Original Article

Correlating the Ear Length and Ear Width with Mid Facial Height: A Mophometric Study

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ABSTRACT:
Introduction - Face is the most expressive part of human body and its deformity can have a significant impact on a patient's self-image and the ability to function and interact socially. Microtia is one such major facial congenital anomaly of the external ear which includes a spectrum of deformities ranging from a grossly normal but small ear to the absence of the entire external ear.Traditionally, for replacing missing ear, either the ear on contralateral side or the donor's ears in bilateral cases are used as a guide. For bilateral cases, it becomes a prediction which is arbitrary, cumbersome, time consuming and can even be wrong at times. Hence, in the following study an attempt was made to find a correlation of the ear length and ear width with the mid facial height which is considered to be constant throughout the life. **Methods** - We selected 40 subjects between the ages of 18 and 30 year to measure the ear length, ear width and mid facial height using electronic digital calliper. Measurements were subjected topearson test and linear regression analysis. **Results** – On analysing the data we obtained, we observed a highly significant relationship between mid-facial height and ear length (p value < 0.001, for both ear). However, relationship between mid-facial height and ear width was not significant. **Conclusion**- In prosthetic rehabilitation cases of face, where esthetics are of prime concern, estimation should either be completely eliminated or be minimised as much as possible.In the present study, mid facial height has been used as a reference to predict ear length. The results of the present study state that, there exists a definite correlation between ear length and mid-facial height.
Key words – Auricular prosthesis, maxillofacial, ear length, mid-facial height, anthropometery.

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Quick Response Code	
	Website: www.jamdsr.com
	DOI: 10.21276/jamdsr.2017.5.12.06

INTRODUCTION

Since 17th and 18th century, artists and anatomists have mentioned about proportional evaluation of the face in their neoclassical facial canons.[1]Many renaissance artists believed that facial beauty was rooted in balanced proportions and facial symmetry.[2] The relationship between size and proportion of different facial measurements is considered to affect the perception of aesthetics. The growth of prosthodontics has enabled the restoration of patients with maxillofacial defects. Microtia is one such major congenital maxillofacial defect involving external ear. Microtia encompasses a spectrum of congenital anomalies of the auricle that range in severity from mild structural abnormalities to complete absence of the ear (anotia).[3] Epidemiologically, the reported prevalence varies among regions, from 0.83 to 17.4 per 10,000 births and the prevalence is considered to be higher in Hispanics, Asians, Native Americans, and Andeans. Microtia mostly occurs unilaterally, but 7–23%

of affected individuals have bilateral involvement.[4] Although, various surgical techniques are available for treating such deformities but there have been situations where Maxillofacial Prosthodontist have done wonders in treating such deformities by providing lifelike prosthesis replacing missing ears. While fabricating a part of body that too of face, where aesthetics is of prime concern, one must always consider the factors like size, shape, position, colour etc. Traditionally, for replacing missing ear, either the ear on contralateral side or the donor's ears in bilateral cases are used as a guide. But various studies have reported that both the ear of even one person are not same especially in height and length, hence these methods are arbitrary, cumbersome, time consuming and can even be wrong at times. Hence, in the following study an attempt was made to find a definite correlation between the ear length and width with the mid facial height which is considered to be constant throughout the life.

METHODS

We selected 40 subjects among the undergraduate and postgraduate students from Bapuji Dental College and Hospital, Davangere, Karnataka, India. To minimize the effect of aging on facial proportion, subjects included were between the ages of 18 and 30 year.[5,6,7] Other inclusion criteria were the subjects with symmetrical appearing face and subjects with the both parents of Indian origin. Care was taken to avoid subjects with gross facial asymmetries, history of facial trauma and surgery, congenital facial defects, subject with ear disease or congenital defects and mixed parental ethnicity.

Measurements were made using electronic digital calliper as it is considered as one of the most reliable method for external ear measurements.[8] Anthropometric points of face and ear were used to record ear length & ear width and mid-facial height. Fig.1 (A & B) is an illustration of anthropometric points used in the study.
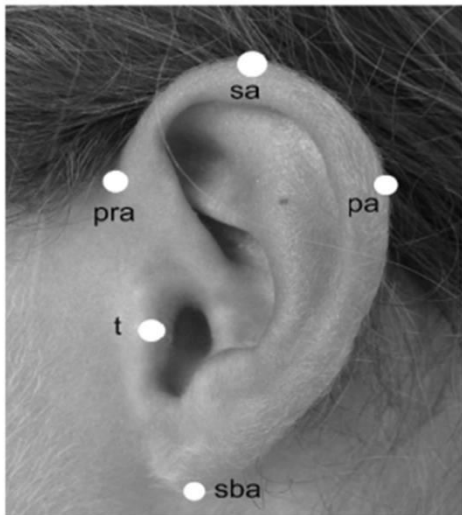
Figure 1: A - Anthropometric points of ear. sa – superaurale, sba – subaurale, pra – preaurale, pa – postaurale, t – tragus.
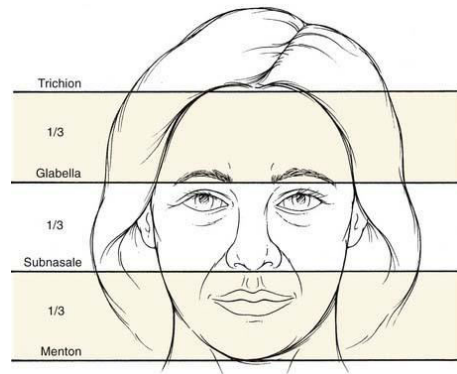
Figure 1 B - For making the measurement, points were marked as following:-

sa – sba = Ear Length
pra – pa = Ear Width
g – sn = Midfacial height

Finally measurements were made and tabulated. All recorded data was statistically analysed by pearson test and linear regression analysis.

RESULTS

Ear length and width were analysed using mid-facial height as base. The relationship of the ear length (sa-sba) and ear width (pra-pa) was observed with mid facial height (g-sn) to see if these dimensions of ear could be determined. Also difference in length and width of right and left side ear was observed. All the observation were tabulated and correlation analysis and regression analysis was done.

For length of the ear, mean length for left ear was 63.19 ± 3.97 mm and for right ear it was 62.45 ± 4.07 mm. For the width of the ear, mean width for left ear was 32.68 ± 2.28 mm and for right it was 32.45 ± 2.18 mm. Finally, mean mid facial height was 58.37 ± 4.09 mm. (Table 1)

Table 1: Mean length and width of left and right ear

	N	Maximum (in mm)	Minimum (in mm)	Mean	Standard deviation
Left ear length	40	69.36	57.23	63.19	3.97
Right ear length	40	68.48	55.72	62.45	4.07
Midfacial height	40	66.19	51.34	58.37	4.09
Left ear width	40	36.18	28.44	32.68	2.28
Right ear width	40	35.74	28.32	32.45	2.18

Table 2: Correlation between ear length and width

	Pearson correlation(r)	p value
Midfacial – left ear length	.735	0.001*
Midfacial – right ear length	.740	<0.001*
Midfacial- left ear width	.306	0.20
Midfacial – right ear width	.334	0.07

Both Pearson correlation test and regression analysis showed similar results. Pearson correlation test was carried out to assess the strength of relation between the variables. The regression analysis results determined the formulae to derive ear length and width of right and left side ear using mid facial height.

On analysing the data we obtained, we observed a highly significant relationship between mid-facial height and ear length (p value < 0.001, for both ear). However, relationship between mid-facial height and ear width was not significant. (Table 2)

Further on regression analysis, formulae were derived, to obtain ear – length after measuring mid-facial height.

For Left Side – **Ear length= 20.4 + 0.72(Mid facial height)**

For Right Side -**Ear Length = 17.6 + 0.76(Mid Facial Height)**

DISCUSSION

The successful fabrication of ear prosthesis depends not only on the technical aspect of the fabrication but also on ideal dimensions, visibility, positioning and angulation. In case of unilaterally missing or malformed ear, these factors are easier to determine, as pinna of the contralateral side can act as a guide. But in bilateral cases no such guide exists. This significantly increases the difficulty of restoring such cases. Traditionally for bilateral cases, donor's ear with approximate matching depending on the discretion and IQ of the operator are used. Hence it becomes an arbitrary, method which is more cumbersome, time consuming and can even be wrong at times as it is very subjective. As in prosthetic rehabilitation cases of face, where aesthetics are of prime concern, estimation or subjective errors should either be completely eliminated or be minimised as much as possible. There is previous research on correctly positioning the ear prosthesis with the help of laser scanning in conjunction with computer-aided design/manufacturing.[9]But information and researchon the dimensions of ear and their correlation with facial measurements is still lacking. Although in literature, various attempts have been made to provide relationship between various landmarks of face and ear length, but none have stood the test of time.[10]

In the present study, mid facial heighthas been used as a reference to predict ear length and ear width. The results of the present study state that, there exists a definite correlation between ear length and mid-facial height.Also, after carrying out regression analysis, an equation has been derived which provides a definite method to assess ear length and ear width especially in the bilateral missing ear cases.Therefore, these set of equations provides a Maxillofacial Prosthodontist with a scaffold for treatment planning in cases of auricular prosthesis.

CONCLUSION

The challenge of restoring patients with bilaterally missing ears to normalcy can be significantly reduced by using the results of this study. As multiple variables are involved in success of auricular prosthesis functionally as well as aesthetically, finding a standardised relation between anthropometric measurements can offer successful outcomes. From the present study, we are able to conclude that mid facial height can be used as one of such anthropometric measurement, to measure ear length and ear width. Still further research is required in this direction to increase the predictability.

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