

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**



Thesis submitted to

BLDE (DEEMED TO BE UNIVERSITY), Vijayapura, Karnataka, INDIA

Under the faculty of Medicine

For the award of the

DOCTOR OF PHILOSOPHY

(MEDICAL)

In

ANATOMY

Under the guidance of

Dr. Babasaheb G.Patil

Co-guidance of

Dr. Sanjeev I. Kolagi

By

LOHIT V. SHAHA

Reg No. 14PhD005

Department of Anatomy

Shri B.M.Patil medical college, Hospital and Research center,

BLDE (Deemed to be University), Vijayapura, Karnataka, INDIA.

2019



BLDE (Deemed to be University)

Vijayapura, Karnataka, India.

CERTIFICATE BY THE GUIDE

Certificate

This is to certify that this thesis entitled “**Computed tomographic study of morphometry of sella turcica – in north Karnataka region.**” is a bonafide research work carried out by Mr. Lohit V Shaha under my supervision and guidance in the Department of Anatomy, BLDE (Deemed to be University) Shri B.M.Patil medical college, Hospital and Research center, Vijayapura, Karnataka, INDIA, in the fulfillment of the requirements for the degree of Doctor of Philosophy in Anatomy.

Seal & Signature of the Guide

Professor
Dept. Of Anatomy
B.L.D.E. University's
Shri B.M. Patil Medical College,
Vijayapura-586103.

Dr. B.G.PATIL

Professor of Anatomy,
BLDE (Deemed to be University)'s
Shri B. M. Patil Medical College
Hospital & Research Centre,
Vijayapura, Karnataka

Date: 24.07.19

Place: Vijayapura.



BLDE (Deemed to be University)

Vijayapura, Karnataka, India.

CERTIFICATE BY THE CO- GUIDE

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Seal & Signature of the Co-Guide

**Professor & HOD
Dept. of Anatomy
S. N. Medical College
BAGALKOT**

Dr. SANJEEV I KOLAGI

Professor and HOD of Anatomy,
S Nijalingappa Medical College, HSK
Hospital & Research Centre,
Bagalkot, Karnataka

Date: **23.07.2019**

Place: Bagalkot.



BLDE (Deemed to be University)

Vijayapura, Karnataka, India.

ENDORSEMENT BY THE HOD AND PRINCIPAL

This is to certify that the thesis entitled "Computed tomographic study of morphometry of sella turcica – in north Karnataka region." is a bonafide research work done by Mr. Lohit Shaha under the supervision of Dr. B. G. Patil (Guide), Professor of Anatomy, BLDE (Deemed to be University)'s Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka and Dr. Sanjeev I Kolagi (Co-guide), Professor and HOD of Anatomy, S. Nijalingappa Medical College and HSK Hospital &RC, Bagalkot.

Seal & Signature of the HOD
Professor & H.O.D.
Dept. of Anatomy
BLDE (Deemed to be University)
Shri B. M. Patil Medical College,
Vijayapura 586103.

DR. B. M. BANNUR
Professor & Head of Anatomy,
BLDE (Deemed to be University)'s
Shri B. M. Patil Medical College,
Hospital & Research Centre,
Vijayapura, Karnataka.

Date: 24.07.19

Place: Vijayapura

Seal & Signature of the Principal

DR. ARAVIND PATIL
Principal,
BLDE (Deemed to be University)'s
BLDE (Deemed to be University)
Shri B. M. Patil Medical College,
Hospital & Research Centre,
VIJAYAPUR 586103,
Vijayapura, Karnataka.

Date: 24.07.19

Place: Vijayapura



BLDE (Deemed to be University)

Vijayapura, Karnataka, India.

DECLARATION BY THE CANDIDATE

I hereby declare that this thesis entitled “**Computed tomographic study of morphometry of sella turcica – in north Karnataka region.**” is a bonafide and genuine research work carried out by me under the guidance of **Dr B. G. Patil**, Professor of Anatomy Shri B.M.Patil medical college, Hospital and Research center, Vijayapura, Karnataka, India. No part of this thesis has been formed the basis for the award of any degree or fellowship previously.

Date: **23.07.2019**

Place: Vijayapura


Signature of the candidate

Lohit V Shaha

Reg No. 14PhD005

Department of Anatomy

Shri B.M.Patil medical college,
Hospital and Research center,

BLDE (Deemed to be University),

Vijayapura, Karnataka, INDIA.

DEDICATED TO

MY GRANDMOTHER

Late smt Vimalabai Mohanlal Shaha, who donated
her body for the purpose of research,

MY TEACHERS,

MY PARENTS,

MY FRIENDS.

ACKNOWLEDGEMENT

“Feeling gratitude and not expressing it, is like wrapping a present and not giving it.”

~William Arthur Ward

To begin with, I thank the most merciful and compassionate **LORD ALMIGHTY**. It is with deep reverence, humility and folded hands that I look up to you, the supreme force, for giving me fortitude, courage, perseverance, drive and good health to complete this study assignment. With your blessings and benevolence the doors of opportunity to this adobe of knowledge were laid bare and the journey was made most memorable in the company of the most adorable teachers and a loving family.

At the outset, I would like to express my deep sense of gratitude to my research guide **Dr. B.G.Patil**, Professor, Dept of Anatomy, Shri B M Patil Medical College Hospital and Research Center, Vijayapura. Each meeting with him added invaluable aspects to the implementation and broadened my perspective. He has always made himself available to clarify my doubts despite his busy schedules and I consider it as a great opportunity to do doctoral program under his guidance and to learn from his research expertise.

It is with sincerity and deep sense of gratitude that I thankfully acknowledge my honored co guide and beloved teacher **Dr Sanjeev I Kolagi**, Professor and HOD, Dept of Anatomy, S Nijalingappa Medical College, HSK Hospital and RC, Bagalkote, for presenting me such an interesting thesis topic. His valuable guidance, scholarly inputs and constant encouragement I received throughout my research work. This feat was possible only because of unconditional support provided by him. Each meeting with him added invaluable aspects to the implementation and broadened my perspective. He has guided me with invaluable suggestions, lightened up the way in my darkest times and encouraged me a lot in the academic life. From him I have learned to think critically, to select problems, to solve them and to present their solutions. I would like to thank him for furthering my education in research.

I am grateful to **Dr. M. S. Biradar**, Vice-Chancellor BLDE (Deemed to be University), Vijayapura, **Dr. J. G. Ambekar**, Registrar, BLDE (Deemed to be University), Vijayapura, and **Mr. Satish B. Patil**, Deputy Registrar, BLDE (Deemed to be University), Vijayapura, for their valuable support and timely help.

I owe my most sincere gratitude to **Dr Aravind Patil**, Principal & Dean Shri B M Patil Medical College Hospital and Research Center, Vijayapura for providing an excellent research environment and facilities to work in the institute.

My sincere gratitude to the **Dr Tejaswini Vallabha** Vice principal, Shri B M Patil Medical College Hospital and Research Center, Vijayapura and chairman of Ph.D committee, BLDE(DU), Vijayapura and beloved teacher **Professor Kusal K Das** Laboratory of Vascular Physiology & Medicine, Dept of Physiology, visiting professor school of Medicine and University of Leeds UK, who were a constant source of inspiration during my entire research work and thesis. They had rendered constant support whenever I needed.

My sincere thanks to **Dr. Nilima Dongre**, Associate Professor of Biochemistry, BLDE (Deemed to be University)'s Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura, for her untiring suggestions, constant support, timely advice and encouragement for completing my research work successfully.

I am extremely grateful to the Chairman of the B V V Sangha , **Hon'ble Dr Veranna Charantimath** , Governing council chairman **Sri Siddanna Shettar**, and the Principal & Dean S Nijalingappa Medical College, HSK Hospital and RC, Bagalkot, **Dr Ashok Mallapur** for permitting me to carry out this study and providing institutional facilities.

I express heartfelt thanks to all the members of PhD committee BLDE (DU) for the classes and correcting my mistakes throughout my research.

I would like to express the deepest appreciation to **Dr B M Bannur** professor and Head, Dept of Anatomy , BLDE (DU)'s Shri B M Patil Medical College Hospital and Research Center, Vijayapura for his constant support during the course of my study all along the way.

I would like to express my sincere gratitude to **Dr Rudresh Halawar** and Dept of Radiology , SNMC, Bagalkot for providing samples timely and helping me to carry out research work and facilities to work in the radiology department. My special gratitude to **Mr Ameen** senior technician dept of Radiology for his great contribution and assistance during the radiological investigations.

I extend my thanks to **Dr Manjunath Aithal** Prof . HOD Physiology and **Dr Basavaraj Devarnavadagi** Prof, HOD Biochemistry BLDE (DU)'s Shri B M Patil Medical College Hospital and Research Center, Vijayapura for their needed help during progress report presentations.

Advice given by **Mrs Vijaya Soragavi** and **Mr. Mohd Shannawaz**, statisticians, Dept of Community medicine, BLDE (DU)'s Shri B M Patil Medical College Hospital and Research Center, Vijayapura and **Dr Manjula R & Dr Umesh Ramadurg** Department of Community medicine S Nijalingappa Medical College, HSK Hospital and RC, Bagalkot were really a great help in data analysis and data interpretations.

My sincere thanks to **Dr. Anita Herur**, Professor of Physiology S Nijalingappa Medical College, HSK Hospital and RC, Bagalkot, for her untiring suggestions, constant support and encouragement for completing my research work successfully.

I wish to acknowledge the help provided by my all colleagues of department of Anatomy BLDE (DU)'s Shri B M Patil Medical College Hospital and Research Center, Vijayapura and S Nijalingappa Medical College, HSK Hospital and RC, Bagalkot.

I extend my thanks to **Mrs Manjula chief librarian** and **Mr Shivkumar asst librarian** BLDE (DU)'s Shri B M Patil Medical College Hospital and Research Center, Vijayapura for their needed help during thesis preparation and plagiarism.

I will be failing in my duty if I don't acknowledge some of my friends with whom I shared my research experiences since it was a joy and enlighten to me. I am fortunate to have friends like **Dr Naseema, Dr Sangamesh Rakaraddi, Mr Anandgouda Naiknur, Mr Sujendra Kulkarni** for the support.

My parents have passed onto me a wonderful humanitarian lineage, whose value cannot be measured by any worldly yardstick. I extend my thanks to my parents **Sri Vijaykumar, Sri Bharatsingh and Smt Suvarna, Smt Padmavati**. I extend my warmest thanks to my wife **Dr Sapna**, brother in law **Anup, Surendra** and my sister **Veena and Pooja** who supported me in each and every step. I express heartfelt thanks to my son **Sankalp and** my nephew **shashank** never disturbed me to achieve this last

stage of my endeavor. I thank to all family members and kids who supported me in positive way.

I wish to express my special thanks to all my relatives and my dear friends for all the support throughout my study.

LOHIT V SHAHA

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LIST OF ABBREVIATIONS

SYMBOLS	ABBREVIATIONS
Mm	Millimeter
Cm	Centimeter
SD	Standard deviation
P	Probability value
W	Width
D	Depth
ANOVA	Analysis of variance
S Dim	Specific Dimension
A	Area
I	Interclinoid distance
R	Correlation coefficient
PCA	Principal component analysis
UNIFESP	Universidade Federal de São Paulo
ST	Sella Turcica
ACTH	Adrenocorticotropic hormone
HGH	Human growth hormone
UCLP	Unilateral cleft lip and palate
BCLP	Bilateral cleft lip and palate
ACL	Anterior clinoid ligament
PCL	Posterior clinoid ligament
ICL	Inter clinoid ligament
ACP	Anterior clinoid process

PCP	Posterior clinoid process
CL	Cleft lip
LBW	Lateral bone window
m:f	Male : Female
TS	Tuberculum sella
PClin x	Posterior clinoid
FH	Frankfort plane
SL	Sellar Length
SW	Sellar Width
SHA	Sellar Height Anterior
SHP	Sellar Height Posterior
SHM	Sellar Height Median
SA	Sellar area
CT	Computed Tomography
MDCT	Multi Detector Computed Tomography
3D	Three Dimension
X	Mean
Σxi	Sum of all variable
X_i	Value of variable
N	Sample size
χ^2 value	Chi-square value

ABSTRACT

Introduction; Sella turcica is an important structure in middle cranial fossa, which lodges master of endocrine gland pituitary gland. It is a saddle shaped concavity in the body of sphenoid bone. It is bounded by dura of cavernous sinuses bilaterally, the lamina dura and dorsum sellae posteriorly and the tuberculum sellae and planum sphenoidale anteriorly.

Objectives of the study: To establish the normative reference standards of sellar morphometry in adults and to look for sexual dimorphism of sella turcica.

Materials and methods: This is a hospital based cross sectional study. Consent form duly signed has been taken. 1650 Computed tomographic images of skulls covering sellar region from patients undergoing CT scan from radiology department of SNMC and HSK hospital, Bagalkot, and were analyzed for the sellar morphology by using radiant dicom viewer software. The patients were divided in to five groups with an interval of 10 years. Clinical features of the patients were also being noted down in the proforma. The morphology as sellar length, width, sellar height anterior , posterior, median, sellar area were measured and morphological variations and shapes of sella were described.

Results: Normal sella was found in 90% of the participants. 65% of the participants had oval shaped sella and least had flat shaped sella. Whereas no statistical significant difference was observed in the morphometry of sella turcica among the male and female age groups as well as between the two genders.

Conclusion: The result of this study will serve as a normative reference standard for morphology of sella turcica that could assist in more objective evaluation and detection of pathological conditions of sella turcica and pituitary gland.

Key words: Sella turcica, Sphenoid, Computed tomography.

CHAPTER NO 1

INTRODUCTION

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

INTRODUCTION

The sphenoid bone is the keystone for the base of cranial cavity. It is located between the frontal, temporal and occipital bones in the base of skull¹.

It has central body, paired greater and lesser wings spreading laterally from it and two pterygoid processes descending from the junctions of the body and greater wings². The body of the sphenoid bone forms the central part of middle cranial fossa. The sella turcica resembles the shape of Turkish saddle⁴. The sella turcica, fossa for pituitary gland is situated on the intracranial surface of body of sphenoid bone³. The anterior border of sella turcica is represented by the tuberculum sellae and posterior border by the dorsum sellae². The floor forms the roof of the sphenoid air sinuses⁴. The master of endocrine orchestra, pituitary gland is located in sella turcica. Two anterior and two posterior clinoid process projects over the pituitary gland. The anterior clinoid processes are formed by the medial and anterior prolongations of the lesser wing of sphenoid bone. The posterior clinoid processes formed by prolongation on the end of dorsum sellae².

The floor of the pituitary fossa is narrower and formed by body of the sphenoid bone which contains sphenoid sinuses. The roof of sinus is deeply concave and houses the pituitary gland [Hypophysis Cerebri]. It is therefore termed the pituitary [hypophyseal] fossa, also known as the sella turcica⁴.

A fold of dura, the diaphragma sellae is attached to anterior and posterior clinoid processes. It is small, circular and horizontal sheet of dura matter. It forms a roof over the sella turcica and often almost completely covers the pituitary gland. The infundibulum and pituitary stalk pass into pituitary fossa through a central opening in diaphragma sellae. There is a wide individual variation in the size of these openings. In the past, the diaphragma sellae was an important landmark structure in pituitary surgery. Because of extension of pituitary tumor above sella, it was an indication for a sub-frontal approach through craniotomy. However trans-sphenoidal approach is currently the first preferred option, irrespective of whether there is suprasellar extension⁴.

In the anteromedial part of middle cranial fossa, the dura ascends as the lateral wall of cavernous sinus and reaches the ridge produced by the anterior continuation of

the free border of tentorium and runs medially as the roof of cavernous sinus, where it is pierced by the internal carotid artery. Medially the roof of sinus is continuous with the upper layer of the diaphragma sellae. At or just below the opening in the diaphragm for the infundibulum and pituitary stalk, the dura, arachnoid and pia mater blend with each other and with the capsule of pituitary gland. The layers of the meninges cannot be distinguished within the sella turcica, and the subarachnoid space is obliterated⁴.

1.1 DEVELOPMENT OF SPHENOID BONE

Until the seventh or eighth month in utero, the sphenoid bone has pre-sphenoid part anterior to the tuberculum sellae with which the lesser wings are continuous and a post-sphenoidal part consisting of the sella turcica and dorsum sellae with the greater wings and pterygoid processes. Most parts of the bone is developed from cartilage⁴.

There are six ossification centers for pre-sphenoidal parts and eight centers for post-sphenoidal part.

1.1.1 Pre-sphenoidal part

The centre for each wing appears at about 9th week of fetal life. Later two bilateral centers appear for pre-sphenoidal body. The center for each sphenoidal concha appears at about 5th month of intrauterine life (IUL)⁴.

As the sphenoidal concha enlarges, it partly surrounds the posterosuperior expansion of the nasal cavity which becomes sphenoidal air sinus. The posterior conchal wall is absorbed and the sinus invades the presphenoid component. In 4th year, the concha fuses with the ethmoidal labyrinth and before puberty it fuses with the sphenoid and palatine bones. Its anterior deficiency persists as an opening for sphenoidal sinus⁴.

1.1.2 Post sphenoidal part

A center appears in greater wings at about 8th week of fetal life. One in basal cartilage of each wing. Remaining part of Greater wings & lateral pterygoid plate

ossifies in mesenchyme. Two centers appear for flanking the sella turcica at 4th month of fetal life and they soon fuse with other. The center for medial pterygoid plate appears at 9th to 10th week of IUL⁴.

The hamulus is chondrified during the 3rd month of IUL and at once they begin to ossify. The medial and lateral pterygoid plates join about 6th month of IUL. A center for each lingual appears during 4th month of IUL and soon they join the body⁴.

1.1.3 Postnatal development

The presphenoidal and postsphenoidal parts fuse at 8th month of IUL, but an unciform cartilage persists after birth in lower part of junction.

At birth, the bone is tripartite and consists of

- a) Central part [body & lesser wings]
- b) Two lateral part [each consisting of greater wings and pterygoid processes]

During the first year, the greater wings and body unite around pterygoid canals and the lesser wings extend medially above the anterior part of the body, meeting to form the smooth, elevated jugum sphenoidale⁴.

Although sphenoidal sinus can be identified in 4th month of IUL as an evagination of posterior part of nasal capsule, by birth it represents an outgrowth of sphenothamoidal recess. Pneumatization of the body of sphenoid commences in second or third year and spreads first into pre-sphenoid and later invades the post-sphenoid part. It reaches its full size in adolescence, but often enlarges further by absorption of its walls as age advances⁴.

Premature synostosis of the junction between pre-sphenoid and post-sphenoid parts, or of the sphenoid-occipital suture, produces a characteristic appearance obvious in profile of an abnormal depression of nasal bridge [hypertelorism]⁴.

In growing child, the clivus is the site of sphenoid-occipital synchondrosis. The premature closure of this joint give rise to the characteristic skull appearances seen in Achondroplasia⁴.

The importance of size and shape of the sella turcica in connection with the occurrence of symptoms of pituitary diseases has long been recognized⁵.

Clinicians should be familiar with the normal radiographic anatomy and morphologic variability of this area in order to recognize and investigate the deviations that may reflect pathological situations even before its clinical manifestations⁶.

The sella turcica is an important structure in radiographic analysis of neurocranial and craniofacial complex. In orthodontics, sella point which is located at the center of sellae turcica is one of the most commonly used landmarks in cephalometry. Such landmarks located within craniofacial region are used to measure the positions of maxilla & mandible in relations to cranium and to themselves⁷.

In non pathological cases, the morphological variations were observed. In specific pathologic condition special variations were observed in sella turcica. Deviation in the anterior wall of sella turcica is associated with deviation of fronto nasal development area. As posterior wall deviation is associated with malformation of posterior structures like cerebellum⁸.

The CT scan is superior option than the X-ray to study the bony parameters. On review of literature morphometry of such clinical important entity is not described in standard text books of Anatomy and Radiological text books. There were studies on dimensions of sella turcica done with cephalometry in western countries and very few studies in Indian population. The computed tomography of dry skull was studied, but there are insufficient data found on live individuals to investigate the morphometry of sella turcica.

The purpose of this study was to determine the average shape and size of sella turcica in Indian population that could assists in more objective evaluation and detection of pathological conditions.

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CHAPTER NO 2

AIMS AND OBJECTIVES OF THE STUDY

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

OBJECTIVES OF THE STUDY

- 1) To establish the normative reference standards of sellar morphometry in adults.
- 2) To look for sexual dimorphism of sella turcica.

CHPATER NO 3

REVIEW OF LITERATURE

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

3.1 THE ANATOMY OF SELLA TURCICA HAS BEEN DESCRIBED AS VARIABLE

Anatomically, the sella turcica is subdivided into three segments; it consists of an anterior wall, posterior wall and floor. At birth, sella turcica consist of a shallow depression and dorsum is not yet ossified. By the 4 year of age, the outline of sella appears more rounded.

The morphology of regular sella is analyzed by radiographs from childhood to adult. The anterior wall of the sella turcica appears to be unchanged during the normal course of development. The increasing in size of sella turcica under normal conditions was a result of resorption and opposition processes on dorsum sellae².

Morphologically three basic shapes – oval, round and flat have been classified. Among these oval and round types being the most common. The morphological variations was assessed and classified into five aberrations: “oblique anterior wall, sella turcica bridging, double contour of floor, irregularity (notching) in posterior part of the dorsum sellae and pyramidal shape of sellae”².

The size of sella turcica was quite variable and studies have shown different ‘normal’ dimensions. These include 5 to 16mm in antero-posterior diameter with a depth of 4 to 12mm and 1.8mm to 12mm in antero-posterior diameter with a depth of 4 to 12mm. The sagittal dimension increases by 0.5 to 1 mm annually until puberty, when the definitive oval shape of adult sella is attained. The average anteroposterior dimension of sella in midsagittal plane about 1.07 cm, whereas the average depth and transverse dimensions are 0.8cm and 1.2cm respectively^{3, 5}.

3.2 STUDIES BASED ON MORPHOMETRY OF SELLA

TURCICA

Camp (1924) has considered the signify dimension of habitual sella turcica in 500 beneficial person individuals, exclusive of deliberating the age, sex, form of radiographs, enlargement element or identification. 10.6mm in anteroposterior and 8.1mm in depth and categorized sella turcica into 3 kinds: round, flat and oval. Oval being most common, flat being least frequent. They have also found a sellar bridge in five cases (4.5 %) in the same study.⁵

Silverman (1957) has studied the 320 radiographs of one month to eighteen years of age. The mean sella area was calculated (length and breadth). Pituitary fossa of men tend to be large than that of women from 1-13 years, because of juvenile enlargement surge in female which begins 2 years former than male. Widespread changes have been observed in the pituitary fossa dimensions in eleven to fifteen years of women. Thereafter, there will be increased growth in men which is universally two -three years later than women results in equalization in sella area in both genders ⁶.

Taveras and Wood (1964) had described the method for determining sellar size on radiographs. They have measured the greatest anteroposterior diameter of pituitary fossa. point of measurement was tuberculum sellae. They've measured the depth of fossa from summit of dorsum sellae to tuberculum sellae. Using this method, the widest anteroposterior measurement of patient's sella became 16mm, even as the finest depth changed into 17 mm. Sellar sizes had been quite variable. These include 5-16mm (average 8mm) in the AP diameter, with a depth of 4-12mm (average 8mm), 1.8mm- 12mm in the AP diameter with a depth of 6-8mm and 5-16mm (average 10.5mm) in the AP diameter, with a depth of 4-12mm (average 10.5mm)⁷.

Longitudinal study conducted by **Meslen (1974)** revealed that the growth of sella turcica decreases after one year of age. Then there is an amplified intensification speed at the moment of teens. Later the growth slows and ceases in the late adolescent or premature parenthood⁸.

Pretson (1979) separated cephalometric radiographs of subjects in to 3 groups in line with the age five- nine, ten-fourteen, fifteen-seventeen years and in line with

their skeletal / facial variety; class I, II, and III. There has been no statistically large association among facial type and the mean sella area of pituitary fossa. When association of age on sella turcica size was analyzed, the sellar length of older age group became continuously larger than younger group in the present research. In conclusion on lateral radiographs of 182 people in 5-17 years age range growth of pituitary fossa increases in size with age⁹.

Microsurgical anatomical analysis on 250 sphenoidal blocks obtained from dead bodies of various ages by **Quakinine and Hardy (1987)**, revealed that anteroposterior distance was 8mm, oblique girth of sella turcica was 12mm and average vertical diameter was 6mm¹⁰.

Tammoscheit UG (1989) analyzed the growth related changes of shape and size of outline of human sella from birth to eighteen years of age in a longitudinal and random sample study. The growth related changes of contour of the sella are characterized by a wide variety. The size of the outline of sella increases rapidly from birth to two years of age and thereafter continually and steadily without any proven pubertal influence to its final size and shape.¹¹

Tetradis s et al (1999) conducted a study on 325 orthodontic patients including 134 males and 191 females. There have been 266 whites, 25 African individuals, 24 Hispanics, and 10 others. The patient's age ranged from 6 to 49 years with a mean age of 21.5 years. Studied on lateral cephalograph, the length of sella turcica changed ranging from 6 to 17mm with a mean of 10.9 ± 1.8 mm, while the depth ranging from 2.5mm to 12.5mm with a mean of 7.6 ± 1.7 mm. There were statistically noteworthy divergence amid the four age clusters for the length (ANOVA, $p < 0.001$) and the depth (ANOVA, $p < 0.007$) of the sella turcica. In the majority of the cases (94%), the sella had the characteristic morphology. In 19 cases, the sella appeared as a variation of normal, 7 shallow, 5 J shaped, 4 double floors and 3 had middle clinoid processes. There were 59 instances of intracranial calcification so called "bridged sella"¹³.

Choi et al (2001) stated the size and shape of sella turcica in two hundred Korean orthodontic sufferers among the age commencing six to forty two years. The modification in the dimensions of sella turcica according to age, had a significant positive linear trend to length, depth, and width until 25 years. After 26 years of the

age, no significant increase was found in the sella turcica dimensions. Especially, the sella turcica length had more proportional increase than sella turcica depth and width¹⁴.

Axellsson S et al (2004) studied in the Norwegians to ascertain the normative longitudinal cephalometric principles of length and to portray the morphology of sella turcica among the ages 6-21 years using lateral radiographic cephalograph. They included 35 men and 37 women . All were Caucasians with ANB angle class I molar and canine without a obvious facial disharmony. The length of sella turcica became regular at some point of the observation duration and depth and diameter became more with age. There has been no difference among depth and diameter. The length of sella was large in males but the significant difference observed between 12 ($p<0.5$) and 18($p<0.001$) year old age companies. The ordinary morphology of sella turcica turned into observed in 71% male and in 65% female group along with 5 special morphological aberration kinds. The female patients had slightly greater aberrant morphology of sella turcica¹⁵.

A study conducted via **Alkofide EA** revealed the morphometry of sella turcica using lateral cephalograph of 184 Greeks (91 males and 93 females). The age from 6 and 17 years. Described three heights of sella turcica (anterior, posterior, median), its length and width careful in relative to Frankfort reference line. Anterior Sellar height was larger in females by 0.5mm. Linear dimensions and area were found to be drastically associated amid age, but all the correlations were minimal (r^2 below 8 percent). The shapes of sella turcica as described by PCA, was different in males and females chiefly at the posterior part of the sella. Age was not found to be interrelated with shape coefficients. Although, in female cluster, the shape was marginally not significant¹⁷.

Andredaki et al conducted study on one hundred and eighty Saudi people (Ninety males and Ninety females) with age ranging from eleven to twenty six years. The connection among skeletal type and sella size. Divided in to skeletal category; 60 class I, 60 class II, 60 class III. The results showed that sella turcica is in normal morphology in preponderance of subjects (sixty seven percentages). There was no distinction among the genders. When the age altered into evaluated, huge dissimilarity was found among older (fifteen years and greater) and adolescent (eleven- fourteen

years) age groups on the 0.01 and 0.001 ranges. Size in older age cluster becomes larger than younger age cluster. Whilst sella size was compared with skeletal type, a tremendous peculiarity was revealed in diameter of sella ($p < 0.01$). The bigger diameter was present in skeletal class III, while in skeletal class II smaller diameter was apparent. While skeletal type and genders were compared with size of sella, the age substantially related to length ($p < 0.01$) and diameter ($p < 0.001$)¹⁸.

In study by **Ruiz and Wafe** on one hundred skulls, the skulls after being measured and labeled, subjected to tomography in three planes, “coronal, axial and sagittal”¹⁹. The consequent measurements have been calculated with the images obtained, the length on axial sections, the height and area on sagittal sections. The results of radiological measurements of sella turcica were length ranged 6-15.1mm, height ranged 2.9 mm to 11.1 mm and area ranged 8 mm² to 79 mm². They observed that sella turcica was a constant anatomic structure however with a variable shape¹⁹.

Samira Zabihiyan (2009) conducted a study on 90 random adult autopsy specimens in which the cause of death being trauma. Any history of metabolic or pituitary diseases was excluded. All data measurements were taken by two experienced physicians to measure sellar diameters. Measurements were taken with the following landmarks; sellar width was measured between interclinoid ligaments; sellar length was the distance from tuberculum sella to dorsum sella and sellar height vertical distance was measured perpendicular to the plane from sellar diaphragm to the sellar floor. In these 90 cases, 60 were males (66%) and 30 were females (34%). Cadaver age was between 18-90 years with the mean age of 40.8 ± 16.8 (SD). Sellar length was ranged from 6.25 to 12.5mm with a mean of 9.16 ± 1.11 (SD). Sellar width was ranged from 8.56 to 14.7 with a mean 11.66 ± 1.35 (SD). Sellar height was ranged from 7.50 ± 15.0 with a mean of 8.56 ± 1.25 (SD). They came to conclusion that minor sellar changes imply the presence of micro adenoma or pituitary pathology and size may be different in different populations²⁰.

A study conducted by **Marcotty p (2010)** found no significant difference amid skeletal class I, and skeletal class III sufferers regarding the length, depth and the diameter of sella turcica. An assessment of morphology between the women and men revealed no difference in length, depth and diameter of sella turcica. Both clusters had greater sella turcica linear proportions of length, depth and diameter than the ones

observed in sella turcica dimensions in normal adults. Skeletal class III sufferers presented a considerably higher incidence of sella turcica bridging i.e. 16.8% in evaluation with skeletal class I sufferers whose value was 9.4 percentages²¹.

Filipovic Gordana et al done a study to analyse the linear dimensions of sella turcica via radiological evaluation of various malocclusions, the existence of sexual dimorphism and to analyze relation amid the sizes of sella turcica with malocclusions. This research done on ninety persons who were divided into 3 clusters according to the value of ANB angles (30 people in each cluster). The linear dimensions have been measured. The study proved that the humans with the malocclusion of the II class had the minimal value of the linear dimensions of sella turcica and sufferers with malocclusion class III had the maximum values of the linear dimensions of sella turcica. In none of groups there was sexual dimorphism. According to the result, they concluded that there had been an association amid the size of sella turcica and malocclusions²³.

A study carried out with the aid of **Ahsan MS et al** measured and defined the dimensions and form of the sella turcica. They located the correlation among women and men and all three skeletal clusters. Lateral cephalometric radiographs of one hundred and eighty patients above 15 years of age were divided equally into cluster I, II and III (60 patients in each cluster) with same genders distribution (90 males and 90 ladies). Sella turcica was normal in 66.7% patients. No difference discovered in linear dimensions among males and females. Whilst skeletal kind changed into as compared to sellar linear dimensions, no huge difference observed²⁴.

Chavan et al (2012) conducted a study to present a set of baseline dimensions of sella turcica by radiographs. In this research, lateral radiographs of skulls of 440 subjects ranging thirteen to fifty five years of age (230 males and 210 females) were included. The various parameters of sella turcica were observed in this research. There were supreme anteroposterior diameter, depth and area of sella turcica were found to be maximum without gender differenc²⁵.

A study was conducted by **Chauhan et al (2014)** to scrutinize the morphology and the magnitude of sella turcica in North Indians cephalograph. 180 healthy persons (90 males and 90 females) with an age range between twelve- sixty five years were included. Sella width, length, sella height anterior, posterior and median was

measured after the magnification of radiographs. Sellar dimensions were increased in females compared to males. Typical sellar morphology was found only in 28% of cases. Atypical sella with oblique anterior wall was 23% and irregular sellae were 18%. No pyramidal shaped sella was observed in this population. Significant differences in sellar height and width was observed in linear parameters among genders. The size of the sella turcica was more in grown-up age groups when compared to younger age groups ²⁶.

Osunwoke KA et al (2014) had analyzed the measurements of sella turcica by using lateral skull X ray films in adult Nigerian population. Analyzed the two parameters- the sellar length and sellar depth. Total 100 radiographs of adults (69 males and 31 females) were used for study. The sellar length was 12.61 ± 1.64 mm and depth was 8.97 ± 2.11 mm in males. The sellar length was found to be 12.55 ± 1.50 mm and 8.87 ± 1.75 mm depth respectively in females. There were no noteworthy differences amid the measurements of sella in male and female individuals. ²⁷

Mushrat Islam et al (2017) measured the morphological shape and size of sella turcica in Bangladeshi's by using 3D CT images with age assortment commencing eighteen to sixty five years. They have measured sellar length, diameter and width with respect to Frankfort line (FH) in 166 (108 males and 58 females) Bangladeshi subjects. There was no statistical significance between both the sexes. They found three unique shapes- flat (28%), ovoid (48.1%) and circle (23.4%)²⁸. "They found morphological variations as oblique anterior wall (4.8%), double counter of floorboards (6.6%), sella turcica bridging (0%), and irregularity in posterior part of dorsum sellae (16.2%), pyramidal shape of dorsum sellae (3%) and normal sella (69.2%)"²⁸.

Singhellakis PN et al (1983) conducted reserch to estimate " volume of sella turcica "²⁹ (VST) in normal individuals and sufferers with idiopathic gonadotrophin deficiency by X ray films. 883 controll subjects (507 male and 376 female) and 135 adult patients among peripheral endocraniopathies or idiopathic gonadotrophin deficiency were included. They found the significant difference ($p > 0.05$) in mean VST value of males (1356 ± 22 mm³) than that of females (1428 ± 25 mm³). There was progressive amplifying of VST in women once they reach age of 45. Below 45 years, VST was similar with male. VST was significantly increased in peripheral endocrine

insufficiencies. Abnormal sella turcica was observed in 27% of cases of idiopathic gonadotrophin deficiency²⁹.

The study was conducted to determine the radiological dimensions of pituitary fossa in normal adults of Niger Delta region of Nigeria by **Al Udoka** by normal radiographs of the lateral view of skull in 440 adults (220 males and 220 females). X ray films were utilized. Males had greater sella size than females. There was no considerable discrepancy between the genders³⁰.

Roy M et al studied the growth of pituitary fossa in human by using X rays of 40 children (22 boys and 18 girls), radiographed at regular intervals. The length and depth of pituitary fossa were measured. They observed that there was increase in the rate of growth of the depth but not the length during same year as child experiences its pre adolescent growth spurt in stature. They concluded that due to resorption, remodeling of dorsum sellae and osteoclastic activity in floor of the fossa there was increase in sellar dimensions³¹.

Eman A Alkofide conducted study in Saudi Arabia to appraise the morphology and dimensions of sella turcica in 95 cleft and 190 non cleft subjects of 11-27 yrs of age by lateral cephalograph. The subjects were divided in to two groups, eleven- fourteen years of age and exceeding 15 years of age. "The sella turcica morphology was categorized in to six shapes and the size of sella turcica was measured in terms of length, depth and diameter in millimeters"³². Majority of the subjects with cleft exhibit an abnormal sella turcica when compared to non cleft subjects. Decreased size of sella turcica observed in cleft subjects than that of non cleft subjects. The size of sella turcica was increasing with the age in subjects with and without cleft³².

A study was conducted to measure the morphology of sella turcica in Iraqi adults by **Yassir A et al (2010)** using lateral cephalometric radiographs. 130 samples (67 female and 63 males) with age ranging 17-25 years radiographs were used. The samples were divided according to ANB angles in to three skeletal classes. The size of sella turcica was determined. The t test was used to test gender difference, while ANOVA test was performed to find statistical significant difference in size of sella turcica among skeletal patterns. Sella turcica measurements were slightly higher in males than females. There was no statistical significant difference amid the genders.

With the normal morphology, six distinct variations of sella turcica were analyzed with highest percentage of normal morphology³³.

Ashraf Mohamed et al (2015) conducted a research to record the normal morphometry of sella turcica and to find differences involving the genders. Analysis was done in thirty six formalin fixed adult cadavers skulls (22 males and 14 females). They found that there was no difference between male and female with regards to linear proportions of sella turcica. Statistical differences were found regarding genders in both right and left sides ($p=0.004$ and 0.001) respectively³⁴.

3.3 CLINICAL SIGNIFICANCE OF SELLA TURCIA

Gorden and Bell (1922) studied the radiographs of children, aged from one year to twelve years and classified the sella in to “three shapes- circular, oval and flat / saucer shaped”³⁵. They revealed that the majority of the subjects had circular or oval shaped sella turcica. They observed that all cases do not fit in to the broad three way classification ³⁵.

Direct measurements of 110 skulls was done by **Camp (1924)** and found that the structure exhibit variations between sella turcica and clinoids processes. Direct bony connections have been visible in five instances (4.5 percentages). Fusion of anterior and posterior clinoid processes i.e. Sella Bridge has been found in many samples⁴.

Carsters (1949) reported that out of 461 younger guys, sella turcica bridge was located in 4.6 percent of the subjects. In addition they reported the sella turcica bridge of eight percentage in various diseases. He considered that persistent diseases may had an effect on the pituitary gland and thereby also on sella turcica. So the crucial infections which were not clinically manifested can be evident within the sella turcica vicinity, both in the form of bridge of sella turcica and as an expansion of sella turcica³⁶.

In a cranial study of autopsy by **Busch (1951)** on 343 individuals by direct inspections observed the complete sella Turcica Bridge in 1.54 percent of individuals and incomplete sella turcica bridge in 1.74 percent of individuals. He also affirmed that no case of diagnosed pituitary gland diseases were found in study sample and could not associate any clinical features in five sella turcica cases³⁷.

Busch noted the complete sellar diaphragm in only 42 percent of 788 autopsy cases of patients without any pituitary diseases. A reflection of sellar diaphragm (dura) makes a noose around the stalk as it enters the fossa. Usually air does not enter the fossa during Pneumoencephelogram. When it does so, the radiologic diagnosis is referred to as an “empty sella”. He also noticed an appearance of empty sella with compression and flattening of the pituitary gland against the floor and walls of sella in 5.5 percent of the cases³⁷.

Younghusband et al (1952) studied the visual, endocrine and neurological symptoms in 164 patients. They found the enlarged sella turcica in 44 percent of cases. But further they were not able to study because of lack of clinical symptoms. The study concluded that the enlargement of sella turcica was not due to pituitary tumors producing clinical symptoms³⁸.

Muller conducted a study (1952) to find out a correlation between a sella turcica bridge and ophthalmological problems in 1040 radiographs. He found the bony sella bridge in 3.85 percent of cases and pseudo-bridge in 3.2 percent (total 7 percent) of cases. But there was no relation incidence of sella turcica bridge and symptoms of the eyes³⁹.

Platzer (1957) showed an alliance amid the occurrence of sella turcica bridge and pathway of internal carotid artery. He found the bony sella turcica bridge in 5.9 percent of cases by direct inspection on 220 hemi sectioned heads⁴⁰.

Bergland et al (1968) found 6 percent of sella turcica bridge by direct inspection in 225 autopsied skulls⁴¹.

Mc Lachian (1970) conducted a study on 141 patients with acromegally, in which 25 patients showed minimal abnormalities of sella turcica on plain films and computed tomographs. These findings were compared with a similar number of plain films of skulls from patients whose autopsy studies showed no intrasellar or parasellar pathological conditions. Abnormalities of shape, double contour and erosions were found frequently in both the groups which were difficult to define⁴².

A series of studies in orthodontic literature by **Bjork (1955) and Melsen (1974)** noted variation in shape of sella turcica. They observed that the morphology of sella turcica remains unchanged after twelve years of age. The anterior sella turcica wall was stable at 5 years of age. Resorption at the posterior boundary of the sella turcica was from sixteen to eighteen years of age^{43, 44}.

Randall and colleagues (1972) arbitrarily divided the empty sella syndrome into two categories- primary and secondary. Idiopathic origin was defined as primary and is presumed to be due to faulty embryonic development of diaphragm sella allowing herniation of archnoid membrane into the sella, which in turn permit compression of normal pituitary tissue by transmitted cerebrospinal fluid pressure.

The secondary causes were due to removal of pituitary contents by a surgical procedure or shrinkage by irradiation. Because empty sella turcica was noted to contain tumors secreting adenocorticotrophic hormone (ACTH), human growth hormone (HGH), prolactin⁴⁵. Spontaneous partial pituitary infarction or unidentified mechanisms may be responsible for an empty sella. In patients with normal pituitary function, a mild bitemporal field defects were noted⁴⁶. Unidentified mechanisms may be responsible for an empty sella. In such cases, the optic nerve herniated in to sella turcica but it was thinned⁴⁷.

The radiographic study was done by **Swanson and Du Boulay (1975)** in 85 patients who were free from the pituitary diseases. Double floor of sella turcica was noted in 31 percent of cases and thinning of lamina dura was detected in 16.5 percent of cases. Although it has been argued that incidence of these borderline abnormalities would be consistent with the same percentage of undiagnosed tumors found on autopsy. It is important to practice over interpretation of plain films and tomographic findings of sella turcica appearance⁴⁸.

Weisberg et al (1976) conducted a prospective evaluation of seventy five patients with enlarged sella turcica. Primary intrasellar tumors were observed in 27 instances, which have been categorized as pituitary adenomas. They stated that 18 of the 27 patients showed the pituitary disorder with tumors, of which 67% had been women⁴⁹.

In another study by **MORI et al (1977)**, CT scanning detected all 17 pituitary tumors larger than 1.5cm. Three out of five pituitary tumors between 1.5cm and 0.5cm, no tumors were detected smaller than 0.5cm. The accuracy of CT scan was compared with other investigations and found that pneumoencephelography was 100 percent accurate, CT scanning was 95 percent accurate, angiography was 88 percent accurate, radionuclide scintigraphy was 31 percent accurate and skull films was 35 percent accurate in detecting the pituitary tumors⁵¹.

Friedland B (1996) mentioned the shapes of sella turcica. The three basic shapes were oval, flat and round. While inspecting the sella turcica, it is very important to evaluate its base. The floor of sella turcica is seen as distinct cortical streak. sometimes, double floor can be seen. Such appearance may be manifestation of irregular development of floor or a normal variant. The sphenoid sinuses may

pneumatize dorsum sellae, resulting in small posterior clinoid processes⁵³. “The internal carotid artery produces a carotid groove. It falsehood bordering to the medial barricade of the cavernous sinus which might also be the motive of a fake or ersatz double floor, thinning or inflatable of the base or erosion of lamina dura or dorsum sellae which in sufferers may additionally imply pathologic lesions especially in patients with significant signs or symptoms”⁵³.

Kjaer et al (1988a) analyzed the radiographs of sixteen kids (9 women and 7 men) with myelomeningocele. The contour of anterior wall of sella turcica was always in an obliquely anteroposterior direction instead of the normal craniocaudal direction in myelomeningocele patients. Consequently the sella turcica seemed huge cranially with diverging anterior partitions. This appearance gave an image of a widespread sella turcica in myelomeningocele with greatly less depth than normal⁵⁴.

Kjaer et al (1988b) analyzed the radiographs of cluster of children with lumbosacral myelomeningocele and observed that the anterior wall of the sella turcica differed from normal in all subjects⁵⁵.

In fetuses with trisomy 21, the modifications in sella turcica had been in anterior part with basilar part of occipital bone⁵⁶.

However in trisomy 18, the changes in sella turcica were constantly seen posteriorly in association with malformations in the basilar part of occipital bone⁵⁴.

Kjaer and Fischer Hansen (2000) reported an eighteen week fetus unilateral oro-ocular cleft combined with UCLP. An abnormal shaped sella turcica with a caudally open funnel was found⁵⁷.

In another study, **Becktor JP (2000)** analyzed 177 radiographs who had undergone mixed surgical and orthodontic remedy. Radiographs revealed the sella turcica bridge in those subjects where a continue band of bony tissue was seen from the anterior to the posterior clinoid process across the sella turcica. Two types of sella turcica bridges were identified: type A which manifested ribbon like fusion and type B which is extension of the anterior and / or the posterior clinoid process⁵⁸.

Kjaer et al (2001) showed an abnormal morphology of sella turcica in five out of ten subjects in a cluster of subjects with minimal degree of holoprosencephaly⁵⁹.

Cederberg RA (2003) studied the lateral cephalometric radiographs of 255 subjects presenting for orthodontic evaluations. 50% Calcification of ICL was observed in 39% of samples, and in 8% of samples it was completely calcified. Petroclinoid analysis revealed absence of calcification in 67% of cases, 23% subjects showed partial calcification and 9% subjects showed complete calcification. Spearman's correlations were computed among age and grade of calcification in the PCL, $r=0.185$ ($p=0.003$) and a huge involvement amid the grade of calcification in petroclinoid and ICL's $r=0.186$ ($p=0.003$). In addition, chi square test demonstrated statistically significant association between the presence of calcification in the PCL to distribution of age ($p=0.041$) and between the presence of calcification in ICL to the distribution of age ($p=0.045$)⁶⁰.

Axelsson et al (2004) conducted a research, where one third of the subjects presented with an abnormal sella turcica. They studied the sellar morphology and five morphological variations types were identified; "oblique anterior wall, sella turcica bridging, double contour of floor, irregularity (notching) in the posterior part of dorsum sellae and pyramidal shape of dorsum sellae"¹⁵. In female subjects aberrant sella turcica morphology was observed¹⁵.

Axelsson et al (2004a) also reported that an abnormality or notching of dorsum sellae was seen in William's syndrome⁶¹.

Jones RM (2005) compared the prevalence of sella turcica bridging and sella dimensions in 150 Caucasian subjects who had surgical – orthodontic treatment of their malocclusion. Randomly selected cluster of 150 subjects were treated contemporaneously by orthodontic means only. Before the procedure cephalometric radiographs were scanned and analyzed. A sella turcica bridge commencing from anterior to posterior clinoid process observed. The dimensions of sella turcica were analysed. In the cluster treated by united surgical orthodontic means, the prevalence of bridging was 16.7%, where as 7.3% in orthodontics only cluster ($p=0.012$). There was noteworthy enlarge in the mean surface area ($p=0.02$) and mean perimeter of sella turcica ($p=0.01$) in the combined surgical orthodontic cluster compared with

orthodontics only cluster. The mean interclinoid distance was less in the surgical orthodontic cluster ($p=0.02$)⁶².

Nielsen et al (2005) performed a research on radiographs of forty new born with cleft lip and palate and revealed that about fifty percent of the subjects had deviations in sellar morphology with the most deviations happening in UCLP sufferers. The prevalence of an oblique anterior wall and a double contour floor were the most common deviations observed in this research and had been more regularly seen in CL subjects⁶³.

Leonardi R (2006) evaluated 34 (20 males and 14 females) lateral cephalometric radiographs ranging from eight and sixteen years, with PDC and subsequent mandible premolar aplasia and as compared with the control group. A homogeneous scoring scale was customary to enumerate the extent of a sella turcica bridge from every radiograph (no calcification, partly calcified and utterly calcified). The prevalence of whole calcification of Inter Clinoid Ligament in youth with teeth anomalies was 17.6 percentages, at the same time as an incidence of 9.9 percentages in control cluster. A moderately calcified sella turcica was found in 58.8 percent of teens with teeth anomalies compared with 33.7 percentages in control cluster. There has been statistically considerable divergence seen with chi square records ($p=0.004$) in between degree of calcification of ICL and occurrence of dental anomalies. Consistent with these findings, the prevalence of sella turcica bridge in children with dental anomalies was more, whilst age and gender do not impact the ossification of ICL. The very early appearance during development of a sella turcica bridge should alert clinicians to possible tooth anomalies in life later⁶⁴.

Alkofide (2007) analyzed one hundred and eighty radiographs of sufferers without cleft lip & palate. Morphology of sella was normal in 67% of cases, despite of gender and age. In 33 percent of subjects, variation in morphology was present. An unequal dorsum sella was seen in 11 percent of cases, while an oblique anterior wall and binary countered sella turcica were nearby in 9 percent of subjects¹⁸.

Alkofide EA (2008) studied and analyzed lateral cephalometric radiographs of 195 non cleft and 95 cleft individuals. They divided in two clusters by age; eleven to fourteen years of age and fifteen years and above. Abnormal shaped sella turcica was observed in mainstream of cleft sufferers compared by non cleft ($p<0.005$), extra so in

subjects with unilateral cleft lip and palate and bilateral cleft lip and palate ($p=0.0000$, $p=0.020$ correspondingly). posterior wall notching was the most common aberrations found in cleft sufferers accompanied by a double contour of sella turcica and an oblique anterior wall³².

Zimmerman et al (1967)⁶⁶; **Laron et al (1969)**⁶⁷; **Zuppinger et al (1971)**⁶⁸; **Sultan et al (1996)**⁶⁹; they have all revealed that association exists amid cleft lip & palate and functions of hypophysis cerebri.

Rudman et al (1978)⁷⁰; **Bowers et al (1987)**⁷¹; have recognized that the youngsters with clefts, that too palate, a shorter physique than in their unaltered peers. Viable explanations for the height divergence have been ascribed to pituitary insufficiency that can fluctuate since secluded escalation hormone scarcity to absolute panhypopituitarism unrelated with hereditary aphasia of pituitary gland [Zimmerman et al (1967)⁶⁶; Laron et al (1969)⁶⁷; Rimoin (1976)⁷²]. Due to this investigators had encouraged an entire pituitary assessment in children with cleft lip and palate and growth retardation.

Zagga AD et al (2008) performed research on 228 samples (171 males and 57 females), of this male to female ratio became 3:1. The most common variety became oval. The most common type of base of sella turcica in African's was concave. The difference in frequency of concave shapes of sella turcica's base and that of flat and convex sorts became predominantly statistically substantial ($p<0.001$)⁷³.

Jianxin Wang et al (2014) investigated the morphometric analysis of sella turcica by using lateral bone window of 530 cases of dry skull base specimens. The mean area size of LBW on left side and right side was $75.99\pm 25.81\text{mm}^2$ and $76.00\pm 25.53\text{mm}^2$ correspondingly without much difference between sides⁷⁴.

A study conducted by **Subhadradevi et al (2013)** on 100 prenatal and 64 postnatal cadavers of both sexes and different age groups to establish morphological and morphometric parameters of sella turcica. By using digimatic calipers, the sellar length and sellar diameter was measured. They found the shape of diaphragma sella was convex in 11% of individuals, concave in 42.7 percentages and flat in 46.3 percentages. There was no statistical significance involving males and females in age wise distribution of postnatal sella turcica's length and diameter⁷⁵.

A study conducted to compute the volume of sella turcica by **Lance A C Hilton (1982)**, in the normal children 6-16 years of age. 960 skull radiographs were made for orthodontic purposes. For most of age groups, the sellar dimensions in males were greater than females. The sellar volume increases with the age⁷⁶.

Morphometry of sella turcica was measured in 90 random adult autopsy specimens. History of metabolic or pituitary diseases was excluded. 60 were males and 30 were females. Cadaveric age was between 18-90 years. Sellar length was ranging from 6.5-12.5 mm. Sellar width was ranging from 8.56-14.7mm and sellar height was ranging from 7.5-15.0mm²⁰.

Radio Anatomical discrepancy of posterior clinoid process (PCP) was studied by **Asem salma** in 3-D CT of thirty six cadaveric heads. In this PCP was variable in five specimens (14%). In two specimens, dorsum sellae was absent and in one specimen, the posterior clinoid process (PCP) and the anterior clinoid process (ACP) were attached unilaterally and in two specimens it associated bilaterally⁷⁷.

J H Abu Ghaida (2017) et al conducted a study on 509 Jordan's healthy individuals to ascertain the normal dimensions of sella turcica by using computed lateral cephalograms. Out of 509, 252 were males and 257 were females aged between 10-40 years. They divided in to two groups, adolescent and adult age groups of both genders. To measure the dimensions, view box 3 software was used. The sella turcica's width, length and area were 8.72mm, 7.68mm, 6.25mm, 40.80mm² and 8.67mm, 7.42mm, 6.38mm, 41.26mm² in males and females respectively. Sellar parameters were significantly different between adolescent and adult age group⁷⁸.

Yasin Yasa et al evaluated the sella turcica's shape & dimensions in 54 cleft subjects and 85 without cleft individuals by using cone beam computed tomography. The length of sella turcica was larger in cleft subjects than non cleft subjects. Diameter and depth were constantly increased from more than 15 to less than 25 years in overall assessments. There was no significant diversity seen between the genders. Most common shape of sella turcica was round in both subjects and in both groups⁷⁹.

A study conducted by **Tejavathi et al (2015)** to measure the shape and morphology of sella turcica by using a lateral cephalometric study in different age group and gender. They had measured "length, depth, anteroposterior diameter and

shape of sella⁸⁰. There was no change in linear dimensions of sella turcica between the genders⁸⁰.

Haider Ali Hasan et al conducted study on Malay population to appraise the size and the morphology of sella turcica by using 3 D CT scan. In this study, total one hundred and eighty three (113 men and 70 women) subjects were involved. They had been divided in to four clusters children (0-6 years), pre adolescent (7-12 years), adolescent (13-20 living) and adults (21-35 existence). They measured the sellar height (anterior, posterior, and median), length, diameter, area and width with respect to Frankfort line (FH). The shapes were assessed by morphometric method. There was no noteworthy distinction in size of sella turcica amid all age clusters. Sella turcica shape was found in 3 different shapes. U shape in 57.9 percent, J shape in 22.6 percent and shallow in 17.5 percent of cases respectively⁸¹.

In a study of the hypophyseal area by **Halaing Y et al**, they found an additional fossa in sellar floor. They conducted this study on 205 crania and 10 adult cadavers were also dissected. Larger anterior depression and smaller posterior concave fossa was noted in 21.5 % of crania and six dissected specimens. Anterior depression alone or a posterior fossa alone occurred in 2.4 % and 72% of crania respectively. Posterior fossa was seen commonly in this series⁸².

Ozan et al (2016) conducted the study in Turkish population to assess the morphometry of sella turcica by using CT scan. They included 101 subjects aged between 17-70 years (60 males and 41 females). The subjects were divided in to seven groups. They had measured the sella turcica's distance end to end, girth, sellar height anterior; median, posterior, sellar area, sellar depth and sellar anteroposterior diameter. There was insignificant discrepancy found amid males and females in sella turcica's length and width⁸³.

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CHAPTER NO 4

MATERIAL AND METHODS

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

MATERIAL AND METHODS

Type of study : Observational study

Study design : Cross sectional study

Duration of collection of data: 2 years: June 2015 to May 2017.

Study population: This is a hospital based cross sectional study. Consent form duly signed has been taken.

Computed tomographic images of skulls covering sellar region from patients getting CT scan from Radiology department of SNMC and HSK hospital, Bagalkot, and were analyzed for the sellar morphology by using radiant dicom viewer software. The patients were divided in to five groups with an interval of 10 years. Group 21-30 Years, Group 31-40 Years, Group 41-50 Years, Group 51-60 Years, and Group 61-70 Years. Clinical features of the patients were also being noted down in the proforma.

4.1 SAMPLE SIZE CALCULATION:

Sample size calculation done by using open epi 2.3.1 version. At 95% confidence level and 80% power of the study.

According to the study done by M ROY et al (Length) mean \pm SD of sella turcica in male (adult); 0.18 \pm 0.24 and (Length) mean \pm SD of sella turcica in female (adult); 0.15 \pm 0.19. Total sample size is 1636. (~1650).

4.2 ETHICAL CLEARANCE:

The present study protocol was approved by the institutional ethics committees of both the institutes BLDE (DU) - IEC Ref No-125/2015-16 and SNMC/IECHSR/2015-16/A-09 -1.1.

4.3 INCLUSION CRITERIA:

- CT images of normal brain covering sellar region of adult patients more than 20 years of age.
- CT images of normal PNS covering sellar region of adult patients more than 20 years of age.
- CT images with clear visualization and recognition of dorsum sellae and tuberculum sellae.

4.4 EXCLUSION CRITERIA:

- CT images of Road traffic accident cases.
- CT images of Head injury cases.
- Poor quality CT images.
- CT images of craniofacial deviation
- CT images of Pathological cases involving sellar and parasellar region

4.5 THE FOLLOWING MEASUREMENTS WERE

CALCULATED:

4.5.1 a)Sellar length: Measured as the distance from the tuberculum sellae to the posterior clinoid process.

4.5.2 b) Sellar width (Anteroposterior greatest diameter): Measured from the maximum convexity on anterior part (sellar anterior) to maximum convexity on posterior part (sellar posterior)

4.5.3 c)Sellar height :

Sellar height anterior: Calculated by using vertical distance, as measured **perpendicular** to Frankfort horizontal from tuberculum sellae (TS) to sellar floor.

Sellar height median : Calculated by using vertical distance, as measured perpendicular to Frankfort horizontal from a point midway between TS and posterior clinoid process (PClin) to sellar floor.

Sellar height posterior: Calculated by using vertical distance, as measured perpendicular to Frankfort horizontal from posterior clinoid process (PClin) to sellar floor¹ .(fig no 1)

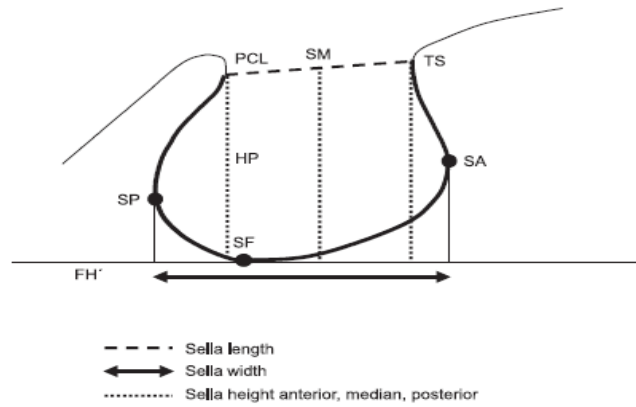


Figure 1. Schematic guide for measurements of sella turcica

4.5.4 d) Area of sella turcica: It is calculated by multiplication of greatest anteroposterior diameter (sellar width) with depth of sellar turcica (sellar height median)³

4.5.5 e) Morphological variations were described as ²:

- Normal
- Oblique anterior wall
- Double contour of the floor
- Sella turcica bridging
- Irregularity in posterior wall
- Pyramidal shape

4.5.6 f) The shapes of sella turcica were described as ⁴:

- Oval
- Circular
- Flat

4.6 STATISTICAL ANALYSIS:

Data collected was tabulated in Microsoft excel and was analyzed by epi info software. Categorical outcomes were summarized by rates (%) and proportions and numerical outcomes were analyzed by mean \pm SD.

To test the difference between the mean t test and ANOVA test were used. Significance level was kept at p value < 0.05 .

4.7 BIBILOGRAPHY

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CHAPTER NO 5

RESULTS

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

RESULTS

5.1 DISTRIBUTION OF AGE AND SEX IN VARIOUS STUDY GROUP

The present study included 1650 patients visiting the department of Radiology, SNMC and HSK hospital, Bagalkot for CT scan of PNS and Brain covering sellar region. Out of 1650 subjects, 781(47%) were males and 869 (53%) were females (Table no-1). These subjects were divided into five groups depending upon their age with the class interval of ten i.e. 21-30(n=568), 31-40(n=427), 41-50(n=217), 51-60(n=254) and (n=184) years. (Table no- 2).

Table no – 1 - **GENDER WISE DISTRIBUTION OF SUBJECTS**

Subjects	Males	Females
1650	781 (47%)	869 (53%)

Table no – 2 - **DISTRIBUTION OF SUBJECTS ACCORDING TO AGE GROUP AND GENDER.**

Age group	Subjects	Males	Females
21-30 Years	568 (34.42%)	288	280
31-40 Years	427 (25.87%)	187	240
41-50 Years	217 (13.15%)	108	109
51-60 Years	254 (15.39%)	123	131
61-70 Years	184 (11.15%)	75	109
Total	1650	781	869

5.2 CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES IN THE STUDY GROUP OF 21- 30 YEARS

In the study group of 21-30 years, there were 568 subjects consisting of 288 males and 280 females.

SELLAR LENGTH

In male subjects, the maximum length of Sella Turcica was 13.6mm, minimum length was 5.3mm & mean length was 8.67 ± 1.49 mm. In female subjects, the maximum length was 13.7mm, minimum length was 5.3mm and the mean length was 8.75 ± 1.82 mm. No significant differences were observed between males and females participants. The t value was 0.57 and p value was 0.56. (Table No. 3, Figure No 2).

SELLAR WIDTH

In male subjects, the maximum width was 15.4 mm, the minimum width was 7.2 mm & the mean width was 10.73 ± 1.38 mm. In female subjects, the maximum width was 15.5 mm, minimum was 7.4mm and mean was 10.93 ± 1.31 mm. There was no sexual dimorphism seen. The t value was -1.77 and p value was 0.07 (Table No. 3, Figure No 2).

SELLAR HEIGHT ANTERIOR

In male subjects, the maximum height in anterior region was 6.4 mm, the minimum height was 2.3mm & the mean height was 3.88 ± 0.87 mm. In female subjects, the maximum height in anterior region was 6.3 mm, the minimum height was 2.3 mm and the mean height was 3.91 ± 0.86 mm. There was no gender difference observed. The t value was -0.41 and p value was 0.68 (Table No. 3, Figure No 2).

SELLAR MEDIAN HEIGHT

In male subjects, the maximum height in median region was 13.2mm, the minimum height was 5.3mm & the mean height was 8.36 ± 1.45 mm. In female subjects, the maximum height in middle region was 13.2mm, minimum was 5.5mm and mean was 8.58 ± 1.48 mm. There was no sexual dimorphism seen. The t value was -1.78 and p value was 0.07 (Table No. 3, Figure No 2).

SELLAR HEIGHT POSTERIOR

In male subjects, the maximum height in posterior region was 6.5mm, the minimum height was 2.2 mm & the mean height was 3.92 ± 0.79 mm. In female subjects, the maximum height in posterior region was 6.9mm, the minimum height was 2.2mm and the mean height was 4.04 ± 0.93 mm. No considerable differences seen among the genders. The t value was 1.65 and p value was 0.09 (Table No. 3, Figure No 2).

SELLAR AREA

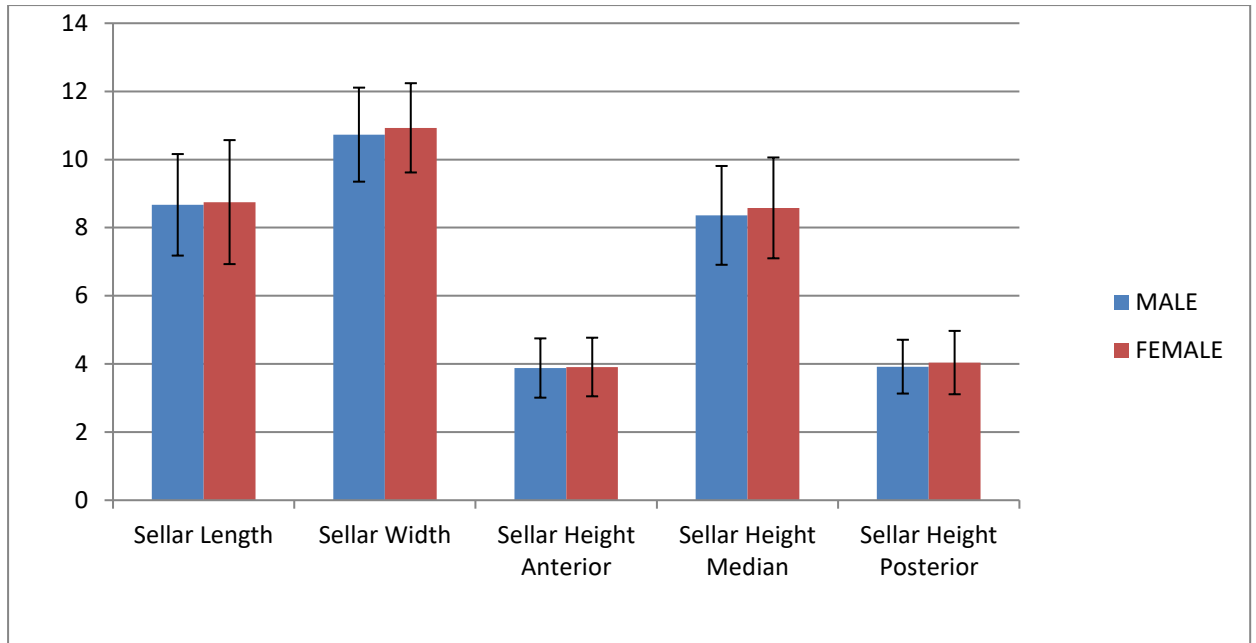
In male subjects, the maximum area was 209.44 mm sq, the minimum area was 51.41 mm sq & the mean area was 93.85 ± 24.15 mm sq. In female subjects, the maximum area was 212.35mm sq, the minimum area was 51.94 mm sq and the mean area was 96.86 ± 27.98 mm sq. No considerable differences seen between male and female participants. The t value was -1.37 and p value was 0.17 (Table No. 3, Figure No 2).

Table No 3. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES & FEMALES IN THE STUDY GROUP OF 21- 30 YEARS

STUDY GROUP OF 21- 30 YEARS					
	MALES	FEMALES			
Parameters	Mean \pm SD	Mean \pm SD	t value	p value	Significance
Sellar length (mm)	8.67\pm1.49	8.75\pm1.82	0.57	0.56	NS
Sellar width (mm)	10.73\pm1.38	10.93\pm1.31	-1.77	0.077	NS
Sellar height anterior (mm)	3.88\pm0.87	3.91\pm0.86	-0.41	0.68	NS
Sellar height median (mm)	8.36\pm1.45	8.58\pm1.48	-1.78	0.07	NS
Sellar height posterior (mm)	3.92\pm0.79	4.04\pm0.93	1.65	0.097	NS
Sellar area (mm sq)	93.85\pm24.15	96.86\pm27.98	-1.37	0.17	NS

* SD – Standard deviation, NS – non significant.

Figure No 2- CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES IN THE STUDY GROUP OF 21- 30 YEARS.



5.3 CORRELATION BETWEEN SELLAR DIMENSIONS IN MALES AND FEMALES IN THE STUDY GROUP OF 31- 40 YEARS

In study group of 31-40 years, there were 427 subjects consisting of 187 males and 240 females.

SELLAR LENGTH

In male subjects, the maximum length was 13.8mm, the minimum length was 5.1mm & the mean length was 8.74 ± 1.64 mm. In female subjects, the maximum length was 13.7mm, the minimum length was 5.1mm and the mean length was 8.61 ± 1.63 mm. No considerable differences seen between male and female participants. The t value was 0.82 and p value was 0.42 (Table No. 4, Figure No 3).

SELLAR WIDTH

In male subjects, the maximum width was 15.6mm, the minimum width was 7.7mm & the mean width was 10.74 ± 1.34 mm. In female subjects, the maximum width was 15.5 mm, the minimum width was 7.8mm and the mean width was 10.75 ± 1.25 mm. There was no sexual dimorphism seen. The t value was -0.08 and p value was 0.94 (Table No. 4, Figure No 3).

SELLAR HEIGHT ANTERIOR

In male subjects, the maximum height in anterior region was 6.0 mm, the minimum height was 2.1mm & the mean height was 3.89 ± 0.82 mm. In female subjects, the maximum height in anterior region was 5.8mm, the minimum height was 2.3mm and the mean height was 3.84 ± 0.75 mm. No significant differences were observed between male and female study subjects. The t value was 0.66 and p value was 0.51 (Table No. 4, Figure No 3).

SELLAR HEIGHT MEDIAN

In male subjects, the maximum height in median region was 13.3mm, the minimum height was 5.3mm & the mean height was 8.24 ± 1.52 mm. In female subjects, the maximum height in middle region was 12.7mm, the minimum height was 5.4mm and the mean height was 8.27 ± 1.34 mm. There was no sexual dimorphism seen. The t value was 1.08 and p value was 0.2 (Table No. 4, Figure No 3)

SELLAR HEIGHT POSTERIOR

In male subjects, the maximum height in posterior region was 6.9mm, the minimum height was 2.2 mm & the mean height was 3.95 ± 0.91 mm. In female subjects, the maximum height in posterior region was 6.8mm, the minimum height was 2.2mm and the mean height was 3.97 ± 0.9 mm. No significant differences were observed between male and female study subjects. The t value was -0.23 and p value was 0.82 (Table No. 4, Figure No 3).

SELLAR AREA

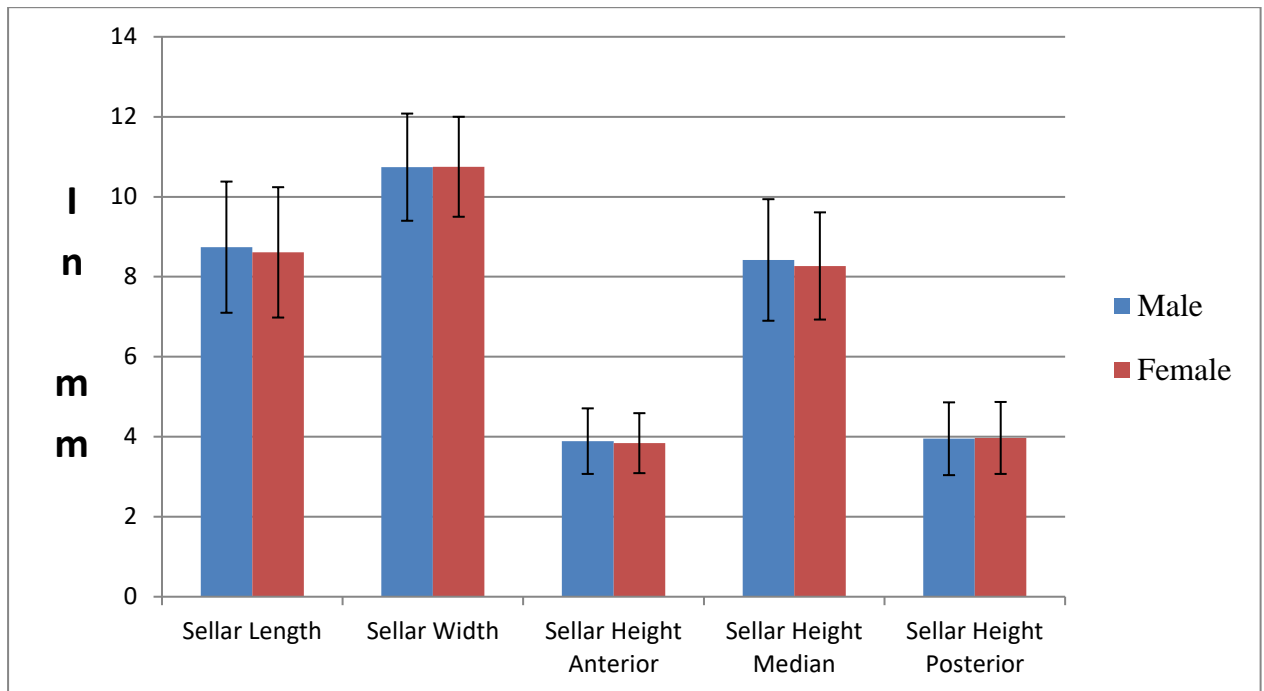
In male subjects, the maximum area was 215.28 mm sq, the minimum area was 48.96mm sq & the mean area was 94.91 ± 26.75 mm sq. In female subjects, the maximum area was 212.35mm sq, the minimum area was 48.96 mm sq and the mean area was 93.5 ± 35.63 mm sq. No considerable differences seen among the genders. The t value was 0.55 and p value was 0.58 (Table No. 4, Figure No 3).

Table No 4. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 31- 40 YEARS

STUDY GROUP OF 31- 40 YEARS					
	MALES	FEMALES			
Parameters	Mean \pm SD	Mean \pm SD	t value	p value	Significance
Sellar length (mm)	8.74\pm1.64	8.61\pm1.63	0.82	0.42	NS
Sellar width(mm)	10.74\pm1.34	10.75\pm1.25	-0.08	0.94	NS
Sellar height anterior (mm)	3.89\pm0.82	3.84\pm0.75	0.66	0.51	NS
Sellar height median (mm)	8.42\pm1.52	8.27\pm1.34	1.08	0.2	NS
Sellar height posterior (mm)	3.95\pm0.91	3.97\pm0.9	-0.23	0.82	NS
Sellar area (mm sq)	94.91\pm26.75	93.5\pm35.634	0.55	0.58	NS

* SD – Standard deviation, NS – non significant.

Figure No 3. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 31- 40 YEARS



5.4 CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 41- 50 YEARS

In the study group of 41-50 years, there were 217 subjects consisting of 108 males and 109 females.

SELLAR LENGTH

In male subjects, the maximum length was 12.2mm, the minimum length was 5.6mm & the mean length was 8.98 ± 1.6 mm. In female subjects, the maximum length was 13.2mm, the minimum length was 6.4mm and the mean length was 9.0 ± 1.6 mm. There was no sexual dimorphism seen. The t value was 0.09 and p value was 0.93 (Table No. 5, Figure No. 4).

SELLAR WIDTH

In male subjects, the maximum width was 14.2mm, the minimum width was 8.2mm & the mean width was 10.97 ± 1.28 mm. In female subjects, the maximum width was 14.1 mm, the minimum width was 7.3mm and the mean width was 11.03 ± 1.38 mm. No significant differences were observed between male and female study participants. The t value was -0.33 and p value was 0.74 (Table No. 5, Figure No. 4).

SELLAR HEIGHT ANTERIOR

In male subjects, the maximum height in anterior region was 6.1 mm, the minimum height was 2.1mm & the mean height was 3.89 ± 0.76 mm. In female subjects, the maximum height in anterior region was 5.8mm, the minimum height was 2.4mm and the mean height was 3.86 ± 0.79 mm. There was no gender difference observed. The t value was 0.26 and p value was 0.78 (Table No. 5, Figure No 4).

SELLAR HEIGHT MEDIAN

In male subjects, the maximum height in median region was 12.5mm, the minimum height was 5.5mm & the mean height was 8.57 ± 1.41 mm. In female subjects, the maximum height in middle region was 13.2mm, the minimum height was 4.2mm and the mean height was 8.53 ± 1.55 mm. No considerable differences seen among the genders. The t value was 0.19 and p value was 0.84 (Table No. 5, Figure No. 4).

SELLAR HEIGHT POSTERIOR

In male subjects, the maximum height in posterior region was 6.6mm, the minimum height was 2.4mm & the mean height was 4.07 ± 0.92 mm. In female subjects, the maximum height in posterior region was 6.5mm, the minimum height was 2.1mm and the mean height was 4.03 ± 0.92 mm. There was no gender difference observed. The t value was 0.32 and p value was 0.75 (Table No. 5, Figure No. 4).

SELLAR AREA

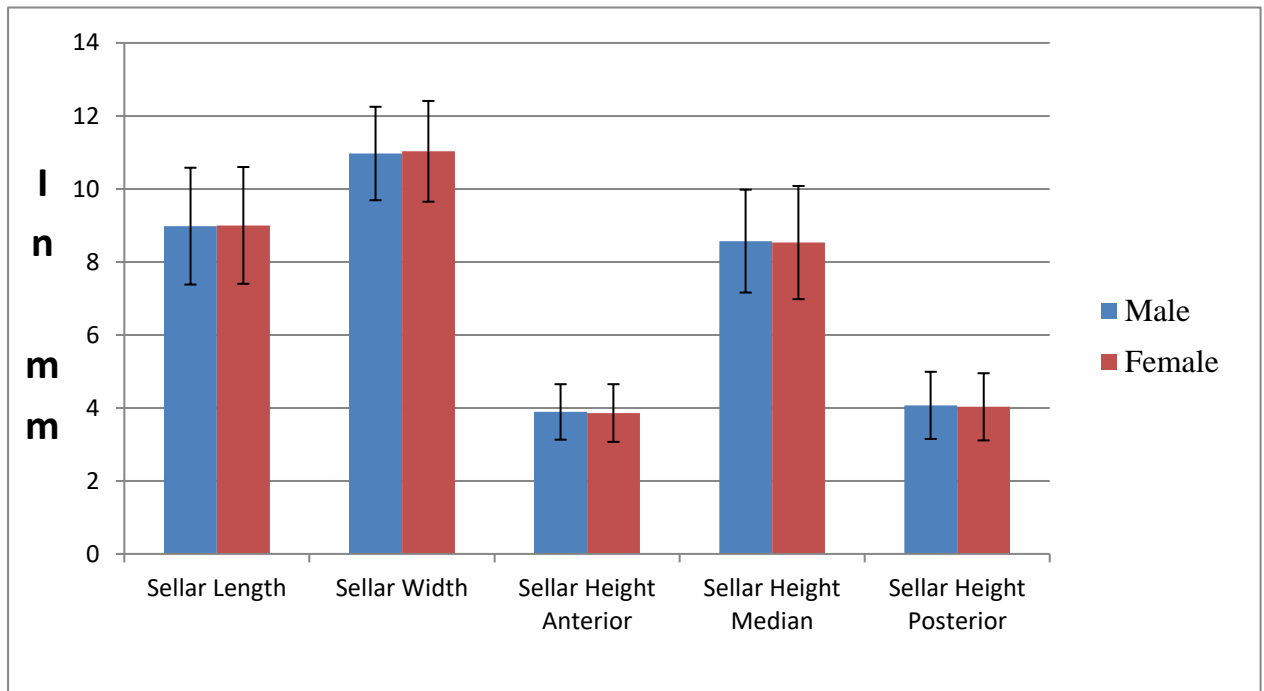
In male subjects, the maximum area was 173.24 mm sq, the minimum area was 58.24mm sq & mean was 99.27 ± 23.8 mm sq. In female subjects, the maximum area was 174.84mm sq, the minimum area was 54mm sq and the mean area was 99.71 ± 24.43 mm sq. No considerable differences seen between male and female participants. The t value was -0.13 and p value was 0.89 (Table No. 5, Figure No. 4).

Table No 5. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 41- 50 YEARS

STUDY GROUP OF 41- 50 YEARS					
	MALES	FEMALES			
Parameters	Mean \pm SD	Mean \pm SD	t value	p value	Significance
Sellar length (mm)	8.98\pm1.6	9\pm1.6	0.09	0.93	NS
Sellar width(mm)	10.97\pm1.28	11.03\pm1.38	-0.33	0.74	NS
Sellar height anterior (mm)	3.89\pm0.76	3.86\pm0.79	0.26	0.78	NS
Sellar height median (mm)	8.57\pm1.41	8.53\pm1.55	0.19	0.84	NS
Sellar height posterior (mm)	4.07\pm0.92	4.03\pm0.92	0.32	0.75	NS
Sellar area (mm sq)	99.27\pm23.8	99.71\pm24.43	-0.13	0.89	NS

* SD – Standard deviation, NS – non significant.

Figure No 4. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 41- 50 YEARS



5.5 CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 51- 60 YEARS

In the study group of 51-60 years, there were 254 subjects consisting of 123 males and 131 females.

SELLAR LENGTH

In male subjects, the maximum length was 12.6mm, the minimum length was 6mm & the mean length was 8.84 ± 1.59 mm. In female subjects, the maximum length was 13.4mm, the minimum length was 5.6mm and the mean length was 8.66 ± 1.65 mm. No significant differences were observed between the male and female study subjects. The t value was 0.88 and p value was 0.38 (Table No. 6, Figure no 5).

SELLAR WIDTH

In male subjects, the maximum width was 13.9mm, the minimum width was 7.8mm & the mean width was 10.77 ± 1.37 mm. In female subjects, the maximum width was 15.2 mm, the minimum width was 7.2 mm and the mean width was 10.73 ± 1.39 mm. There was no sexual dimorphism seen. The t value was 0.23 and p value was 0.82 (Table No. 6, Figure no 5).

SELLAR HEIGHT ANTERIOR

In male subjects, the maximum height in anterior region was 5.4 mm, the minimum height was 2.4mm & the mean height was 3.82 ± 0.77 mm. In female subjects, the maximum height in anterior region was 5.9mm, the minimum height was 2.5mm and the mean height was 3.85 ± 0.76 mm. No considerable differences seen among the genders. The t value was -0.31 and p value was 0.75 (Table No. 6, Figure no 5).

SELLAR HEIGHT MEDIAN

In male subjects, the maximum height in median region was 11.9mm, the minimum height was 5.3mm & the mean height was 8.56 ± 1.49 mm. In female subjects, the maximum height in middle region was 12.6mm, the minimum height was 5.8mm and the mean height was 8.6 ± 1.45 mm. There was no sexual dimorphism seen. The t value was -0.21 and p value was 0.82 (Table No. 6, Figure no 5).

SELLA HEIGHT POSTERIOR

In male subjects, the maximum height in posterior region was 6.8mm, the minimum height was 2.2mm & the mean height was 4.03 ± 0.93 mm. In female subjects, the maximum height in posterior region was 6.4mm, the minimum height was 2.1mm and the mean height was 4.06 ± 0.98 mm. There was no sexual dimorphism seen. The t value was -0.25 and p value was 0.8 (Table No. 6, Figure no 5).

SELLAR AREA

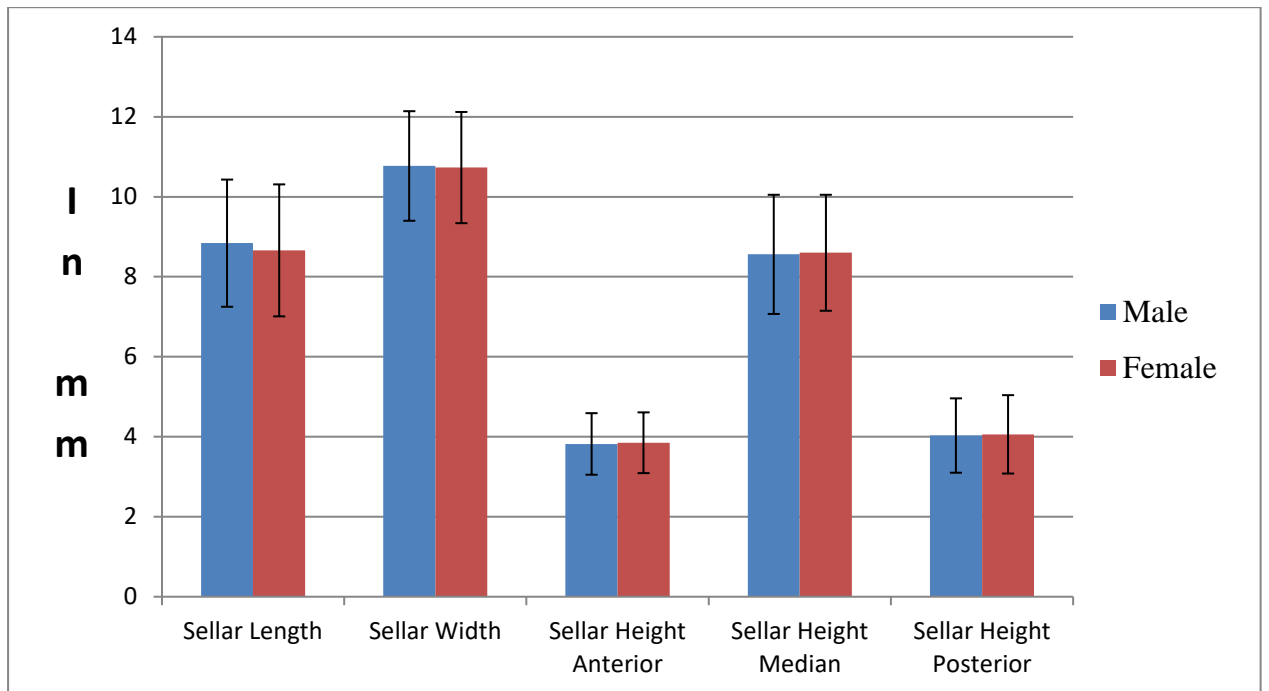
In male subjects, the maximum area was 156.16mm sq, the minimum area was 58.74mm sq & the mean area was 95.92 ± 24.99 mm sq. In female subjects, the maximum area was 203.68mm sq, the minimum area was 52.56mm sq and the mean area was 93.83 ± 26.86 mm sq. No significant differences were observed between genders. The t value was 0.64 and p value was 0.52 (Table No. 6, Figure no 5).

Table No 6. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 51- 60 YEARS

STUDY GROUP OF 51- 60 YEARS					
	MALES	FEMALES			
Parameters	Mean \pm SD	Mean \pm SD	t value	p value	Significance
Sellar length (mm)	8.84\pm1.59	8.66\pm1.65	0.88	0.38	NS
Sellar width(mm)	10.77\pm1.37	10.73\pm1.39	0.23	0.82	NS
Sellar height anterior (mm)	3.82\pm0.77	3.85\pm0.76	-0.31	0.75	NS
Sellar height median (mm)	8.56\pm1.49	8.6\pm1.45	-0.21	0.82	NS
Sellar height posterior (mm)	4.03\pm0.93	4.06\pm0.98	-0.25	0.8	NS
Sellar area (mm sq)	95.92\pm24.99	93.83\pm26.86	0.64	0.52	NS

* SD – Standard deviation, NS – non significant.

Figure no 5. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 51- 60 YEARS



5.6 CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 61- 70 YEARS

In the study group of 61-70 years, there were 184 subjects consisting of 75 males and 109 females.

SELLAR LENGTH

In male subjects, the maximum length was 13.6mm, the minimum length was 5.5mm & the mean length was 9.04 ± 1.76 mm. In female subjects, the maximum length was 13.6mm, the minimum was 6.2mm and the mean length was 8.87 ± 1.62 mm. There was no sexual dimorphism seen. The t value was 0.66 and p value was 0.5 (Table No. 7, Figure no 6).

SELLA WIDTH

In male subjects, the maximum width was 15.4mm, the minimum width was 7.4mm & the mean width was 11 ± 1.45 mm. In female subjects, the maximum width was 15.4 mm, the minimum width was 8.3 mm and the mean width was 11 ± 1.45 mm. No significant differences were observed between genders. The t value was 0 and p value was 0.9 (Table No. 7, Figure no 6).

SELLAR HEIGHT ANTERIOR

In male subjects, the maximum height in the anterior region was 6.2 mm, the minimum height was 2.4mm & the mean height was 4.02 ± 0.87 mm. In female subjects, the maximum height in anterior region was 6.1mm, the minimum height was 2.6mm and the mean height was 4 ± 0.85 mm. No considerable differences seen between male and female participants. The t value was 0.16 and p value was 0.88 (Table No. 7, Figure no 6).

SELLAR HEIGHT MEDIAN

In male subjects, the maximum height in the median region was 13.2mm, the minimum height was 4.2mm & the mean height was 8.87 ± 1.67 mm. In female subjects, the maximum height in middle region was 13.2mm, the minimum height was 5.8mm and the mean height was 8.79 ± 1.58 mm. No considerable differences seen

among the genders. The t value was 0.25 and p value was 0.81 (Table No. 7, Figure no 6).

SELLAR HEIGHT POSTERIOR

In male subjects, the maximum height in posterior region was 6.1mm, the minimum height was 2.4mm & the mean height was 4.13 ± 0.86 mm. In female subjects, the maximum height in posterior region was 5.8mm, the minimum height was 2.2mm and the mean height was 4.03 ± 0.84 mm. There was no sexual dimorphism seen. The t value was 0.76 and p value was 0.43 (Table No. 7, Figure no 6).

SELLAR AREA

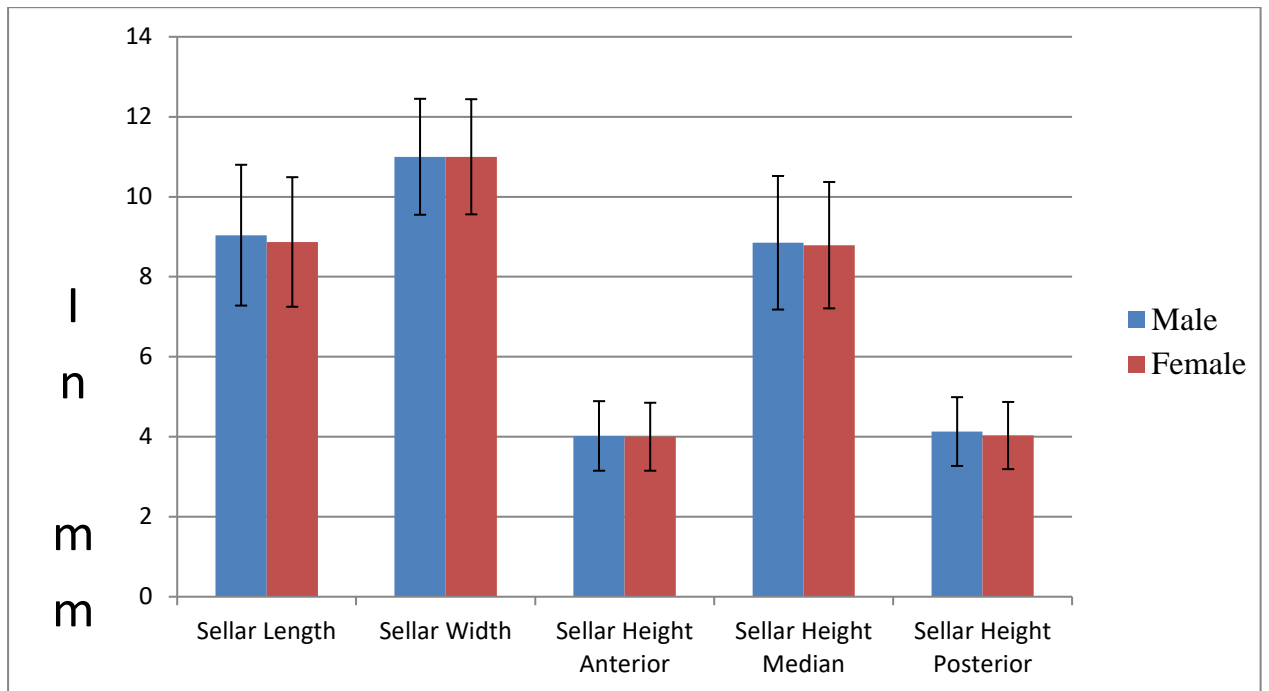
In male subjects, the maximum area was 209.44mm sq, the minimum area was 54.45mm sq & the mean area was 100.77 ± 29.85 mm sq. In female subjects, the maximum area was 209.4mm sq, the minimum area was 61.06mm sq and the mean area was 98.77 ± 28.22 mm sq. There was no gender difference observed. The t value was 0.46 and p value was 0.64 (Table No. 7, Figure no 6).

Table No 7. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 61- 70 YEARS.

STUDY GROUP OF 61- 70 YEARS					
	MALES	FEMALES			
Parameters	Mean \pm SD	Mean \pm SD	t value	p value	Significance
Sellar length (mm)	9.04\pm1.76	8.87\pm1.62	0.66	0.5	NS
Sellar width(mm)	11\pm1.45	11\pm1.44	0	0.9	NS
Sellar height anterior (mm)	4.02\pm0.87	4\pm0.85	0.16	0.88	NS
Sellar height median (mm)	8.85\pm1.67	8.79\pm1.58	0.25	0.81	NS
Sellar height posterior (mm)	4.13\pm0.86	4.03\pm0.84	0.76	0.43	NS
Sellar area (mm sq)	100.77\pm29.85	98.77\pm28.22	0.46	0.64	NS

* SD – Standard deviation, NS – non significant.

Figure no 6. CORRELATION BETWEEN THE SELLAR DIMENSIONS IN MALES AND FEMALES OF THE STUDY GROUP OF 61- 70 YEARS



5.7 ANALYSIS OF THE MORPHOLOGY OF SELLA TURCICA **BETWEEN THE AGE GROUPS**

5.7.1 SELLAR LENGTH

The mean sellar length among the male study subjects was 9.45mm. The maximum length was 13.8 mm and the minimum length was 5.1mm. The mean length was highest among the 61-70 age groups (9.04±1.76) followed by 41-50 age group (8.98±1.6), 51-60 age group (8.84±1.59), 31-40 age group (8.74±1.64) and 21-30 age group (8.67± 1.49). The differences in the mean were not statically significant among the different age groups (p = 0.25). (Table No 8)

Similarly in female study subjects, the mean length was 9.4mm. The maximum length was 13.7 mm and the minimum length was 5.1mm among the female subjects. The highest length was observed among 41-50 age group (9±1.6) followed by 61-70 age group (8.87±1.62), 21-30 age group (8.75±1.82), 31-40 & 51-60 age group (8.6±1.63 , 8.6±1.65). The differences in the mean were not statically significant among the different age groups. (p= 0.3) There was no sexual dimorphism seen (Table No 8)

Table No 8. ANALYSIS OF THE SELLAR LENGTH BETWEEN THE AGE GROUPS

Age in years	SELLAR LENGTH(in mm)	
	MALES	FEMALES
	MEAN ± SD	MEAN ± SD
21- 30	8.67±1.49	8.75±1.82
31-40	8.74±1.64	8.61±1.63
41-50	8.98±1.6	9±1.6
51-60	8.84±1.59	8.66±1.65
61-70	9.04±1.76	8.87±1.62
	F=1.3	F= 1.2
	p= 0.25	p= 0.3

* SD – Standard deviation

5.7.2 SELLAR WIDTH

The maximum sellar width was 15.6 mm and the minimum width was 7.2mm among the male subjects. The mean width was 11.4mm. The mean width was highest among the 61-70 age groups (11 ± 1.45) followed by 41-50 age group (10.97 ± 1.28), 51-60 age group (10.77 ± 1.37), 21-30 age group (10.73 ± 1.38) and 31-40 age group (10.7 ± 1.34). The differences in the mean sellar width were not statically significant among the different age groups. ($p= 0.35$) (Table No. 9)

In female study subjects, the maximum width was 15.5 mm and the minimum width was 7.2 mm and the mean width was 11.35mm. The highest width was observed among 41-50 age group (11.03 ± 1.38) followed by 61-70 age group (11 ± 1.4), 21-30 age group (10.93 ± 1.31), 31-40 age group (10.75 ± 1.25) and 51-60 age group (10.73 ± 1.39). The differences in the mean were not statically significant among the different age groups ($p= 0.16$). No significant differences were observed between male and female subjects. (Table No 9)

Table No 9. ANALYSIS OF THE SELLAR WIDTH BETWEEN THE AGE GROUPS

Age in years	SELLAR WIDTH (in mm)	
	MALES	FEMALES
	MEAN \pm SD	MEAN \pm SD
21- 30	10.73 \pm 1.38	10.93 \pm 1.31
31-40	10.74 \pm 1.34	10.75 \pm 1.25
41-50	10.97 \pm 1.28	11.03 \pm 1.38
51-60	10.77 \pm 1.37	10.73 \pm 1.39
61-70	11 \pm 1.45	11 \pm 1.44
	F=1.12	F=1.64
	p=0.35	p=0.16

* SD – Standard deviation

5.7.3 SELLAR HEIGHT (ANTERIOR)

The maximum height of sella in anterior region was 6.4 mm and the minimum height of sella in anterior region was 2.1mm among the male subjects irrespective of age groups. The mean height of the sella in anterior region was 4.25mm. The mean height of the sella in anterior region was highest among the 61-70 age groups (4.02±0.87) followed by 31-40, 41-50 age group (3.89±0.82, 3.89±0.76), 21-30 age group (3.88±0.87) and 51-60 age group (3.82±0.72). The differences in the mean were not statically significant among the different age groups (p= 0.6). (Table No 10)

In female study subjects, the maximum height of sella in anterior region was 6.3mm and the minimum height of sella in anterior region was 2.2 mm among the female subjects irrespective of age groups. The mean height of the sella in anterior region was 4.25mm. The highest height of the sella in anterior region was observed among 61-70 age group (4±0.85mm) followed by 21-30 age group (3.91±0.86), 41-50 age group (3.86±0.79), 51-60 age group (3.85±0.76) and 31-40 age group (3.84±0.75). The differences in the mean were not statically significant among the different age groups (p=0.47). No considerable differences seen among the genders. (Table No 10)

Table No 10. ANALYSIS OF THE SELLAR HEIGHT ANTERIOR BETWEEN THE AGE GROUPS

Age in years	SELLAR HEIGHT ANTERIOR (in mm)	
	MALES	FEMALES
	MEAN ± SD	MEAN ± SD
21- 30	3.88±0.87	3.91±0.86
31-40	3.89±0.82	3.84±0.75
41-50	3.89±0.76	3.86±0.79
51-60	3.82±0.77	3.85±0.76
61-70	4.02±0.87	4±0.85
	F= 0.69	F= 0.9
	p=0.6	p=0.47

* SD – Standard deviation

5.7.4 SELLAR HEIGHT (MEDIAN)

The sellar median height was ranging from 4.2 mm to 13.3mm in males and from 4.2 mm to 13.2mm in female study subjects. The mean heights were 8.75mm and 8.70mm in male and female study subjects respectively. (Table No 11)

In male study subjects amongst the different age groups, the mean height was 8.36 ± 1.45 , 8.42 ± 1.52 , 8.57 ± 1.41 , 8.56 ± 1.49 , 8.85 ± 1.67 mm in 21-30, 31-40, 41-50, 51-60, 61-70 yrs respectively. . No significant differences were observed between different age groups of male participants ($p=0.2$) (Table No 11)

Similarly amongst the different age groups of female subjects, the mean height were 8.58 ± 1.48 , 8.27 ± 1.34 , 8.53 ± 1.55 , 8.6 ± 1.45 , 8.79 ± 1.58 mm in 21-30, 31-40, 41-50, 51-60, 61-70 yrs respectively. No significant differences were observed between different age groups of female participants ($p=0.2$). There was no sexual dimorphism seen (Table No 11)

Table No 11. ANALYSIS THE OF SELLAR HEIGHT MEDIAN BETWEEN THE AGE GROUPS

Age in years	SELLAR HEIGHT MEDIAN (in mm)	
	MALES	FEMALES
	MEAN \pm SD	MEAN \pm SD
21- 30	8.36\pm1.45	8.58\pm1.48
31-40	8.42\pm1.52	8.27\pm1.34
41-50	8.57\pm1.41	8.53\pm1.55
51-60	8.56\pm1.49	8.6\pm1.45
61-70	8.85\pm1.67	8.79\pm1.58
	F=1.89	F=2.90
	p=0.11	p=0.22

* SD – Standard deviation

5.7.5 SELLAR HEIGHT (POSTERIOR)

The maximum height of the sella in posterior region was 6.9 mm and the minimum height of sella in posterior region was 2.2mm among the male subjects irrespective of age groups. The mean height of the sella in posterior region was 4.55mm. The mean height of sella in the posterior region was highest among the 61-70 age groups (4.13±0.86) followed by, 41-50 age group (4.07±0.92), 51-60 age group (4.03±0.93), 31-40 age group (3.95±0.91) and 21-30 age group (3.92±0.79) .The differences in the mean were not statistically significant among the different age groups. (p= 0.25) (Table No 12)

In female study subjects, the maximum height of sella in the posterior region was 6.2mm and minimum height of sella in the posterior region was 2.1 mm among the female subjects irrespective of age groups. The mean height of sella in the posterior region was 4.15mm. The highest height of sella in posterior region was observed among 51-60 age group (4.06±0.98) followed by 21-30 age group (4.04±0.93), 41-50 and 61-70 age group (4.03±0.92 and 4.03±0.84) and 31-40 age group (3.97±0.9). The differences in the mean were not statistically significant among the different age groups. (p= 0.89). No considerable differences seen among the genders. (Table No 12)

Table No 12. ANALYSIS OF THE SELLAR HEIGHT POSTERIOR BETWEEN THE AGE GROUPS

Age in years	SELLAR HEIGHT POSTERIOR(in mm)	
	MALES	FEMALES
	MEAN ± SD	MEAN ± SD
21- 30	3.92 ±0.79	4.04 ±0.93
31-40	3.95 ±0.91	3.97±0.9
41-50	4.07±0.92	4.03±0.92
51-60	4.03±0.93	4.06±0.98
61-70	4.13±0.86	4.03±0.84
	F= 1.35	F=0.28
	p=0.25	p=0.89

* SD – Standard deviation

5.7.6 SELLAR AREA

In male subjects, the mean sellar area were 93.85±24.15, 94.91±26.75, 99.27±23.8, 95.92±24.99 and 100.77±29.85mm² in 21-30, 31-40 , 41-50, 51-60 and 61-70 yrs respectively. The differences in the mean were not statistically significant among the different age groups. (p= 0.15) (Table No 13)

In female subjects, the mean sellar area were 96.86±27.98, 93.5±25.64, 99.71±24.43, 93.83±26.86 and 98.77±28.22 mm² in 21-30, 31-40, 41-50, 51-60 and 61-70 yrs respectively. The differences in the mean were not statically significant among the different age groups. (p= 0.17). No significant differences were observed between males and females. (Table No 13)

Table No 13. ANALYSIS OF THE SELLAR AREA BETWEEN THE AGE GROUPS

Age in years	SELLAR AREA(in mm ²)	
	MALES	FEMALES
	MEAN ± SD	MEAN ± SD
21- 30	93.85 ± 24.15	96.86 ± 27.98
31-40	94.91 ±26.75	93.5 ± 25.64
41-50	99.27 ± 23.8	99.71 ± 24.43
51-60	95.92 ± 24.99	93.83 ±26.86
61-70	100.77 ± 29.85	98.77 ± 28.22
	F=1.69	F=1.62
	p=0.15	p=0.17

* SD – Standard deviation

5.8 MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA BASED ON GENDER

Among 1650 subjects, 90% subjects were having normal sella, 08% subjects had oblique anterior wall and 02% of the subjects had pyramidal shaped sella turcica. The other types such as double contour of the floor, Sella turcica bridging, irregular posterior wall were not found among our study subjects.

Table No 14. **MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA**

Subjects	Morphological variations of sella turcica		
	Normal	Oblique anterior wall	Pyramidal
1650	1485 (90%)	132 (08%)	33 (02%)

5.8.1 In the study group of 21-30 years, there were 566 subjects (288 males and 280 females)

Male subjects

Among 288 male subjects, the shape of the sella was normal in 259 subjects (89.93%), oblique anterior wall was in 23 (7.98%) subjects and pyramidal was in 06 (2.08%) subjects. (Table No 15)

Female subjects

Among 280 female subjects, the shape of the sella was normal in 248 (88.57%), oblique anterior wall was in 27 (9.64%) subjects and pyramidal was in 05 (1.78%) subjects. (Table No 15)

MORPHOLOGICAL VARIATIONS OF SELLA TURCICA

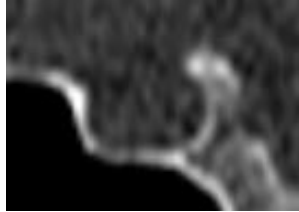


Figure no 7. Normal sella turcica

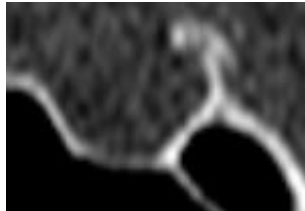


Figure no 8. Oblique anterior wall



Figure no 9. Pyramid sella turcica

Table No 15. MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA AMONG GROUP OF 21-30 YEARS BASED ON GENDER

Gender		Morphological variations of the sella turcica		
		Normal	Oblique anterior wall	Pyramidal
Males	N	259	23	06
	%	89.93	7.98	2.08
Females	N	248	27	05
	%	88.57	9.64	1.78

5.8.2 In the study group of 31-40 years, there were 427 subjects (187 males and 240 females).

Male subjects

Among 187 male subjects, the shape of the sella was normal in 166 subjects (88.77%), oblique anterior wall was in 16 (8.55%) subjects and pyramidal was in 05 (2.67%) subjects. (Table No 16)

Female subjects

Among 240 female subjects, the shape of the sella was normal in 221 (92.08%) subjects, oblique anterior wall was in 13 (5.41%) subjects and pyramidal was in 06 (2.5%) subjects. (Table No 16)

Table No 16. MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA AMONG THE GROUP OF 31-40 YEARS BASED ON GENDER

Gender		Morphological variations of the sella turcica		
		Normal	Oblique anterior wall	Pyramidal
Males	N	166	16	05
	%	88.77	8.55	2.67
Females	N	221	13	06
	%	92.08	5.41	2.5

5.8.3 In the study group of 41-50 years, there were 217 subjects (108 males and 109 females).

Male subjects

Among 108 male subjects, the shape of the sella was normal in 101 subjects (93.51%), oblique anterior wall was in 05 (4.62%) subjects and pyramidal was in 02 (1.85%) subjects. (Table No 17)

Female subjects

Among 109 female subjects, the shape of the sella was normal in 96 (88.07%) subjects, oblique anterior wall was in 11 (10.09%) subjects and pyramidal was in 02 (1.83%) subjects. (Table No 17)

Table No 17. MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA AMONG THE GROUP OF 41-50 YEARS BASED ON GENDER

Gender		Morphological variations of the sella turcica		
		Normal	Oblique anterior wall	Pyramidal
Males	N	101	05	02
	%	93.51	4.62	1.85
Females	N	96	11	02
	%	88.07	10.09	1.83

5.8.4 In the study group of 51-60 years, there were 254 subjects (123 males and 131 females).

Male subjects

Among 123 male subjects, the shape of the sella was normal in 113 (91.86%) subjects, oblique anterior wall was in 09 (7.37%) subjects and pyramidal was in 01 (0.8%) subjects. (Table No 18)

Female subjects

Among female 131 subjects, the shape of the sella was normal in 123 (93.89%) subjects, oblique anterior wall was in 07 (5.34%) subjects and pyramidal was in 01(0.76%) subjects. (Table No 18)

Table No 18. MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA AMONG THE GROUP OF 51-60 YEARS BASED ON GENDER

Gender		Morphological variations the of sella turcica		
		Normal	Oblique anterior wall	Pyramidal
Males	N	113	09	01
	%	91.86	7.37	0.8
Females	N	123	07	01
	%	93.89	5.34	0.76

5.8.5 In the study group of 61-70 years, there were 184 subjects (75 males and 109 females).

Male subjects

Among 75 male subjects, the shape of the sella was normal in 64 (85.33%) subjects, oblique anterior wall was in 06 (8%) subjects and pyramidal was in 05(6.6%) subjects. (Table No 19)

Female subjects

Among 109 female subjects, the shape of the sella was normal in 100(91.74%) subjects, oblique anterior wall was in 04 (3.66%) subjects and pyramidal was in 05 (4.58%) subjects. (Table No 19)

**Table No 19. MORPHOLOGICAL VARIATIONS OF THE SELLA TURCICA
AMONG THE GROUP OF 61-70 YEARS BASED ON GENDER**

Gender		Morphological variations of the sella turcica		
		Normal	Oblique anterior wall	Pyramidal
Males	N	64	06	05
	%	85.33	08	6.6
Females	N	100	04	05
	%	91.74	3.66	4.58

5.9 SHAPES OF SELLA TURCICA BASED ON GENDER

The shapes of the sella turcica were described as oval, flat and circular. Among these 1650 subjects, maximum subjects had oval shape i.e. 66.48%, circular shape was in 25.33% subjects followed by flat shaped in 8.18% subjects. (Table No 20)

Table No 20. **SHAPES OF THE SELLA TURCICA**

Subjects	Shapes of the sella turcica		
	Oval	Circular	Flat
1650	1097 (66.48%)	418 (25.33%)	135 (8.18%)

5.9.1 In the study group of 21-30 years, there were 566 subjects (288 males and 280 females)

Male subjects

Among 288 male subjects, the shape of the sella was Oval in 183 subjects (63.54%), Circular was in 74 (25.69%) subjects and flat was in 31 (10.76%) subjects. (Table No. 21)

Female subjects

Among 280 female subjects, the shape of the sella was Oval in 194 subjects (69.28%), Circular was in 69 (24.64%) subjects and was flat in 17 (6.07%) subjects. (Table No. 21)

Table No 21. **SHAPES OF THE SELLA TURCICA AMONG THE GROUP OF 21-30 YEARS BASED ON GENDER**

Gender		Shapes of the sella turcica		
		Oval	Circular	Flat
Males	n	183	74	31
	%	63.54%	25.69%	10.76%
Females	n	194	69	17
	%	69.28%	24.64%	6.07%

SHAPES OF SELLA TURCICA

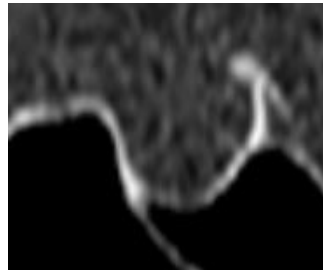


Figure no 10. Oval shaped sella turcica

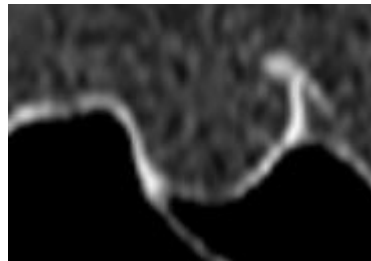


Figure no 11. Circular shaped sella turcica

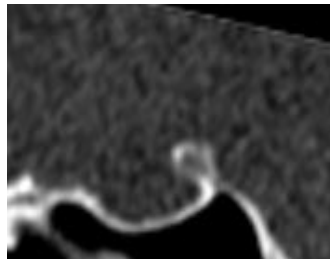


Figure no 12. Flat shaped sella turcica

5.9.2 In the study group of 31-40 years, there were 427 subjects (187males and 240 females).

Male subjects

Among male subjects, the shape of the sella was Oval in 109 (58.28%) subjects; Circular was in 58 (31.01%) subjects and flat was in 20 (10.69%) subjects. (Table No 22)

Female subjects

Among 240 female subjects, the shape of the sella was Oval in 159 (66.25%) subjects, Circular was in 63 (26.25%) subjects and flat was in 18(7.5%) subjects. (Table No 22)

Table No 22 SHAPES OF THE SELLA TURCICA AMONG THE GROUP OF 31-40 YEARS BASED ON GENDER

Gender		Shapes of the sella turcica		
		Oval	Circular	Flat
Males	n	109	58	20
	%	58.28%	31.01%	10.69%
Females	n	159	63	18
	%	66.25%	26.25%	7.5%

5.9.3 In the study group of 41-50 years, there were 217 subjects (108 males and 109 females).

Male subjects

Among 108 male subjects, the shape of the sella was Oval in 77 (71.29%) subjects; Circular was in 23 (21.29%) subjects and flat was in 08 (7.40%) subjects. (Table No 23)

Female subjects

Among 109 female subjects, the shape of the sella was Oval in 63 (57.79%) subjects; Circular was in 36 (33.02%) subjects and flat was in 10 (9.17%) subjects. (Table No 23)

Table No 23. **SHAPES OF THE SELLA TURCICA AMONG THE GROUP OF 41-50 YEARS BASED ON GENDER**

Gender		Shapes of the sella turcica		
		Oval	Circular	Flat
Males	n	77	23	08
	%	71.29%	21.29%	7.40%
Females	n	63	36	10
	%	57.79%	33.02%	9.17%

5.9.4 In the study group of 51-60 years, there were 254 subjects (123 males and 131 females).

Male subjects

Among 123 male subjects, the shape of the sella was Oval in 79 subjects (64.22%), Circular was in 35 (28.45%) subjects and flat was in 09 (7.31%) subjects. (Table No 24)

Female subjects

Among 131 female subjects, the shape of the sella was Oval in 90 subjects (68.70%), Circular was in 28 (21.37%) subjects and flat was in 13 (9.92%) subjects. (Table No 24)

Table No 24. SHAPES OF THE SELLA TURCICA AMONG THE GROUP OF 51-60 YEARS BASED ON GENDER

Gender		Shapes of the sella turcica		
		Oval	Circular	Flat
Males	n	79	35	09
	%	64.22%	28.45%	7.31%
Females	n	90	28	13
	%	68.70%	21.37%	9.92%

5.9.5 In the study group of 61-70 years, there were 184 subjects (75 males and 109 females).

Male subjects

Among 75 male subjects, the shape of the sella was Oval in 58 subjects (77.33%), Circular was in 12 (16%) subjects and flat was in 05 (6.6%) subjects. (Table No 25)

Female subjects

Among 109 female subjects, the shape of the sella was Oval in 85 subjects (78.70%), Circular was in 20 (18.51%) subjects and flat was in 04 (3.70%) subjects. (Table No 25)

Table No 25. SHAPES OF THE SELLA TURCICA AMONG THE GROUP OF 61-70 YEARS BASED ON GENDER

Gender		Shapes of the sella turcica		
		Oval	Circular	Flat
Males	n	58	12	05
	%	77.33%	16%	6.6%
Females	n	85	20	04
	%	78.70%	18.51%	3.70%

CHAPTER NO 6

DISCUSSION

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

6.1 DISCUSSION

The sella turcica is a clinically important structure of middle cranial fossa and its normal morphometry is important in diagnosing the pathologies of sellar and parasellar region^{1&2}. Many studies were done on the size of sella turcica with different methods. The present study was unique because it had largest sample size using CT scans on Indian population. Meschan described that the morphometry of sella turcica ought to be undertaken so that enlargement of intrasellar lesions and increased cranial pressure can be identified³.

The size of sella turcica was studied by Axleson et al in Norwegian population aged six to twenty one years. In their study, the sellar length was almost constant and diameter increased with the age⁴. Quakinine and Hardy performed a microsurgical anatomical study on 250 sphenoidal blocks obtained from cadavers of different age. They found the average transverse width of sella was 12mm, the length was 8mm and average height was 6mm⁵. In our study it was observed that the linear dimensions of sella turcica were almost constant..

Terditis et al conducted research on 325 orthodontic patients of 6-49 years of age. They measured the linear dimensions on lateral cephalograms in which the anteroposterior diameter was ranging from 6.0 to 17.0 mm, the mean value was 10.9±1.8mm and the depth varied 2.5 to 12.5mm with a mean of 7.6±1.7mm⁶. Camp conducted research on adults and reported the values for the width (termed as length in the present study) and value of height (termed as depth in the present study) were 10.6mm and 8.1mm respectively⁷, compared to 8.8mm & 8.52mm in the present study. The linear dimensions were on an average 1.2mm to 2.25mm larger in our present study, when it was similar to Jordians sample⁸.

Haider Ali Hasan et al⁹ conducted study on Malay population by using 3D CT scan to analyze the area of the sella turcica in 183 subjects. One more study conducted in Bangladeshi population to assess the morphology of the sella turcica by using 3D CT of 166 subjects.¹⁰ Compared to the present study, the dimensions are almost similar with the above studies except the sellar height anterior and posterior, which was 3-4mm smaller than above studies, which might be because of the racial differences.

According to Chawan et al¹¹, the average mean length and depth of sella in males were 11.13 mm and 8.10mm. In females, the mean length and depth were

10.73mm and 7.91mm respectively⁹. In the present study, the average mean length and depth of sella in males were 8.71mm and 8.37mm. In females, the mean length and depth were 8.84mm and 8.28mm respectively. CT study on dry skulls by Ruiz et al revealed the average mean length of sella was 10.31mm, depth was 6.33mm and the average mean area of sella was 41.12 sq.mm¹². These discrepancies could be due to the differences in the method and ethnic origin.

A study done by Ozan et al¹³ in Turkey, the sizes were compared between genders. Only the sellar width and length differed significantly when compared to our present study. The differences should be ascribed to the differences in the scheme of measurement in the studies.

Axellson¹⁴, Alkofide¹⁵, Shah MA¹⁶, Yasir Y et al¹⁷, Osunwake EA¹⁸ and TS Mahesh kumar¹⁹ found that there were no statistically noteworthy differences among the genders. Similar findings were also observed in our present study.

Axellson⁴ found that length was larger in males throughout the study period. Tejavathi Ngaraj et al²⁰ reported that there was statistical significant increase in the depth and anteroposterior diameter of sella turcica as the age advances. There was no statistical momentous difference in our study between the genders. Alkofide EA¹⁵, TS Mahesh kumar¹⁹ determined the large distinction between the age clusters. There has been no statistically tremendous difference among the age groups in our study and the morphology was almost similar in both genders. Despite the fact that the size of sella turcica was measured in both the studies, the discrepancies can be attributed to elements like ethnicity.

The values of dimensions of sella in our study was similar with the results of the study done by Chauhan P et al.²¹ A significant difference was found in the linear dimensions between the genders in sella height and width in their study. But in our study, there were no significant differences in the linear dimensions. The discrepancy between those measurements is attributed to different method of the measurements.

Axelsson et al conducted a research in Norway by the use of lateral cephalometric radiographs. The sella turcica morphology was analyzed. "Five types of different morphological variations like oblique anterior wall, bridging of sella turcica, double contour of the floor, irregular surface in posterior aspect of dorsum sellae, pyramid like shape of dorsum sellae were recognized"⁴. Our study revealed that the oblique anterior wall of sella turcica accounted for 6.27% in male and 7.13% in female respectively.

The morphological variations of the sella turcica were commonly seen in syndromic patients such as in Holoprosencephaly. The anterior wall of sella was deviant and partly absent ²⁵.

In Trisomy 21, the anterior wall was affected in different degrees in this genotype from the slight depression in the lower aspect of anterior wall to more severe cases where anterior wall is completely separated from the posterior wall ²⁶. The anterior wall of sella was uneven in Meckel Gruber syndrome²⁷. In Trisomy18, the sella turcica appeared with malformed posterior wall, with a broad base and often with several notches in the posterior wall ²⁷.

Research on morphological shapes of sella turcica in cleft lip and palate patients, majority of cleft sufferers had morphological aberrations including double contour of floor. An irregular posterior wall was common than normal sella turcica. J shaped sella was found in the intracranial aneurysms ²⁸. In the present study, we have found 90% cases of normal sella, pyramidal shaped in 2% cases and 8% of oblique anterior wall of sella turcica.

Gorden et al examined the x ray films of children without any pathology in one to twelve years of age and classified sella turcica in to a few shapes - circular, oval and flat . Circular and oval sella turcica are found in most subjects²⁹. The three types of sella turcica as reported by Jones et al i.e. circular, oval and flat had been considered in the present study to describe the shapes of sella³⁰. In the present study, oval type was seen in 66.48% of subjects, round in 25.33%, flat was the least common i.e, 8.18%. Jones et al did not manuscript the share of dominance of each of anatomical sort of sella turcica³⁰ .

The anatomy and morphological variations of sella turcica are essential for neurosurgeons and ENT surgeons, who operate pathologies of sellar and parasellar area. The sella turcica morphology of Indian inhabitants obtained in this study will serve up as assistance to clinicians. These dimensions can be helpful in detecting pathology of sellar area and in craniofacial aberrations and syndromes.

When these findings were collected geographic proximity seems much different. We may opine, this may be because of inherited and racial factor. However, the subjects of our study, difference in assessment methods, imaging and in individual performing the measurement etc may influence the results of the study and we must consider these differences in parameter. All measurements should be taken in to the consideration during comparison.

Table no 26. COMPARISION OF MORPHOMETRY OF SELLA TURCICA OF PRESENT STUDY WITH PREVIOUS STUDY DONE BY X RAY METHOD.

Author	Study population	Method	Sample size	Age	SL	SW	SHA	SHM	SHP	SIGNIFICANCE
Axelsson et al	Norwegian	X ray	72 M-35 F- 37	6-21 yrs	8.8	11.5	-	7.3	-	NS
Alkofide et al	Saudi Arabia	X ray	190	11-27 yrs	10.78	13.95	-	9.11	-	-
Yasir et al	Iraqi	X ray	130 M- 67 F- 63	17-25 yrs	9.57- 16.16	-		4.83- 11.6	-	NS
Ahasan et al	Pakistan	X ray	180 M – 90 F - 90	Above 16 yrs	11.4 11.2	13.9 11.8	-	9.8 9.9	-	NS
Abu ghaida et al	Jordianian	X ray	509 M- 252 F - 257	10- 40 yrs	7.68 7.42	8.72 8.67	-	6.2 6.3	-	NS
Present study	INDIA KARNATAKA	CT	1650 M- 781 F- 869	21 – 70 yrs	8.85 8.77	10.8 10.8	3.9 3.9	8.5 8.5	4.02 4.02	NS

Author	Study population	Method	Sample size	Age	SL	SW	SHA	SHM	SHP	SIGNIFICANCE
Andredaki et al	Greece	X ray	184 M- 91 F- 93	6-17 yrs	7.1 7.0	8.9 9.1	6.7 7.2	6.6 6.8	6.6 6.5	NS
Chavan et al	Indian Maharashtra	X ray	447 M- 237 F-210	13-55 yrs	10.23 11.12	7.39 8.15	-	-	-	NOT
Puja et al	Delhi	X ray	180 M-90 F-90	12-65	7.8	8.4	7.5	7.5	5.0	S SH SW
Nagaraj et al	Karnataka	X ray	200	8-30 yrs	9.52	11.83	-	8.21	-	NS G S AGE
Present study	INDIA KARNATAKA	CT	1650 M- 781 F- 869	21 – 70 yrs	8.85 8.77	10.8 10.8	3.9 3.9	8.5 8.5	4.02 4.02	NS

* M- Male, F-Female, YRS- Years, SL- Sellar Length, SW- Sellar Width, SHA-Sellar Height Anterior, SHM- Sellar Height median, SHP- Sellar height posterior, NS- Non Significant, S- Significant, G- Gender, CT- Computed Tomography.

Table no 27. COMPARISION OF MORPHOMETRY OF SELLA TURCICA OF PRESENT STUDY WITH PREVIOUS STUDY DONE BY CT SCAN

Author	Study population	Method	Sample size	Age	SL	SW	SHA	SHM	SHP	SIGNIFICANCE
Mushrath et al	Bangladesh	CT	166 M-108 F-58	-	8.63 8.2	8.4 8.6	7.2 6.9	6.6 6.4	6.9 6.7	NS
Yasin et al	Turkey	CT	54 M- 29 F-25	-	10.92 10.72	11.8 11.84	-	7.8 7.6	-	NS
Ozan et al	Turkey	CT	101 M- 60 F- 41	17-70 yrs	9.64 8.5	10.86 9.75	8.0 8.1	7.7 7.7	7.5 7.4	S SL
Haider et al	Malaysia	CT	183 M- 113 F-70	0-35 yrs	8.46	8.21	7.41	7.4	7.44	S SHA
Present study	INDIA KARNATAKA	CT	1650 M- 781 F- 869	21 – 70 yrs	8.85 8.77	10.8 10.8	3.9 3.9	8.5 8.5	4.02 4.02	NS

*All the measurements are in millimeter. M- Male, F-Female, YRS- Years, SL- Sellar Length, SW- Sellar Width, SHA-Sellar Height Anterior, SHM- Sellar Height median, SHP- Sellar height posterior, NS- Non Significant, S- Significant, G- Gender, CT- Computed Tomography

Table no 28. COMPARISION OF MORPHOMETRY OF SELLA TURCICA OF PRESENT OBSERVE WITH PROCEEDING OBSERVE ACCOMPLISHED IN CADAVERS WITH EXTRORDINARY TECHNIQUES

Author	Study population	Method	Sample size	Age	SL	SW	SHA	SHM	SHP	SIGNIFICANCE
Ruiz et al	Brasil	CT skull	100 skulls M-53 F- 47	18-60 yrs	10.31	-	-	6.31	-	NS
Ashraf m et al	Saudi Arabia	Vernire caliper	Cad skull 36 M-22 F- 14	-	10.77 11.57	11.23 11.57	-	10.0 9.5	-	S AP
Subhadradevi et al	Andhrapradesh	Postnatal cadavers	64	11-70 yrs	8-14	-	-	6-11	-	NS
Present study	INDIA KARNATAKA	CT	1650 M- 781 F- 869	21 – 70 yrs	8.85 8.77	10.8 10.8	3.9 3.9	8.5 8.5	4.02 4.02	NS

***All the measurements are in millimeter. M- Male, F-Female, Yrs- Years, SL- Sellar Length, SW- Sellar Width, SHA-Sellar Height Anterior, SHM- Sellar Height median, SHP- Sellar height posterior, NS- Non Significant, S- Significant, , CT- Computed Tomography**

Table no 29. COMPARISION OF MORPHOLOGICAL VARIATIONS OF SELLA TURCICA OF PRESENT STUDY WITH PREVIOUS STUDY DONE BY X RAY AND CT SCAN METHOD.

Author	Study population	Method	Sample size	Normal	OAW	STB	DCF	IPW	PYR
Alkofide et al	Saudi Arabia	X ray	190	127	17	02	16	23	05
Ahasan et al	Pakistan	X ray	180	119	07	00	10	30	14
Mushrath et al	Bangladesh	CT	166	69	4.8	6.6	0	16.2	3
T Nagaraj et al	Karnataka Bangalore	X ray	200 M-100 F-100	37 56	34 24	09 06	04 03	06 08	10 03
Chuavan et al	Delhi	X ray	180 M-90 F- 90	28%	23%	17%	7%	18%	00
PRESENT STUDY	INDIA	CT	1650 M- 781 F- 869	1485	132	-	-	-	33

*M-Male. F-Female,OAW- Oblique Anterior Wall, STB- Sella Turcica Bridging, DCF-Double Contour of the Floor, IPW- Irregular Posterior Wall, PYR- Pyramidal, CT- Computed Tomography.

Table no 30. COMPARISION OF SHAPES OF SELLA TURCICA OF PRESENT STUDY WITH PREVIOUS STUDY DONE BY CT METHOD.

Author	Study population	Method	Sample size	OVAL	ROUND	FLAT
Mushrath et al	Bangladesh	CT	166	48.1%	23.4%	28.3%
Yasin yasa et al	Turkey	CT	85 M- 22 F -63	5.6%	53.7%	40.7%
Ruiz et al	Brasil	CT	100 skulls M- 53 F- 47	48%	41%	11%
PRESENT STUDY	INDIA	CT	1650 M- 781 F- 869	66.48%	25.33%	8.18%

***CT- Computed Tomography.**

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CHAPTER NO 7

SUMMARY AND CONCLUSION

**COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF
SELLA TURCICA – IN NORTH KARNATAKA REGION.**

2019

SUMMARY:

The study included 1650 subjects from patients visiting department of Radiology SNMC and HSK hospital, Bagalkot for CT scan of PNS and brain covering sellar region. Out of 1650 subjects 781(47%) were males and 869(53%) were females.

All the parameters of sella turcica were analysed by using radiant dicom viewer software. The morphology of sella turcica had been calculated by the method described by Andredaki M (2007). The morphological variations has been analysed by a method explained by Stefen a et al (2004). The normal sella turcica morphology reported by camp et al (1923) was used for shape analysis and comparison. Results were then statistically analysed.

1. 90% of the subjects had a normal sella turcica
2. 65% of the subjects had oval shaped sella turcica and 8.18% subjects had flat shaped sella turcica.
3. The mean dimensions of sella turcica includes sellar length 8.8 mm, sellar width 10.83 mm , sellar height anterior 3.9 mm, sellar height median 8.52 mm, sellar height posterior 4 mm in adults .
4. There was no change in dimensions of sella turcica after the adult age.
5. No significant difference was observed among the male and female age groups and in between the two genders.

CONCLUSION:

The result of this study will become normative reference standard dimensions for adult human sella turcica and that could assist in more objective evaluation and detection of pathological conditions of sella turcica and pituitary gland.

These findings would also act as guidelines for the radiologist to interpret well and also guide the neurosurgeons in planning surgical procedures involving sellar region.

SCOPE FOR FURTHER STUDY

- Study of morphology of sella turcica co relating with pathological conditions.

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Annexure -I

PLAGIARISM VERIFICATION CERTIFICATE

- 1. Name of the Student: MR. LOHIT. SHARMA.....Reg No. 14PHD005
- 2. Title of the Thesis: Computed tomographic study of morphometry of sella turcica - in north Karnataka Region.
- 3. Department: Anatomy
- 4. Name of the Guide & Designation: DR B.G. Patil, Professor
- 5. Name of the Co Guide & Designation: DR. S.I. KOLAGI, Professor

The above thesis was verified for similarity detection. The report is as follows:

Software used TURNITIN..... Date: 13-07-2019
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The report is attached for the review by the Student and Guide.
 The plagiarism report of the above thesis has been reviewed by the undersigned.
 The similarity index is below accepted norms.

The similarity index is above accepted norms, because of following reasons:
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The thesis may be considered for submission to the University. The software report is attached.

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 B.L.D.E. University's
 Shri B.M. Patil Medical College,
 Mayapata, 586103, 2017
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 Name & Designation
DR. S.I. KOLAGI
 Professor & HOD
 Dept. of Anatomy
 S. N. Medical College
 BAGALKOT

[Signature]
 Signature of Student



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(Declared vide notification No. F.9-37/2007-U.3 (A) Dated. 29-2-2008 of the MHRD, Government of India under Section 3 of the UGC Act,1956)

The Constituent College

SHRI. B. M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE

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April 10, 2015.

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

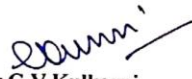
The Ethical Committee of this University met on 16th March 2015 at 11 AM to scrutinize the Synopsis / Research projects of Postgraduate student / Undergraduate student / Faculty members of this University / college from ethical clearance point of view. After scrutiny the following original / corrected & revised version synopsis of the Thesis / Research project has been accorded Ethical Clearance.

Title "Computed tomographic study of morphometry of sella turcica in North Karnataka region."

Name of P.A.D./ P. G. / U. G. Student / Faculty member. Mr.Lohit Shaha Department of Anatomy.

Name of Guide : Dr.B.G.Patil. Professor Department of Anatomy.

Dr. Sharada Metgud
Chairperson, I.E.C
BLDE University,
VIJAYAPUR – 586 103


Dr.G.V.Kulkarni
Secretary, I.E.C
BLDE University,
VIJAYAPUR – 586 103.

Note:-Kindly send Quarterly progress report to the Member Secretary.

Member Secretary,
Institutional Ethical Committee,
BLDE University, BIJAPUR.

Following documents were placed before Ethical Committee for Scrutinization

- Copy of Synopsis / Research project
- Copy of informed consent form
- Any other relevant documents.



Smt. Bangaramma Sajjan Campus, Sholapur Road, Vijayapur – 586103, Karnataka, India.

University: Phone: +918352-262770, Fax: +918352-263303, Website: www.bldeuniversity.ac.in, E-mail: office@bldeuniversity.ac.in
College: Phone: +918352-262770, Fax: +918352-263019, Website: www.bldeuniversity.ac.in, Email: bldeuniversity.ac.in

B.V.V. Sangha's
S. Nijalingappa Medical College & Hanagal Shri Kumareshwar Hospital & Research Centre
Navanagar, Bagalkot-587102, Karnataka State, India.

(Recognized by Medical Council of India and Affiliated to Rajiv Gandhi University of Health Sciences, Karnataka)

SNMC-INSTITUTIONAL ETHICS COMMITTEE ON HUMAN SUBJECTS RESEARCH

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Office of the Institutional Ethice Committee

Ref. No. :

Date:

File No: SNMC/IECHSR/2015-16/A-09-1.1

Date: 26/08/2015

To:

Dr. Lohit V. Shaha
Tutor,
Department of Anatomy,
S.N. Medical College,
Bagalkot-587102

Topic of Protocol: "COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF SELLA TURICA – IN NORTH KARNATAKA REGION."

Subject: Approval for conducting the above reference study and the related documents by IEC.

Dear Dr. Lohit,

The Ethics Committee (EC) meeting of SNMC was held on Saturday, 22nd August, 2015 at 9.30 AM in Medical Education Department Conference hall of S. Nijalingappa Medical College & Hanagal Shri Kumareshwar Hospital & Research Centre, Bagalkot.

Following members of the committee were present:

- | | |
|---|------------------|
| 1. Dr. S. L Hoti, Scientist-F, Officer-in-charge, RMRC, Belgaum. | Chairman |
| 2. Dr. Chandrashekhar V.M., Professor of Pharmacology, HSK College of Pharmacy, Bagalkot. | Member |
| 3. Dr. Lalita D. Hiremath, Professor of Community Medicine, SNMC, Bagalkot. | Member |
| 4. Dr. Anita Herur, Associate Professor of Physiology, SNMC, Bagalkot. | Member |
| 5. Dr. Ashalata Mallapur, Prof.&HOD of OBG, SNMC, Bagalkot. | Member |
| 6. Dr. Chandrashekharayya S. Hiremath, Associate Professor of ENT, SNMC, Bagalkot | Member |
| 7. Mr. Veeresh Athani, Near Sharada Lodge, Bagalkot. | Member |
| 8. Mr. Suresh Revadigar, Advocate, Near Lions School, Extension Area, Bagalkot. | Member |
| 9. Mr. D. G. Bannur, Holebasaveshwar Nilaya, 10th Cross, Vidyagiri, Bagalkot. | Member |
| 10. Dr. Sanjeev Ratna, Professor of Biochemistry, SNMC, Bagalkot. | Member Secretary |

The Ethical Committee of SNMC reviewed the following documents:

1. Research Protocol entitled "COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF SELLA TURICA – IN NORTH KARNATAKA REGION." Version 1.1 and related documents.

Contd.....2

B.V.V. Sangha's
S. Nijalingappa Medical College & Hanagal Shri Kumareshwar Hospital & Research Centre
Navanagar, Bagalkot-587102, Karnataka State, India.

(Recognized by Medical Council of India and Affiliated to Rajiv Gandhi University of Health Sciences, Karnataka)

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Date:

— 2 —

2. Information sheet for patients participating in the research (Consent Form –I):
“COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF SELLA TURICA –
IN NORTH KARNATAKA REGION.” and Certificate of Consent for Patients to Sign;
English version (Consent Form –II).
3. Information sheet for patients participating in the research (Consent Form –I):
“COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF SELLA TURICA –
IN NORTH KARNATAKA REGION.” and Certificate of Consent for Patients to Sign;
Kannada version (Consent Form –II).

Discussion points:

After reviewing the documents submitted by The Principal Investigator, the Committee has decided to grant approval for conducting the above reference study and related documents through 25th August, 2016 (for the period of one year).

You are requested to report to the Ethics Committee the Following:

1. Calculate the sample size based on the previous two months CT scans data and 6-
months onwards from the date of IEC approval and submit it to IEC.
2. Progress of the study at the end of 6 months.
3. Provide a report to the Ethics Committee on completion of the study.

The Ethical Committee of SNMC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice), schedule Y and all other applicable Indian regulations.

If you have any Questions concerning the above, Please feel free to contact undersign.

Thanks & Regards,



(Dr. Sanjeev Ratna)
Member Secretary

**Member Secretary,
IEC
S. N. Medical College
BAGALKOT**

ಬ.ವಿ.ವಿ.ವ. ಸಂಘದ
ಎಸ್.ನಿಜಲಿಂಗಪ್ಪಾ ವೈದ್ಯಕೀಯ ಮಹಾವಿದ್ಯಾಲಯ ಮತ್ತು ಎಚ್.ಎಸ್.ಕೆ ಆಸ್ಪತ್ರೆ ವ ಸಂಶೋಧನಾ ಕೇಂದ್ರ
ನವನಗರ ಬಾಗಲಕೋಟೆ

ಅನಾಟಮಿ ವಿಭಾಗ

COMPUTED TOMOGRAPHIC STUDY OF MORPHOMETRY OF SELLA TURCICA IN NORTH
KARNATAKA REGION.

ಸಂಶೋಧನಾ ಒಪ್ಪಿಗೆ ಪತ್ರ

ಅನುಕ್ರಮ ಸಂಖ್ಯೆ: _____
ರೋಗಿಯ ಹೆಸರು: _____ ವಯಸ್ಸು/ಲಿಂಗ _____
ವಿಳಾಸ: _____
ವೈದ್ಯಕೀಯ ಗುಣಲಕ್ಷಣಗಳು: _____
ದಿನಾಂಕ: _____ ಸಮಯ: _____
ಸಿ.ಟಿ ಸ್ಕ್ಯಾನ್ Brain/PNS: _____

- ವಿಧಾನ ಸ್ವರೂಪ, ಲಾಭ ಮತ್ತು ಅಪಾಯ ಸ್ವರೂಪವನ್ನು ನನ್ನ ಭಾಷೆಯಲ್ಲಿಯೇ ನನ್ನೊಂದಿಗೆ ವಿವರಿಸಲಾಗಿದೆ.
- ಪ್ರಮುಖ ಸಂಶೋಧಕರು ವೈದ್ಯಕೀಯ ಚಿತ್ರಗಳನ್ನು ಮತ್ತು ಮಾಹಿತಿಯನ್ನು ಭವಿಷ್ಯದಲ್ಲಿ ಪತ್ರಕೆಯಲ್ಲಿ, ಕಾನ್ಸರನ್ಸ್ ಮತ್ತು ಪ್ರಕಟನೆಯಲ್ಲಿ, ಶೈಕ್ಷಣಿಕ ಬಳಕೆಯಲ್ಲಿ, ಪ್ರಸ್ತುತ ಉದ್ದೇಶಕ್ಕಾಗಿ ಬಳಸಿಕೊಳ್ಳುವ ಬಗ್ಗೆ ವಿವರಿಸಿದರು. ಹಾಗೂ ನನಗೆ ಮನವರಿಕೊಂಡರು.
- ನನ್ನ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿ ಮತ್ತು ಚಿತ್ರ ಸಂಗ್ರಹದ ಬಗ್ಗೆ ವಿವರಿಸಲಾಗಿದೆ. ನನ್ನ ಮಾಹಿತಿ ಸಂಗ್ರಹಕ್ಕಾಗಿ ಒಪ್ಪಿರುತ್ತೇನೆ.
- ನಾನು ಓದಿ ಮತ್ತು ಈ ಫಾರ್ಮ್ ವಿಷಯ ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ. ಈ ಫಾರ್ಮ್‌ನ ಪ್ರತಿಯನ್ನು ಸ್ವೀಕರಿಸಿರುತ್ತೇನೆ.

ಸಹಿ ಸಾಕ್ಷಿ

ರೋಗಿಯ/ರೋಗಿಯ ಸಂಬಂಧಿಕರ ಸಹಿ

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Computed Tomographic Analysis of Sella Turcica in North Karnataka region

Lohit V. Shaha¹, Babasaheb G. Patil², Sanjeev I. Kolagi³

¹Phd Scholar, Department of Anatomy, Shri B M Patil Medical College and Research Center, BLDE University, Vijayapura- 586103. Karnataka, India

²Professor, Department of Anatomy, Shri B M Patil Medical College and Research Center, BLDE University, Vijayapura- 586103. Karnataka, India

³Professor and HOD, Department of Anatomy, S Nijalingappa Medical College, HSK Hospital and Research Center, Bagalkot – 587103. Karnataka, India

Abstract

Precise anatomical knowledge of sella turcica is utmost importance for radiologist to interpret well; also for neurologist and surgeons operating in sellar region. The present study was undertaken to record the normal dimensions and to determine gender differences in sella turcica morphometry. Two hundred computed tomographic images (116 male and 84 female) of healthy Indians aged 25-70 years were collected. Radiant dicom viewer software was used to determine linear dimensions of sella turcica. Results showed that mean values (in millimeter) of length, width, sellar height anterior, sellar height median and sellar height posterior for males were 8.71, 10.85, 3.87, 8.37, 3.97 respectively; and the same for females were 8.84, 10.95, 3.86, 8.28, 3.95 respectively. There was no significant difference in the above dimensions between male and female sella turcica. The result of present study provides normal morphometric data of sella turcica in this geographic area, which may be useful for further research and clinical manifestation.

Key words: Sella turcica, Computed tomography, Linear dimensions, Morphometry.

INTRODUCTION

Sella turcica is an important structure of middle cranial fossa and is bounded by dura of cavernous sinuses bilaterally, the lamina dura and dorsum sellae posteriorly and the tuberculum sellae and planum sphenoidale anteriorly[1].

The importance of size and shape of sella turcica in connection with the occurrence of symptoms of pituitary diseases has long been recognized. The radiographic differential diagnosis of large sella includes adenomas, Rathke's cleft cyst and aneurysms[2]. Anomalies of sellar region may create confusion in evaluation of Magnetic Resonance Imaging or Computed Tomography and also in regional surgery planning. Removing the anterior clinoid process is an important step in exposing the structure in the cavernous sinus and is highly complicated due to the neuronal and vascular relationship.

The CT scan is superior option than the X-ray to study bony parameters. The purpose of this study is to determine the average size of sella turcica in Indian population that could assist in more objective evaluation and detection of pathological conditions. The study has been undertaken to establish normative reference standard of sellar morphometry and to look for sexual dimorphism of sella turcica.

MATERIALS AND METHODS

After obtaining Institutional ethical clearance, 200 Computed tomographic images of skulls covering sellar region from patients of age group between 25-70 years of both the genders (male-116 and female-84) from Department of Radiology, S. N. Medical College and HSK hospital and RC, Bagalkot, were analyzed for the sellar morphology by using radiant dicom viewer software. CT of normal brain, PNS covering sellar region and CT images having clear visualization with recognition of dorsum sellae

and tuberculum sellae were included in this study. Road traffic accident cases, head injury cases and poor quality images were excluded.

The following measurements were calculated (FIGURE 1):

- Sellar length:** was measured as the distance from the tuberculum sellae to the posterior clinoid process.
- Sellar width** (anteroposterior greatest diameter): was measured from the sellar anterior to sellar posterior.
- Sellar height :**

Sellar height anterior: was calculated by using vertical distance, as measured perpendicular to Frankfort horizontal from tuberculum sellae (TS) to sellar floor.

Sellar height median: was calculated by using vertical distance, as measured perpendicular to Frankfort horizontal from a point midway between TS and posterior clinoid process (PCLin) to sellar floor.

Sellar height posterior: was calculated by using vertical distance, as measured perpendicular to Frankfort horizontal from PCL in to sellar floor[4].

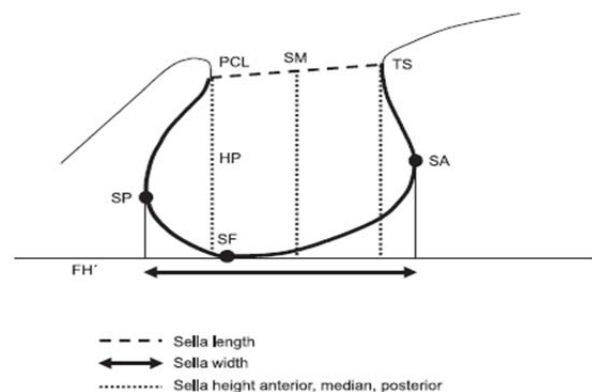


Figure 1. Schematic guide for measurements of sella turcica

Table 1. Linear dimensions of sella turcica in both genders.

Parameters	Male (Mean±SD)	Female (Mean±SD)
Length of sella turcica	8.71±1.73mm	8.84±1.93 mm
Width of sella turcica	10.85±1.73mm	10.95±1.91 mm
Sellar height anterior	3.87±0.92 mm	3.86±0.86 mm
Sellar height median	8.37±1.85mm	8.28±1.83 mm
Sellar height posterior	3.97±0.90mm	3.95±0.89 mm

Table 2. Comparison of sella turcica dimensions of present study with the previous studies

Author	Study population	X ray/CT scan	Sex	Sella length (mm)	Sellar width (mm)	Sellar height anterior (mm)	Sellar height median (mm)	Sellar height posterior (mm)
Chavan et al ⁽²⁾	Maharashtra	X ray	M F	11.13 10.73	- -	- -	8.10 7.91	- -
Ruiz et al ⁽³⁾	Brazil	C T	Both	10.31	- -	- -	6.33	- -
Andredaki et al ⁽⁴⁾	Greece	X ray	M F	7.1 7.0	8.9 9.1	6.7 7.2	6.6 6.8	6.6 6.5
Stefan et al ⁽⁵⁾	Norwegia	X ray	M F	8.9 8.4	11.3 11.7	- -	7.3 7.2	- -
Puja et al ⁽⁶⁾	North India	X ray	M F	7.8 7.53	7.3 8.4	15.4 7.5	5.6 7.5	3.4 5.0
Present study	North Karnataka	CT	M F	8.71 8.84	10.85 10.95	3.87 3.86	8.37 8.28	3.97 3.95

RESULTS

Two hundred images were analyzed in this study 58 % (116) of the images were male and the remaining 42% (84) were females and the range of age was 25- 70 years. The results are shown in table 1. There was no statistically significant difference in morphometry of male and female sella turcica.

DISCUSSION

Various studies were done on sellar morphometry by using lateral cephalograms. There were different opinions regarding sexual dimorphism in sella turcica morphology by various authors[3-6]. Morphology of sella turcica of present study has been compared with previous study is shown in table 2.

According to chavan et al, average mean length and depth of sella in males were 11.13 mm, 8.10mm and in females, mean length and depth were 10.73mm, 7.91mm respectively[2]. In the present study average mean length and depth of sella in males were 8.71mm, 8.37mm and in females, mean length and depth were 8.84mm, 8.28mm respectively. CT study on dry skulls by Ruiz et al revealed average mean length of sella was 10.31mm, depth was 6.33mm and the average mean area of sella was 41.12 sq.mm[3].

Andredaki et al studied morphometry of sella turcica in the age group of 6-17 years, mean length in males and females was 7.2mm and 7.0mm, the mean depth in males and females was 8.9mm and 9.2mm. Anterior height was significantly more in females[4]. A similar study done by Stefen et al does not correlate with the findings of the

above study. No difference between males and females were detected for the depth and diameter of sella turcica, but length was larger in males throughout the observation period; the female subjects had slightly more sella turcicas with abberent morphology[5]. Similar result was obtained in the present study; there was no statistically significant difference in morphometry of male and female sella turcica. Puja et al found that there was significant difference in linear dimensions between the genders in sellar height and width[6].

Increased sellar dimensions in pituitary adenomas were noted by Chang et al[7]. Gilhotra et al mentioned the sellar morphometry also changes in chronic obstructive pulmonary disorder[8]. Sanjeev et al found that sellar bridge formation were two times more common on right side than left side[9].

CONCLUSION

The result of this study will serve as a normative reference standard that could assist in more objective evaluation and detection of pathological conditions of sella turcica and pituitary gland. These findings would also help the radiologist to interpret well and also guide the neurosurgeons in planning surgical procedures involving sellar region.

SCOPE FOR FURTHER RESEARCH

This study has been done with 200 samples, the authors plan to go ahead with this study taking more samples and including other morphology parameters such as area, shape and morphological variations of sella turcica.

ACKNOWLEDGEMENT:

The authors express deep sense of gratitude to Dr. B. M. Bannur, Professor and Head, Department of Anatomy, Sri B. M. Patil Medical College, BLDE University, Vijayapura for the support and guidance.

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The normal dimensions of the Sella Turcica in North Karnataka region- A Computed tomographic study

Lohit V Shaha^{*}, Babasaheb G Patil^{**}, Sanjeev I Kolagi^{***}

Abstract

Aim of the study: Sella turcica is an important structure in middle cranial fossa. It is a saddle shaped concavity in the body of sphenoid bone. It is bounded by dura of cavernous sinuses bilaterally, the lamina dura and dorsum sellae posteriorly and the tuberculum sellae and planum sphenoidale anteriorly. The present study was undertaken to study the normal dimensions of sella turcica morphometry.

Material and methods: This observational study was conducted in S Nijalingappa medical college and HSK hospital, Bagalkot. 1650 computed tomographic images of healthy Indians aged 21-70 years were collected. Radiant Dicom viewer software was used to determine the linear dimensions of sella turcica. Data was analysed using t test and ANOVA with Epi Info software.

Results: The mean values (in millimeter) of length, width and height of sella turcica in different age groups was 8.80 ± 1.65 , 10.83 ± 1.35 and 8.52 ± 1.50 .

Conclusion: The dimensions of sella turcica vary in different populations and these findings could form an initial database for Indian population which may provide a good anatomical knowledge during objective evaluation and detection of pathological conditions of sella turcica and hypophysis cerebri.

Key words: Sphenoid bone, Linear dimensions, Hypophysis cerebri

Introduction

Sella turcica is an important structure in middle cranial fossa. It is a saddle shaped concavity in the body of sphenoid bone. Sella turcica gets its name from Turkish language because of its similarity to the hypophyseal fossa. The pituitary gland is situated in the hypophyseal fossa. It is bounded by dura of cavernous sinuses bilaterally, the lamina dura and dorsum sellae posteriorly and the tuberculum sellae and planum sphenoidale anteriorly (1,2,3)

The importance of morphometry of sella turcica in connection with occurrence of symptoms of pituitary gland diseases has long been recognized. Microsurgery is required for effective and

safe treatment of various pituitary disorders such as macroadenomas or craniopharyngiomas. All anatomical details concerning the possible variants of sellar region must be taken into account by neurosurgeons in order to decide the surgical approach (transfrontal, transethmoidal, transsphenoidal, sublabian or endonasal) to be chosen (4)

The enlarged sella turcica on a radiograph has been found to be associated with adenomas, meningiomas, primary hypothyroidism, prolactinoma, gigantism, acromegaly, empty sella syndrome and Neison's syndrome. A small size may lead to decreased pituitary function causing symptoms such as short stature and retarded skeletal growth(5)

The computed tomography (CT) scan is superior option than X-ray to study the bony parameters. The aim of this study was to determine the average dimensions of sella turcica in different age groups.

Materials and Methods

The radiographic study was conducted after obtaining Institutional ethics committee clearance, during a time period of two years from December 2015 to November 2017. The study included 1650 computed tomographic images of skull covering sellar region from the patients of age group between 21-70 years of both the genders from the department of radiology of S Nijalingappa medical college and HSK hospital, Bagalkot, Karnataka and were grouped into five categories based on the age, i.e., 21-30, 31-40,

* Phd Scholar, ** Professor,

Department of Anatomy, Shri B M Patil Medical College and Research Center, BLDE (Deemed to be University), Vijayapura- 586103. Karnataka, India

*** Professor and HOD, Department of Anatomy, S Nijalingappa Medical College, HSK Hospital and Research Center, Bagalkot – 587103. Karnataka, India

Address for correspondence :

Lohit V Shaha

Phd Scholar, Department of Anatomy,

Shri B M Patil Medical College and Research Center,

BLDE (Deemed to be University),

Vijayapura 586103. Karnataka, India

E mail – drlohitshaha83@gmail.com Mobile no - 9986289021

41-50, 51-60 and 61-70 years respectively. The images were analyzed for sellar morphology by using Radiant dicom viewer software.

Inclusion criteria

CT of normal brain.

CT of normal PNS covering the sellar region.

CT images having clear visualization.

Exclusion criteria

Head injury cases.

Road traffic accident cases.

CT images having poor quality.

The following measurements were calculated (FIGURE 1)

1. **Sellar length:** was measured as the distance from the tuberculum sellae to the posterior clinoid process.
2. **Sellar width:** (anteroposterior greatest diameter): was measured from the sellar anterior(SA) to sellar posterior(SP).
3. **Sellar height :** was calculated by using vertical distance, as measured perpendicular to Frankfort horizontal(FH) from a point midway between Tuberculum sellae and posterior clinoid process (PClin) to sellar floor (6).

Table 1. Age wise distribution of sella turcica parameters

Parameters	N	Mean	SD	Min	Max	p value	Significance
Sellar length (mm)							
21 – 30 years	568	8.71	1.66	5.3	13.7	0.56	ns
31- 40 years	427	8.73	1.64	5.1	13.8	0.42	ns
41- 50 years	217	8.98	1.60	5.6	13.2	0.93	ns
51-60 years	254	8.80	1.59	5.6	13.4	0.38	ns
61- 70 years	184	9.06	1.76	5.5	13.6	0.5	ns
Total	1650	8.80	1.65	5.1	13.8		
Sellar width (mm)							
21 – 30 years	568	10.83	1.35	7.2	15.5	0.94	ns
31- 40 years	427	10.74	1.34	7.7	15.6	0.74	ns
41- 50 years	217	10.97	1.28	7.3	14.2	0.82	ns
51-60 years	254	10.75	1.36	7.2	15.2	0.07	ns
61- 70 years	184	11.0	1.46	7.4	15.4	0.9	ns
Total	1650	10.83	1.35	7.2	15.6		
Sellar height (mm)							
21 – 30 years	568	8.46	1.46	5.3	13.2	0.07	ns
31- 40 years	427	8.41	1.52	5.3	13.3	0.2	ns
41- 50 years	217	8.57	1.41	4.2	13.2	0.84	ns
51-60 years	254	8.55	1.48	5.3	12.6	0.82	ns
61- 70 years	184	8.85	1.68	4.2	13.2	0.81	ns
Total	1650	8.52	1.50	4.2	13.3		

N- Number of individuals, SD-standard deviation, ns- not significant

Statistical analysis: Data collected was tabulated in microsoft excel and was analysed by Epi Info software. Categorical outcomes were summarized by rates (%) and proportions and numerical outcomes were summarized by mean \pm SD. The t test and ANOVA were used to test the difference between means.

Results

1650 images were analyzed in this study and the range of age was 21- 70 years. The results are shown in table 1. There is no statistical significance in the sellar length, sellar width, and sellar height in different age groups.

Discussion

Numerous studies have been done on size of sella turcica, however methods differ widely. Quakinine and Hardy performed a microsurgical anatomical study on 250 sphenoidal blocks obtained from cadavers of different ages, they found the average

transverse width of sella was 12mm, the length 8mm and average height 6mm(7). The size of sella turcica was studied by Axlessen et al in a Norwegian of ages 6-21 years. In their study the sellar length was almost constant and diameter increased with the age(8), It was observed that linear dimensions of sella turcica almost constant in our study. Terditis et al conducted a study on 325 orthodontic patients of 6-49 years of age. They measured linear dimensions on lateral cephalogram, the anteroposterior diameter ranges from 6.0 to 17.0mm, mean value was found to be 10.9 ± 1.8 mm and the depth varied from 2.5 to 12.5mm with a mean of 7.6 ± 1.7 mm(9). Camp conducted a the study on adults(10) and reported the values for the width (termed as length in the present study) and value for height (termed as depth in the present study), as being 10.6mm and 8.1mm, compared to 8.8mm & 8.52mm in the present study.

The linear dimensions were on an average 1.2mm to 2.25mm larger in the present study, when it was compared to a Jordians sample(11).

These discrepancies can be due to difference in method and ethnic origin.

Conclusion

The findings of this study form an initial database for Indian population which may provide a good anatomical knowledge during objective evaluation and detection of pathological condition of sella turcica and hypophysis cerebri. These findings also guide the neurosurgeons in planning surgical procedures involving sellar region. The results of present study of sellar size may be used as reference guide for future studies about sella turcica morphology.

Acknowledgement

The authors express deep sense of gratitude to Dr. B. M. Bannur, Professor and Head, Department of Anatomy, Sri B. M. Patil Medical College, BLDE (Deemed to be University), Vijayapura for the support and guidance.

Source of support : This study has not utilized any financial assistance from any source.

Conflict of Interest : The authors clearly states that they do not have any conflict of interest.

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