

1 **A simple photographic classification of protruding ears**

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2 **Abstract.**

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4 **Background:** Protruding ear is the most commonly found auricular populational deformity  
5 with significant social consequences. The problem is clearly perceptible in frontal facial  
6 images, but a simple photographic classification for prominence has not yet been defined.

7 **Methods:** Frontal facial images of forty patients with protruding ears and 102 controls were  
8 prospectively collected. A rectangle was drawn in each ear, involving its full visible anatomy.  
9 The height of each rectangle was divided by its width in each ear.

10 **Results:** Results show a trend for higher values in the protruding ears group when compared  
11 to controls for both ears.

12 **Discussion:** This finding can be useful for the classification of this auricular deformity.

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14 **Keywords:**

15 Protruding Ears, Prominent Ears, ImageJ, Photography

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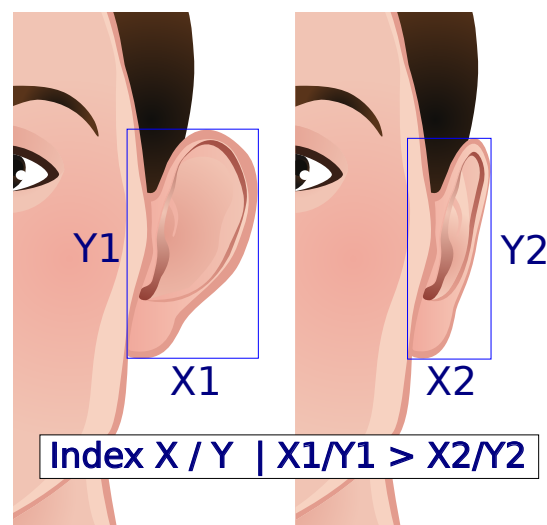
# 1 Introduction

2 Protruding ears are the most frequent developmental disorder of the external ear, affecting  
3 about 5% of the general population (Braun et al., 2014). Measurement of protrusion in frontal  
4 facial photographs was performed by Driessen et al (Driessen, Borgstein, & Vuyk, 2011) in a  
5 retrospective investigation of 44 patients with protruding ears and 102 prospectively collected  
6 normal controls. The author used the subjects' irises for calibrating measurements and  
7 outlined a methodology for measuring protruding ears in frontal facial photographs. However,  
8 there are simpler methods to classify protrusion that are yet unexploited.

9

# 10 Materials and Methods

11 The institution's ethics committee approved the use of the subjects' facial images for the  
12 purpose of this study. After proper informed consent had been obtained, full frontal facial  
13 photographs of both patients and controls were prospectively collected. These photographs  
14 were taken with the head in the Frankfurt plane, looking straight at the camera. The  
15 protruding ears group consisted of 40 patients (age 4 to 18 years) with complaints of  
16 prominent ears. The control group was constituted by 102 subjects in the same age group  
17 without such complaints. All subjects were patients from the outpatient clinic without any  
18 previous auricular procedures or any other visible craniofacial abnormalities.  
19 Photos were processed using ImageJ software (<http://imagej.nih.gov/ij/>). A rectangle was  
20 drawn in each ear, encompassing its full visible anatomy. The height of each rectangle was  
21 divided by its width, thus defining an index (Figure 1). This value was calculated for each ear  
22 and recorded on the image.

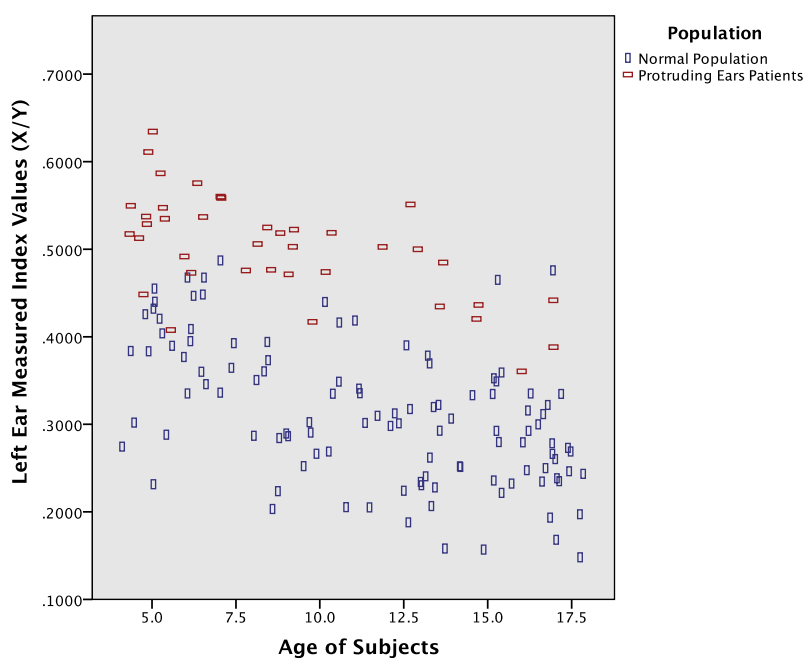


**Figure 1** - A rectangle was drawn in each ear, encompassing its full visible anatomy; When dividing the height by the width of the rectangle, values are higher in patients with protruding ears

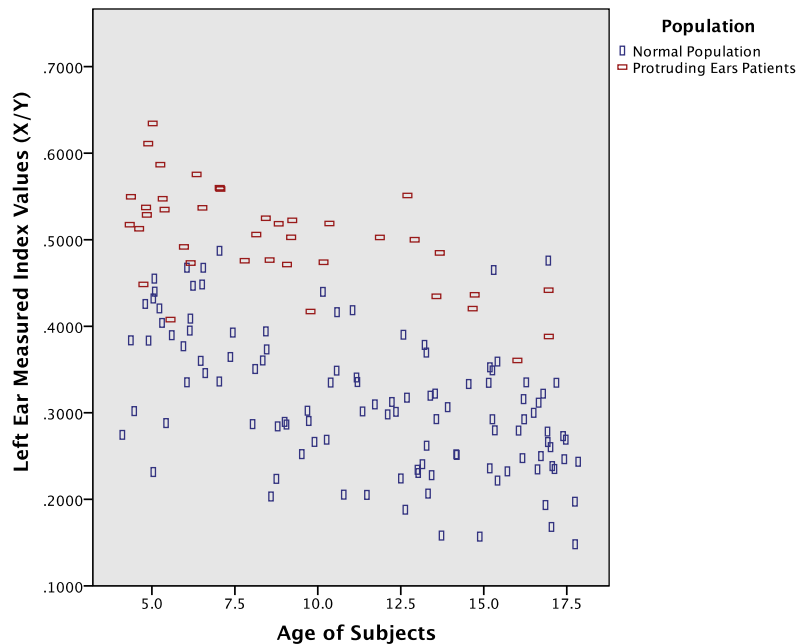
SPSS statistics software version 22.0 (IBM Corporation) was used for statistical analysis.

## Results

The scatter plot combining this index with age shows a trend for higher values in the protruding ears group when compared to controls both in left (Figure 2) and right (Figure 3).

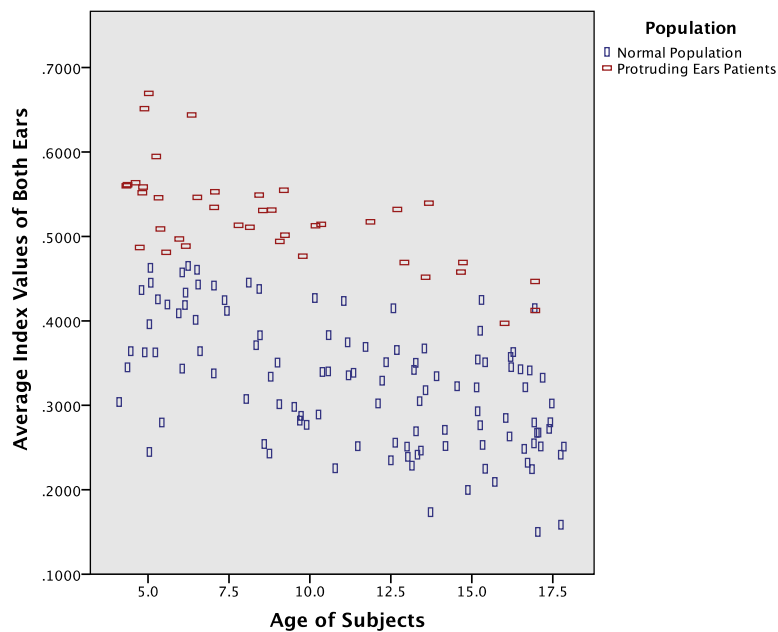


**Figure 2** - The index values (X/Y) for the left ear have a tendency for higher values in the protruding ears group.



**Figure 3** - Index values (X/Y) for the right ear also show higher values for the protruding ears group.

The average of both values also reflects a tendency for higher values in the protruding ears group (Figure 4).



**Figure 4** - The average values (right + left) of the calculated index in the protruding ears group vs. the normal population; a trend for higher values is reported in the protruding ears group.

# 1 Discussion and Conclusion

2 These preliminary findings can be useful for the classification of protruding ears, using  
3 simple frontal facial photographs. However, average values for this index need to be  
4 determined to establish a threshold from which ear protrusion can be classified as such. A  
5 numerical traduction of a visual and somewhat subjective condition can become a novel  
6 approach for the classification of this auricular deformity.

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