European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 10, Issue 03, 2023

Original research article

A Study of Morphometric Study of Orbit in Adult Skulls and CT Images in North Bihar

Dr. Neha Nupur[1], Dr. Pallavi Priyavadini[2], Dr. Ram Prakash Paswan[3], Dr. S. K. Karn[4], Dr. G. K. Mishra[5]

[1]3rd year PG, Department of Anatomy DMCH Darbhanga

[2]3rd year PG, Department of Anatomy DMCH Darbhanga

[3]3rd year PG, Department of Anatomy DMCH Darbhanga

[4]Associate Prof. Department of Anatomy DMCH Darbhanga

[5]Prof. & Head, Department of Anatomy DMCH Darbhanga

Corresponding Author: Dr. S. K. Karn

Abstract

Background and Objective: The eyes speak without words which enhance the beauty of face. The malposition of eyeballs leads to unacceptable cosmetic problem for the people of both sexes and all age groups. To analyse and compare the morphometric measurements of right and left orbital cavity in adult dry skulls and to see the statistical significance in it. To assess the influence of other parameters over bony orbital volume and to evaluate its significance. **Methods**: The quantitative morphometry of orbital cavity was studied in 40 adult dry skulls and computed tomographic images of brain belonging to 60 patients (30 males and 30 females). Adult dry skulls with intact orbital cavities and the computed tomographic images of brain reported as 'normal study' were only included in this study. At DMCH Darbhanga, Study duration of Two years.

Conclusion: The quantitative morphometry of orbital cavity is utmost important without which reconstructive surgeries are not possible. The study of these morphometric parameters in computed tomographic scans is mandatory for the assessment of fractured orbital cavity by comparing it with normal orbital cavity. So in the present study, the morphometry of orbital cavity was studied by two methods.

Keywords: CT,congenital orbital dysplasia, orbital fractures and intraorbital tumors, proptosis.

Introduction

The eyes speak without words which enhance the beauty of face. The malposition of eyeballs leads to unacceptable cosmetic problem for the people of both sexes and all age groups. The word eye constitutes eye ball and orbital cavity[1]. The orbital cavities are intended as a socket for eyeballs, muscles and fascia which keeps the eyeballs in position, nerves and vessels associated with vision, orbital pad of fat and lacrimal apparatus. The eyeballs are situated in anterior one third of orbital cavities. The anterior aspect of eye ball project outside the orbital cavity so that when a needle is passed from lateral orbital margin to bridge of nose, the needle will pass behind the lens. Development of orbit[2]: The development of orbital cavity is

simultaneous process with the development of eye ball which begins during third week of embryonic life, when the embryo is of 2.6mm length. There are four sources contributing to the development of eye ball and orbital cavity. Neuroectoderm of forebrain • Surface ectoderm

Paraxial mesoderm
The optic pit appears in the anterior neural folds around 22nd day of fertilization, which invaginate to form optic groove or sulcus. When the embryo is about 3.2mm stage, optic groove further invaginate to form primary optic vesicle. The proximal part of optic vesicle is constricted to form optic stalk. The surface ectoderm which comes in contact with optic vesicle is thickened to form lens placode. The lens placode deepens to form lens pit. As the lens pit get deepened, simultaneous approachment of their edges form spherical lens vesicle[3]. At the same time optic vesicle invaginates to form optic cup to accommodate the spherical lens vesicle. The process of transformation of optic vesicle to optic cup takes place during 4th week (4 – 5 mm stage) to 6th week (15 – 18 mm stage). The mesoderm around the growing eyeball differentiates to form orbital cavity in order to accommodate them. The bony orbital cavities are developed from visceral mesoderm (mesenchyme) of maxillary process and paraxial mesoderm. The mesenchyme of maxillary process forms the floor and lateral wall of orbital cavity. The roof of orbital cavity is formed by paraxial mesoderm which is the part of mesodermal capsule enveloping the brain. The medial wall of orbital cavity is formed from the portion of paraxial mesoderm of lateral nasal process (Cooper WC 1985) During 5th week, the mesoderm differentiates to form muscle cone (extraocular muscle) around the optic cup. The development of bony orbital cavities is in full progress during second month, advanced during third month and well developed at the end of fourth month of intra uterine life. Apart from optic canal the orbital cavity has superior and inferior orbital fissures. The superior orbital fissure is retort shaped gap between posterior aspect of lateral wall and superior wall of orbit through which the orbital cavity communicates with middle cranial fossa[4]. The superior orbital fissure transmits third, fourth and sixth cranial nerves which innervate the extra ocular muscles, recurrent meningeal branch of lacrimal artery, superior and inferior ophthalmic vein. The inferior orbital fissure lies at the junction of posterior aspect of lateral wall and inferior wall of the orbit. The orbital cavity communicates with pterygopalatine fossa and infratemporal fossa respectively through medial and lateral aspect of inferior orbital fissure. The fissure transmits inferior orbital vessels and nerves, zygomatic nerve and orbital branch of pterygopalatine ganglion. The direct measurement in dry skulls stands as an accurate method to study the quantitative morphometry of orbital cavities5. But there is a need to study the quantitative morphometry of orbital cavity in living people for assessing the deformed orbit and to plan the reconstructive surgery.

Objectives
To analyse and compare the morphometric measurements of right and left orbital cavity in adult dry skulls and to see the statistical significance in it. • To assess the influence of other parameters over bony orbital volume and to evaluate its significance
To analyse and compare the quantitative morphometry of right and left orbital cavity in high resolution computerized tomographic scans and to observe the statistical significance in it.

Material and Method
The quantitative morphometry of orbital cavity was studied in 40 adult dry skulls and computed tomographic images of brain belonging to 60 patients (30 males and 30 females). Adult dry skulls with intact orbital cavities and the computed tomographic images of brain

reported as 'normal study' were only included in this study. At Darbhanga Medical College and Hospital Darbhanga, Study duration of Two years.
Thepatientswithanydiseaseaffectingeyeandorbitalcavitysuchasthyroiddisease,Intraorbitaltumorandcongenitalabnormalitieslikemicrophthalmia,anophthalmiaandorbitofacialcleftwereexcludedfromthestudy.Thestudywasconductedafterobtainingapprovalfromethicscommitteeofinstitution.Inbothdrybonestudyandradiologicalstudy,twelveparameterswеremeasured.Theywereorbitalheight,orbitalbreadth,orbitalindex,lengthofsuperiorwall,lengthofinferiorwall,lengthofmedialwall,lengthoflateralwall,interorbitaldistance,biorbitaldistance,orbitalrimperimeter,orbitalforamenareaandbony
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Results

Theseresultswereobtainedafterthedirectmeasurementineightyorbitalcavitiesoffortyhumanadultdryskullsbyusingdigitalverniercaliper.Thequantitativemorphometryofrightandleftorbitalcavitieswerestudiedindividuallyandanalysedstatistically.

Themeanandstandarddeviationoforbitalheightforeightyorbitalcavitieswas32.64mm±1.39mm.Themeanandstandarddeviationoforbitalheightforrightandleftorbitalcavitieswere32.65mm±1.33mmand32.62mm±1.47mmrespectively.Themeanandstandarddeviationoforbitalbreadthforeightyorbitalcavitieswas40.41mm±1.44mm.Themeanandstandarddeviationoforbitalbreadthforrightandleftorbitalcavitieswere40.50mm±1.55mmand40.33mm±1.34mmrespectively.The

meanandstandarddeviationoforbitalindexforeightyorbitalcavitieswas80.80±2.61.Themeanan dstandarddeviationoforbitalindexforrightandleftorbitalcavitieswere80.65±2.60and80.96±2.6 4respectively.Themeanorbitalindexofbothrightandleftorbitalcavitieswas≤83.Thisclassifiedth eorbitalcavityofSouthIndianpopulationundermicrosemecategory.

Inrightorbitalcavities,orbitalindexwas≤83in31orbitalcavitiesandtheorbitalindexwasbetween8 3to89in9orbitalcavities.Thisclassified77.5%ofrightorbitalcavitiesundermicrosemecategorya nd22.5%undermesosemecategory.Inleftorbitalcavities,orbitalindexwas≤83in32orbitalcavitie sandtheorbitalindexwasbetween83to89in8orbitalcavities.Thisclassified80%ofleftorbitalcaviti esundermicrosemecategoryand20%undermesosemecategoryNoorbitalcavityhadorbitalindex ≥89.Sonoorbitalcavitywasclassifiedundermegasemecategory .Themeansuperiorwalllengthfor eightyorbitalcavitieswas52.04mmanditsstandarddeviationwas2.50mm.Forrightandleftorbital cavitiesthemeanandstandarddeviationofsuperiorwalllengthwas51.97mm±2.54mmand52.10m m±2.49mmrespectively .
Thebonyorbitalvolumewascorrelatedwithotherparametersbyusing PearsonCorrelationTest.

Radiological Results
Themeasurementsweretakenintwodimensionalcomputerizedtomographicimagesofsixtypatie nts(30malesand30females)comprising120orbitalcavities.Thestudyofquantitativeorbitalmorp hometryincomputerizedtomographicscansisveryessentialfordiagnosisoforbitalfractures,plan ningofsurgeryandpredictionofoutcomeafterreconstructivesurgery.Themeanorbitalheightfor1 20orbitalcavitieswas3.19cmanditsstandarddeviationwas0.14cm.Forrightandleftorbitalcavitie sthemeanandstandarddeviationoforbitalheightwas3.18cm±0.13cmand3.19cm±0.14cmrespec tively.Themeanandstandarddeviationoforbitalheightformalewasobservedas3.22cm±0.13cm.I twasobservedas3.21cm±0.13cmand3.23cm±0.13cminmalerightandleftorbitalcavitiesrespecti vely.Themeanandstandarddeviationoforbitalheightforfemalewasobservedas3.15cm±0.14cm. Itwasobservedas3.15cm±0.13cmand3.16cm±0.14cminfemalerightandleftorbitalcavitiesrespe ctively.Themeanandstandarddeviationoforbitalbreadthfor120orbitalcavitieswas3.99cm±0.14 cm.Forrightandleftorbitalcavitiesthemeanandstandarddeviationoforbitalbreadthwas3.99cm± 0.16cmand3.99cm±0.12cmrespectively.

Themeanandstandarddeviationoforbitalbreadthformalewasobservedas4.02cm±0.09cm.Itwas observedas4.02cm±0.10cmand4.02cm±0.09cminmalerightandleftorbitalcavitiesrespectively. Themeanandstandarddeviationoforbitalbreadthforfemalewasobservedas3.96cm±0.17cm.Itw asobservedas3.96cm±0.19cmand3.97cm±0.14cminfemalerightandleftorbitalcavitiesrespecti vely.Themeanandstandarddeviationoforbitalindexfor120orbitalcavitieswas79.68±2.53.Forrig htandleftorbitalcavitiesthemeanandstandarddeviationoforbitalindexwas79.46±2.52and79.89 ±2.55respectively.Themeanorbitalindexofbothrightandleftorbitalcavitieswas≤83.Thisclassifi edtheorbitalcavity ofSouthIndianpopulationundermicrosemecategory.

Discussion
Thequantitativeorbitalmorphometryisutmostimportanceforplanningreconstructivesurgerieso forbitalcavity.Sincetheorbitalcavityshowedregional,racialandethnicvariationstheknowledgeo fquantitativemorphometryoforbitalcavityismandatoryforeachindividualpopulation.
OrbitalHeightandOrbitalBreadth**:**
AccordingtothestudyofSangvichienS(2007)inThaipopulation,themeanorbitalheightformalea ndfemalewas33.44mmand32.89mmrespectively.Themeanorbitalbreadthformaleandfemalew as40.10mmand38.09mmrespectively.ThestudyofUkohaU(2011)[6]inNigerianpopulationreport edthatthemeanorbitalheightofrightorbitalcavitywas31.90mm±0.70mmandleftorbitalcavitywa s31.45mm±0.71mm.Themeanorbitalbreadthofrightorbitalcavitywas36.03mm±0.37mmandle

ftorbitalcavitywas34.98mm±0.38mm.FetouhFA(2014)reportedthattheaverageorbitalheightin Egyptianmaleandfemalewas35.57mm±1.37mmand35.12mm±1.10mmrespectively.Theavera georbitalbreadthinEgyptianmaleandfemalewas43.25mm±1.25mmand42.37mm±1.39mmres pectively.Kaur(2012)[7]reportedthatfornorthIndianpopulation,themeanorbitalheightwas31.9m m±2.2mmand32.2mm±1.8mmforrightandleftsidedorbitalcavityrespectively.Themeanorbital breathforrightandleftorbitalcavitywas39.7mm±2.2mmand38.8mm±3.1mmrespectively.Acco rdingtothestudyofHowaleDS(2012)[8]inMaharashtraregion,themeanorbitalheightwas3.11cma ndthemeanorbitalbreadthwas3.62cm**.**PatilGV(2014)9reportedthattheaverageorbitalheightof maleandfemalewas34.04mm±3.12mmand32.12mm±2.89mmrespectively.Themeanorbitalwi dthofmaleandfemalewas41.89mm±2.34mmand39.02mm±3.08mmrespectively.Accordingtot hestudyofGosaviSN(2014)[10]inIndianpopulation,themeanorbitalheightwas32.31mm±2.52mm andthemeanorbitalwidthwas39.46mm±2.57mm.ThestudyofKumarA(2014)**[11]**inIndianpopulat ionstatedthatthemeanorbitalheightofleftandrightorbitalcavitywas33.56mm±1.54mmand33.4 7mm±1.56mmrespectively.Themeanorbitalwidthofleftandrightorbitalcavitywas41.88mm±1. 73mmand42.06mm±1.69mmrespectively.ThestudyofMekalaD(2015)insouthIndianpopulatio nstatedthatthemeanorbitalheightofmaleandfemalewas3.62cm±0.23cmand3.45cm±0.2cmresp ectively.Themeanorbitalbreadthofmaleandfemalewas4.29cm±0.27cmand4.05cm±0.24cmres pectively.

RADIOLOGICALSTUDY

OrbitalHeightandOrbitalBreadth:WeaverAA(2010)reportedthatthemeanorbitalheightinmale andfemalewas32.44mmand31.75mm.Themeanorbitalbreadthinmaleandfemalewas37.42mm and36.60mm.JiY(2010)[12]
reportedthatthemeanorbitalheightofChinesemenandwomenwas33.35mmand33.22mmrespect ively.ThemeanorbitalbreadthofChinesemenandwomenwas40.02mmand38.00mmrespectivel y.

Inthepresentstudy,themeanorbitalheightofmaleandfemalewas3.22cmand3.15cmrespectively whichwassimilartothestudyofWeaverAAandJiY.Accordingtothepresentstudy,themeanorbita lbreadthofmaleandfemalewas4.02cmand3.96cmrespectively.ItwassimilartothestudyofJiYand lesserthanWeaverAA.

Themeanbonyorbitalvolumeforgroup I(25to35years),groupII(36to50years)andgroupIII(51to6 5years)patientswas23.11cm^3±2.30cm^3,24.14cm^3±2.55cm^3and25.33cm^3±3.09cm^3respectiv ely.Themeanbonyorbitalshowedstatisticalsignificantincreasefromgroup Itogroup III.

Therewassignificantpositivecorrelationfoundbetweentheageandbonyorbitalvolumew hichwassimilartothestudyofFurutaM.

Conclusion

Thequantitativemorphometryoforbitalcavityisutmostimportantwithoutwhichreconstructives urgeriesarenotpossible.Thestudyofthesemorphometricparametersincomputedtomographicsc ansismandatoryfortheassessmentoffracturedorbitalcavitybycomparingitwithnormalorbitalca vity.Sointhepresentstudy,themorphometryoforbitalcavitywasstudiedbytwomethods.

Theaccuratecorrectionoforbitalvolumetopretraumaticstateisveryessentialinthereconstructives urgeriestoavoidanyorbitalasymmetry.Inthepresentstudythebonyorbitalvolumewasmeasuredi ntwodimensionalcomputedtomographicimagesbyusingasoftwareprogram.

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