

# Diagonal earlobe creases and atheromatous disease: a postmortem study

**ABSTRACT**—The association between the grade of earlobe creases and degree of atheromatous disease was investigated in 376 postmortem examinations. Each earlobe crease was individually graded from 0 to 3. The risk of atherosclerosis as a cause of death was nearly doubled in men with grade 3 creases in both earlobes, and more than trebled in women with bilateral high-grade creases. The risk of death from myocardial infarction was 2.50 in men with high-grade creases and 3.70 in women. The earlobe crease is an important sign of atheromatous disease and it may be useful to include it in the clinical examination of patients.

An association between coronary heart disease and bilateral earlobe creases has been known since 1973 and is generally referred to as Frank's sign, after the author of the seminal paper [1]. The sign has subsequently been substantiated in over 30 separate studies in various settings: medical inpatients [2], coronary care unit [3], coronary angiography [4], and a post-mortem study [5]. The presence of the sign does not appear to be consistently linked to any of the common coronary risk factors [6]. We undertook a postmortem study to determine how the classical form of the bilateral earlobe crease and its intermediate forms are related to the degree of atheroma in the major vessels. We also studied the relationship between the cause of death and earlobe crease.

## Patients and methods

The study included 376 postmortem examinations in subjects over the age of 40. All earlobe crease grading was done by one of two doctors not performing post-mortems and blinded to the autopsy findings. The earlobes were graded according to the following system: grade 0 is no crease, grade 1 is any degree of crease

less than 2, grade 2A is a deep diagonal crease greater than 50% but less than 100% across the lobe, grade 2B is a complete crease across the lobe that is superficial but not deep, grade 3 is a deep crease across the whole lobe. Grade 3 in this system is the same as Frank's original description of the diagonal earlobe crease; that is a deep prominent crease in the lobule portion of the auricle. For the purpose of this study, grades 2A and 2B were considered together as grade 2. Each subject in the study could therefore be allocated a grade: for example, 32 is grade 3 in one earlobe and 2 in the other.

In order to assess the interobserver error in grading the earlobe crease, 32 subjects were graded by both observers. There was complete agreement on 28/32 subjects; the other four differed only by one single grade. Coronary artery atheroma was assessed according to the degree of maximal luminal narrowing [7]. The categories were as follows: mild (<50% luminal narrowing), moderate (50–75% luminal narrowing), severe (>75% luminal narrowing). Cerebral and aortic atherosclerosis were categorised into mild, moderate or severe by gross pathological assessment. The cause of death was noted, with special reference to myocardial infarction (including thrombosis without significant atherosclerosis) and atheromatous causes (atheromatous aortic aneurysm rupture, coronary artery atherosclerosis, mesenteric thrombosis secondary to atheroma, and cerebral atherosclerosis).

We investigated the relationship between earlobe crease grade and the degree of atheroma in the major vessels using standard relative risk ratios together with determination of the 95% confidence interval for each such ratio.

## Results

Postmortem examinations were performed on 206 men and 161 women. The mean (SD) age of the men was 70.4 (10.9) and of the women 77.4 (10.5). The size of the earlobe grade subgroups other than 33, 22 and 00 were too small to allow meaningful statistical evaluation (Table 1). The proportion of men and women having high-grade creases (33 and 32) were 36.9% and 24.8% respectively ( $p < 0.05$ ). There was no difference between men and women for the low-grade creases (00 and 01): 36.9% and 36.7% respectively. There was no relationship between the age of the subject and degree of earlobe crease in women. However, in men the mean (SD) age of the 00 group was 66.7 (12.1) and 73.2 (9.4) in the 33 group ( $p < 0.05$ ). The body

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**Table 1.** Number of subjects by earlobe crease grade, age and gender

Earlobe crease grade	Men			Women		
	No.	%	Age (SD)	No.	%	Age (SD)
00	68	33.0	66.7 (12.1)	47	29.2	77.8 (11.2)
10	8	3.9	72.0 (13.4)	12	7.5	82.2 (8.5)
11	7	3.4	74.6 (14.4)	14	8.7	78.3 (12.3)
20	11	5.3	70.7 (10.1)	5	3.1	80.0 (5.8)
21	12	5.8	72.8 (12.7)	8	5.0	72.4 (11.9)
22	15	7.3	72.4 (10.2)	25	15.5	77.5 (10.1)
30	4	1.9	66.8 (11.8)	2	1.3	72.0 (5.9)
31	5	2.4	73.6 (5.6)	8	5.0	75.0 (12.1)
32	24	11.7	70.4 (9.8)	11	6.8	77.8 (11.2)
33	52	25.2	73.2 (9.4)	29	18.0	76.1 (9.7)
<i>Total</i>	<i>206</i>		<i>Mean 70.4 (10.9)</i>	<i>161</i>		<i>Mean 77.4 (10.5)</i>

mass index was determined on 292 subjects and showed no relationship to earlobe crease grade in either sex.

Since all the postmortem examinations were individually conducted by one of three pathologists, it is not possible to assess the degree of agreement between the three with respect to the pathological findings. The

fact that there were no significant differences between the three pathologists when comparing numbers of cases in each atheroma grade and by cause of death suggests minimal inter-observer variation. It was possible to determine an 'atheroma score' for each earlobe crease grade by allocating a score of 1,2,3 to the mild, moderate and severe degrees of atheroma. As

**Table 2.** Relative risk of severe atheroma by main earlobe crease grade

Site of severe atheroma			Earlobe crease grade		
			00	22	33
<b>Coronary</b>	Men	%	43.1	60.0	70.6
		RR		1.39	1.64
		CI		0.83-2.34	1.14-2.35
	Women	%	17.0	70.8	62.1
		RR		4.16	3.65
		CI		2.11-8.23	1.82-7.29
<b>Cerebral</b>	Men	%	11.8	6.7	27.5
		RR		0.57	2.33
		CI		0.07-4.35	1.12-4.87
	Women	%	10.6	24.1	13.8
		RR		2.12	1.30
		CI		0.74-6.09	0.38-4.44
<b>Aortic</b>	Men	%	33.3	46.7	49.0
		RR		1.40	1.47
		CI		0.72-2.72	0.91-2.37
	Women	%	25.5	41.7	44.8
		RR		1.63	1.76
		CI		0.83-3.22	0.93-3.31

RR, relative risk; CI, 95% confidence interval



**Table 3.** Relative risk of atheromatous disease and myocardial infarction as a cause of death

Cause of death			Earlobe crease grade		
			00	22	33
<b>Atheromatous disease</b>	Men	%	35.3	60.0	68.6
		RR		1.70	1.94
		CI		0.98–2.96	1.28–2.95
	Women	%	19.2	37.5	65.52
		RR		1.96	3.42
		CI		0.90–4.28	1.80–6.52
<b>Myocardial infarction</b>	Men	%	23.5	53.3	58.8
		RR		2.27	2.50
		CI		1.14–4.50	1.45–4.31
	Women	%	14.9	36.0	55.2
		RR		2.42	3.70
		CI		1.02–5.71	1.74–7.91

RR, relative risk; CI, 95% confidence interval

coronary, cerebral and aortic atheroma was determined, the maximum 'atheroma score' possible is 9 and the minimum 3. The atheroma score ranged from 5.60 (grade 00) to 6.95 (grade 33) in men, and in women from 4.71 (grade 00) to 7.16 (grade 33). The correlation coefficient between the atheroma score and increasing category of earlobe crease grade was 0.78 ( $p = 0.08$ ) in men and 0.64 ( $p < 0.05$ ) in women.

The relative risks of severe atheroma in the major vessels with the main earlobe crease grades are shown in Table 2. Where the 95% confidence interval for the relative risk ratio includes 1.00, there is a greater than 0.05 probability that the relative risk ratio may be invalid. Therefore those relative risks for which the 95% confidence interval does not include 1.00 are the most important to consider. Such results show that, compared with men without creases in either earlobe (00), the relative risk of severe coronary atheroma is 1.64 in men with the 33 earlobe crease grade; for women it is 4.16 for the 22 grade and 3.65 for the 33 grade. For severe cerebral atheroma the only strongly validated increased relative risk was 2.33 in men with the 33 earlobe crease grade.

The relative risk of myocardial infarction and atheromatous disease as a cause of death for each main earlobe crease grade is shown in Table 3. Atheromatous disease as a cause of death is nearly twice as likely in grade 33 men and 3.42 times in grade 33 women. In both sexes earlobe crease grades 22 and 33 carried a significantly increased relative risk of myocardial infarction as a cause of death. For men the increased relative risk is 2.27 in grade 22 and 2.50 in grade 33; for women it is 2.42 in grade 22 and 3.70 in grade 33.

## Discussion

We found the sensitivity of Frank's sign for detecting severe coronary atheroma to be 62.1% for men and 69.2% for women. The specificity is 65.9% in men and 78.0% in women. Most of the studies on Frank's sign have concentrated on the relationship of the earlobe crease to cardiac disease. In a Finnish study of 286 patients undergoing coronary angiography, 88.9% of patients with bilateral earlobe creases had greater than 50% narrowing of one or more coronary arteries. Only 45.2% of patients without bilateral earlobe creases had the same criteria for significant heart disease [6]. A meta-analysis of the 30 studies involving 6,414 subjects cited in Elliott's review [2] shows the increased relative risk of coronary heart disease to be 2.06 with bilateral earlobe creases. Kirkham's investigation in Brighton [5] showed that Frank's sign is associated with an increased risk of cardiovascular cause of death of 1.55 in men and 1.74 in women. The literature cites two cases of bilateral earlobe creases in patients below the age of 30 who both had coronary artery disease [2,8]. However, children with Beckwith's syndrome have bilateral earlobe creases from birth; this is a congenital marker for the syndrome without an increased risk of cardiovascular disease [9]. No association was found between earlobe creases and coronary artery disease in two studies [10,11]; these were in Hawaiian and American Indian populations. Thus, with these two exceptions, the majority of the world's literature supports the association between earlobe creases and coronary artery disease.

In conclusion, this study shows significantly increased risk of severe atherosclerosis with increasing



grade of earlobe crease. There is a strong association between severe coronary atherosclerosis and high-grade earlobe creases. Myocardial infarction as a cause of death is associated with both middle- and high-grade earlobe creases. Our hypothesis is that one of the underlying pathogenic mechanisms involved in the progression of atherosclerosis, possibly related to collagen degeneration, may also occur in the skin. It may be important to include the earlobe crease grade in the routine clinical examination of a patient as a sign of increased risk of atherosclerotic disease.

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