Indian Journal of Anatomy

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Printed at

Saujanya Printing Press
D-47, Okhla Industrial Area
Phase-1, New Delhi - 20

Indexed in
Index Copernicus, Poland.
EBSCO Publishing's Electronic Databases, USA

Corresponding address
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P.O. Box 9108, Delhi - 110 091(India)
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Indian Journal of Anatomy

July - December 2012
Volume 1 Number 1

Contents

Original article

Indian Journal of Anatomy
Volume 1 Number 1, July - December 2012

Orbital Dimensions

Sayee Rajangam, PhD*, Kulkarni R.N, MD, Lydia Quadrilos, M.Sc***, Sreenivasulu S, M.Sc******

Abstract

Context: Measurements of the orbit are part of the studies in craniometry. **Aims:** The present study reports 3 parameters of the orbit; height, breadth and orbital index. **Settings and Design:** Department of Anatomy, International Medical School, Bangalore. **Material & Method:** The measurements were taken for the right and the left orbital margins of the 51 male and 21 female skulls. **Statistical analysis:** 't' test. **Results:** The measurements of the orbit (height/ width/index) (Right: height 3.509 +/- 0.267, width 4.174 +/- 0.215, orbital index 73.55 +/- 12.89) (Left: height 3.37 +/- 0.257, width 4.082=/- 0.198, orbital index 75.273 +/- 11.132), were increased for the male. The right side measurements for the height and width were increased for both the sexes and the right orbital index for the female skulls. Significance was observed for the orbital index between the male and the female skulls for the right and the left orbits and the orbital index of the female skull between its right and left orbits. The application of the demarcation points have identified that the transverse diameters of the left and the right orbits identified 15 to 22 male skulls. Hence, the transverse diameters of the orbit could be considered as a parameter in sex determination of the skulls. **Conclusion:** The observed differences in the orbital measurements may be because of the sample size and the methodology and also the cardinal features pertaining to the skulls: subjective sex determination, age, racial and geological variations and asymmetry especially in the facial cranium.

Keywords: Male and female skulls; Orbital measurements; Height; Width; Index.

Introduction

The bony orbits are the skeletal cavities and contain the eyes, the peripheral organs of the vision. The walls of the orbits (floor, roof, medial/ lateral walls) protect the eyes from any injury and provide the points of attachment to the extra-ocular muscles, which allow the accurate positioning of the visual axis and determine the spatial relationship between the two eyes, which is considered to be essential for both the binocular vision and the conjugate movements of the eyes. The orbital cavity is approximated to that of the quadrilateral pyramids, with its base being anterior at the orbital opening and the apex in a postero-medial axis. The compromise between the protection and the good field of view has dictated that each eyeball is located anteriorly within the orbit. The eyeball occupies 1/ 5th of the volume of the orbit and the remainder of the orbital cavity is filled with orbital fat and connective tissue, as the source of support to the nerves and vessels. (Standring 2008)[1]

Metrical studies contribute to the comparison between the shapes and sizes of the skulls and its components and are carried out with the help of internationally standard techniques of craniometry, in which linear (chord) or surface distances are measured between varieties of defined cranial landmarks. The cranial points by international

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(Received on 22.05.2012, accepted on 14.06.2012)

agreement, in making linear and certain angular measurements in anthropometry, is by keeping the skull in with Frankfurt plane. In general, from the 3 basic measurements of length (A), breadth (B) and height (C) indices (B/A or C/A or C/B) are calculated and stated as percentages. The most frequently used is the cranial index (CI), the ratio of the breadth of the skull to its length. The calculated CI, even though classifies the types of the skulls (dolicocranic, mesocranic, brachycranic) is known to show a high degree of variations, both within and between the populations. Because of which, it is stated, that CI application may not be of a great value in distinguishing the skulls from different geographic regions and mostly reflects the interactions between the width of the cranial base and the volume of the brain. (Lieberman et al 2000, Standring 2005).[2,3]

As part of craniometry, for the orbit, measurements are calculated and similar to CI, the orbital index (OI) is also derived (maximal orbital height/ breadth x100).

The aim and the rationale of the present study is to report three parameters measured from the right and left margins of the orbit; height (vertical diameter) and breadth (transverse diameter) and the orbital index, from the available subjectively sex determined skulls.

Material and Method

Seventy two skulls were collected from the Department of Anatomy, International Medical School, Bangalore and also from the 1st year Medical Students. Based on the morphology, they were differentiated into 51 male and 21 female skulls. The measurements were taken with the thread and later applied on the scale and then, the values were entered. Height was measured as the maximum distance between the superior and inferior orbital margins and the width also as the maximum distance between the lateral and medial orbital margins. The measurements were taken for the right and the left orbital margins of the male and the female skulls. The measurements were tabulated. The 't' test was applied for the 12 orbital parameters .

Results

In table 1 is given the mean, standard deviation (SD), results of the 't' test and the 'p' values for detecting the significance for the

Table 1: Orbit: Measurements: Mean, SD, 't' test and 'p' value

Height (cms)	Male (51)	Female (21)
Right	3.5 +/- 0.27	3.2 +/ 0.28
Left	3.37+/- 0.26	3.08 +/ 0.21
't' test	0.49	0.48
Width (cms)	Male (51)	Female (21)
Right	4.17 +/ 0.21	3.72 +/ 0.16
Left	4.08+/ 0.19	3.69 +/ 0.16
't' test	0.44	0.16
Orbital index (cms)	Male (51)	Female (21)
Right	73.55+/ 12.9	66.79 +/ 7.46
Left	75.27 +/ 11.13	65.03 +/ 15.77
t' test	0.14	0.14

Sl. No	Parameters	'p' value
1.	Height (male)	0.393
	Right Vs left	NS
2.	Height (male Vs female)	0.397
	Right	NS
3.	Height (female)	0.119
	Right Vs left	NS
4.	Height (male Vs female)	0.174
	Left	NS
5.	Width (male)	0.290
	Right Vs left	NS
6.	Width (male Vs female)	0.07
	Right	NS
7.	Width (female)	0.49
	Right Vs left	NS
8.	Width (male Vs female)	0.145
	Left	NS
9.	Index (male)	0.152
	Right Vs left	NS
10.	Index (male Vs female)	0.003
	Right	Significant
11.	Index (female)	0.0007
	Right Vs left	Significant
12.	Index (male Vs female)	0.028
	Left	Significant

NS: non-significant

height, width and orbital index between the right and left orbits of the male and the female.

It was observed, that the measurements of the orbit (height/ width/index and the range); whether for the right or the left side, were increased for the male. Between the right and the left side, for the male, the right side orbital measurements for the height and width were increased for the male. For the female, the height, width and the orbital index of the right side were increased than the left orbit. It also may be noted that the range in the orbital index was more for the left side for the male and the female orbits.

Significance was observed for the orbital index between the male and the female for the right and the left orbits and the orbital index of the female between its right and left orbits.

Discussion

The review of literature available for the orbitometry is less than the investigations for the craniometry. The parameters for the orbit, on its height, width and antero-posterior diameters may be important in the exploration of the orbit especially, in the orbital floor exploration. (Lieberman and McCarthy 1999)[4]

The ocular vertical diameter (23.5 mm) is rather less than the transverse and the antero-posterior diameters (24 mm). The antero-posterior diameter at birth is 17.5 mm and at puberty 20 to 21 mm; it may vary considerably in myopia (29 mm) and in hypermetropia (20 mm). In females, all diameters are on an average slightly less than in the male. (Standring 2005)[3]. In the present study too, for the male and the female, whether from the right or the left side, the vertical diameter (height) of the orbits was less than that of the transverse diameter (width) and the 3 parameters (height/ width/ orbital index) were less for the female than the findings in the male.

In 1993, fetal development of the human orbit has been studied. The development of the orbits in 70 human fetal skulls was investigated by measuring the width and height of the orbital entrance, as well as the volume and depth of the orbital cavity and the interorbital width. For determination of the orbital volume, the imprint method was used and the remaining parameters were estimated. The measurements showed a linear growth rate for the orbital width, height and depth. After transformation to the cubic root, the values of the orbital volume also demonstrated a linear increase. The orbital index (height/width x 100) expressed the change in the oval outline of the orbital entrance, during fetal development from a flat, wide form to a nearly round form at birth. No statistically significant difference between the right and left orbit was found. (Haas et al 1993)[5]. In the present study, significance was observed for the orbital index between the male and the female skulls for the right and the left orbits and the orbital index of the female skull between its right and left orbits.

The cranial index is known to show a high degree of variations, both within and between the populations. Because of which, it is stated, that its application may not be of a great value in distinguishing the skulls from different geographic regions and mostly reflects the interactions between the width of the cranial base and the volume of the brain. (Lieberman et al 2000, Standring 2005).[2,3] It may be noted that the values for the orbital axis, visual axis and optic axis varies between the individuals and depends on the angle between the orbital axes and the median plane. (Standring 2005, Standring 2008, Millodot 2009)[1,3,7]. In the present study, as stated for the cranial index, the orbital index showed variations between the male and the female orbits.

The available literature on the sex determination, age determination and racial/ geological variation for the skulls is plenty; because they may be the reflected causes for the observed differences in the craniometry as well as for the orbitometry.

Sex determination: (Standring 2008, 2005)[1,3] For many crania, the sex determination is difficult because, the variation is greater within than between the sexes. Sexual differences are detected in measurements; the mandible, orbits, tooth size and pattern of dental eruption did not reach the level of discrimination, to allow the accurate and reliable assessment. The defining characteristics of sex in adults, therefore became male oriented and reflected the effects of the increased mass of muscles of the mastication, which are attached to the mandible and the muscles associated with maintaining the erect head. It is reported that using the skull alone, sex can be predicted with over 80% accuracy in the adult. Generally, male skulls are more robust/ thicker bones in neuro-cranial vault; more marked muscle origins and insertions (temporal and nuchal lines); prominent external occipital protuberances/ mastoid processes; large frontal sinuses/ glabella/ superciliary arches/ tooth size/ maxillary arch; pronounced supra-orbital ridges/ square shaped superior margins of orbits. Female skulls are more gracile/ forehead higher/ more vertical/ more rounded/clear retention of the frontal eminences in the female. The obvious genetic and racial variations must be considered when attempting to assign the sex from the skulls.

Age determination: (Standring 2008)[1]

Age being a continuous variable, the relationship between chronological age and skeletal maturity is closest in the juvenile years and therefore greater accuracy is achieved in the prediction of age from the juvenile than from the adult. The dental and the chronological age show a stronger correlation than the skeletal and chronological age. The differences in the skulls between the two sexes are seen only after puberty. Adult males tend to be larger than females in a number of features due to a combination of faster rates of growth during puberty and longer period of growth.

Racial/ Geographic variations: (Standring 2005)[3]

Several major studies assessed the variations in cranial shape among and between the populations. Variations in the shape of the human cranium are far greater within than between the populations**.** It is reported that some features are evident for the shapes of the cranium from the populations of different geographic origin.

The determination of racial or genetic origin is difficult to achieve, although the physical and forensic anthropological scientists insist on doing that. In the migrant modern world, it has become restrictive. In spite of the overlap, there exists the representation. Geographical origin and the recognized physical traits enabled the 4 traditional races of man: Caucasoid, Negroid, Mongoloid and Australoid. The Indian subcontinent is included in the Caucasoid The skull has a rounded to long shape (dolicocephalic); steep forehead; narrow nasal aperture/ a prominent nasal spine/ a steeple shaped nasal root; moderately developed supraorbital ridging/ narrow interorbital distance; prominent chin; long and narrow palate; not overly prominent cheek bones and a tendency to maxillary protrusion or mandibular retrusion.

The current research on racial discrimination is by genetic markers; hence, the skeletal indicators now play a significantly reduced role. (Bamshead and Olson 2003)[7].

In the present study, for the orbital measurements, the skulls were subjectively sexed. Still, for the vertical and transverse diameters of the orbit, the formula of the demarking points (Jit and Singh 1966)[8] was attempted to find out the best parameter towards the sex determination of the skull. The demarking points of the present study were assumed to spread over the 3 SD values over and above the mean value of the vertical and transverse diameter. (Table 2)

Table 2: Orbit: Measurements: Demarking points (DP)

Orbit- Height				
-	Right		Left	
Height (cms)	Male (51)	Female (21)	Male (51)	Female (21)
Mean	3.5	3.2	3.37	3.08
SD	0.27	0.28	0.26	0.21
3 x SD	0.81	0.84	0.78	0.63
DP	3.2+ 0.84=> 4.04	3.5- 0.81=< 2.69	3.08+ 0.63=> 3.71	3.37- 0.78=< 2.59
n & % of the male or female skulls beyond DP	3/51= 5.88	NIL	6/51= 11.76	NIL
Width (cms)	-	-	-	-
Mean	4.17	3.72	4.08	3.69
SD	0.21	0.16	0.19	0.16
3 x SD	0.63	0.48	0.57	0.48
DP	3.72+ 0.48=> 4.2	4.17- 0.63=< 3.54	3.69+ 0.48=> 4.17	4.08- 0.57=< 3.51
n & % beyond DP	22/51= 43.13	NIL	15/51= 29.41	NIL

In the male, the demarcation points for the vertical diameters of the right and the left orbits have contributed to a certain extent towards the sex determination. On the other hand, the transverse (width) diameters; especially in the right side have identified that 22 skulls could be definitely male. For the female, the demarcation points for the orbits' vertical and transverse diameters have not contributed towards the sex determination of the skulls.

As for the geographic distribution and racial origin of the skulls; it may be noted that they were from Karnataka, India and belonged to

Appendix 1: Orbit- Measurements: Mean & SD

Sl. No	Male- Right			Male- Left		
-	Height (cms)	Width (cms)	Index	Height (cms)	Width (cms)	Index
1	3.9	4.9	79.59	3.8	4	95
2	3.8	4.4	66.36	3.6	4.7	76.59
3	3.9	4.3	50.69	3.8	4.1	52.68
4	4	4	100	3.9	4	97.5
5	3.5	4.5	77.77	3.5	4	87.5
6	3.7	4.1	50.24	3.6	4.2	65.71
7	3.7	4.1	50.24	3.6	4.4	61.81
8	3.3	4	82.5	3.8	4.4	66.36
9	3.5	4.5	77.77	3.2	4	80
10	3.5	4	87.5	3.5	3.9	69.74
11	3.4	4.5	75.55	3.5	4	87.5
12	3.5	4	87.5	3	4.3	69.76
13	3.4	4	85	3.2	4.4	72.72
14	3.1	4.2	90.47	3.3	4.3	76.74
15	3.2	4.5	71.11	3	4.3	69.76
16	3.2	4.3	74.41	3.2	4	80
17	4	4.5	68.88	3.1	4	77.5
18	3.8	4.1	52.68	4	4	100
19	3.8	4.2	90.47	3.4	3.9	67.17
20	3.5	4.3	61.39	3.5	3.9	69.74
21	3.5	4	87.5	3.2	4.4	72.72
22	3.4	4.2	80.95	3.5	4	87.5
23	3.1	4	77.5	3.3	3.9	64.61
24	3.4	4	85	3.3	4	82.5
25	3.9	4.2	52.85	3.1	3.9	79.48
26	3.2	3.9	62.05	3.2	4.1	78.04
27	3.5	3.9	69.74	3.6	3.9	52.3
28	3.6	4.5	80	3.5	4	87.5
29	3.5	3.9	69.74	3.3	4	82.5
30	3.4	4	85	3.5	3.8	52.1
31	3.1	4.1	75.6	3.1	4.1	75.6
32	3.3	4	82.5	3	4.1	73.17
33	3.1	4.4	70.45	3.1	4	77.5
34	3.2	4.3	74.41	3.1	4.2	73.8
35	3.4	4	85	3	3.6	63.33
36	3.2	3.9	62.05	3.3	4	82.5
37	3.2	4.1	78.04	3.3	4	82.5
38	3.7	4	92.5	3.1	4	77.5
39	3.5	4.2	63.33	3.2	4.1	78.04
40	3.3	4.1	60.48	3.1	4.1	75.6
41	4	4.5	68.88	3.9	4.4	68.63
42	3.7	4.4	64.09	3.4	4.3	79.06
43	3.8	4.1	52.68	3.4	4.3	79.06
44	3.5	4	87.5	3.6	3.9	52.3
45	3.9	4.1	55.12	3.3	4	82.5

Sl. No	Female- Right			Female- Left		
-	Height (cms)	Width (cms)	Index	Height (cms)	Width (cms)	Index
1	3.3	3.9	64.61	3.4	3.8	69.47
2	3.7	3.9	54.87	3.5	3.6	57.22
3	3.6	3.8	54.73	3.5	3.9	69.74
4	3	3.5	65.71	3.1	3.6	66.11
5	3	3.5	65.71	3.1	3.5	68.57
6	3.1	3.7	63.78	3	3.9	76.92
7	2.9	3.9	74.35	2.9	3.7	78.37
8	3.4	3.8	69.47	3	3.8	78.94
9	3.8	3.9	57.74	3.4	3.7	51.89
10	3.2	3.4	54.11	3	3.4	68.23
11	3.3	3.7	69.18	3.2	3.7	66.48
12	3	3.8	78.94	3	3.6	63.33
13	2.8	3.7	75.67	2.9	3.3	67.87
14	2.9	3.8	76.31	2.7	3.8	71.05
15	3	3.8	78.94	3	3.7	61.08
16	2.9	3.4	65.29	2.9	3.9	74.35
17	3.1	3.6	66.11	2.9	3.8	76.31
18	3.2	3.8	64.21	3.1	3.7	63.78
19	3.5	3.9	69.74	3.2	3.7	66.48
20	3.1	3.7	63.78	2.9	3.6	60.55
21	3.4	3.8	69.47	3.1	3.9	79.48

the traditional race of Caucasoid. The age determination based on the maxillary alveolar arches indicated that the skulls could be towards adult and old age.

The observed differences in the orbital measurements may be because of the sample size and the methodology and also the cardinal features pertaining to the skulls: subjective sex determination, age, racial and geological variations and asymmetry especially in the facial cranium.

References

1. Standring S. Gray's Anatomy. *The Anatomical Basis of Clinical Practise,* 40th edition. Spain; Churchill Livingstone - Elsevier, 2008; 419- 421 & 655- 656.
2. Lieberman DE, Pearsom OM, Mowbray KM. Basicranial influence on overall cranial shape. *J Hum Evol* 2000; 38: 291- 315.
3. Standring S. Gray's Anatomy. *The Anatomical Basis of Clinical Practise,* 39th edition. Philadelphia; Churchill Livingstone -Elsevier, 2005; 487- 489.
4. Lieberman DE, McCarthy RC. The ontogeny of cranial base angulation in humans and chimpanzees and its implications for reconstructing pharyngral dimensions. *J Hum Evol* 1999; 36: 487- 517.
5. Haas A, Weiglein A, Faschinger C, Müllner K. Fetal development of the human orbit. *Graefes Arch Clin Exp Ophthalmol* 1993; 231: 217-220.
6. Millodot M. *Dictionary of Optometry and Visual Science*, 7th edition. Philadelphia; Butterworth-Heinemann-Elsevier, 2009.
7. Bamsead M, Olson S. Does race exist? *Sci Am* 2003; 289: 78- 85.
8. Jit I and Singh S. The sexing of adult clavicles. *Indian J Medical Research* 1966; 54: 551- 557.

Original article

Indian Journal of Anatomy
Volume 1 Number 1, July - December 2012

Variations in the Shape of Human Hyoid Bone in Western Maharashtra

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Abstract

A study of 91 human hyoid bones consisting of 51 male and 40 female bones obtained from medicolegal postmortems and dissected cadavers from the department of Anatomy was conducted. The hyoid bones were classified according to its shape into 5 different types based on the studies of Papadopoulos et al [1] and Harjeet and Jit[2].The V-type was dominant in males (29.4%)and U-type in females (30%).An attempt was also made to classify the hyoid bone according to its symmetry and isometry.

Key words: Hyoid bone; Sexual dimorphism; Western Maharashtra.

Introduction

Hyoid bone is a symmetric, U-shaped bone suspended from the tips of the styloid process by the stylohyoid ligament. The name hyoid is derived from the greek word 'hyoides' meaning shaped like the letter 'upsilon' or letter 'U'[1]. The Hyoid bone is present in many mammals; it allows a wider range of tongue, pharyngeal and laryngeal movements by bracing these structures alongside each other in order to produce variation. Due to its position, the Hyoid bone is not susceptible to easy fracture. In a suspected case of murder, a fractured hyoid strongly indicates throttling or strangulation[3].In the year 1979,Koebke and Saternus[4] first classified the hyoid bone into 4 types-Parabolic (40.9%), Hyperbolic (35%), Horseshoe (13.1%) and Asymmetric (11%).This classification was modified in the year 1989 by Papadopoulos et al[1] and the hyoid bone was classified into 5 different types—Type U, Type V(triangular),Type H(horseshoe),Type B (boat shape) and Type D (deviating). In their study it was seen that type D was the leading type in men covering almost half of the male population. On the contrary Type H and B occurred with equal frequency in females covering almost two-third of the female population.

Harjeet and Jit (1996)[2] have classified the shapes of the hyoid bone based on the study of Papadopoulos et al[1] in adults, children, neonates and fetuses. According to their study, in adult males, V-type and in adult females. U-type hyoid bones were the leading types. Significant sexual difference was found in U and V type bones.

O'Halloran, Miller and Walker (1998)[5] studied age and sex related variation in hyoid bone morphology by taking a series of 30 measurements on digitized radiograph of 315 hyoid bones from people of known age and sex. They concluded that most of the bones were highly symmetrical. Pollanen and Ubelaker (1997)[6] studied forensic significance of the polymorphism of hyoid bone shape. The reason why some hyoids fracture in strangulation and others do not is related to anatomic features of hyoid bone. They studied dimensions and shape of 100 hyoid bones and compared the metric parameters of fractured

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(Received on 02.05.2012, accepted on 08.06.2012)

hyoid bones from ten cases (8 females and 2 males) of strangulation. The length and breadth of female hyoid bones were smaller than that of the male bones. Based on qualitative assessment they classified hyoid bones into hyperbolic (55%) and Parabolic (45%) types.

The present study was done to determine the incidence of various shapes in adult male and female hyoid bone. The hyoid bones were also classified according to their symmetry and isometry.

Material and methods

Ninety-one human hyoid bones from different religion and caste were collected from medicolegal postmortems as well as dissected cadavers from the department of Anatomy. The study included 51 male and 40 female bones.

Each hyoid bone was collected by dissecting neck. Midline incision was taken on neck and the incision was extended from symphysis menti to suprasternal notch. Strap muscles of neck were dissected and were reflected to both sides and the front part of larynx was exposed. Hyoid bone was identified which is present above the thyroid cartilage. It was separated from base of tongue and then it was separated from larynx. The bone was obtained with partial attachment of muscle fibres and ligaments. It was cleaned and kept in a labeled container indicating the serial number and sex of the bone to avoid mixing of the specimens. The bone was kept for maceration for 2 weeks and then dried for 1 week. Each bone was photographed and was classified on the basis of its shape into following 5 types:

1) U-Type: It is half circle anteriorly and the greater cornua are almost straight. (Photograph-1a)

2) V-type: It is half circle anteriorly and resembles the letter V. (photograph-1b)

3) Horse shoe-type: It is half circle anteriorly and the greater cornua face each other. (Photograph-1c)

4) Boat-type: It resembles a boat and the two greater cornua deviate from each other. (Photograph-2a)

5) Deviated-type: One greater cornua deviates more than the other making the cornua asymmetrical. (Photograph-2b).

The percentage of asymmetric and anisometric bones was also calculated.

A bone is symmetric if the middle of all its transverse diameters fall on the sagittal axis (photograph 3) otherwise it is an asymmetric hyoid bone (Photograph 4).

A bone is isometric if the tips of both greater cornua fall on the same horizontal line (photograph 5) otherwise it is an anisometric bone and the tips of both greater cornua do not coincide on the same axis (Photograph 6).

The data thus obtained was tabulated separately for male and female and was analyzed statistically by univariate method.

Observation

After drying the bones were photographed and classified into five different types based on the classification of Papadopoulos et al[1] and Harjeet and Jit[2]. The incidence of various shapes of hyoid bones in males and females is given in Table1.In males V-type is common (29.4%) followed by U-type (25.4%).In females U-type is common (30%) followed by V-type (17.5%).

Table 2 shows the incidence of asymmetric and anisometric hyoid bones .In the present study 19 male (37.2%) and 10 female (25%) hyoid bones were classified as asymmetric. Similarly 15 male hyoid bones (29.4%) and 8 female hyoid bones (20%) were classified as anisometric.

Discussion

The hyoid bones were first classified according to their shape by Koebke and Saternus[4] into 4 types: Parabolic (40.9%),Hyperbolic (35%), Horseshoe type (13%),and Asymmetric (11%).They observed that the Parabolic was commonest type in men (45.4%) followed by Hyperbolic (30.6%) and in females the Hyperbolic was the leading type (43.7%) followed by Parabolic (31.7%).

Papadopoulos et al[1] examined the shapes of 38 male and 38 female bones and classified the hyoid bones into 5 types: U-type (18.4%),V-type (5.3%),B-type (26.3%), H-type (21.1%) and D-type (28.9%). Their U-type corresponds to Hyperbolic and their V and B types to Parabolic types of Koebke and Saternus[4]. In their study Deviated type was dominant in males (47.1%) and in females the Horseshoe and Boat types were present in equal proportion in about two-third of the female bones.

Harjeet and Jit[2] classified the hyoid bones based on the study of Papadopoulos et al[1] in North-West Indians. They found U-type in 24.7%, V-type in 28.3%, B-type in 5.7%, H-type in 10.7% and D-type in 20.1% of bones. They observed a significant sexual difference in U and V type of bones. In males V-type and in females U-type hyoid bones were the leading types which covered about one-third of the specimens.

Table 3 shows a comparison between the observation of the two previous workers and the present findings regarding the shape of hyoid bones. In our study V-type was dominant in males(29.4%) and U-type in females(30%). The incidence of V and U type hyoid bones is much higher than that recorded by Papadopoulos et al[1] but corresponds with the observations of Harjeet and Jit(1996)[2]. The increase in the incidence of V-shaped hyoid bones in males could be related to a decrease in superior thyroid angle in males which occurs with increasing age. (Harjeet and Jit)[7].

Table 2 shows the frequency of asymmetric hyoid bones according to their shape and sex distribution. A total of twenty-nine hyoid bones (19 male and 10 female) were classified as asymmetric.Papadopoulos et al[1] observed asymmetry in 52.6% male and 42.1% female bones. Similarly in the study by Harjeet and Jit[2] asymmetry was 56% in males and 51% in females. In the present study the asymmetry of hyoid bone was common in Deviated type in males (47.3%) and in U-type in females (40%).

Similarly twenty-three hyoid bones (15 male and 8 female) were classified as anisometric in the present study. The frequency of anisomery was also greater in males (29.4%) as compared to females (20%).In males the frequency of anisometry was highest in Deviated type (33.3%) while in females anisometry was seen in equal proportions in V-type, Boat-type and Deviated types (10%).

Source of funding and conflict of interest: Nil

Table 1: Incidence of various shapes of hyoid bones in males and females

Sr. No.	Shape	Male (n=51)	Female (n=40)	Total (n=91)
1	U –type	13 (25.4%)	12 (30%)	25 (27.4%)
2	V –type	15 (29.4%)	07 (17.5%)	22 (24.1%)
3	Boat –type	04 (7.8%)	O7 (17.5%)	11 (12%)
4	Horse-shoe type	07 (13.7%)	08 (20%)	15 (16.4%)
5	Deviated-type	12 (23.5%)	06 (15%)	18 (19.7%)

Table 2: Incidence of asymmetric and anisometric hyoid bones in males and females

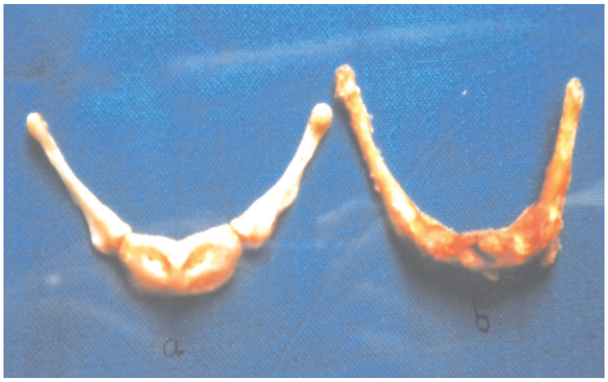
Sr. No.	Shape	Sex	Asymmetric bones	Anisometric bones
1	U type	M	2 (10.5%)	2 (13.3%)
		F	4 (40%)	1 (5%)
2	V-type	M	4 (21%)	4 (26.6%)
		F	3 (30%)	2 (10%)
3	Boat type	M	1 (5.2%)	1 (6.6%)
		F	Nil	2 (10%)
4	Horse-shoe type	M	3 (15.7%)	3 (20%)
		F	1 (10%)	1 (5%)
5	Deviated type	M	9 (47.31%)	5 (33.3%)
		F	2 (20%)	2 (10%)
6	Total	M	19 (37.2%)	15 (29.4%)
		F	10 (25%)	8 (20%)

Table 3: Comparison of present study with previous studies

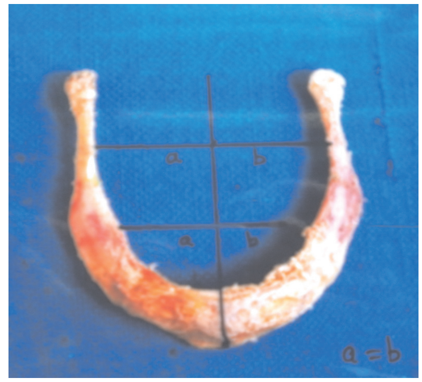
Shape	sex	Papadopoulos et al	Harjeet and Jit I	Present study
U-type	M	6(15.4%)	41(20.5%)	13(25.4%)
	F	8(21.1%)	33(33%)	12(30%)
V-type	M	2(5.3%)	67(33.5%)	15(29.4%)
	F	2(5.3%)	18(18%)	7(17.5%)
H-type	M	4(10.5%)	20(10%)	7(13.7%)
	F	12(31.6%)	12(12%)	8(20%)
B-type	M	8(21.1%)	28(14%)	4(7.8%)
	F	12(31.6%)	19(19%)	7(17.5%)
D-type	M	18(47.1%)	44(22%)	12(23.5%)
	F	4(10.5%)	18(18%)	6(15%)

Photograph 1: Shapes of hyoid bone a) U-type) V-type c) Horse shoe type

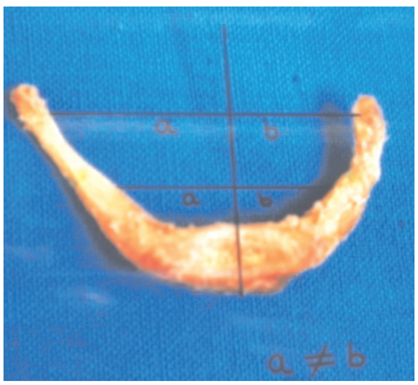
Photograph 2: Shapes of hyoid bone a) Boat -type b) Deviated -type



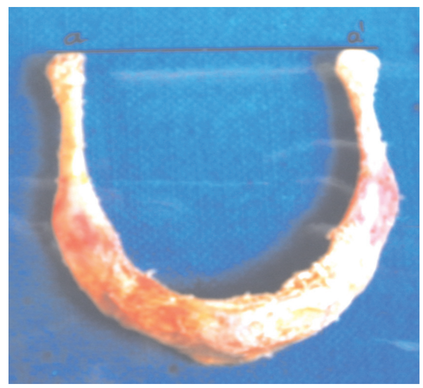
Photograph 3: A symmetric hyoid bone



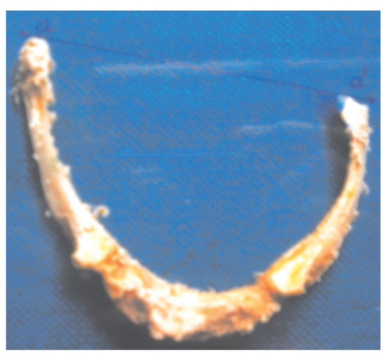
Photograph 4: An asymmetric hyoid bone



Photograph 5: An isometric hyoid bone



Photograph 6: An anisometric hyoid bone



References

1. Papadopoulos N,Lykaki G,Anastopoulou et al.The shape and size of the human hyoid bone and a proposal for an alternative classification. *Journal Anatomy* 1989; 163: 249-260.
2. Harjeet, Jit I. Shape, size and sexual dimorphism of the hyoid bone in northwest Indians. *Journ Anat Soc India* 1996; 45(1): 4-22.
3. Hyoid bone-Wikepedia, the free encyclopedia. http://en.wikipedia.org/wiki/Hyoid-bones.
4. Koebke J, Saternus KS. Zur morphologie des adulten menschlichen. *Zungenbeins zeitschrift fur Rechsmedizi* 1979; 84 :7-18.
5. O'Halloran, Miller and Walker. Age and sex related variation in hyoid bone morphology. *Journal Forensic Science* 1998; 43(6): 1138-1143.
6. Pollanen M.S. and Ubelaker D.H.Forensic significance of hyoid bone shape. *Journal Forensic Science* 1997; 42(5): 890-892
7. Harjeet, Jit I. Dimensions of thyroid cartilage in neonates, children and adults in northwest Indian subjects. *Journ Anat Soc India* 1992; 41: 81-92.

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Indian Journal of Anatomy
Volume 1 Number 1, July - December 2012

Anomalous Origin of Splenic Artery from Left Gastric Artery: A Case Report

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Abstract

Normally splenic artery takes origin from the coeliac trunk. Variations in the branches of the coeliac trunk are well established. Here reporting a rare case of coeliac trunk with two main branches hepatic artery and left gastric artery in place of the three classical arteries. In the present study splenic artery arises from the left gastric artery which was a little narrower in its lumen & the spleen was also having a subnormal size. Origin of splenic artery has the clinical significance in laparoscopic surgery as splenectomy also in splenography & operations over pancreas & stomach .Success of surgical operations of the spleen and radiological investigation of related area depends on course of splenic artery.

Key words: Coeliac trunk; Anomalous origin; Splenic artery; Left gastric artery.

Introduction

Coeliac trunk arises from front of the abdominal aorta just below the aortic opening of diaphragm. It is the artery of foregut and develops from one of the vitelline arteries[1] and supplies all derivatives of the foregut. It divides into three terminal branches namely the left gastric ,hepatic and splenic arteries. So splenic artery is one of the main and largest branch of coeliac trunk .It runs horizontally to the left along the upper border of pancreas behind the lesser sac. In the routine observations, occasionally it may arise from abdominal aorta or still rarely from superior mesenteric artery.

In the present study, splenic artery arises from another branch of the coeliac trunk i.e. left gastric artery. Earlier it is mentioned that splenic artery may start either from superior mesenteric artery or abdominal aorta[2] and as per Gray's Anatomy[3] there is no variation of splenic artery being mentioned. Variations of the branches of celiac trunk and their relationship to surrounding structures are therefore of particular importance from a surgical perspective[4,5].

Case report

Anomalous origin of splenic artery was observed during the routine abdominal dissection for the first M.B.B.S. medical undergraduates in the department of Anatomy. In approximately 50 year old male cadaver splenic artery was not found, while searching the branches of the coeliac trunk viz- Hepatic artery, Left gastric artery & Splenic artery. Then the related dissected area of the coeliac trunk at the 12th thoracic vertebral level was explored. Also it was confirmed whether the splenic artery has took aberrent origin from the abdominal aorta or below from the superior mesenteric artery. By tracing splenic artery from hilum of spleen , it was

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(Received on 22.08.2012, accepted on 29.10.2012)

found that splenic artery arises from the left gastric artery (Figure 1) .Also we confirmed for its branches & the size of the lumen of the artery.

It was found that spenic artery was having small length & small calibre (Lumen) . We examined the size & shape of the spleen, which was found to be subnormal in size with normal splenic shape. [Size of spleen : 9cm. Length x 7cm Breadth x 2.5cm Thick And Weight : 61gms]. We also observed the sizes of coeliac trunk & its other branches left gastric & hepatic artery. They were found to be of normal size. Gastro-duodenal artery was found to take origin directly from coeliac trunk.

Discussion

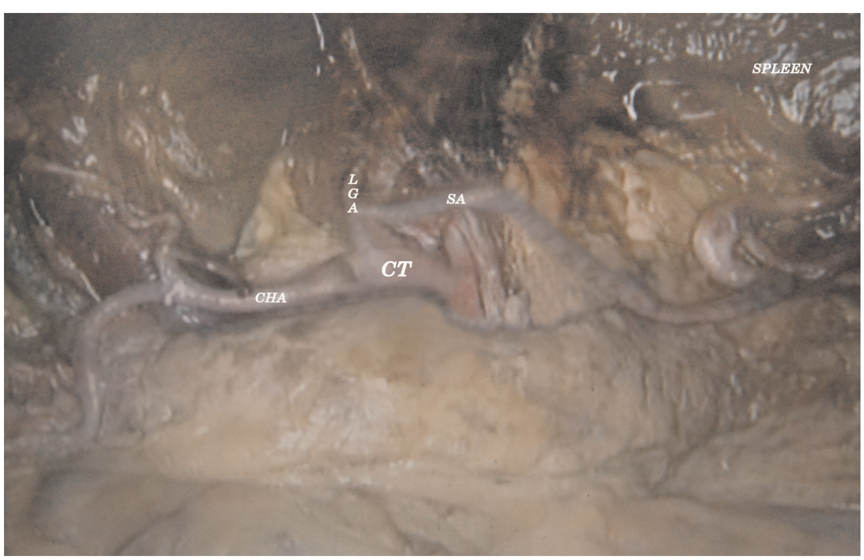
Splenic artery is the largest branch of coeliac trunk. It runs along the upper border of pancreas. It is tortuous in its course to allow free movements of spleen and passes through the lienorenal ligament to reach the hilum of spleen. It gives rise to numerous pancreatic, 5-7 short gastric & left gastroepiploic arteries and supplies other than spleen to pancreas, stomach & greater omentum.

Studies on arterial variations of the abdomen showed that 87.7% of the coeliac trunk exhibited the classical trifurcation. An incomplete coeliac trunk , namely bifurcation, accounted for 5.8–24.1%. Besides these variations, the coeliac trunk itself may be absent, its branches may arise directly from the aorta[6,7].

With the past experience of dissecting human cadavers during dissection for under graduates , we have come across this very rare case anomalous origin of splenic artetry from left gastric artery. In this case of anomalous origin of the splenic artery both length & caliber of the splenic artery was subnormal in size. The spleen which was getting the blood supply from this artery was also subnormal in size. It is unfortunate that we did not have the case history of the patient, with which all ailments the particular person suffered from during his life time. Hence we cannot correlate his ailments with the anomalous origin, small size of both splenic artery & spleen. No previous similar work is found for comparison.

Knowledge of variations concerning the branches of celiac trunk is of extreme clinical importance in the areas of the appleby procedure[8], laparoscopic surgery and

Figure 1: Dissection of abdominal Region showing the anomalous origin of splenic artery from left gastric artery. (CT: Coeliac Trunk , SA: Splenic Artery ,LGA:Left Gastric Atrery, CHA:Common Hepatic Artery)



radiological procedures in the upper abdomen, and should be kept in mind by clinicians to avoid complications. Knowledge of anatomical variations of the branches of coeliac trunk is essential to successfully accomplish surgical, oncologic, or interventional procedures including lymphadenectomy around hepato-spleno-mesenteric trunk, aortic replacement with reimplantation of the trunk, or chemoembolization of liver malignancies, all of which can potentially create significant morbidity because of the large visceral territory supplied by a single vessel[9].

Arterial variations should be taken care during the abdominal operative procedures. Vascular anomalies are usually asymptomatic; they may become important in patients undergoing diagnostic angiography for gastrointestinal bleeding, celiac axis compression syndrome, or prior to an operative procedure or transcatheter therapy[10]. During the surgical approach over the spleen & extrahepatic biliary apparatus, it is imperative for the surgeon to take the note of such anomalous origin of splenic artery.

References

1. Sadler TW. *Langman's Medical Embryology*. 10th Ed. Baltimore; Williams and Wilkins, 2006; 183.
2. Lee McGregor. McGregors Anatomy. *A Synopsis of surgical Anatomy,* 12th Ed.1986; 110.
3. Peter L.Williams.Gray's Anatomy. *Variations of the splenic and hepatic arteries,* 39th Ed.1995; 1552.
4. Vandamme JP, Bonte J. The branches of the celiac trunk. *Acta Anat* 1985; 122: 110–114.
5. Kahraman G, Marur T, Tanyeli E, Yýldýrým M. Hepatomesenteric trunk. *Surg Radiol Anat* 2001; 23: 433–435.
6. Morettin LB, Baldwin-Price HK, Schreiber MH. Congenital absence of the celiac axis trunk. *Am J Roentgenol Radium Ther Nucl Med* 1965; 95: 727–730.
7. Yamaki K, Tanaka N, Matsushima T, Miyazaki K, Yoshizuka M. A rare case of absence of the celiac trunk: the left gastric, the splenic, the common hepatic and the superior mesenteric arteries arising independently from the abdominal aorta. *Ann Anat* 1995; 177: 97–100.
8. Kimura W, Han I, Furukawa Y, Sunami E, Futakawa N, Inoue T, Shinkai H, Zhao B, Muto T, Makuuchi M, Komatsu H. Appleby operation for carcinoma of the body and tail of the pancreas. *Hepatogastroenterology* 1997; 44: 387–393.
9. Losanoff JE, Millis JM, Harland RC, Testa G. Hepato-spleno-mesenteric trunk. *J Am Coll Surg* 2007; 204: 511.
10. Yalcin B, Kocabiyik N, Yazar F, Ozan H, Ozdogmus O. Variations of the branches of the celiac trunk. *Gulhane Tip Dergisi* 2004; 46: 163–165.

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Case report

Indian Journal of Anatomy
Volume 1 Number 1, July - December 2012

Variant Formations of Median Nerve

Sudke Geetanjali B*, Kulkarni P.R., Dope Santoshkumar A.*****

Abstract

Variations in formation of median nerve by more than two roots are relatively uncommon as compared to other variations. During routine dissection for undergraduates, we observed two variations in the formation of median nerve. In one case unilateral variation was observed in 40 year old male cadaver in left axillary region. Here the formation of median nerve was by four roots. Three roots coming from lateral cord joined single root from medial cord leading to median nerve formation. In other case formation was by three roots, two roots from lateral cord and one from medial cord. This variation was present bilaterally. However, in both the cadavers the distribution of the anomalous median nerve was normal in arm, forearm and palm. Presence of such additional roots must be kept in mind during surgery to avoid their injury. It can also explain some unusual clinical symptoms.

Key words: Median nerve; Variations; Lateral cord.

Introduction

Variations in arrangement and branching pattern of brachial plexus are common and have been thoroughly studied and reviewed earlier.[1-3] These variations are more observed at the level of its formation of trunks, divisions, cords and its terminal branches. The median nerve is one of the branches of the brachial plexus which shows frequent variation in its formation. Usually, Median nerve is formed in axilla by two roots by contributions from the lateral cord originating from ventral roots of C5, C6 & C7 and medial cord from ventral roots of C8 &T1. Lateral root arises from lateral cord of brachial plexus, medial root from medial cord. Medial root crosses in front of third part axillary artery to unite with lateral root in a Y shaped manner either in front of or on the lateral side of the artery to form the median nerve. It lies lateral to third part axillary artery and enters arm at the lower border of Teres major[4].

The knowledge of the anatomical variations of the peripheral nerves in the upper limbs are important as these abnormal nerves could be injured during surgical procedures. It can also explain some of the unusual clinical symptoms.

Case report

We encountered two relatively uncommon variations in the formation of median nerve by more than two roots while dissecting for undergraduates in the Department of Anatomy, Government Medical College, Latur.

Case 1

During routine dissection, unilateral variation in formation of median nerve was observed in a 40 year old male cadaver. Variation was observed in left axillary region. Median nerve is formed by one medial and

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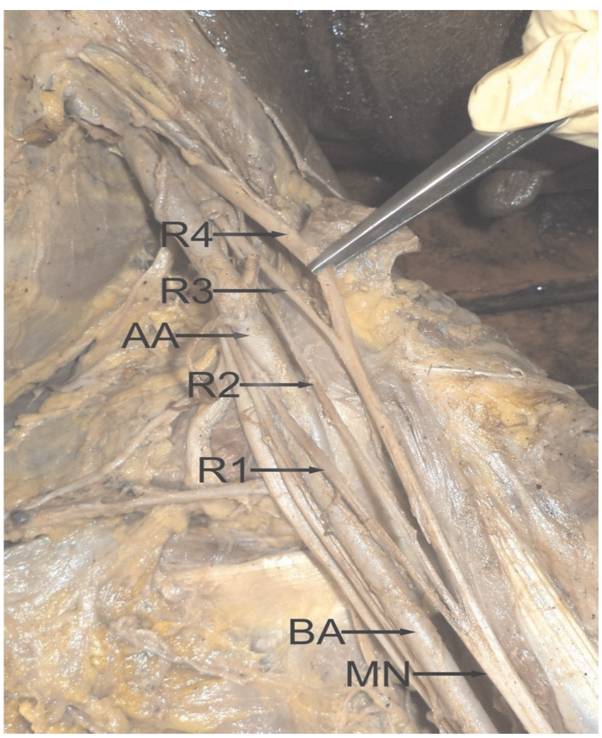
(Received on 05.11.2012, accepted on 27.11.2012)

three lateral roots coming from medial and lateral cords of brachial plexus respectively. Medial root crossed in front of axillary artery to join the three lateral roots forming median nerve lateral to brachial artery. The two lateralmost roots from lateral cord joined with each other, the trunk thus formed joined with the formation of median nerve. Median nerve thus formed by single root from medial cord and three roots from lateral cord continued lateral to brachial artery. The other branches from lateral cord were musculocutaneous and lateral pectoral nerve. Branches from medial cord were ulnar, medial pectoral, medial cutaneous nerve of arm and medial cutaneous nerve of forearm. Arterial pattern of upper limb was normal. Right axillary region was meticulously dissected but formation of median nerve on right side was as routinely described. (Figure 1)

Case 2

A bilateral variation was observed in a 50 year old male cadaver. Median nerve is formed by lateral and medial roots coming from lateral and medial cords of brachial plexus respectively in front of third part of axillary artery. After its formation, median nerve trunk continued anterior to the brachial artery. At the level of the insertion of coracobrachialis muscle, the median nerve trunk received a communicating branch from the lateral cord of brachial plexus, after the latter gave off the musculocutaneous nerve. Finally, the median nerve trunk consisting of lateral root, medial root and communicating branch from lateral cord continued lateral to the brachial artery. The distribution of median and musculocutaneous nerves was normal in arm. The arterial pattern in arm was also normal. The pattern of supply of median nerve in forearm and palm was also found to be normal. (Figure 2)

Figure 1: Shows four roots forming median nerve



R1: Medial root of median nerve, R2: Lateral root of median nerve, R3,R4: Additional roots from lateral cord, AA: Axillary artery, BA: Brachial artery, MN: Median nerve

Figure 2: Shows three roots forming median nerve

R1: Medial root of median nerve, R2: Lateral root of median nerve, R3: Additional root from lateral cord, AA: Axillary artery, MCN: Musclocutaneous nerve, MN: Median nerve

Discussion

To know about the variations of brachial plexus is helpful to anatomists, radiologists, anesthesiologists and surgeons to prevent any postoperative complications during surgery.

There is mounting evidence that connections between the musculocutaneous nerve and the median nerve are very frequent.[1,5] Unilateral median nerve formation of four roots, where three of them were from the lateral fascicle and two of them were communicating with the musculocutaneous nerve was also observed[5]. There may be formation of median nerve posterior to axillary artery[6,7] or two roots may traverse separately. The median nerve may directly coming from the lateral cord[8].

In the present study we observed multiple roots forming median nerve. Some of the research workers has shown the variations in the formation of median nerve. In a study involving 196 upper limbs, three roots forming median nerve was found in 22.4% cases and formation by 4 roots was found in 3.57% cases[9,10]. The medial root of the median nerve was found to receive a supplementary branch from the medial aspect of the terminal portion of the lateral cord[11].

The variations encountered in the present study can be explained embryologically. The upper limb buds are visible by day 26 or 27 which elongate by proliferation of mesenchyme. It lies opposite to the lower five cervical and upper two thoracic segments. As soon as buds form, the ventral primary rami of the spinal nerves penetrate into the mesenchyme of limb bud and establish intimate contact with differentiating mesodermal condensations[12]. The early contact between nerve and muscle cell is a prerequisite for their complete functional differentiation[13]. Thus the limb muscles develop from the mesenchyme of local origin, while the axons of the spinal nerves grow distally to reach the muscles and/ or the skin[12]. The alterations in signaling between mesenchymal cells and neuronal growth cones can lead to variations which once formed would persist postnatally.

Result of an exploratory intervention of the arm for peripheral nerve repair with these variations could be successful only if surgeon is aware of such variations. Signs of median nerve lesion can be observed in a patient with intact median nerve if such a variation is present and additional roots are injured.

References

1. Kerr AT. The brachial plexus of nerve in man, the variations in its formation and branches. *Am J Anat* 1918; 23: 285–395.
2. Uzun A, Bilgic S. Some variations in the formation of the brachial plexus in infants. *Turk J Med Sci* 1999; 29: 573–7.
3. Venieratos, D. and Anagnostopoulou, S. Classification of communications between the musculocutaneous and median nerves. *Clinical Anatomy* 1998; 11: 327-31.
4. Williams PL, Bannister LH, Berry MM. *Gray's Anatomy,* 38th Ed. Edinburgh; Churchill Livingstone, 1998; 1266–72.
5. S. Uzun, Seelig L. A variation in the formation of the median nerve: communicating branch between the musculocutaneous and median nerves in man. *Folia Morphol* 2001; 60(2): 99–101.
6. Pandey S. K. Anatomical variations of the cords of brachial plexus and the median nerve. *Clin Anat* 2007; 20(2): 150-6.
7. Chitra R. A rare variant formation of median nerve: a case report. *Internet Journal of Neurology* 2007; 8(2).
8. S Bhanu P. Formation of median nerve without medial root of medial cord and associated variations of brachial plexus. *International Journal of Anatomical Variations* 2010; 3: 27–9.
9. Budhiraja V. Anatomical variations of median nerve formation: embryological and clinical correlation. *J Morphol Sci* 2011; 28(4): 283-6.
10. Satyanarayana N. Rare variations in the formation of median nerve - embryological basis and clinical significance. *Nepal Med Coll J* 2009; 11(4): 287-90.
11. Pais, D, Casal D. A variation in the origin of the median nerve associated with an unusual origin of the deep brachial artery. *J Morphol Sci* 2010; 27(1): 35- 8.
12. Moore KL, Persaud TVN. *The Developing Human Clinically Oriented Embryology*, 8th Ed. Philadelphia; Saunders, 2008; 365- 417.
13. Saddler TW. *Langman's Medical Embryology*. In: Muscular system, 10th ed. Philadelphia; Lippincott Williams and Wilkins, 2006; 146-7.

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[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003;61:347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997;195 Suppl 2:3-9.

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[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000;71:1792-801.

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[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

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[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

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[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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