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Dimension Dynamics of Stapes

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ABSTRACT
Stapes being smallest bone of our body lacks periosteum and is connecting link between middle ear and internal ear. Thus any anatomical variation in this area leads to surfeit of disorders which affect hearing tremendously creating conductive hearing loss. Present study included 30 pair of stapes which were procured from the temporal bone of cadavers. All possible anatomical dimensions were recorded by using digital vernier calipers and the datas were analyzed using medcalc software. The dimensions of stapes are helpful in creating prosthesis and also can be used as homograft for future use.
Keywords: *Stapes, prosthesis, ossicles and footplate.*

Introduction

Stapes is the smallest bone of human body and lacks periosteum. The small bones are anatomically stable in both ethnically and geographically different populations. Also sizes of cranium and body have no correlation with that of ossicles thereby having substantial phylogenetic value (Crevecoeur 2007). Once necrosed stapes cannot be regenerated. Its various anatomical variations create crucial difference in transmission of sound waves from tympanic membrane to the oval window. Thus any anomaly affecting it may create a glut of disorders. Thus present study has been conducted to record all possible dimensions and characteristics of stapes.

Material and Method

This study was conducted on 60 stapes obtained from cadavers in Department of anatomy at Government medical college, Kota .Temporal piece were separated from the dissected cadavers. Petrous part of bone was chipped off carefully with chisel and hammer close to arcuate eminence till the head of malleus become visible. It was traced medially & roof of middle ear was removed slowly and carefully. Malleus was separated first

with the help of pointed forcep then incus, finally stapes was taken out carefully with the help of needle. After removal bones were cleared of ligaments and washed.

Measurements were taken with digital vernier caliper. Each reading was taken thrice & the mean of all the three was taken to rule out the error.

1) Total height of stapes: distance b/w top of head and footplate of stapes (g-h)
2) Diameter of head (D)
3) Length of foot plate =(i-j)
4) Breadth of foot plate (k-l)
5) Thickness of foot plate(t)
6) Weight of bone(w) in mg

Non parametrical measurements were

1. Presence or absence of neck
2. Shape of obturator foramen
3. Shape of footplate
4. Attachment of crus away or near the margin

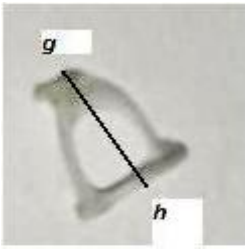


Fig 1 stapes without neck

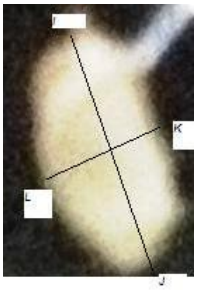


Fig 2: oval foot plate

Fig 3 Stapes with neck and oval obturator foramen

Fig 4. Round obturator foramen

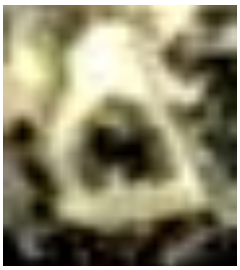


Fig 5 horse shoe obturator foramen and no neck

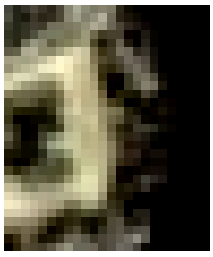


Fig 6 Constricted footplate

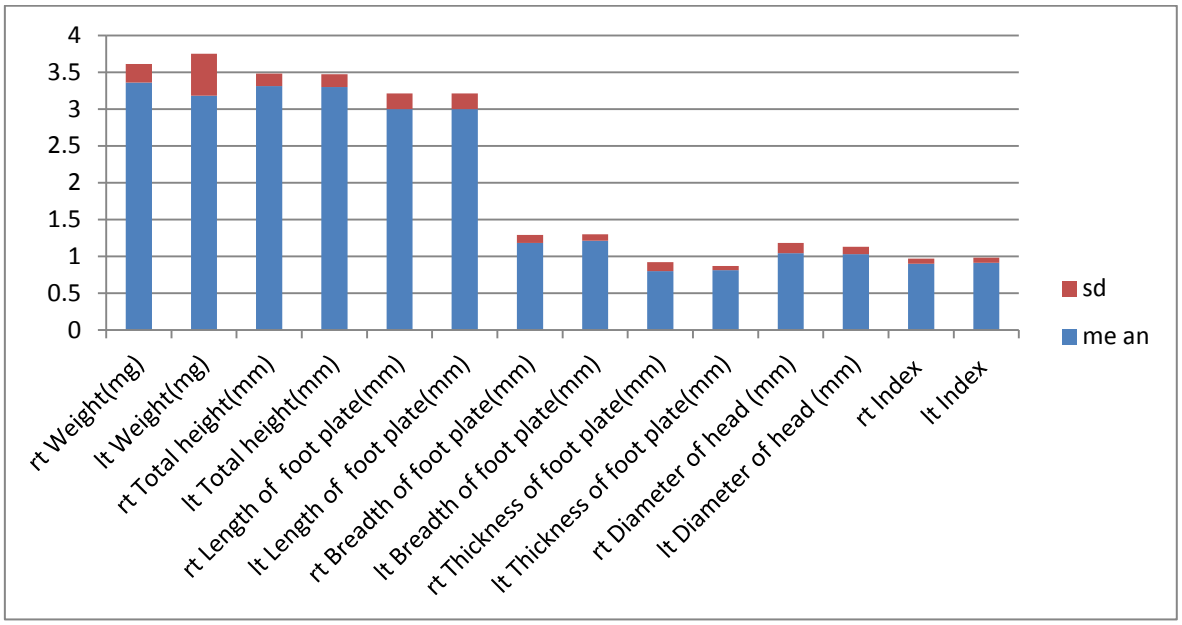
Fig 7 Crus attatchment away from margin

Fig 8: Crus attatchment near the margin

Table no (1) Showing t-test between right and left stapes

Variables	right stapes		left stapes		t-test	p-value
	mean	±sd	mean	±sd		
Weight(mg)	3.36	0.25	3.18	0.57	1.61	< 0.001
Total height(mm)	3.31	0.17	3.3	0.17	0.23	0.966
Length of foot plate(mm)	3	0.21	3	0.21	-0.02	0.87
Breadth of foot plate(mm)	1.18	0.11	1.21	0.09	0.91	0.3688
Thickness of foot plate(mm)	0.8	0.12	0.81	0.06	-0.6	0.001
Diameter of head (mm)	1.04	0.14	1.03	0.1	0.27	0.089
Index	0.9	0.07	0.91	0.07	0.87	0.15

Graph 1: Comparision between rt and lt sided stapes



Rt- right, lt- left

Table no. 2: (Regression equation between various dimension of stapes and their respective weight)

Variable		Coeff. Of Determination (R^2)	P value	Regression equation
Dependent(y)	Independent(x)			
Rt stapes Weight	Rt Height	0.07	0.03	y = 2.0926 + 0.3827 x
Lt Stapes Weight	Lt Height	0.22	<0.0001	y = 2.3873 + 0.2694 x
Rt Stapes Weight	Rt Length of foot plate	0.01	<0.0001	y = 3.3586 + 0.0004819 x
Lt Stapes Weight	Lt Length of foot plate	0.09	<0.0001	y = 2.8722 + 0.1351 x
Rt stapes Weight	Rt Breath of foot plate	0.06	<0.0001	y = 2.7191 + 0.5423 x
Lt Stapes Weight	Lt Breath of foot plate	0.26	<.0001	y = 2.5824 + 0.5760 x
rt stapes wt	rt thickness of fp	0.07	<.0001	y = 3.8094 + -0.5617 x
Lt Stapes Weight	lt thickness of fp	0.06	<.0001	y = 2.9657 + 0.3817 x
rt staes wt	rt stapes diameter of head	0.02	<.0001	y = 3.1284 + 0.2232 x
Lt Stapes Weight	lt stapes diameter of head	0.09	<.0001	y = 2.9852 + 0.2832 x

(Rt –right,Lt -left , Coeff-coefficient)

Table no. 3: Comparision between non parametrical datas of right and left stapes

Parameters	Rt stapes			Lt stapes			Chi square	P value	Contingency coefficient
Neck	Present	Absent		Present	Absent				
	63%	37%		63.30%	36.70%		2.31	0.13	0.27
Shape of obturator foramen	horse shoe	oval	round	horse shoe	oval	Round			
	73.30%	13.30%	13.30%	63%	20%	17%	41.1	<0.0001	0.76
Shape of foot plate	constricted	oval		constricted	Oval				
	16.70%	83.30%		30%	70%		0.276	0.6	0.096
Crus Attatchment	away from margin	near margin		away from margin	near margin				
	80.00%	20.00%		87%	13%		17.85	<.0001	0.61

Discussion

The stapes in the present study is the lightest of all the three ossicles but the difference in the dimensions of left and right side were not very significant except the weight. Right sided stapes were heavier than the left side though the left sided stapes footplate was thicker than the right side. Also a positive correlation was found between its various dimensions and the weight of the stapes in the present study. The dimensions were compared with that of previous studies in the table no. 4[1,2,3,4,5,6,7,8,9,10,11] and 5[10,11] as follows .

Table no 4: Comparision of parametrical datas of present and previous studies

Authors	Height(mm)	Length of foot plate	Thickness of foot plate	Diameter of head	Breadth of foot plate	Weight	Index
Das etal 1966	3.29	2.79			1.43		
Harneja & chaturvadi 1973	3.12	2.68			1.26		
Arsenberg et al 1981	3.2	2.8			1.3		85.1
aWengenetal 1995			0.51				
Bouchet & Giraud et al 1996	3.5						
Erdogan etal 2002	3.2	2.6			1.3		80.1
Wadhwa etal 2005	3.41	2.97	0.39	1.24			
Padmini etal 2014	2.75	2.36			1.91		87.2
Rathva etal 2014	3.33	2.78			1.34		
Present study	3.26	3.02	0.81	1.033	1.19	3.275	90.5%

Table no 5: Comparision of Non parametrical datas with Previous studies.

Parameter	Characteristics	Present study	Wadhwa et al 2005	Unur et al 2002
Neck	Present	63%	20%	Noticed
	Absent	37%	80%	
Shape of obturator foramen	Oval	12%	20%	Noticed all the shapes
	Round/circular	20%	30%	
	Horse/tunnel	68%	10%	
	Triangular	-	40%	
	Without whole		Absent	
Attachment of crus	Away from margin	83.50%	Noticed length of attachment	Noticed symmetry of Crura
	Near margin	16.50%		
Shape of Obturator Foramen	Constricted	23%	Noticed	-
	Oval	77%		

Conclusion

Osteometric dimensions are useful in prosthesis designing which can be used in ossicular reconstruction. Also stapes may be used to create a bank for homograft in ossiculoplasty.

Consent –Not applicable

Ethical approval –Not applicable as study is on cadavers in department of anatomy, GMC kota.

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