210$; $p = 0.232$).

Of the 105 participants, 32 (30.5 per cent) admitted to recurrent ear infections or otalgia. The right ear alone was affected in 37.5 per cent of the surfers, the left ear alone was affected in 25.0 per cent and both ears were affected in 37.5 per cent. The presence of symptoms

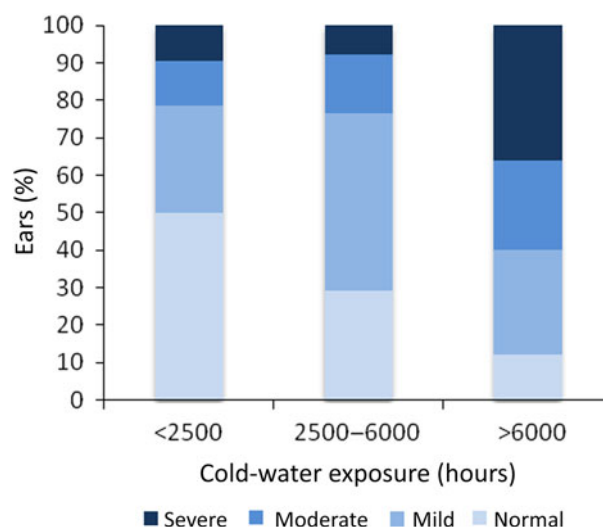


FIG. 2

Relative severity of external auditory canal exostosis per cold-water exposure group (total ears, $n = 210$; less than 2500 hours cold-water exposure, $n = 84$; 2500–6000 hours cold-water exposure, $n = 76$; more than 6000 hours cold-water exposure, $n = 50$).

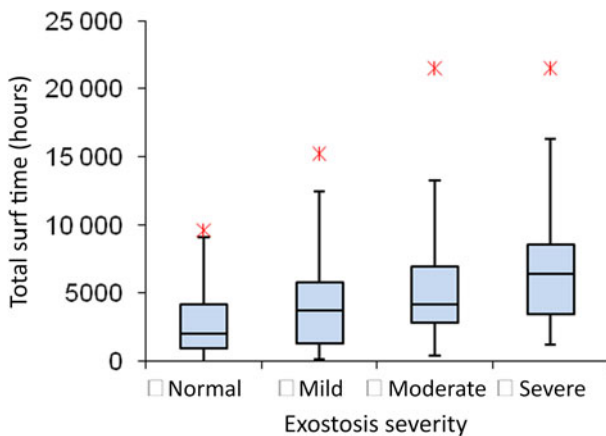


FIG. 3

Severity of external auditory canal exostosis according to absolute cold-water exposure time.

significantly increased with the degree of exostosis ($n = 210$; $p = 0.002$).

The use of earplugs was recorded in 23 surfers, with an average duration of use of 3 years (range, 1 month to 17 years; SD = 5 years). Only 13 of these participants were using the earplugs on a regular basis. More symptomatic surfers than non-symptomatic surfers were using earplugs ($n = 105$; $p < 0.005$).

Between 1999 and 2011, a total of 175 surgical operations for external auditory canal exostosis were performed at the Royal Cornwall Hospital. Over the years, the number of procedures performed has been increasing by an average of 1.23 operations per year ($F = 13.299$, $p = 0.004$) (Figure 4). These operations are technically demanding, taking about 2 hours to perform. In addition, they usually involve an overnight stay, with at least two subsequent out-patient appointments.

Discussion

Our findings suggest that external auditory canal exostosis is common in Cornish surfers, and with an increase in the popularity of the sport it is likely to

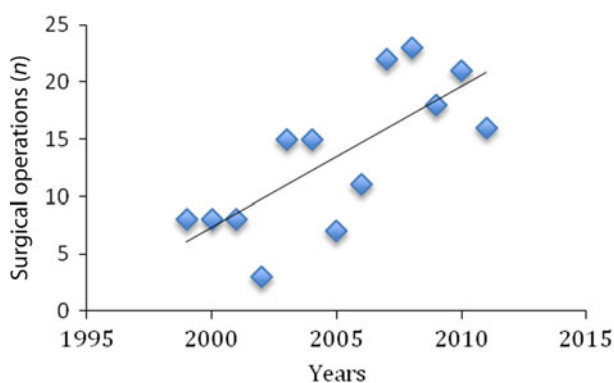


FIG. 4

Number of surgical operations performed at the Royal Cornwall Hospital for external auditory canal exostosis from 1999 to 2011 ($R^2 = 0.547$).

become more of a health problem. The percentage of exostosis in our cohort is comparable to the prevalence rates reported in other cold-water surfing areas in the world (Table 1).²⁻⁸

The occurrence of exostosis is thought to be related to cold-water exposure, although the exact pathogenesis is not clearly defined. A significant correlation between the duration of cold-water exposure and external auditory canal exostosis was demonstrated, which is in line with the widely accepted cold-water hypothesis. Cold-water irrigation is thought to induce osteoblastic activity within the external auditory canal, leading to new bone growth and exostosis formation, which probably serves to protect the underlying tympanic membrane against cold.¹¹ Within our group of surfers with the most cold-water exposure, 12.0 per cent had no exostosis, and 28.0 per cent had only mild signs of external auditory canal exostosis.

In a previous study performed by the senior author of this paper (IMS), which examined the post-operative recurrence rate of external auditory canal exostosis, a surprisingly high incidence of otosclerosis was described (10 per cent), suggesting a possible link between the two pathologies.⁹ The incidence of histological otosclerosis as determined by post-mortem examination is significantly higher than the clinical prevalence and shows a less marked sex distribution.¹² This condition is inherited as an autosomal condition with incomplete penetrance. However, other environmental factors such as measles infection and water fluoridation may also have a bearing on the prevalence of the disease.¹²

Otosclerosis is more common in Caucasians and rare in the African population, similar to external auditory canal exostosis.^{13,14} No audiograms were performed in the current study, but further research evaluating a possible link between these two pathologies would be interesting.

In the same previous study by the senior author, there was a cohort of four patients who had significant recurrence of exostosis even though they had stopped surfing and were no longer exposed to cold water.⁹ It appears that the bone of the external auditory canal had become unstable and was undergoing spontaneous osteoneogenesis somewhat similar to otosclerosis.

These findings raise the possibility of an interaction between a potential underlying genetic predisposition and other environmental factors such as cold water, which may influence the severity of the disease in a particular person. Certainly, some individuals seem to be very resistant to new bone formation and others are very prone.

The cooling effect of the wind is another recognised co-factor in the aetiology of external auditory canal exostosis. Surfers exposed to the same direction of wind for a long period of time might be expected to have more extensive exostotic changes in the wind-exposed ear.⁷ In Cornwall, south-westerly winds predominate, with most individuals surfing along the

TABLE I
PUBLISHED EXOSTOSIS PREVALENCE RATES

Study (year)	Country	Participants (n)	Exostosis prevalence (%)	Sea temperature (°C)
Umeda <i>et al.</i> ² (1989)	Japan	51	80.0	9.5–14.5
Chaplin & Stewart ³ (1998)	New Zealand	92	73.0	10–14
Wong <i>et al.</i> ⁴ (1999)	USA	307	73.5	9.4–16.6
Kroon <i>et al.</i> ⁵ (2002)	USA			
– Total surfers		202	38.0	1.6–35
– Cold-water surfers		33	73.0	1.6–15.6
– Warm-water surfers		169	31.0	15.6–35
Altuna Mariezkurrena <i>et al.</i> ⁶ (2004)	Spain	41	61.0	12–19
Hurst <i>et al.</i> ⁷ (2004)	Australia	300	76.0	13–19
Nakanishi <i>et al.</i> ⁸ (2011)	Japan	373	59.8	16–28
Current study	UK	105	63.8	8–16

north coast. Surfers spend more time facing away from the beach in anticipation of the waves to come, and, theoretically, the left ear should receive more exposure to wind. However, we found no significant difference between the right and left ear in our cohort of surfers.

It has also been suggested that the age at which surfers start the sport might have a significant impact on the development of this pathology. A negative relationship between the age of starting surfing and the development of external auditory canal exostosis has been described, suggesting a slower development of this disease if the cold-water stimulus is encountered at an early age.⁹ These findings were not reproduced in the current study.

Although surfers in general do know about the condition of surfer's ear, only half of them are aware of the associated symptoms.¹⁵ In our cohort, few individuals were using earplugs, but, interestingly, there was no significant difference in the severity of exostosis between those wearing earplugs and those not using

them at all. However, more symptomatic surfers were using earplugs, suggesting that their symptoms are the reason for the earplug use (Figure 5). Most of those surfing with earplugs had started using them after having surfed for years without any ear protection. There is a need to persuade surfers to start using earplugs as soon as they start surfing to prevent the onset of exostosis and subsequent problems with otitis externa.

Only 1 of the 105 participants had previously undergone surgery for surfer's ear. Unfortunately, he continued surfing without regular ear protection and both ear canals were again observed to have subtotal obstruction from exostosis.

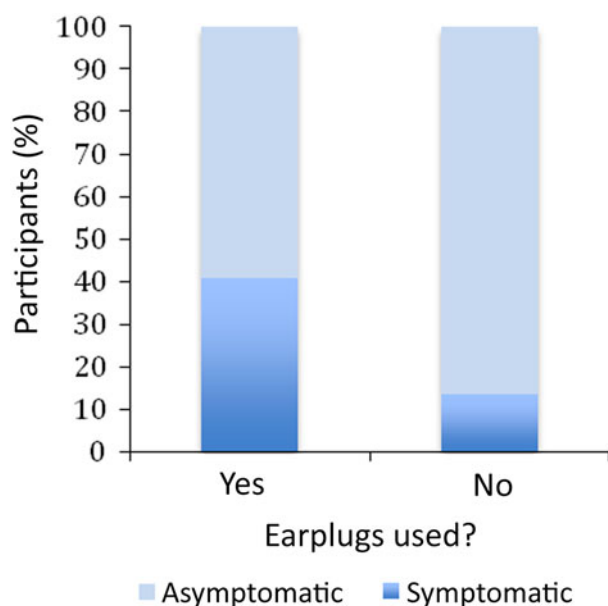


FIG. 5

Symptomatic and asymptomatic surfers and earplug use. (Earplug users, $n = 23$; non-earplug users, $n = 82$.)

- **Surfers in cold-water regions are commonly affected by external auditory canal exostosis; worldwide prevalence ranges from 61 to 80 per cent**
- **The prevalence in Cornish surfers was found to be 63.81 per cent**
- **This study also confirmed a significant correlation between cold-water exposure and degree of external auditory canal exostosis**
- **There was individual variation in susceptibility to external auditory canal exostosis; 12 per cent of surfers with excessive cold-water exposure showed no exostosis**
- **Earplugs were only used by a few, mainly symptomatic surfers**
- **The number of surgical operations for external auditory canal exostosis has increased by 1.23 operations per year**

Approximately one-third of the participants (30.5 per cent) had experienced recurrent otitis externa as a result of external auditory canal exostosis, which causes entrapment of water medial to the exostosis. The symptoms often require input from the primary (and on occasion the secondary) healthcare systems, and because of chronicity, treatment is taking up increasing amounts of healthcare time.

Between 1999 and 2011, the number of surgical operations performed at the Royal Cornwall Hospital for external auditory canal exostosis had been increasing by 1.23 operations per year. In the 19 years between 1980 and 1999, 87 operations for external auditory canal exostosis were performed, with an average of 4.5 operations per year. In the 9 years between 2003 and 2012, this number had increased to 117 operations, with an average of 13 operations per year.

Should this trend continue, the healthcare system would need to accommodate twice the number of surgical operations in 10 years' time. The concern is not only related to the overall increase in the number of initial operations, but also the need for revision surgery in those individuals who continue to surf without the regular use of earplugs. A high incidence of recurrence post-surgery in individuals who have stopped surfing suggests that the bone of the external auditory canal might become unstable.⁹ The popularity of surfing as a sport continues to increase in many regions of the country, and in the current time of austerity within the National Health Service, expenditure for this self-inflicted, potentially preventable disease could become controversial.

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