TO EVALUATE THE MORPHOLOGY OF SOFT PALATE CORRELATING WITH AGE AND GENDER: A DIGITAL CEPHALOMETRIC STUDY

DISSERTATION

Submitted to

BABU BANARASI DAS UNIVERSITY, LUCKNOW,

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MASTER OF DENTAL SURGERY

In

ORAL MEDICINE AND RADIOLOGY

By

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BATCH: 2018-2021

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I hereby declare that this dissertation entitled **" To Evaluate the Morphology of Soft Palate correlating with Age and Gender: A Digital Cephalometric Study"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Saurabh Srivastava**, Reader, Dept of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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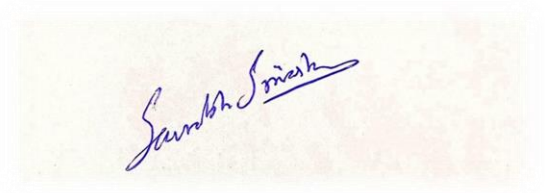

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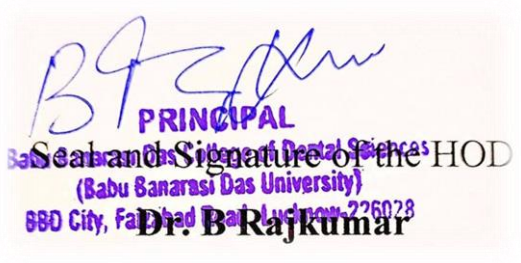

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ACKNOWLEDGEMENT

GRATITUDE CAN TRANSFORM COMMON DAYS INTO THANKSGIVING, TURN ROUTINE JOBS INTO JOY, AND CHANGE OPPORTUNITIES INTO BLESSINGS.

-WILLIAM ARTHUR WARD

The words are few and language seems feeble when heart is full of gratitude.

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" A teacher is next only to God as he imparts the two most important attributes of life – Knowledge and Wisdom."

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- **Dr. Himanshi**

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF GRAPHS

LIST OF ANNEXURES

ABBREVIATIONS

- BBDCODS - Babu Banarasi Das College of Dental Sciences
- BBDU - Babu Banarasi Das University
- OMR - Oral Medicine and Radiology
- F.O. - Forensic Odontology
- OSA - Obstructive Sleep Apnea
- OSMF - Oral Submucous Fibrosis
- VL - Velar Length
- VW - Velar Width
- CT - Computed Tomography
- MRI - Magnetic Resonance Imaging
- CBCT - Cone Beam Computed Tomography
- UAD - Upper airway diameter
- MP-H - Mandibular-to-hyoid bone distance (MP-H).

ABSTRACT

INTRODUCTION

The oral cavity is an intricate phenomenon with sophisticated details and varied functions, and a thorough understanding of normal anatomy and anomaly that helps in diagnosis and successful treatment of many complex cases. Soft palate is a major part of oral cavity that helps in diagnosing different velar incompetency like cleft palate, OSA, OSMF etc. with the help of clinical examination and radiographic examination like lateral cephalogram.

AIM

The aim of the study is to evaluate the morphology of the soft palate by digital lateral cephalometry in representative Lucknow population.

OBJECTIVES

- To investigate the velar morphology in different age groups using digital lateral cephalogram.
- To investigate the differences in the velar morphology between both gender using digital lateral cephalogram.
- To correlate the various morphological aspects of soft palate with snoring.

MATERIALS AND METHOD

The study sample consisted of 200 patients from both genders. All the enrolled subjects will be grouped into four. For gender and age determination, the subjects will be selected according to the inclusion and exclusion criteria. Morphology of soft palate will be categorized based on radiographic analysis. For snoring, a predilection for developing OSAS was evaluated by asking for snoring to the close relatives of the patient.

RESULTS

In the present study, velar morphology was classified into six type, the correlation of soft palate morphology (length, width and type) with snoring habits was recorded and found that, in Lucknow population, soft palate length is associated with snoring but both width and shape were found not to be associated with it.

CONCLUSION

It can be concluded that lateral cephalogram can be efficiently used to assess the morphology of soft palate.

KEYWORDS: Soft Palate, OSA, Lateral Cephalogram, Snoring**,**

INTRODUCTION

The oral cavity is an intricate phenomenon with sophisticated details and varied functions, and a thorough understanding of normal anatomy, and anomaly that helps in diagnosis and successful treatment of many intriguing cases. Oral cavity is restricted by the palate, the floor of the mouth, the cheeks and therefore the lips, also as by the uvula and therefore the palatine arches on each side of the uvula.[1,2]

The part of the palate posterior to hard palate is made up of fibro – muscular tissue which is known as **soft palate**. During embryogenesis, the fronto – nasal process fuses with two palatine processes leading to the formation of palate. After this, the mesodermal tissue of the palate goes through intramembranous ossification in the anterior portion to configure the hard palate and posterior portion remains as fibromuscular tissue to form the soft palate which separates the nasopharynx from the oropharynx.[3,4] It has an important role in different crucial functions of the oropharyngeal region. It has various morphologies in several diseases, so it is necessary to access and determine the various shapes of the palatal velum in normal patients.[5] It participates in palatopharyngeal opening and closure which helps in normal functions such as sucking, deglutition, respiration, pronunciation, and phonation.[3] Patients with cleft patients, enlarged adenoids, obstructive sleep apnea (OSA), ill-fitting maxillary dentures, oral submucous fibrosis (OSMF), and skeletal malocclusions commonly present with palatopharyngeal deficit.[3,6,7]

The key to successful management of any patient is performing a radical evaluation, which can help in formulating the early diagnosis of any disease. which can be suspected in the dental clinics while taking case history. Obstructive sleep apnea (OSA) is a common medical disorder with potentially severe health and social consequences.[8]

Clinical examination of oral cavity reveals variation in the morphology consistency of the soft palate in normal persons which provides the data helping to determine the variations in the above mention variables of soft palate anatomy in diseased states.

Morphology of soft palates has classified by You at el[9], based on their morphology as Types: 1 (leaf- based), 2 (rat-tail shaped), 3 (butt-like), 4 (straight line), 5 (S-shaped) and 6 (crook shaped).

Clinical visualization of the soft palate becomes inadequate due to limited accessibility of the velopharyngeal region in cases where mouth opening is restricted, therefore, it becomes mandatory to rely on diagnostic methods apart from clinical evaluation / cadaveric observation like, anthropometric studies or utilizing of radiographic methods.[10]

Amongst the various imaging techniques for determining age and gender of a patients in Forensics, lateral cephalogram being a less expensive, more useful, easily achieved radiographic procedure with minimal radiation exposure that can be utilized for the morphometric evaluation of soft palate and surrounding structures.[2]

It can be done in two positions, upright and supine for OSA patients in normal individuals and for the cadavers. Supine position shows much accurate results.[11]

The utilizing of the lateral cephalometric can be done for gender determination using the remains of human skeleton followed by estimation of age, this may be very useful in mass calamities, natural or man – made for the gender and age determination based on the soft tissue and skeletal remains.

Soft palate is one of the major soft tissue in the oral cavity which is a prime determinant in patients of OSMF, in diagnosis of OSA and / or for evaluating the age and gender of a humans. It is an increasingly common, chronic, sleep-related breathing disorder.[12,13,14] which is characterized by periodic narrowing and obstruction of the pharyngeal airway during sleep. Untreated OSA is associated with long-term health consequences including cardiovascular disease,[14] metabolic disorders, cognitive impairment and depression.[15]

The available literature on the different morphologies of the soft palate has never been documented in Lucknow population. Hence, we attempt to study a correlation between different velar morphologies and probe variations with age, gender, and morphometric assessment based on the length and width of the same. The present study also seeks a possible relation between snoring and any particular velar morphology as an indicator for the early diagnosis of obstructive sleep apnea syndrome (OSAS).

AIM AND OBJECTIVES

AIM

The aim of the study is to evaluate the morphology of the soft palate by digital lateral cephalometry in representative Lucknow population.

OBJECTIVE

1) To evaluate morphology of soft palate in different age groups using digital Lateral Cephalogram.
2) To evaluate the morphological details of soft palate in both the genders using digital Lateral Cephalogram.
3) To correlate the various morphological aspects of soft palate with snoring.

REVIEW OF LITERATURE

3.1) Forensic Science

According to Brig. D. V. Taylor (1968), the most accepted definition of forensic dentistry or forensic odontology (FO) is "The application of dental knowledge to the elucidation of legal problems."[16] It was more stated by Keiser–Nielson (1980) as "The branch of forensic medicine which in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of the dental findings."[16] As defined by Margot (2011b, p. 91), ''Forensic science is something which looks at the least likely, fragmented, imperfect, uncontrolled element in an event: the trace. It has to be decrypt and understood to explore for more knowledge about the event..'' In forensic science, the first challenge—that will impact on the entire process — is to recognize and detect the trace since the source or activity that produced it is usually unknown and the event happened in the past.[17]

Skeleton has always aided in genetic, anthropological, odontological and forensic investigation of living and non- living individual[16]. Skull bones and pelvis have been majorly used in sex and age determination. The first phase of forensic is to evaluate the difference in morpho-metric characteristics to identify an individual, and many studies reveal that there exist differences in the skull and other bones of male and female, as well as different age groups[18].

Gender determination is usually the first step of the identification process in any adult skeleton. For medico legal practice, chronological age assessment is an important part. These procedures for age estimation are bit complicated and involve consideration of many factors. Out of all the hard tissues, bones are important as they undergo a lot of changes since birth till adulthood and changes in their composition and structure continue into old age and even after death.[19]

3.2) ROLE OF RADIOGRAPHY IN FORENSICS

To establish identification, radiography plays an important role in forensic odontology. This may take the precise form of comparison between antemortem and post-mortem radiographs. Radiographs may also be taken to determine the age of a minor victim and even help in the assessment of the gender and ethnic group.[20]

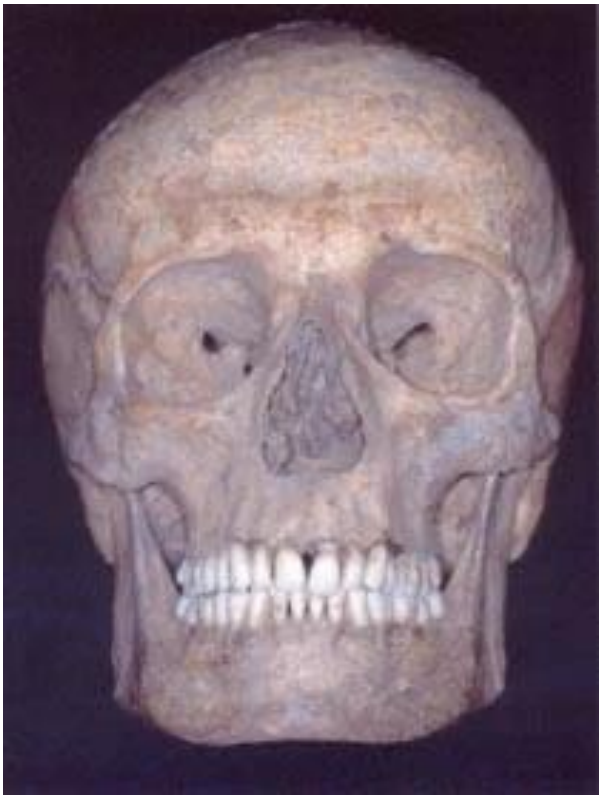
3.2.1) History

Just one year after the discovery of X-Ray by Roentgen, use of radiology in forensic sciences was introduced in 1896 which had showed the presence of lead bullets inside the head of a victim.[21] Schuller[22] in 1921, proposed the possibility of utilizing radiological images of facial sinuses for identification purposes. Hazebroucq[23] et al in 1993, described a system for identification based on osteotomy of maxilla and mandible which can also be used for age determination. Austin and Maples[24] (1994) have described a study for evaluating the accuracy of methods of images superimposition and concludes that with two antemortem radiographs (frontal and lateral view) and without dental data, identification can be made.

3.2.1) Radiography of Skull for Identification

As described above, the remaining parts of soft tissue and skeleton was used to identify genders. After the London Black Death epidemic of 1348, from the wreck of the Mary Rose which sank in 1545, 31 skulls were represented for cephalometric values.

Lateral cephalograms were taken in a movable cephalostat, with the skulls mounted over it, in position upside down to facilitate fixing of the mandible. The Frankfort horizontal line was aligned.. Eleven standard cephalometric points were digitised for direct recording and to find genders. Earlier the radiograms of the modern Group do not contain part of the occipital area of the cranium due to the practice of collimating the X-Ray beam on modern machines. In order to permit calculation of cranial measurement, 3 additional points were recorded on the calvarium outline of each film. These were points on the skull intersected by lines at 45° anteriorly, vertically and 45° posteriorly to the SN plane, based on Sella.[25]



PHOTOGRAPH 1: A Black death skull (frontal view)

PHOTOGRAPH 2: Black death skull (Lateral View)

3.3) SOFT PALATE

It is the fibromuscular part of the palate that is attached to the posterior edge of the hard palate. The soft palate plays a key role in velopharyngeal closure, which refers to the normal apposition of soft palate with posterior and lateral pharyngeal walls. It takes part in most of the oral functions, especially velopharyngeal closure which is related to the normal function of sucking, swallowing, and pronunciation.[26]

3.3.1) Development of Soft Palate [27]

From the medial borders of the maxillary prominences new outgrowth forms that creates the shelves of the secondary palate. These palatal shelves grow downward beneath the tongue, to partially fill the nasal cavities. At about the ninth gestational week, these shelves extend, make contact, and fuse with each other above the tongue.

3.3.2) Anatomy of Soft Palate [28]

Soft palate is a freely movable, muscular fold, attached from the posterior border of the hard palate. It apart the nasopharynx from the oropharynx, and is often looked upon the crossroads between the food and air passages.

The soft palate has two surfaces and two borders, anterior and posterior and superior and inferior, respectively. The anterior surface is concave and is noticeable with median raphe. The posterior surface is convex, and is moving superiorly with the floor of the nasal cavity. The superior border is connected to the posterior border of the hard palate, combining each side with the pharynx. The inferior border is free and not attached with any borders rather bounds the pharyngeal isthmus. From the middle, there hangs a conical projection, called the uvula. Two curved fold membrane extend laterally and downwards, from both side of the base of the uvula. The anterior fold is called the palatoglossal arch or anterior pillar of faucets. It contains the palatoglossus muscle and reaches the side of the tongue at the junction of its oro-pharyngeal parts. This fold forms the lateral boundary of the oropharyngeal isthmus or isthmus of faucets. The posterior fold is called the palatopharyngeal arch or posterior pillar of faucets, which contains the palatopharyngeal muscle and forms the posterior boundary of the tonsillar fossa, merging it inferiorly with the lateral wall of pharynx.

3.3.3) Muscles of the soft palate: [28]

1. Tensor palate (tensor veli palatine)
2. Levator palate (levator veli palatini)

3. Musculus uvulae
4. Palatoglossus
5. Palatopharyngeus

3.3.4) Nerve supply: [28]

1. Motor nerves: all muscles of the soft palate except the tensor veli palatine are supplied by the pharyngeal plexus. The fibers of this plexus are derived from the cranial part of the accessory nerve through the vagus. The tensor veli palatine is supplied by the mandibular nerve.
2. General sensory nerves are derived from:
   a) Posterior lesser palatine nerves
   b) The glossopharyngeal nerve
3. Special sensory or gustatory nerves for taste sensations
4. Secretomotor nerves are also a part of the lesser palatine nerves.

3.3.5) Blood supply: [28]

Arteries -1. Greater palatine branch of maxillary artery

2. Ascending palatine branch of facial artery

3. Palatine branch of pharyngeal artery

Veins- pass through the pterygoid and tonsillar plexuses of veins

Lymphatics- Drain into the upper deep cervical and retropharyngeal lymph node.

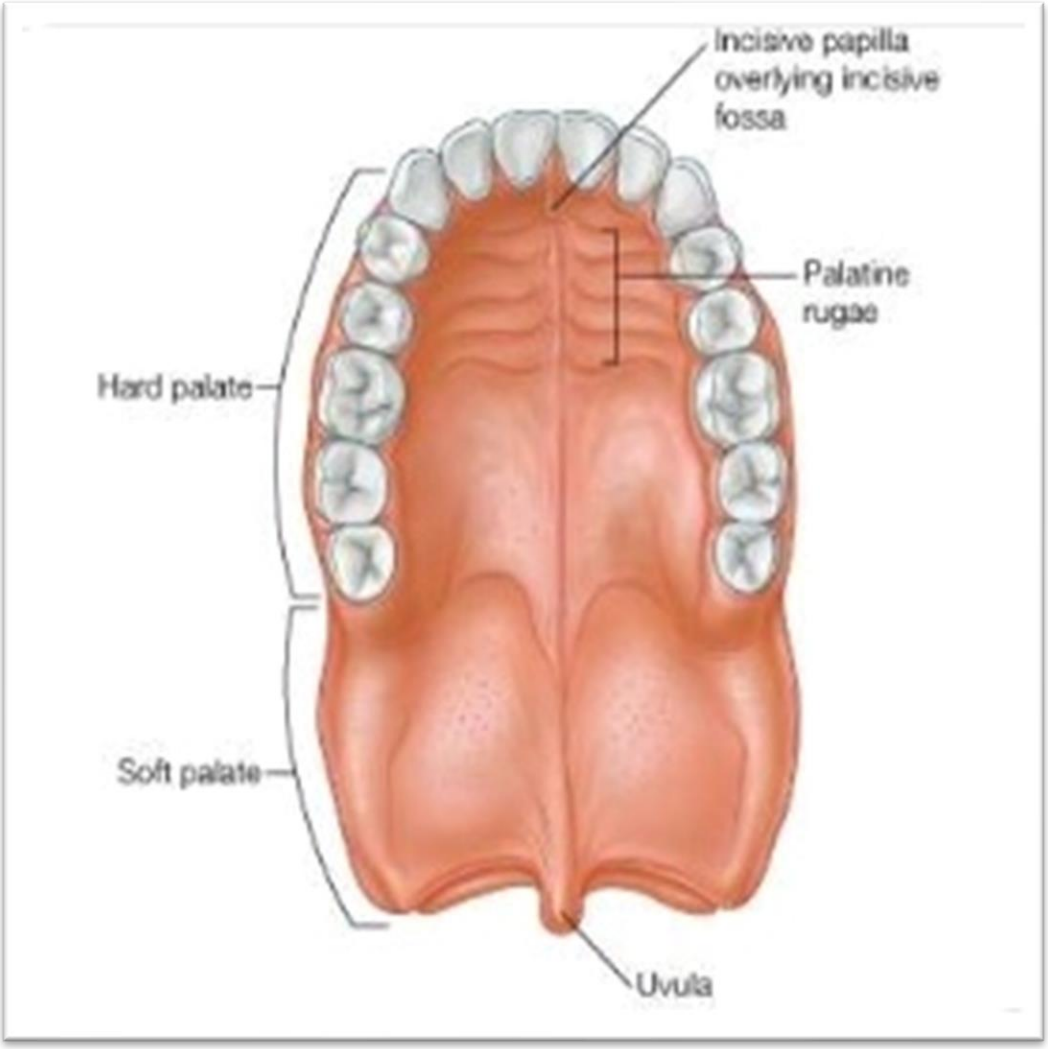


FIGURE - 1: Anatomy of Soft Palate

3.4) MORPHOLOGY OF SOFT PALATE

Six basic types of shapes of the soft palate were seen. This classification is basically on the basis of radiograph, given by **You *et al*.**[9] viz.

• **Type 1: Leaf shaped shaped** - the middle portion of the soft palate was slightly elevated

• **Type 2: Rat-tail shaped** - the soft palate with bulged anterior portion and constricted free border

• **Type 3: Butt-like** soft palate which showed a shorter and fatter appearance

• **Type 4: Linear shaped.**

• **Type 5: S-shaped/twisted/distorted soft palate.**

• **Type 6: Crooked appearance** the posterior most portion of the soft palate hooked up anterior superiorly.

According to **Guttal *et al*.**[5] study **(2012),** there were some additional variants of soft palate found, viz.

• **Type 7: U-shaped soft palate** - Type 2, with blunt end.

• **Type 8:** Variants which did not fit into either of the above-mentioned categories.

In addition to the above-mentioned types, three different types were found in **Nagaraj et al.**[29] study **(2016),** *viz.*

• **Type 9: Cone Shaped.**

• **Type 10: Triangular shape.**

• **Type 11: V shaped.**

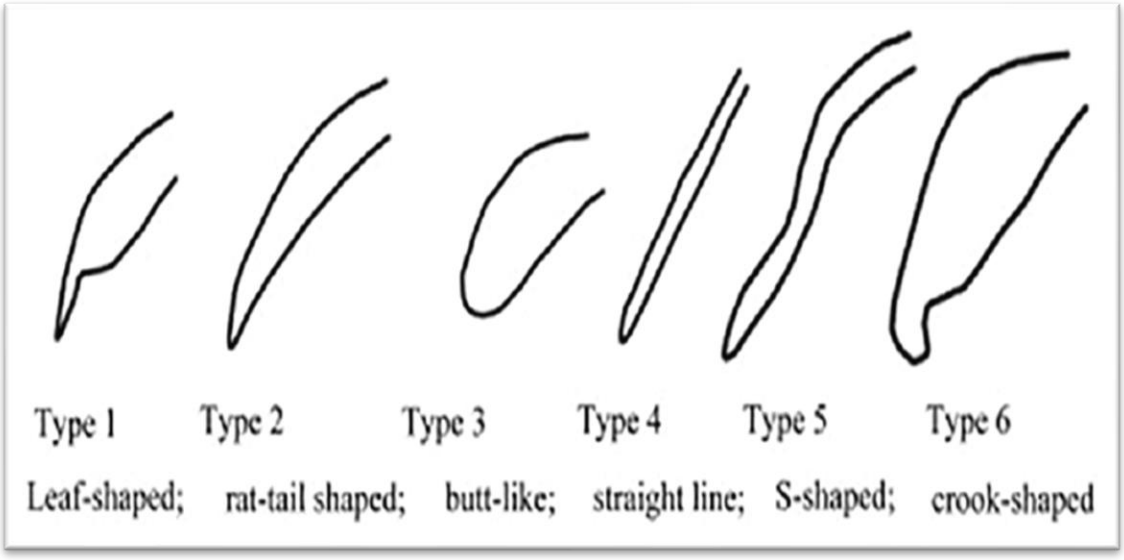


FIGURE - 2: Schematic Representation of different types of Soft Palate according to You et al classification (2008)

You et al in 2008 conducted a study with, the sample comprised of 200 normal subjects whose age ranged from 5 – 48 years (mean 19.37 years). The velar morphology on lateral cephalometry was examined and categorized into six types. The difference in the dimensions of soft palate between each pair of types and in proportion to different age and gender groups were also studied. There was seen a significant difference between the pre-adult and adult

groups and also between male and female groups in proportion to velar length. However, there was no significant difference between any two of the other 5 types.[9]

Praveen BN, Amrutesh Sunita, Pal Sumona, Shubhasini AR, Vaseemuddin Syed in 2011 done his study with sample of 80 patients, whose age ranged from 9 to 31 years. Velar shape was examined on digital cephalograms and was allocated to one of the six pattern as described by You et al. The difference in proportion and between genders were studied and classified soft palate into six types based on radiographic appearance. Type – 2 rat tail shape soft palate is the most common type observed in both the genders. There is no significant differences in proportion of various shapes of soft palate between genders.[30]

Verma P, Verma KG, Kumaraswam KL, Basavaraju S, Sachdeva SK, Juneja S in 2014 was aimed to observe the differences in the morphology of soft palate in both the genders. The correlations of radiographic velar length (VL), velar width (VW) with soft palate variants were studied. The study sample consisted of 300 subjects with the age group between 15 and 45. The soft palate morphology on lateral cephalograms was examined and classified into six types. The most frequent type of soft palate was leaf shaped (48.7%), and the least common was crook shaped (3.0%) among both the genders.[31]

Smriti Komal, Pal Keerthilatha Murali Dhar, Vineetha Ravindranath, Pentapati Kalyana Chakravarthy in 2015 taken 100 individuals (50 males and 50 females) who were aged between 15 to 45 years. Type 1 was most common shape of the soft palate (30%) followed by type 6 (19%), types 2 and 3 (17 and 17%), type 4 (11%) with least being type 5 (6%). There was no significant difference in the distribution of shape of soft palate between males and females .[32]

Upadhyaya Chandan, Neupane Iccha, Sapkota Binam, Srivastava Shatakshi in 2017 done a retrospective study on 263 lateral cephalograms and were classified on the basis of radiographic appearance. In the order of occurrence; rat tail type of soft palate was most prevalent followed by leaf type, butt type, straight line, crooked type and S shaped. [33]

C. Vani, T. Vinila Lakshmi, V. Dheeraj Roy in 2017 aimed a study consisted of 150 digital cephalograms of subjects aged between 20 to 60 years and found that Type 1 was the most common type followed by type 4 and type 6 among all age groups. Type 5: S-shaped soft palate was found in considerable proportions among all the age groups (6.7% - 25.8%).[34]

3.5) GENDER DETERMINATION

Identification of human skeletal parts is an important structure in forensic analysis. Gender determination is the first step in adult skeleton, followed by age. In mass disasters sex determination is based on the available parts of the skeleton and in such cases 100% accuracy is not possible.

Kumar DK, Gopal K. Saraswathi in 2011 aimed a study with sample comprised of 100 normal subjects age ranged from 15-35 years. The morphology of the soft palate on lateral cephalogram were examined and categorized into six types. The variation of the soft palate between genders groups were also studied. There was a significant difference in the morphology of soft palate and also between male and female groups in proportion to velar type.[35]

Kruthika S Guttal, Rohit Breh, Ramaprakasha Bhat, Krishna N Burde, Venkatesh G Nalkmsur in 2012, in their study, a total of 200 digital lateral cephalograms were analysed for the velar morphology and categorized into different types. It was observed that the velar length was significantly higher in males than females.[5]

Deepa V, David Chaya M, Ram Narayan BK in 2013. Conducted a study with total of 120 normal subjects, whose age ranged from 5 years and above were included. The variations in the velar morphology on lateral cephalometry was examined and categorized into different types. The dimensional differences in proportion to different age and gender groups were also studied in normal individuals, cleft palate patients and OSA patients. The morphology of the soft palate was classified into six types with an additional type. No significant difference was observed between males and females with respect to the mean length in normal group.[36]

Vasavi Krishnamurthy Santosh, Pooja Singh, Sandeep S. Pagare in 2015. Conducted a study with a sample of 100 normal digital lateral cephalograms were assessed for the difference in morphology of the soft palate and evaluated. The morphology of the soft palate showed seven different types of soft palate. Males showed significantly longer and denser soft palate than the females.[37]

Smriti Komal, Pal Keerthilatha Murali Dhar, Vineetha Ravindranath, Pentapati Kalyana Chakravarthy in 2015 done a study with a total of 100 individuals (50 males and 50 females) who were aged 15 to 45 years were retrieved. There was no significant difference in the distribution of shape of soft palate between males and females ($p = 0.312$).[32]

Tejavathi Nagaraj, Rahul Dev Goswami, Leena James, N. Sreelakshmi, Bhavana T. Veerabasavaiah, R. Shruthi in 2016 conducted a study using 200 lateral cephalograms. Radiographs were collected and the morphology of soft palate were analyzed. Soft palate length and thickness were also calculated and found that the soft palate length and width was significantly higher in males than females.[29]

Tanya Khaitan, Ramaswamy Pachigolla, Ginjupally Uday, Praveen Kumar Balmuri, Sai Kiran Chennoju, Sreenivasulu Pattipati in 2016 done a study with total 200 patients belonging to both the genders, in the age group 5-55 years, were taken. All the study samples were subjected for lateral cephalometric radiograph and the morphology of the soft palate was categorized. The mean length of soft palate was found to be higher in males.[15]

Upadhyaya Chandan, Neupane Iccha, Sapkota Binam, Srivastava Shatakshi in 2017 done a study with a total of 263 lateral cephalograms. Rat tail type of soft palate was most prevalent followed by leaf type, butt type, straight line, crooked type and S shaped. There was no significant difference between male and female subjects.[33]

Smruthi Valambath, Prabhath Ramakrishnan in 2019 conducted a study in which a comparison was carried out from 299 normal individuals whose age ranged from 5 to 85 years according to the shape and gender to assess if certain shapes could be directly attributed to a gender variation. Velar morphology was classified into six types, The results showed no corelation between particular velar morphologies and gender.[38]

Babita Prasad, Renuka Ammanagi in 2021 conducted a study with a total of 200 patients belonging to both gender, in the age group 18 – 50 years were selected and found that type 2 was the commonest type observed and the relation between different type of soft palate in various age groups was found to be non – significant.[39]

3.6) AGE DETERMINATION

For medico legal practice, chronological age assessment is an important part. The procedures for age determination is a bit complicated and involves consideration of many factors. Changes related to chronological age can be seen in both hard and soft tissue.

Soft palate is one of the soft tissue present in the oral cavity, we can look for the age changes that occurs in it with the help of cephalometry.

Kruthika S Guttal, Rohit Breh, Ramaprakasha Bhat, Krishna N Burde, Venkatesh G Nalkmsur in 2012 has done a study with a total of 200 digital lateral cephalograms were analysed for the velar morphology and categorized into different types. A significant increase in the length of soft palate was observed with increase in age.[5]

Deepa V, David Chaya M, Ram Narayan BK in 2013 conducted a study with total of 120 normal subjects, whose ages ranged from 5 years and above were included. The variation of the soft palate on lateral cephalometry was examined and classified into different types. The dimensional differences in proportion to different age and gender groups were also studied in normal individuals, cleft palate patients and OSA patients. The morphology of the soft palate was classified into six types with an additional type. There was a significant increase in the length of soft palate with age.[36]

Vasavi Krishnamurthy Santosh, Pooja Singh, Sandeep S. Pagare in 2015 has done a study with a sample of 100 normal digital lateral cephalograms for the variations in morphology of the soft palate and evaluated. The variation in the soft palate showed seven different types. There was a significant difference in length of the soft palate between preadult and adult age groups.[37]

Tejavathi Nagaraj, Rahul Dev Goswami, Leena James, N. Sreelakshmi, Bhavana T. Veerabasavaiah, R. Shruthi in 2016, the study was conducted using 200 lateral cephalograms. Radiographs taken and variation in the morphology of soft palate were analysed. Soft palate length and thickness were also calculated and found that there is an increase in soft palate length till the age of 30 years and showed a decrease thereafter. Velar width was more in males and showed variation in different age groups.[29]

Tanya Khaitan, Ramaswamy Pachigolla, Ginjupally Uday, Praveen Kumar Balmuri, Sai Kiran Chennoju, Sreenivasulu Pattipati in 2016 conducted a study with a total of 200 patients of both the genders, between the age group of 5-55 years, were selected. All the study samples were subjected to lateral cephalogram and the variation in the soft palate was categorized. There was a positive correlation between age and type of soft palate.[15]

Upadhyaya Chandan, Neupane Iccha, Sapkota Binam, Srivastava Shatakshi in 2017 has done a study with a total of 263 lateral cephalograms. Analysis was done. Rat tail type of soft palate was most prevalent followed by leaf type, butt type, straight line, crooked type and S shaped. There was no significant difference through age groups. [33]

C. Vani, T. Vinila Lakshmi, V. Dheeraj Roy in 2017. C. Vani, T. Vinila Lakshmi, V. Dheeraj Roy in 2017. Conducted a study with 150 digital cephalograms of subjects aged

between 20 to 60 years taken and found that there was no significant correlation found between the different age groups and the type of soft palate.[34]

3.7) SOFT PALATE ANOMALIES

Clefting of the soft palate in the presence of an intact hard palate exist as a spectrum of anatomic severity, to a complete separation of both sides extending forward into the palatine bones and finally into the palatal shelves of the maxilla. Careful examination of the anatomy of the submucous cleft, as compared with that of the normal soft palate, can give valuable view into the embryologic defects. The developmental model provides a pathway for surgical approaches to its repair.

Kai Wermker, Susanne Jung, Ulrich Joos, and Johannes Kleinheinz in 2012 aimed to evaluate cephalometrically the nasopharyngeal development of patients with complete unilateral cleft lip and palate. Influencing factors were evaluated and cleft to non-cleft subjects were compared to each other. The lateral cephalograms of 66 patients with cleft lip and palate were measured and compared to the cephalograms of 123 healthy probands. Significant differences between cleft and control group: the cleft patients showed a maxillary retro position and a reduced maxillary length; the inclination of the maxilla was significantly more posterior and cranial; the anterior nasopharyngeal height was reduced; The velum length was reduced. In the cleft group, collection of mandibular retrognathia and an anterior position of the hyoid were noticed. Skeletal configuration and type of growth were predominantly vertical.[40]

3.8) OBSTRUCTIVE SLEEP APNOEA

Obstructive sleep apnea (OSA) is a disorder with some serious complications if left untreated. Dentists plays key role in the early diagnosis of this condition, resulting in improved patient's prognoses. The key to the successful management is only done by performing a thorough evaluation, which can help ensure the early diagnosis**.**

Obstructive sleep apnea (OSA) is a common medical disorder with potentially severe health results. OSA and its associated co-morbidities[41,42] are common medical conditions with relatively high mortality rates. OSA is implicated in the common complaint of simple snoring and upper airway obstruction.[43]

Untreated OSA can lead to hypertension, diabetes, cardiovascular disease and other cardiac conditions (e.g., myocardial infarction, congestive heart failure, cerebrovascular accidents, and cardiac arrhythmia)[44,45], cognitive dysfunction, and depression, leading to decreased concentration.

Kaur S, Rai S, Sinha A, Ranjan V, Mishra D, Panjwani S in 2015 studied the relation between craniofacial structures and pharyngeal airway space along with soft palate and tongue in patients using lateral cephalogram. The correlation of upper airway and soft-tissue measurements with neck circumference (NC) and body mass index (BMI) was explicated to evaluate on lateral cephalogram, in order to determine the etiology of obstructive sleep apnea (OSA)s. Lateral cephalograms of 45 subjects were used to measure the pharyngeal airway Significant reduction was found in pharyngeal airway in ANB group II. There is an increase in size of soft palate and tongue with increasing BMI and NC.[46]

Reddy Lavanya1, Dara Balaji Gandhi Babu, Sunandha Chavva, Mamatha Boringi, Shefali Waghray, Mounica Yeladandi in 2016 conducted a study on 206 patients divided into a high-risk group and a control group after answering the Berlin questionnaire. Cephalometric analysis was performed. Within a total of 206 patients, 93 were in the high-risk group and 113 were in the control group. No significant difference was found between the groups with respect to gender, and the patients ranged in age from 18 to 65 years. Also, we found that middle-aged individuals of both genders were more likely to develop OSA.[47]

Smruthi Valambath, Prabhath Ramakrishnan in 2019. Lateral cephalograms were taken from 299 normal individuals age ranged between 5 to 85 years The soft palate morphology was categorized, and the corelated to gender, age, length and width of the soft palate. A snoring questionnaire was given to the relatives of the patients for assessment regarding snoring habit. The results showed no corelation between particular velar morphologies and age or gender but showed a positive corelation between snoring and Type 6, Type 5, and Type 1 palates.[38]

3.9) MISCELLANEOUS ASPECTS

Samdani D, Saigal A, Garg E in 2015 conducted a study with a total of 250 individuals both male and female equally taken within the age range of 14 to 28 years visited for orthodontic treatment. The velar morphology was examined and categorized into 6 types and further noted that rat tail type was the most common and distorted s- shaped was the least. Patients with Angle's class I malocclusion had rat tail type soft palate, those with Angle's class II had leaf-shaped soft palate, and with Angle's class III had crooked shaped soft palate. Angle's class II and class III malocclusions were correlated with soft palate shapes, whereas Angle's class I malocclusion was highly significantly correlated with the shape of soft palate and types of malocclusion.[48]

Priyal Agrawal in 2016 has done a study with 121 samples of CBCT scans of individuals aged between 15 to 45 years. Velar morphology was examined and categorized into 6 types and

further found that type 2 (rat tail)type was the most common type of soft palate with significant higher value of velar length and width in males whereas pharyngeal depth and Need's ratio was higher in females.[49]

Supriya Rathore, Neelkant Patil, Mohit Sareen in 2019. A total of 100 patients, categorized under two group, with and without diagnosed with OSMF found leaf type, the most common type of soft palate followed by bifid type the least. Also noted, as the grade of OSMF increases, size of soft palate shortens and becomes bulkier**.**[50]

4.0) CEPHALOMETRY:

Lateral cephalometric radiographs are important in growth analysis, diagnosis, treatment planning, therapy monitoring, and evaluation of treatment outcome. Digital dental radiography is used in dental office today for the acquisition, measurement, and analysis of cephalometric images.[51]

4.3) Patient Positioning:[52]

The lateral cephalometric radiograph displays numerous cranial, facial, and oral anatomic structures imaged from the lateral aspect. Additionally, structural points of reference leading to angular and distance measurements may be visualized to assess growth patterns.

The visualization of the structures in the radiographic image is dependent on proper alignment of the x-ray beam and the patient. Proper alignment of the x-ray beam relative to the cephalostat may be evaluated by exposing a test film of the head-stabilizing ear rods without a patient positioned in the cephalostat. Proper alignment is assured if the radiopaque circle representing the film-side ear rod is reasonably centered within the image of the beam-side ear rod. This helps to ensure that the midsagittal plane will be perpendicular to the x-ray beam once the patient is placed within the ear rods.[53]

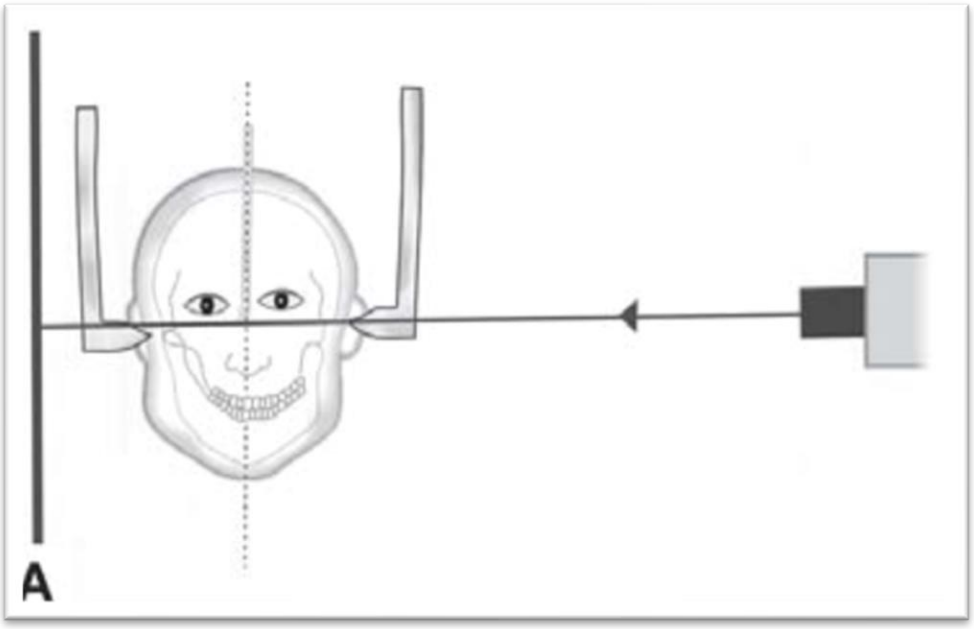


FIGURE 3: Lateral cephalogram, the film is parallel to the midsagittal plane and the X-ray beam is directed perpendicular to the film

An 8 x 10- inch film cassette/digital sensor equipped with the appropriate film and intensifying screens is placed either horizontally or vertically in the cephalostat cassette holder. The proper x-ray beam collimator must be selected depending on the film cassette's orientation. The anterior border of the film should be placed so that the soft tissue outline of the nose will be captured on the film image. The patient is then positioned within the cephalostat ear rod, exerting moderate pressure on the external auditory meatus. Excessive horizontal movement of the head within the cephalostat will create variations in beam-object alignment, thus causing inaccurate image analysis and comparison when cephalometric superimpositions are made.

The patient's Frankfort horizontal plane will be parallel to the floor. Some x-ray technicians prefer to place the patient's canthomeatal line upward 10 degree relative to the floor. Either method of placement will result in the patient's occlusal plane being in the proper downward orientations. A locking nasal positioner is then secured against the bridge of the patient's nose to eliminate rotation around the ear rod in the sagittal plane and for future reference in subsequent exposures.[54.55]

As this point the film cassette is moved to the desired distance from the patient's midsagittal plane. The central ray of the x-ray beam will enter and exit the patient near the horizontal axis of the auditory meatus.[55]

The amount of x-ray energy necessary to penetrate certain dense areas of the human skull will, in most cases, "burn out" the soft tissue of the nose, lips, and chin, thus resulting in excessive density in those areas. Imaging the patient's soft tissue profile without the loss of bony details may be accomplished by attenuating or blocking out some of the beam's energy with a soft tissue shield. This shield is often a wedge of aluminum placed on the x-ray film cassette so that it primarily covers the area behind the patient's soft tissue profile. In some machine, a small aluminum attenuator is placed within the x-ray beam inside the tube-head, which has the additional benefits of reducing the radiation dose to the soft tissues and producing a less-distinct wedge image than when the shield is placed in direct contact with the film cassette. Care must always be taken not to reduce the beam energy to the point of obliterating the opaque image of the nasal bone, anterior nasal spine, and the long axis of the maxillary and mandibular incisors located near the shielded area.[54,55]

Once properly positioned, the patient should be instructed to close to centric position, swallow, and hold the body of the tongue in the posterior area of the soft palate. This will reduce the radiolucent band in the resulting image representing the pharyngeal air space commonly superimposed across the angle of the mandible. The patient should then be instructed to remain still throughout the exposure.

A lateral cephalometric radiographs is needed routinely. Lateral cephalograms have two purposes: (1) they showed details of skeletal and dental relationships that cannot be observed in other ways, and (2) they allow a precise evaluation.

4.1) Factor Affecting Cephalometric Radiographs:

Patient positioning and X-ray tube head settings are the two most critical factors in consistently producing cephalometric images of high diagnostic quality.

Generally, patients are positioned within the cephalostat using adjustable bilateral ear rods placed within each auditory meatus, usually while the patient is standing. The midsagittal plane of the patient is vertical and perpendicular to the x-ray beam. The patient's Frankfort plane is oriented parallel to the floor. Positioning for the PA cephalogram is identical to that for the lateral cephalogram except that the patient is rotated 90 degrees, i.e. facing the film.[56]

Veena Arali, Mini Ajitha, Nagarathna C in 2019 had conducted a study with the help of lateral cephalometry to diagnose OSA in pediatric patients with a habit of mouth breathing. A total of 40 children were taken with age ranged between 7 to 10 years dividing them into two groups, test group and control group and noted that children present in test groups had medium

sized adenoids than the control groups and concluded that larger the size of adenoids, more are the chances leading to OSA.[57]

4.2) Radiographic Magnification:

The x-ray emanating from the source have a divergent pattern, there is a variation in the amount of magnification of the object in any radiograph. To reduce the magnification in lateral cephalometric radiographs, distance should be increases between source of x-ray and the object to be radiographed in order to take advantage of the central beam, and also decrease the distance between the object and the radiographic film. The distance should be approx. 152.4 cm between the x-ray source and the sagittal plane, considering that increasing the distance would result in loss of penetration of rays. According to Weens magnification of craniofacial structures varies from almost 0% up to 24% in objects close to the film or objects in the exact center of the rays.[58]

To minimize variations between different patients and obtain consistent measurements in an individual's over time, it is recommended to maintain constant this distance. An average distance of 15 cm is often used; although it would be ideal to position the frame as close to the patient's head as possible to reduce the magnification.[59]

MATERIALS AND METHOD

This study was conducted in Department of Oral Medicine and Radiology of Babu Banarasi Das College of Dental Sciences, Lucknow (UP). Ethical clearance for the dissertation was obtained from the institutional ethical committee [(IEC code – 07) BBDCODS/01/2019], in accordance with the declaration of Helsinki, for researches involving human subject.

The study population was drawn randomly from the out- patient department of Oral Medicine and Radiology. The study sample consisted of 200 patients from both genders. Proper consent was taken, radiographs was done, data had been collected and send for statistical analysis.

SELECTION OF THE PATIENTS

Eligibility criteria were set for the patients to be included or excluded in the study.

Inclusion criteria

1. Subjects who are well oriented to person, place and time.
2. Age groups from 20 to 60 years.
3. Proper visibility of soft palate on the radiograph

Exclusion Criteria

1. Patients should not have history of any systemic disease that might affect bone metabolism.
2. Any pathology or congenital anomaly in the palate that could affect the interpretation of the radiographic image.
3. Patients below 20 years of age.
4. Patient with facial or palatal deformities or facial trauma.
5. Poor quality radiographs and radiographs with incomplete details.

SAMPLING METHOD

1. The study group consist of 200 individuals within the age group of 20-60 years attending the Department of Oral Medicine and Radiology, for digital lateral cephalometric radiographs.
2. Random sampling method has been used.

METHODOLOGY

In the present study, all the subjects fulfilling the above criteria will be enrolled after obtaining written and informed consent which was both bi-lingual in nature.

All the enrolled subjects will be grouped into four, each group having 50 patients each with equal gender distribution.

- **GROUP A**: 20 - 29 years
- **GROUP B**: 30 - 39 years
- **GROUP C**: 40 - 49 years
- **GROUP D**: 50 - 60 years

STEPS PERFORMED

Armamentarium (step for clinical examination)

1. Dental chair with illuminating facility.

2. A pair of sterile disposable gloves and mouth mask.

3. Stainless steel kidney tray, mouth mirror, straight probe, tweezers and explorer

Steps for clinical examination

1) The subject will be selected according to the inclusion and exclusion criteria.
2) Case history will be recorded in a case history proforma.
    - snoring habit was recorded by asking question about it to the subject's attender.
    - Response was recorded either as yes or no.
3) Each patients will be informed about the protocol and will be given appropriate instructions after obtaining a written consent.
4) Referred for radiographic examination

Step For Radiographic Study

Materials and Equipment used in the study with specifications and Company

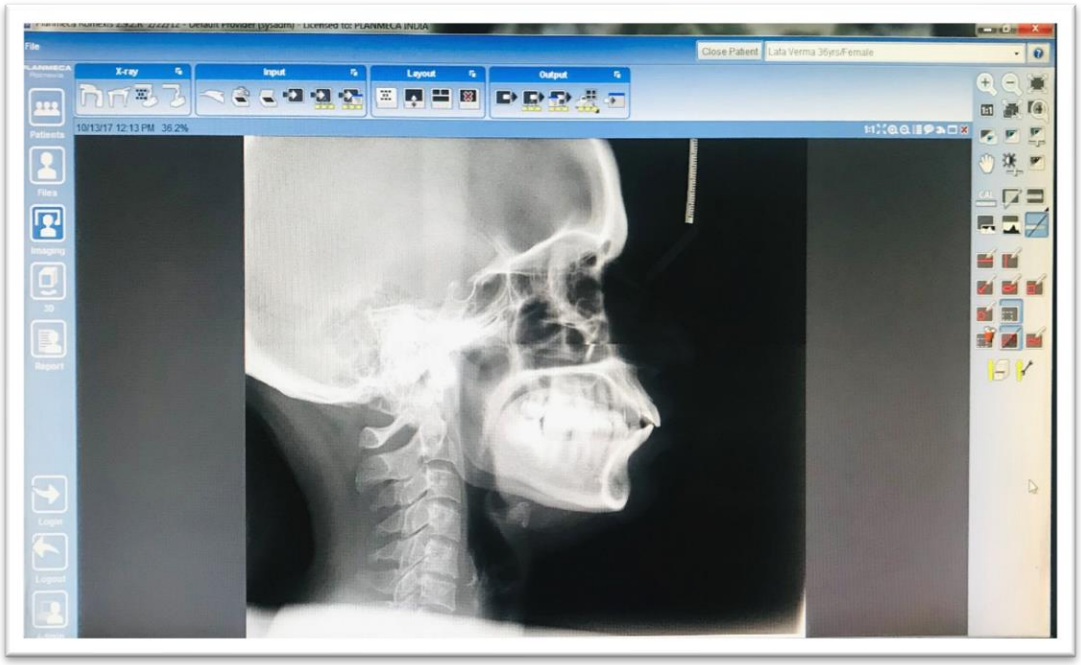
1. Digital lateral cephalometric radiograph
   [Planmeca Proline XC, SN:XC430638, 180-240V, 50 Hz]
   Installed in AERB (Atomic Energy Radiation Board) certified quality assurance facility
2. Planmeca Romexis 2.9.2.R software was utilized for morphometric details and data collection.

- The subjects will be selected according to the inclusion and exclusion criteria as mentioned above.
- Participants will be positioned in the cephalostat with Frankfurt horizontal plane parallel to the floor.
- With upper and lower teeth in centric occlusion and oropharyngeal musculature relaxed, digital lateral cephalogram will be taken.

- Antero- posterior and supero - inferior dimensions as well as morphology of soft palate will be analyzed from the cephalograms.
- The length of the soft palate will be measured by the linear distance from the posterior nasal spine (PNS) to the tip of the uvula.
- Supero- inferior dimension of soft palate will be measured at the thickest area of soft palate.
- Morphology of soft palates will be classified based on their morphology according to You *at el.*(2008) as Types: 1 (leaf- based), 2 (rat-tail shaped), 3 (butt-like), 4 (straight line), 5 (S-shaped) and 6 (crook shaped).

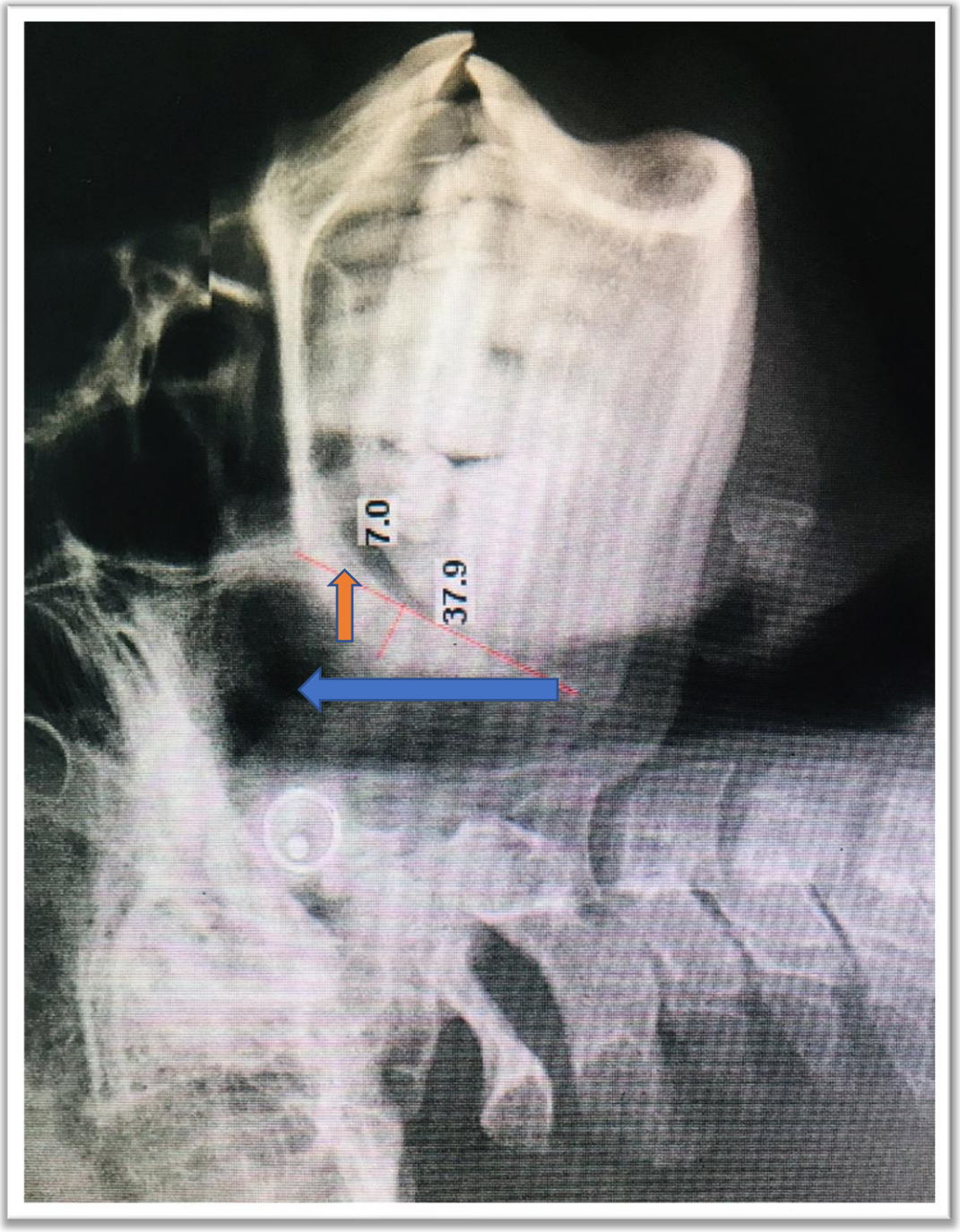
PHOTOGRAPH-4 : Armamentarium – Diagnostics (kidney tray, mouth mirror, probe, explorer, tweezer), gloves, mouth mask, head cap

PHOTOGRAPH 5: Patient along with the Lateral Cephalometric Machine



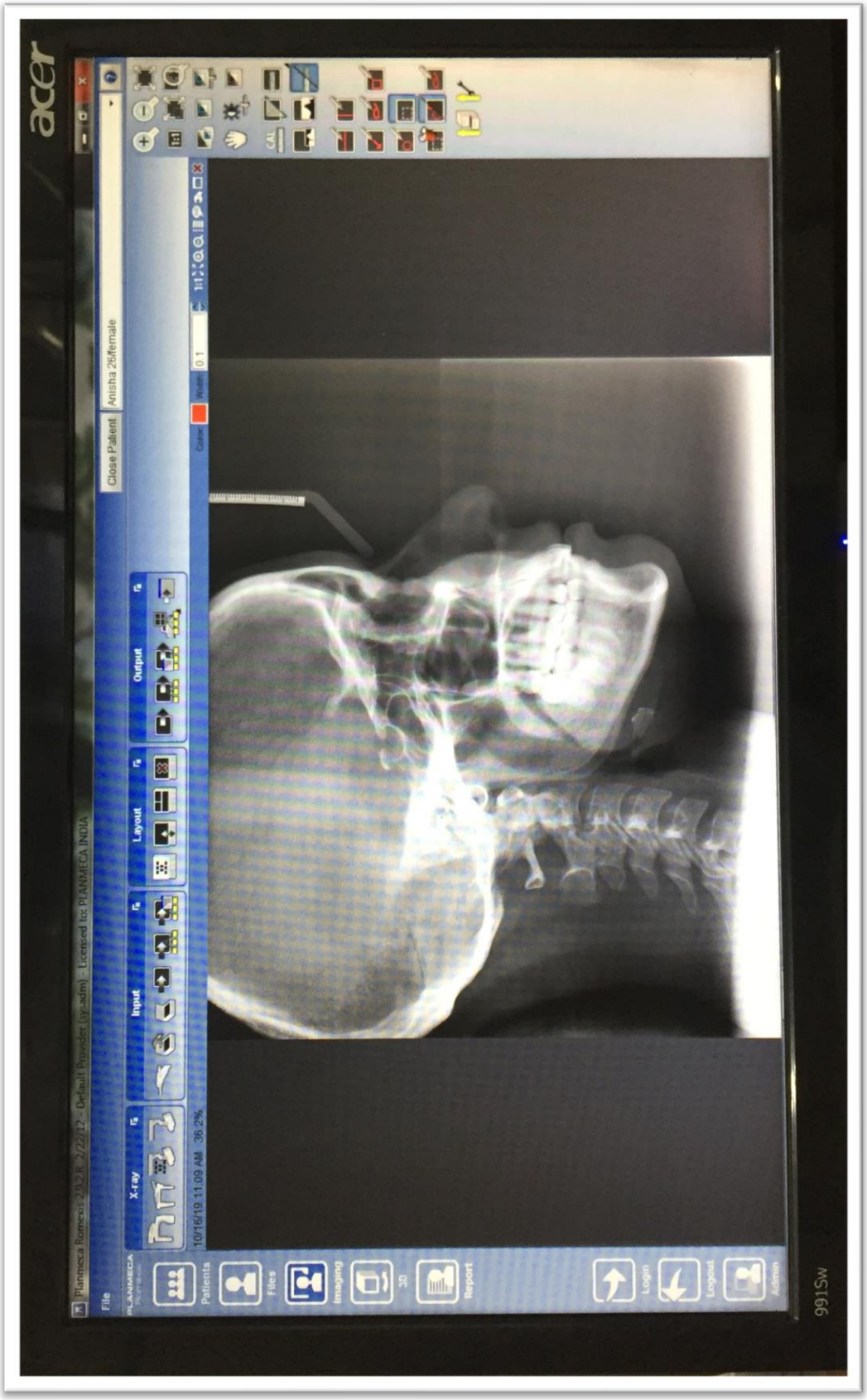
PHOTOGRAPH 6: Romex software used for taking Lateral Cephalometric Radiograph

PHOTOGRAPH 7: Lateral Cephalometric Radiograph with the measurement of the soft palate.

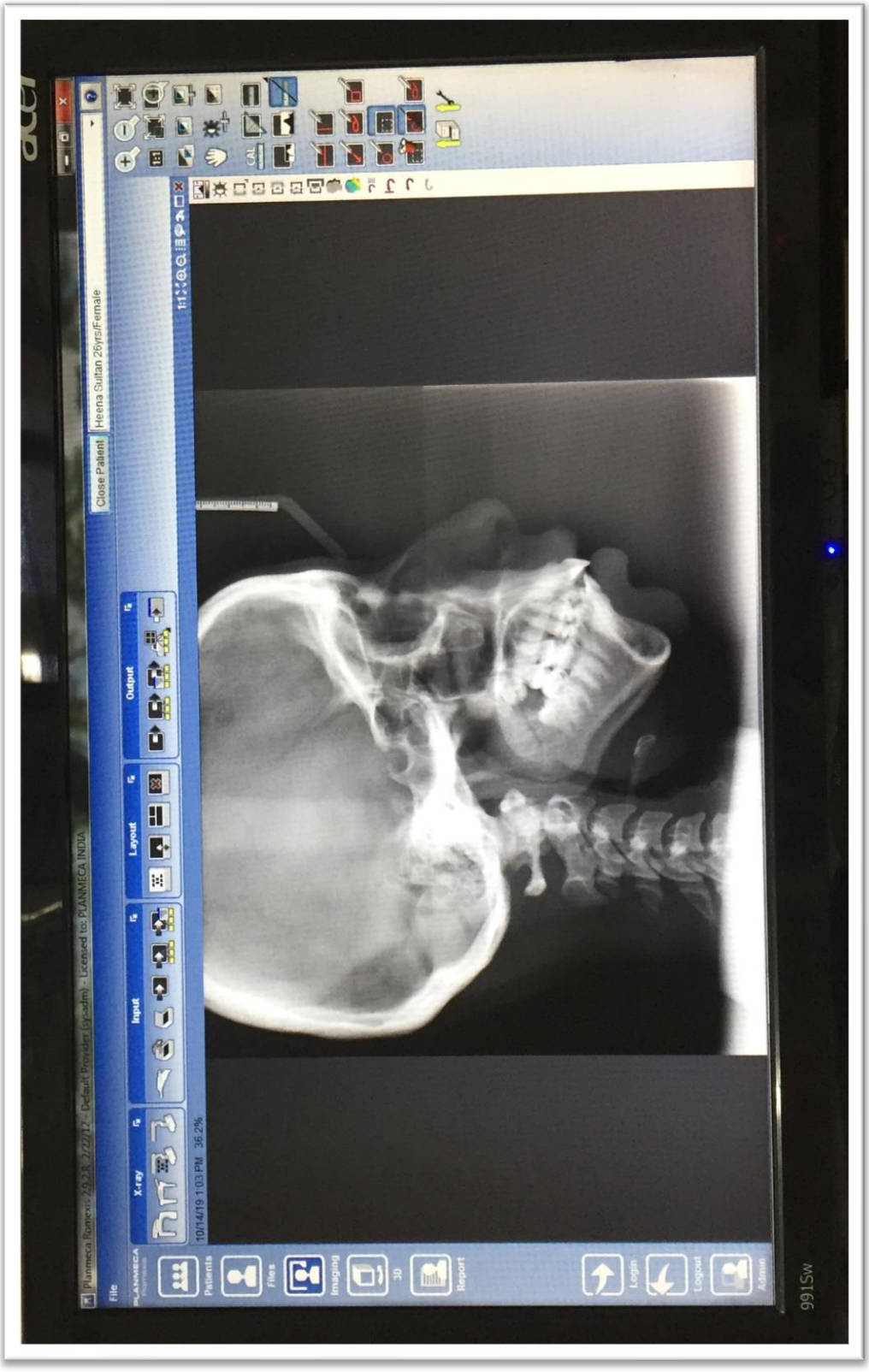


PHOTOGRAPH 8: Measurement of soft palate (antero – posterior and supero – inferior dimensions)

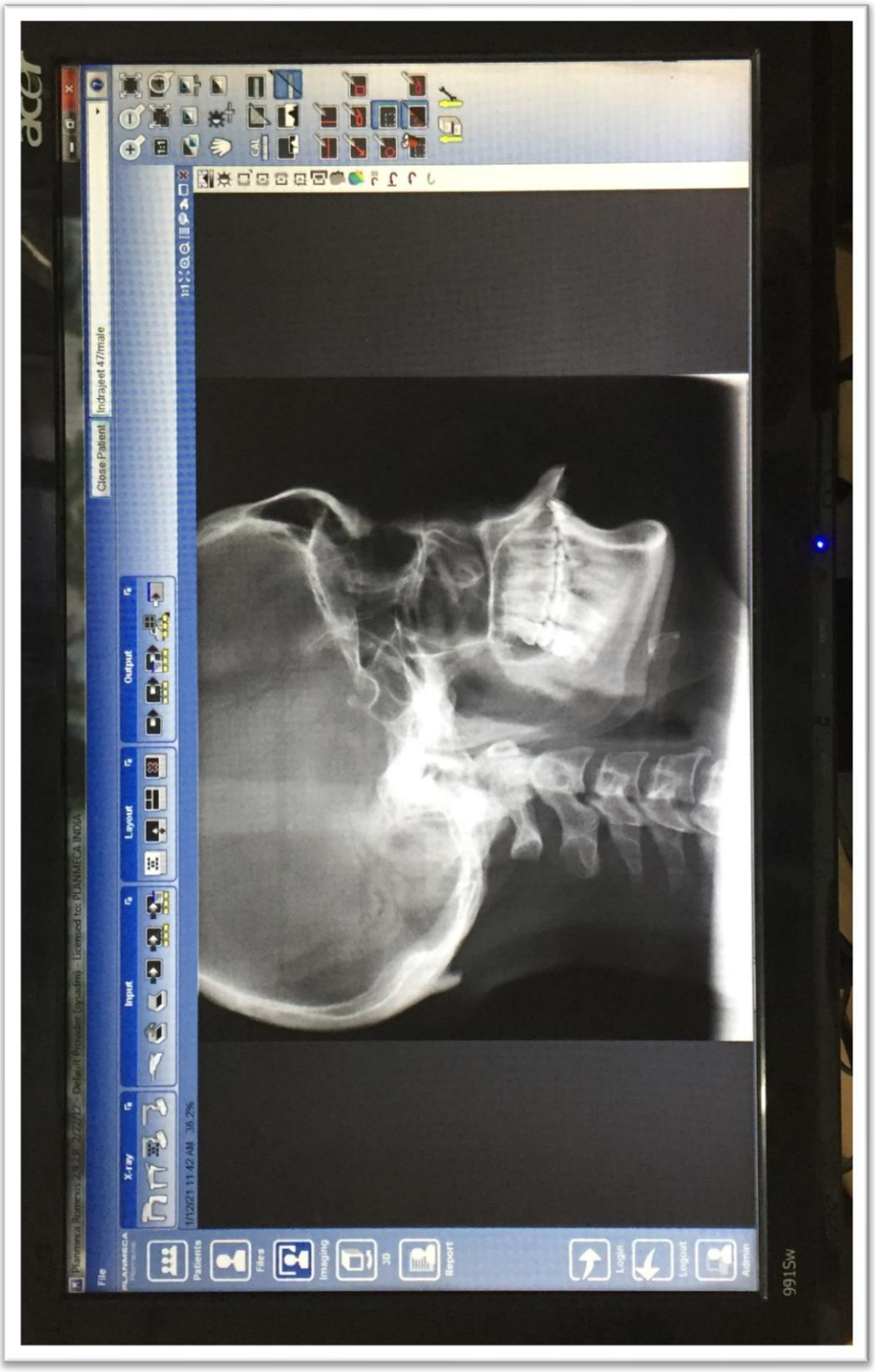
PHOTOGRAPH. 9: Lateral cephalometric radiograph for the shape of the soft palate (Leaf-Shape) TYPE -1



PHOTOGRAPH. 10**:** Lateral cephalometric radiograph for the shape of the soft palate (Rat-tail Shape) TYPE -2



PHOTOGRAPH. 11: Lateral cephalometric radiograph for the shape of the soft palate (Butt -Shape) TYPE - 3



PHOTOGRAPH. 12: Lateral cephalometric radiograph for the shape of the soft palate (Straight -Shape) TYPE - 4

PHOTOGRAPH. 13:Lateral cephalometric radiograph for the shape of the soft palate (S - Shape) TYPE - 5

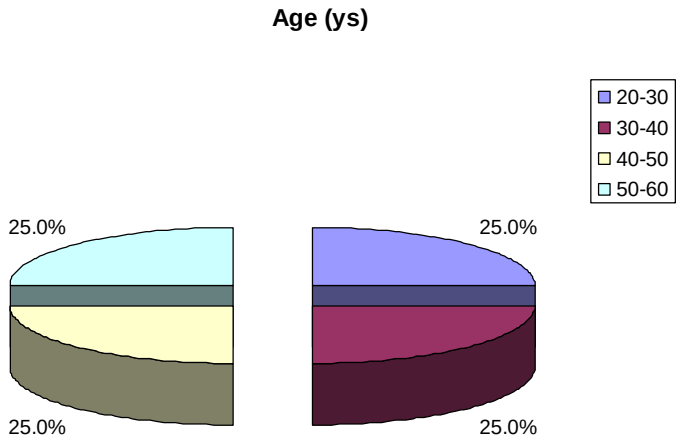
PHOTOGRAPH. 14 **:** Lateral cephalometric radiograph for the shape of the soft palate (Crooked - Shape) TYPE - 6

RESULTS

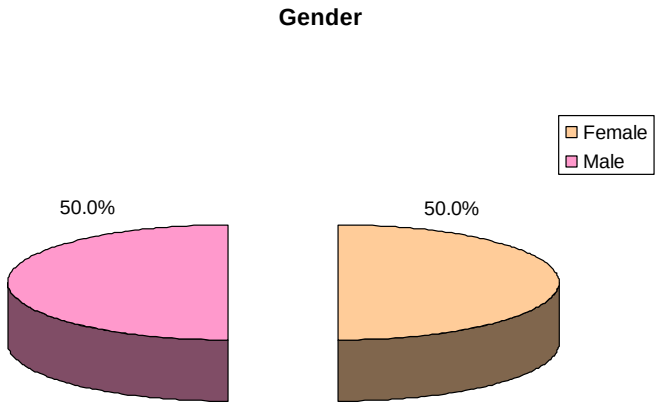
The present result showed a digital cephalometric study evaluates the morphology of soft palate correlating with age and gender. Total 200 subjects, representative of Lucknow population were recruited. The outcome measures of the study were soft palate morphology (length, width, type and snoring) assessed at the time of presentation (enrolment). The soft palate length and width were measured in millimetre (mm).

Table 1: Basic Characteristics of recruited subjects

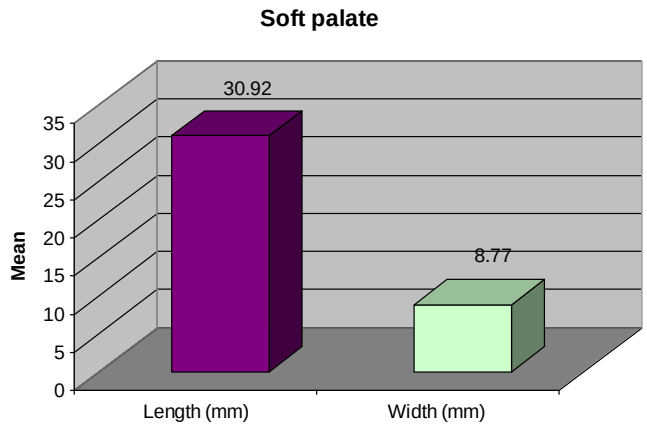
Basic characteristics	**No. of subjects (n=200) (%)**
Age (yrs):	
20-30	50 (25.0)
30-40	50 (25.0)
40-50	50 (25.0)
50-60	50 (25.0)
Gender:	
Female	100 (50.0)
Male	100 (50.0)
Soft palate length (mm)	30.92 ± 0.28
Soft palate width (mm)	8.77 ± 0.12
Soft plate shape (type):	
Leaf shaped (type 1)	79 (39.5)
Rat-tailed shaped (type 2)	43 (21.5)
Butt-like (type 3)	9 (4.5)
Distorted/s-shaped (type 4)	43 (21.5)
Crooked shaped (type 5)	26 (13.0)
Soft palate snoring:	
No	79 (39.5)
Yes	121 (60.5)



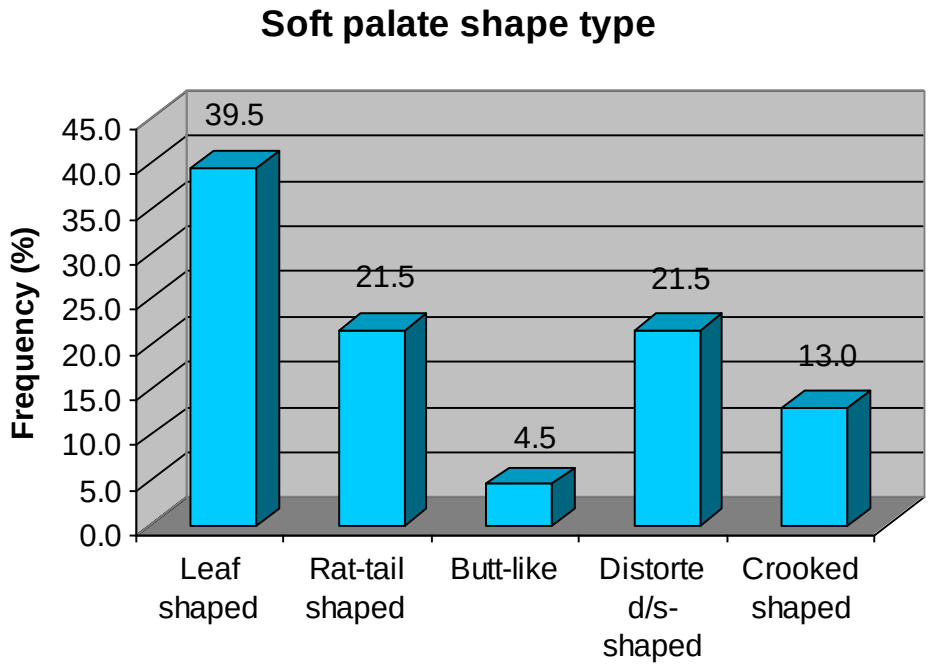
Graph 1. Distribution of age of recruited subjects



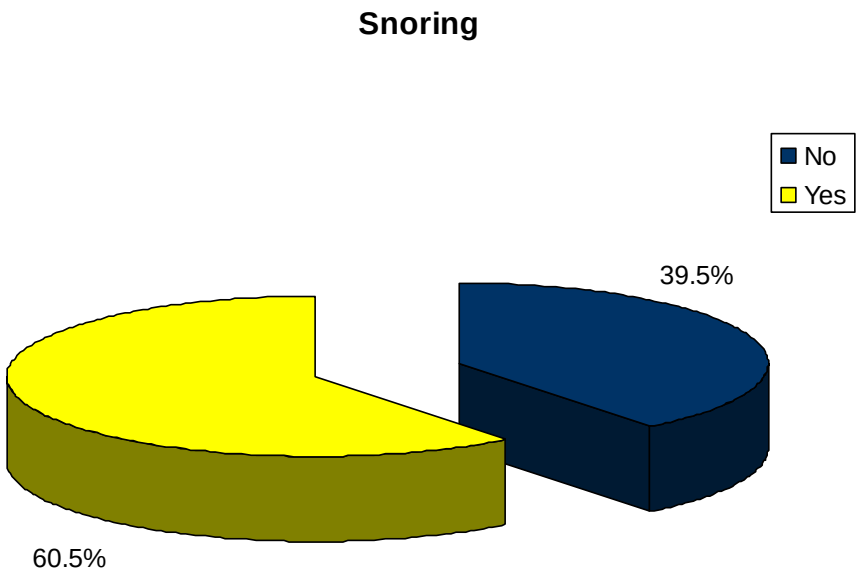
Graph 2. Distribution of gender of recruited subjects.



Graph. 3. Soft palate mean length and width of recruited subjects.



Graph 4. Distribution of soft palate shape type of recruited subjects.

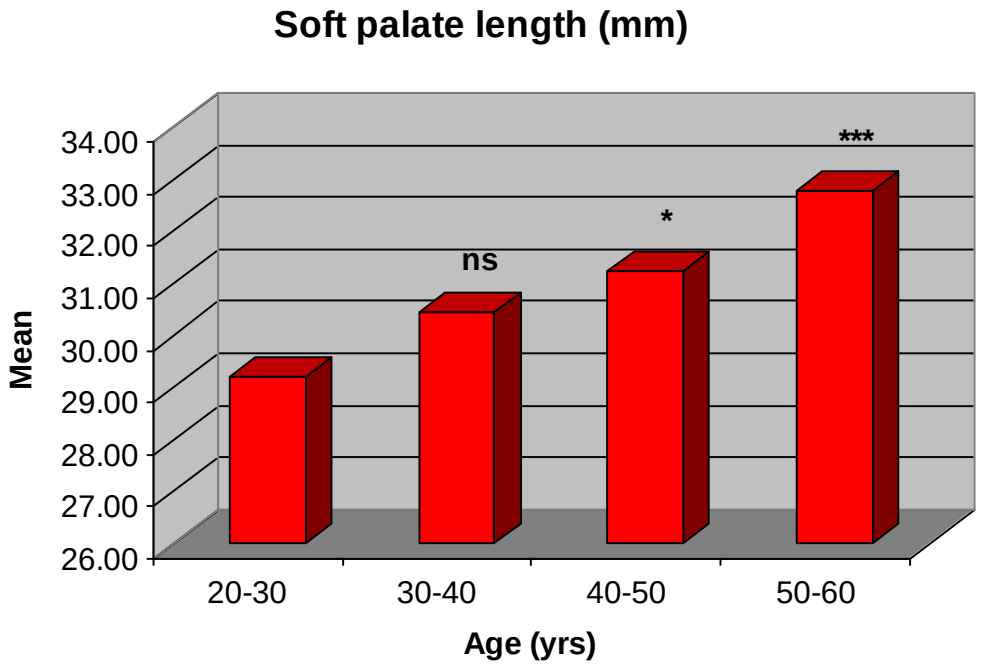


Graph 5. Distribution of soft palate shape snoring of recruited subjects.

Table 2: Distribution of soft palate length (mm) according to age of recruited subjects (n=200)

Age (years)	N	Soft palate length (mm) (Mean ± SE)	F Value	*P* value
20-30	50	29.20 ± 0.41	8.01	<0.001
30-40	50	30.44 ± 0.52		
40-50	50	31.23 ± 0.60		
50-60	50	32.78 ± 0.56		

The soft palate length of four different age groups were summarised in Mean ± SE and compared by ANOVA (F value)



Graph. 6. Comparison of difference in mean soft palate length among different age groups of recruited subjects.

A) Age

I. Soft palate length

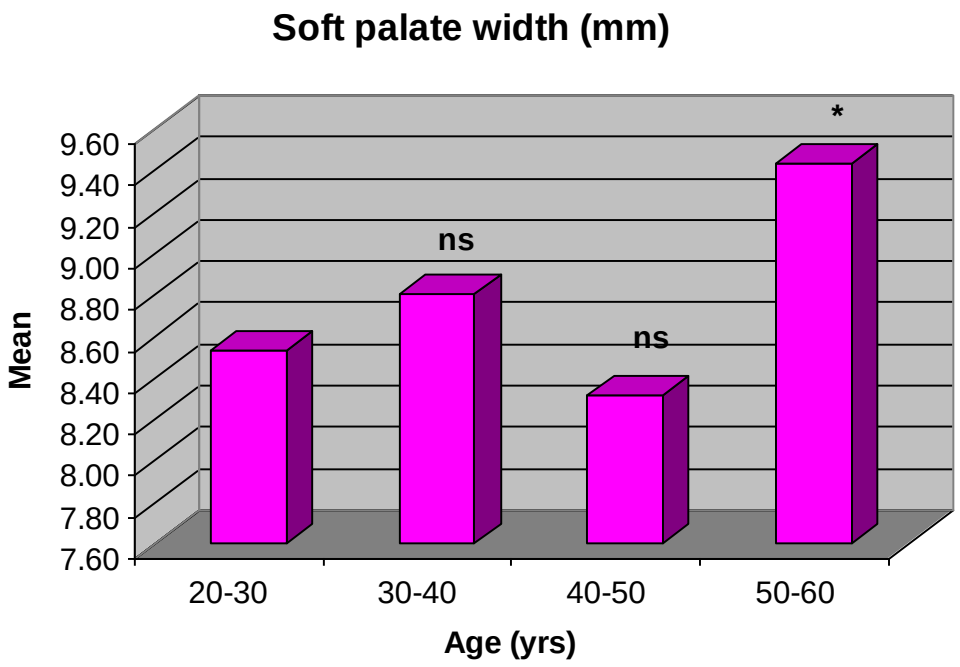
The soft palate length of recruited subjects according to age (20-30, 30-40, 40-50 and 50-60 years) is summarised in Table 2 and also shown in Fig. 6. The mean soft palate length show linear increase with age i.e. as age increases; soft palate length also increases (20-30 years < 30-40 years < 40-50 years < 50-60 years). Comparing the mean soft palate length among different age groups, ANOVA showed significantly different soft palate length among the groups ($F=8.01$, $P < 0.001$) (Table 2).

Further, comparing the difference in mean soft palate length between the different age groups (i.e. inter groups), Tukey test showed significantly ($P < 0.05$ or $P < 0.001$) different and higher soft palate length in 50-60 years as compared to both 20-30 and 30-40 years (Table 3 and Fig. 6). Furthermore, it was also found significantly ($P < 0.05$) different and higher in 40-50 years as compared to 20-30 years. However, it did not differ ($P > 0.05$) between other age groups i.e. found to be statistically the same.

Table 3: Distribution of soft palate width (mm) according to age of recruited subjects (n=200)

Age (years)	N	Soft palate width (mm) (Mean ± SE)	F Value	*P* value
20-30	50	8.54 ± 0.22	3.99	0.009
30-40	50	8.81 ± 0.21		
40-50	50	8.32 ± 0.25		
50-60	50	9.43 ± 0.28		

The soft palate width of four different age groups were summarised in Mean ± SE and compared by ANOVA (F value)



Graph 7. Comparison of difference in mean soft palate width among different age groups of recruited subjects.

II. Soft palate width

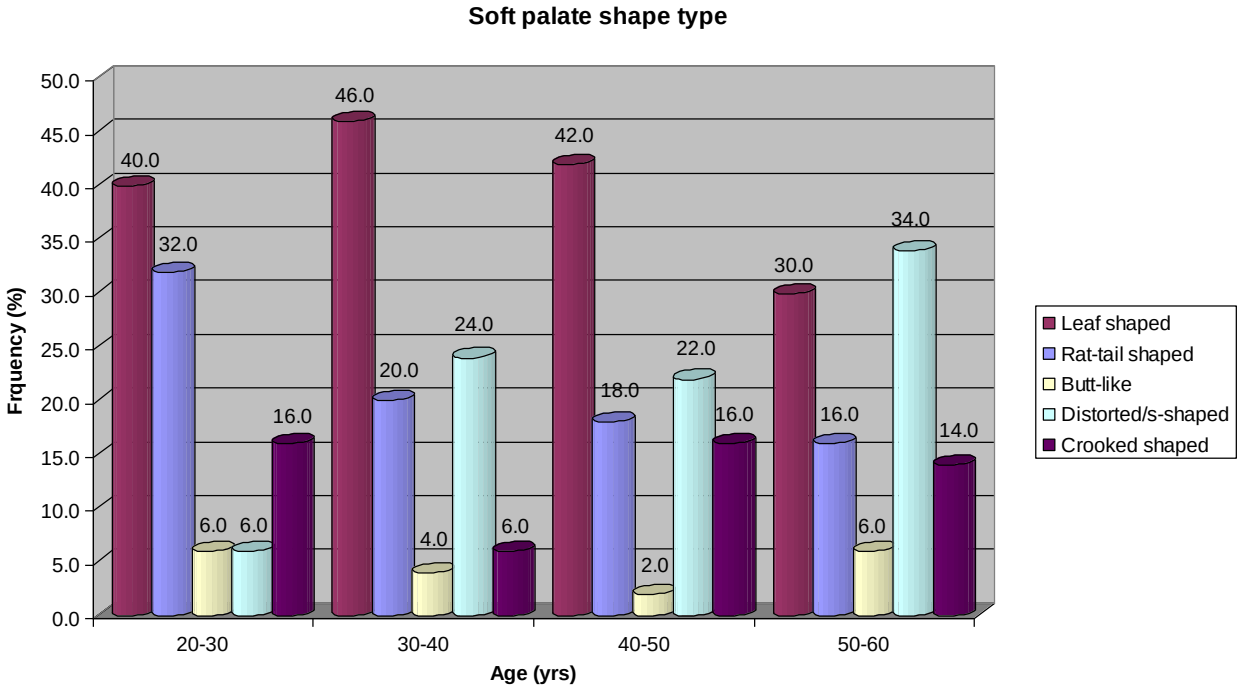
The soft palate width of recruited subjects according to age (20-30, 30-40, 40-50 and 50-60 years) is summarised in Table 4 and also shown in Fig. 7. The mean soft palate width did not show any trend with age. The mean soft palate width was highest in 50-60 years followed by 30-40 years, 20-30 years and 40-50 years, the least (40-50 years < 20-30 years < 30-40 years < 50-60 years). Comparing the mean soft palate width among different age groups, ANOVA showed significantly different soft palate width among the groups (F=3.99, $P = 0.009$) (Table 4).

Further, comparing the difference in mean soft palate width between the different age groups (i.e. inter groups), Tukey test showed significantly ($P < 0.05$ or $P < 0.01$) different and higher soft palate width in 50-60 years as compared to both 20-30 and 40-50 years (Table 5 and Fig. 7). However, it did not differ ($P > 0.05$) between other age groups i.e. found to be statistically the same.

Table 4: Distribution of soft palate shape type according to age of recruited subjects (n=200)

Soft palate shape type	20-30 years (n=50) (%)	30-40 years (n=50) (%)	40-50 years (n=50) (%)	50-60 years (n=50) (%)	χ^2 value	*P* value
Leaf shaped	20 (40.0)	23 (46.0)	21 (42.0)	15 (30.0)	18.57	0.099
Rat-tail shaped	16 (32.0)	10 (20.0)	9 (18.0)	8 (16.0)		
Butt-like	3 (6.0)	2 (4.0)	1 (2.0)	3 (6.0)		
Distorted/s-shaped	3 (6.0)	12 (24.0)	11 (22.0)	17 (34.0)		
Crooked shaped	8 (6.0)	3 (6.0)	8 (16.0)	7 (14.0)		

The soft palate shape type of recruited subjects according to age were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



Graph 8. Distribution of soft palate shape type among different age groups of recruited subjects

III. Soft palate shape type

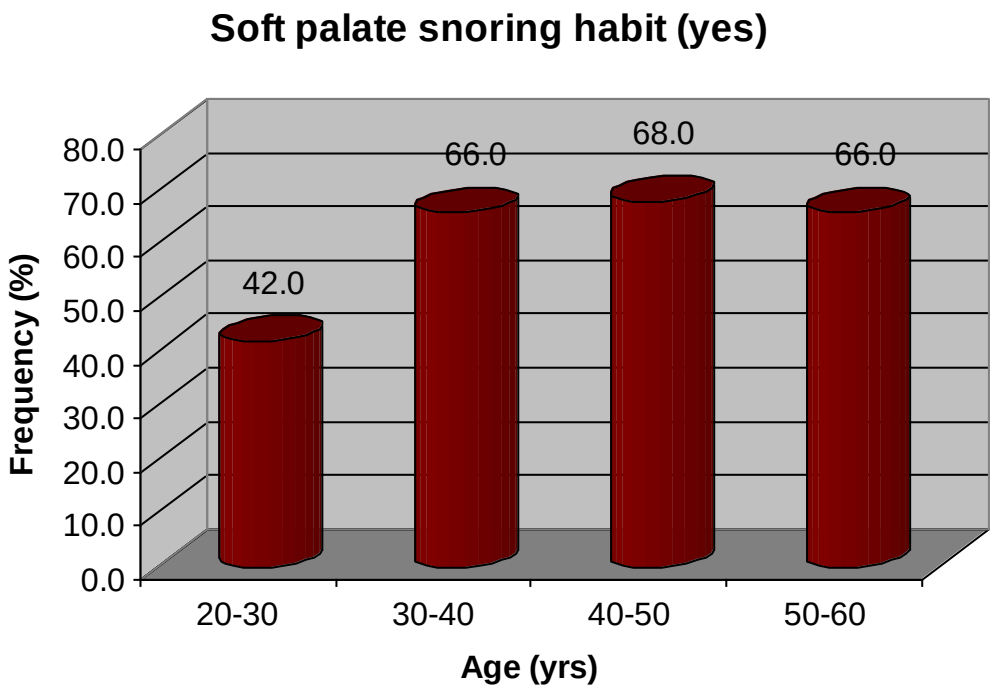
The distribution of soft palate shape type (leaf shaped, rat-tail shaped, butt-like, distorted/s-shaped and crooked shaped) of recruited subjects according to age (20-30, 30-40, 40-50 and 50-60 years) is summarised in Table 6 and also shown in Fig. 8. In age group 20-30, 30-40 and 40-50 years, the soft palate shape type "leaf shaped" the most frequent whereas in 50-60 years it was "distorted/s-shaped". In contrast, in all age groups, the "butt-like" shape type was the least frequent.

Comparing the frequency (%) of soft palate shape type among different age groups, χ^2 test showed similar ($P > 0.05$) frequency of soft palate shape type among the groups ($\chi^2=18.57$, $P = 0.099$) i.e. did not differ significantly. In other words, in Lucknow population, soft palate shape type may not be associated to age.

Table 5: Distribution of soft palate snoring habit according to age of recruited subjects (n=200)

Soft palate snoring	20-30 years (n=50) (%)	30-40 years (n=50) (%)	40-50 years (n=50) (%)	50-60 years (n=50) (%)	χ^2 value	*P* Value
No	29 (58.0)	17 (34.0)	16 (32.0)	17 (34.0)	9.60	0.022
Yes	21 (42.0)	33 (66.0)	34 (68.0)	33 (66.0)		

The soft palate snoring of recruited subjects according to age were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



Graph . 9. Distribution of soft palate snoring habit among different age groups of recruited subjects.

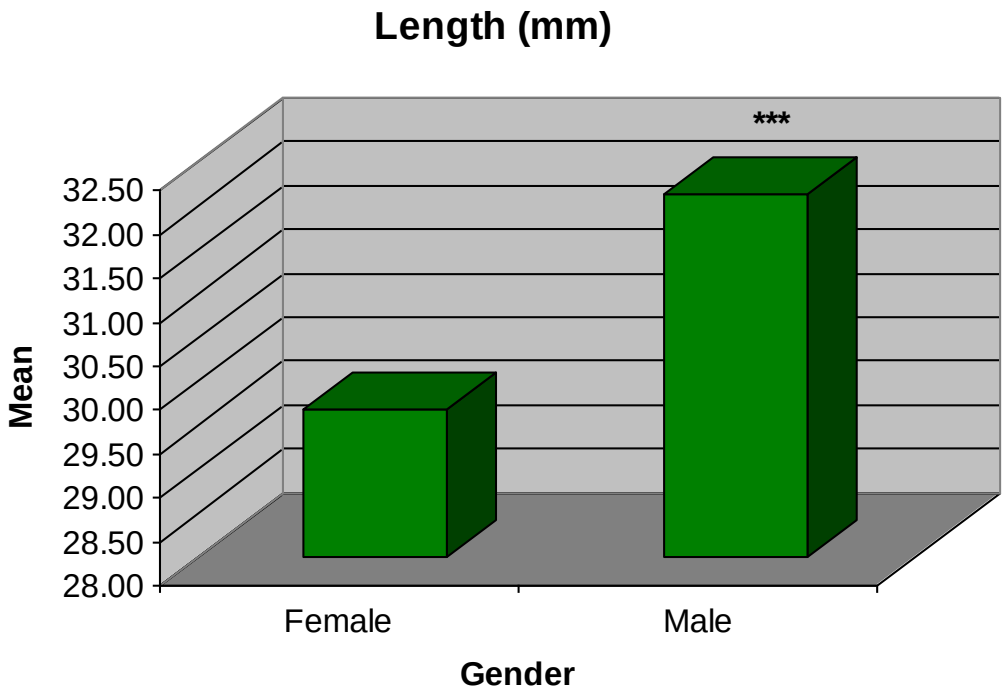
IV. Soft palate snoring

The distribution of soft palate snoring habits (yes/no) of recruited subjects according to age (20-30, 30-40, 40-50 and 50-60 years) is summarised in Table 7 and also shown in Fig. 9. The frequency (%) of snoring habit "yes" was higher in higher age group (30-60 years) than lower age group (20-30 years). Comparing the frequency (%) of soft palate snoring habits among different age groups, χ^2 test showed significantly ($P < 0.05$) different and higher "yes" snoring frequency in higher age group (30-60 years) as compared to lower age group (20-30 years) (χ^2=9.60, P = 0.022). In other words, in Lucknow population, soft palate snoring habits may be associated with age.

Table 6: Distribution of soft palate length (mm) according to gender of recruited subjects (n=200)

Gender	n	Soft palate length (mm) (Mean ± SE)	Mean difference	t value	*P* value
Female	100	29.69 ± 0.33	2.46	4.64	<0.001
Male	100	32.15 ± 0.41			

The soft palate length of four different gender groups were summarised in Mean ± SE and compared by Student's t test (t value)



Graph 10. Comparison of difference in mean soft palate length between two gender groups of recruited subjects.

B. Gender

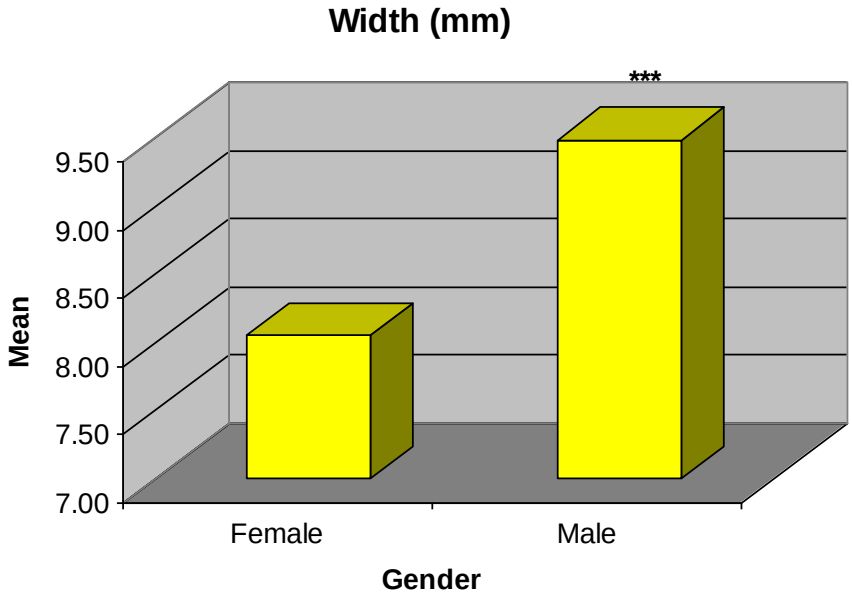
I. Soft palate length

The soft palate length of recruited subjects according to gender (male and female) is summarised in Table 8 and also shown in Fig. 10. The mean soft palate length was comparatively higher in males than females (female < male). Comparing the difference in mean soft palate length between two gender groups, Student's t test showed significantly different and higher (7.7%) soft palate length in males as compared to females (29.69 ± 0.33 vs. 32.15 ± 0.41, mean difference=2.46, t=4.64, $P < 0.001$) (Table 8 and Fig. 10).

Table 7: Distribution of soft palate width (mm) according to gender of recruited subjects (n=200)

Gender	n	Soft palate width (mm) (Mean ± SE)	Mean difference	t value	*P* value
Female	100	8.06 ± 0.14	1.43	6.41	<0.001
Male	100	9.49 ± 0.18			

The soft palate width of four different gender groups were summarised in Mean ± SE and compared by Student's t test (t value)



Graph 11. Comparison of difference in mean soft palate width between two gender groups of recruited subjects.

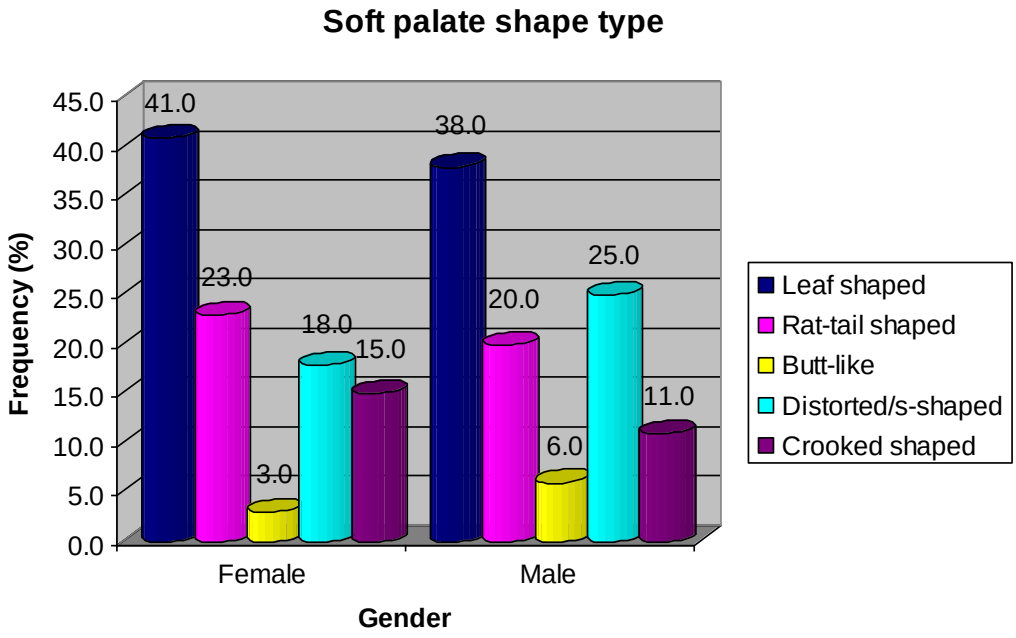
II. Soft palate width

The soft palate width of recruited subjects according to gender (male and female) is summarised in Table 9 and also shown in Fig. 11. Like soft palate length, the mean soft palate width was also comparatively higher in males than females (female < male). Comparing the difference in mean soft palate width between two gender groups, Student's t test showed significantly different and higher (15.1%) soft palate width in males as compared to females (8.06 ± 0.14 vs. 9.49 ± 0.18, mean difference=1.43, t=6.41, $P < 0.001$) (Table 9 and Fig. 11).

Table 8: Distribution of soft palate shape type according to gender of recruited subjects (n=200)

Soft palate shape type	Female (n=100) (%)	Male (n=100) (%)	χ^2 value	*P* value
Leaf shaped	41 (41.0)	38 (38.0)	3.09	0.545
Rat-tail shaped	23 (23.0)	20 (20.0)		
Butt-like	3 (3.0)	6 (6.0)		
Distorted/s-shaped	18 (18.0)	25 (25.0)		
Crooked shaped	15 (15.0)	11 (11.0)		

The soft palate shape type of recruited subjects according to gender were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



Graph 12. Distribution of soft palate shape type between two gender groups of recruited subjects.

III. Soft palate shape type

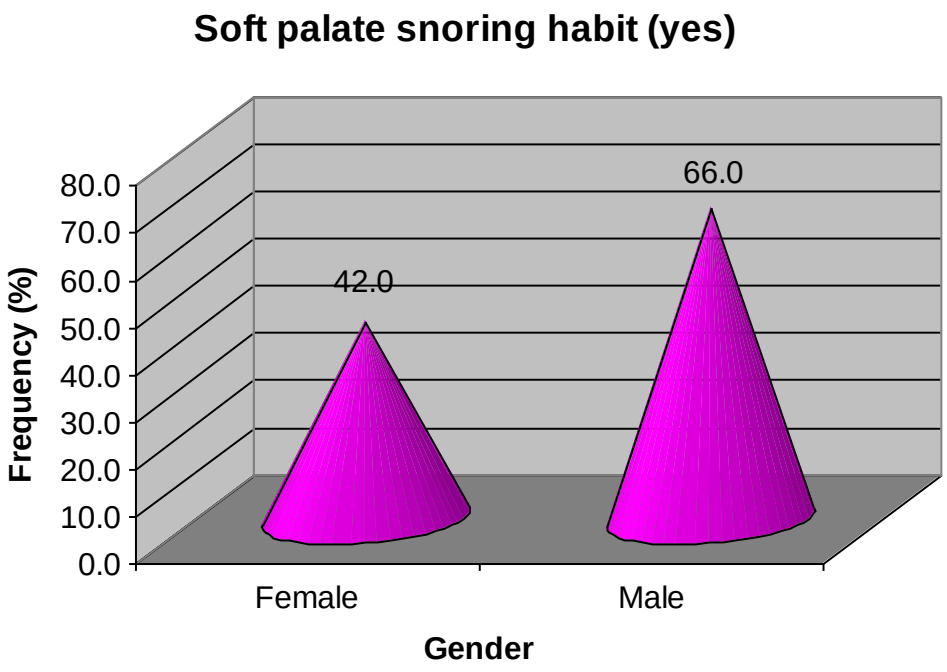
The distribution of soft palate shape type (leaf shaped, rat-tail shaped, butt-like, distorted/s-shaped and crooked shaped) of recruited subjects according to gender (male and female) is summarised in Table 10 and also shown in Fig. 12. In both the genders, the frequency of soft palate shape type "leaf shaped" was the maximum and "butt-line" the minimum.

Comparing the frequency (%) of soft palate shape type between two gender groups, χ^2 test showed similar ($P > 0.05$) frequency of soft palate shape type between the groups ($\chi^2=3.09$, $P = 0.545$) i.e. did not differ significantly. In other words, in Lucknow population, soft palate shape type may not be associated to gender.

Table 9: Distribution of soft palate snoring habit according to gender of recruited subjects (n=200)

Soft palate snoring	Female (n=100) (%)	Male (n=100) (%)	χ^2 value	*P* value
No	58 (58.0)	34 (34.0)	1.03	0.311
Yes	42 (42.0)	66 (66.0)		

The soft palate snoring of recruited subjects according to gender were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



Graph 13. Distribution of soft palate snoring habit between two gender groups of recruited subjects.

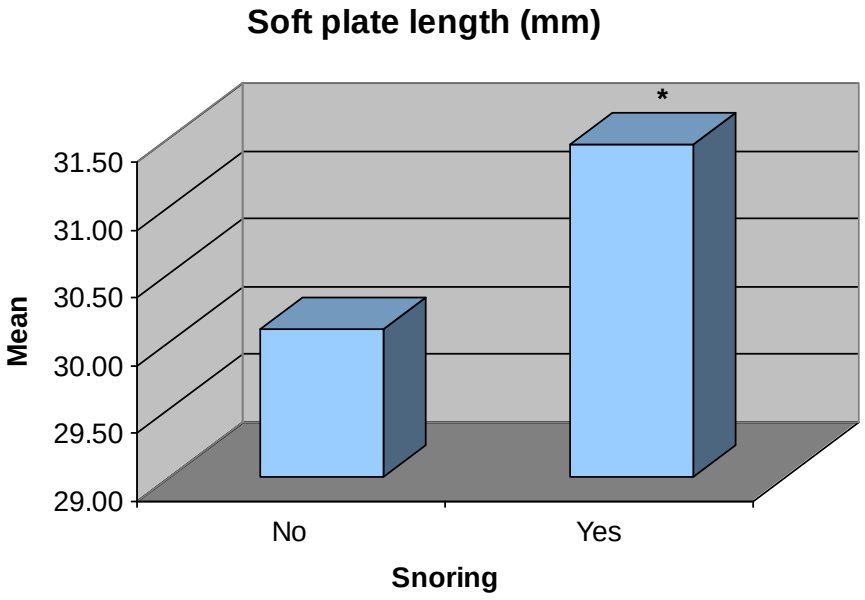
IV. Soft palate snoring

The distribution of soft palate snoring habits (yes/no) of recruited subjects according to gender (male and female) is summarised in Table 11 and also shown in Fig. 13. The frequency (%) of snoring habit "yes" was 9% higher in males than females (female < male) but not differ ($P > 0.05$) between the two groups (57.0% vs. 66.0%, χ^2=1.03, $P = 0.311$). In other words, in Lucknow population, like soft palate shape type, the snoring habit also not found to be associated with gender.

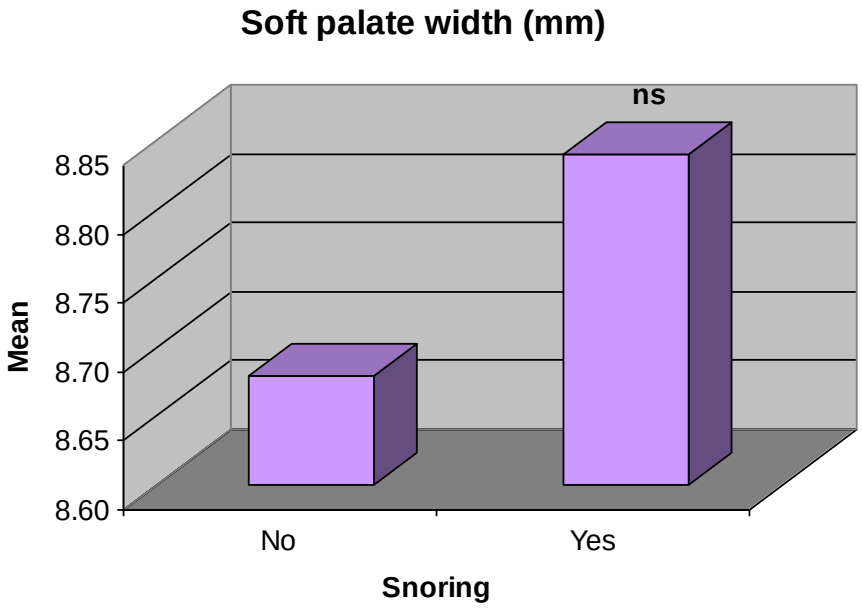
Table 10: Correlation of soft palate morphology (length, width and type) with snoring of recruited subjects (n=200)

Soft palate morphology	Snoring		t/χ^2 value	*P* value
	No (n=79) (%)	Yes (n=121) (%)		
Length (mm)	30.09 ± 0.41	31.46 ± 0.37	2.44	0.016
Width (mm)	8.68 ± 0.18	8.84 ± 0.17	0.61	0.546
Shape (type):				
Leaf shaped	36 (45.6)	43 (35.5)	2.57	0.632
Rat-tail shaped	15 (19.0)	28 (23.1)		
Butt-like	4 (5.1)	5 (4.1)		
Distorted/s-shaped	14 (17.7)	29 (24.0)		
Crooked shaped	10 (12.7)	16 (13.2)		

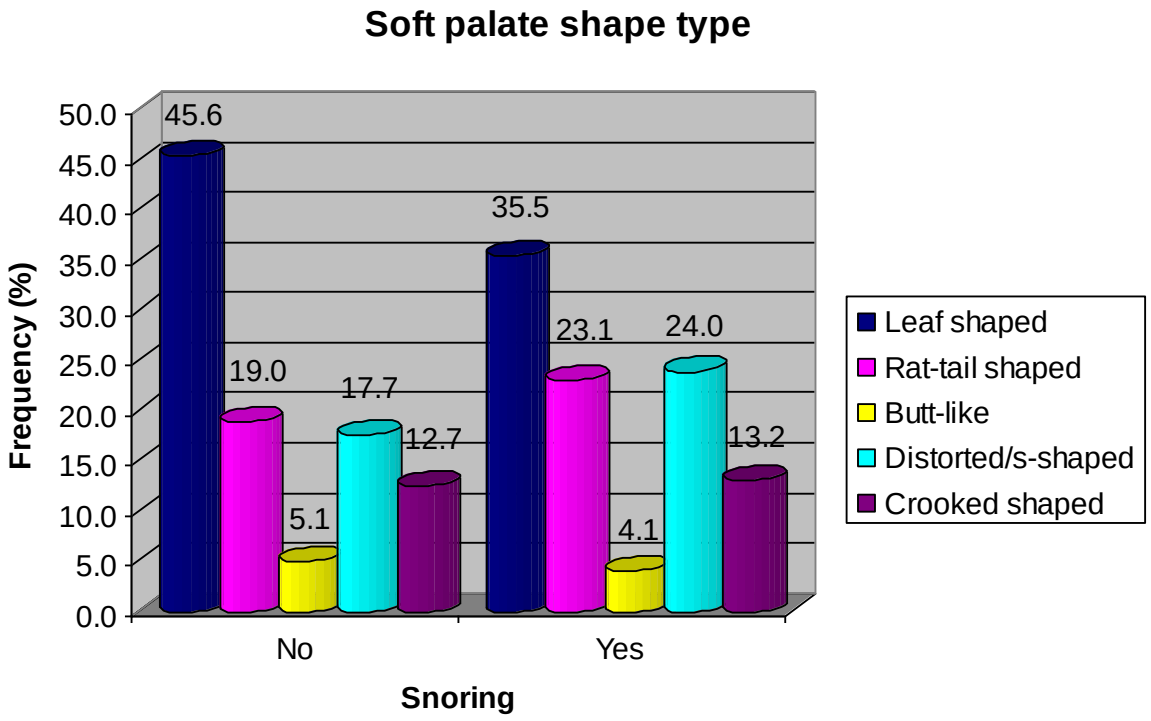
The soft plate length and with according to snoring were summarised in Mean ± Se and compared by Student's t test (t value) whereas shape were summarised in number (n) and percentage (%) and compared by χ^2 test (χ^2 value).



Graph 14. Comparison of difference in mean soft palate length between two snoring groups of recruited subjects.



Graph 15. Comparison of difference in mean soft palate width between two snoring groups of recruited subjects.



Graph 16. Distribution of soft palate shape type between two snoring groups of recruited subjects.

C. Snoring

The correlation of soft palate morphology (length, width and type) with snoring habits (yes/no) is summarised in Table 12 and also depicted in Fig. 14-16, respectively. On comparing, Student's t test showed significantly ($P < 0.05$) different and higher (4.4%) mean length in subjects those who snored as compared to those who did not snored (30.09 ± 0.41 vs. 31.46 ± 0.37, mean difference=1.37, t=2.44, $P = 0.016$). In contrast, mean width was found similar ($P > 0.05$) between the two groups though it was 1.8% higher in subjects those who snored as compared to those who did not (8.68 ± 0.18 vs. 8.84 ± 0.17, mean difference=0.61, $P = 0.546$). Further, soft palate shape (type) also not differed ($P > 0.05$) between the two snoring groups (yes/no) i.e. found to be statistically the same ($\chi^2=2.57$, $P = 0.632$).

In conclusion, in Lucknow population, soft palate length may be associated to snoring but both width and shape were found not to be associated with snoring.

DISCUSSION

In forensics, gender determination is one of the important part followed by estimation of age. In cases of any natural calamity or man – made disaster, gender and age determination is done on the basis of remaining parts of soft tissue and skeleton. Soft palate is one of the major soft tissue present in the oral cavity which has prospects in determining age and gender with different diagnostic measures.

The variations within the morphology of soft palate, its length and density in patients helps to determine various diseases like OSMF, OSA and other incompetency related to it. OSA is a potentially serious sleeping disorder with a noticeable sign of snoring present. For diagnosing these diseases, clinical examination is the very first step to be followed, but due to the limited approach to the velopharyngeal region, it has become mandatory to rely on some diagnostic methods for complete evaluation like Lateral cephalometry, CT Scan or MRI Scan.

Lateral cephalogram is the most commonly used radiographic technique for assessing velar and pharyngeal morphology. It is a relatively inexpensive method and provides a good assessment of the soft-tissue elements that define the soft palate and its surrounding structures with minimal radiation exposure. The soft palate morphometric analysis and configuration of adjacent structures can be defined in terms of their length and width in the median sagittal plane on a lateral cephalogram. A digital radiographic technique is mainly used to perform this work as it enables the technician to take the image from the posterior to the anterior in the sagittal plane. Further, standard software is used to enhance and elicit the velar morphology by adjusting the contrast and for gradations.

This study has been carried out to find different velar morphology and there variations with age, gender. Also, morphometric assessment done based on the length and width along with correlation between snoring and any particular velar morphology as an indicator for the early diagnosis of obstructive sleep apnea syndrome (OSAS) has also been.

Studies done earlier on the morphology of soft palate mainly had observations over the shape, and correlation either with age or gender.

In the present study, there was an assessment of the morphology of soft palate corelating both with age and gender and along with, finding a positive pathway for patients with history of snoring, for reaching to the probable diagnosis of OSA.

Deficit in literature regarding documented and published research on velar morphology in Lucknow population lead us to take this study. A total of 200 subjects were taken for doing

this study, progressively over a time period of one year from February 2019 to January 2020, and all are the representatives of Lucknow population.

1) AGE

1.1) Length: In this study, the mean soft palate length of recruited subjects according to age (ranged from 20 – 60 years) was found to be 30.92 ± 0.28. On further dividing age into 4 groups, the mean soft palate length showed linear increase with age i.e. as age increases; soft palate length also increases and so the mean value of age increases.

Comparing our observation, study done by **Kruthika S Gutthal et al (2012)[5]** in which they had taken a sample of 200 digital lateral cephalograms with an age ranged from 15 to 30 years and had divided them into 4 groups for finding the length, thickness and shape of the soft palate. Result showed there is an increase in length of soft palate as the age increases with a mean value of 30.05 ± 4.27 which was similar with the present study.

Another study done by **V Deepa et al. (2013)[36]** in which they had taken 120 normal subjects, 15 cleft palate patients and 15 OSA patients with age ranged from 5 year onwards categorizing them into 2 groups and 2 subgroups and had observed a significant increase in the length of the soft palate as age increases with a mean value of 32.65 ± 5.01, for the normal subjects.

Study done by **Verma P et al (2014)[31]** in which he had taken 300 normal subjects with age ranged from 15 to 45 years and had divided into 6 groups. Result showed a linear increase in the length of the soft palate as age increases with a mean value of 31.32 ± 3.49.

Study was done by **Santosh et al. (2015)[37]** in which they had taken a sample of 100 digital lateral cephalograms with age (ranged from 15 to 26 years), further divided into 4 groups and analyzed it for the difference in the morphology of the soft palate and also for assessing the length and density of the soft palate and found that there was a significant difference in length of the soft palate between preadult and adult age groups with a mean values of 31.76 ± 3.98 and 34.54 ± 3.81 respectively, showing an increase in the length of the soft palate as age the increases.

Another study done by **C Vani et al (2017)[34]** in which she had taken a sample size of 150 patients between age ranged from 20 to 70 years and had categorized them into 5 groups for assessing the morphology of soft palate and it's relation with age. Result showed no corelation between soft palate and age, this may be due to the less sample size taken.

1.2) Width: In this study, the mean width of the palate for the 4 groups was found to be 8.77 ± 0.12. This mean value did not showed any trend with age. It was highest in 50-60 years followed by 30-40 years, 20-30 years and 40-50 years found to be the least.

Comparing our observation, study done by **Kruthika S Gutthal et al (2012)[5]** in which she had taken 200 digital lateral cephalogram age ranged from 15 to 30. Result showed the width of soft palate a mean value of 7.68 ± 2.01, with no corelation found between the age specific and the width of the soft palate. Width was highest in 26 – 30 years group, followed by 21 – 25 years, and 30 years and above group. This result was quite similar with the present study.

1.3) Shape: In the present study, the distribution of soft palate shape type (leaf shaped, rat-tail shaped, butt-like, distorted/s-shaped and crooked shaped) of recruited subjects according to age groups were noted and found that in the group of 20-30, 30-40 and 40-50 years, the soft palate shape type "leaf shaped" was found to be the most frequent type whereas in 50-60 years it was "distorted/s-shaped" and in contrast, in all age groups, the "butt-like" shape type was the least frequent with a values of 39.5%, 21.5% and 9% respectively and no corelation found between age and shape of the soft palate.

On comparing our finding, a similar study was done by **You M et al. (2008)[9]** in which he had taken the sample of 200 normal subjects whose age ranged from 5 – 48 years for assessing the velar morphology on lateral cephalometry, was examined and categorized into six types and found that leaf shaped soft palate was the most common type amongst all the age groups, also had described it as a classic velar morphology but the age was not associated with any of the type of soft palate.

Study done by **Kumar DK et al. (2011)[35]** in which they had taken a sample size of 100 patients whose age ranged from 15 – 35 years and examined the morphology of soft palate with the help of digital lateral cephalometry and categorized it into 6 types. Result showed that the leaf-shaped soft palate was the most frequent type in 40% cases, followed by rat tail type in 28%, butt type in 15% cases, straight line type in 12% cases, crook shaped type in 3% cases and S-shaped type being the least in 2% cases.

Another similar study done by **V Deepa et al. (2013)[36]** in which they had taken 120 normal subjects, with age ranged from 5 year onwards categorizing them into 2 groups and 2 subgroups and had also observed leaf type soft palate to be the most common type present amongst all the age groups with a value of 38% followed by rat tail type, butt type, straight line, distorted type and crooked type with values 20%, 5%, 10%, 10% and 13% respectively and is not related to any age group.

Study done by **Khaitan T et al (2015)[15]** in which they had taken digital lateral cephalogram of 200 normal subjects with age ranged from 5 to 55 years and had categorized them into 5 groups for investigating the morphology of soft palate. The result showed leaf type soft palate was the most common type found in all age group with value of 47.5%, followed by rat tail type, butt type, straight type, distorted type and crooked type with values 33.5%, 7.5%, 4.5%, 1.5% and 1.5% respectively.

C Vani et al (2017)[34] also had done a study for investigating the morphology of soft palate by taking 150 normal subjects with age ranged from 20 – 60 years and had divided them into 5 groups. Digital lateral cephalogram was done and the morphology of soft palate was classified into 6 types. Further, result showed leaf type soft palate was the most common type to be found amongst all the age groups, with a value of 38% and also found no corelation between any age group and types of soft palate.

Study done by **Upadhyay Chandan et al. (2017)[33]** in which he had taken 263 digital lateral cephalograms of normal subjects with age ranged from 18 to 40 years and had divided them into 3 groups, found rat tail type soft palate to be the most common type with a value of 35% and s- shaped type the least common with value of 6.5%.

Pepin et al (1999)[60] described S-shape as a hooked appearance of the soft palate. In their study, hooking of the soft palate was defined as an angulation of about 30° between the distal part of the uvula and the longitudinal axis of the soft palate. They stated that hooking of the soft palate plays a major role in pharyngeal collapse, as hooking results in a sudden and major reduction in the oropharyngeal dimensions, which therefore dramatically increases the upper airway resistance and the trans pharyngeal pressure gradient. So, this was concluded by the author that hooking of the soft palate in patients indicated a high risk for obstructive sleep apnea syndrome (OSAS). In the present study, S-shaped soft palate was found in 43% cases.

2) GENDER

2.1) Length In our study, the soft palate length of recruited subjects according to both the genders with equal number of males (100) and females (100) was noted and observed that the mean length of the soft palate was comparatively higher in males than females with mean values of 32.15 ± 0.41 and 29.69 ± 0.33 respectively.

Comparing our finding, a similar study was found which was done by **Kruthika S Gutthal et al (2012)[5]** in which they had taken 200 digital lateral cephalograms of 79 males and 121 females with age ranged between 15 to 30 years for assessing the variation in the morphology, length and thickness of the soft palate in both the genders. The result showed the length of the

soft palate is higher in males with a mean value of 30.81 ± 4.30 than females with mean value of 29.56 ± 4.20, which was quite similar with the present study done.

Another similar study was done by **Verma P et al (2014)[31]** in which he had taken 300 normal subjects in equal genders (150 males and 150 females) with age ranged from 15 to 45 years. Result showed the length of soft palate was more in males with a mean value of 31.69 ± 2.90 than females with a value of 29.96 ± 2.70.

Study done by **Khaitan T et al (2015)[15]** in which he had taken 200 normal subjects in equal genders (100 males and 100 females) to illustrate difference in the morphology of soft palate. Result showed the length of the soft palate was higher in males with a mean value of 34.59 ± 4.78 than females with a mean value of 33.01 ± 3.89, which was also quite similar with the present study.

Another similar study done by **Tejawathi Nagaraj et al (2016)[29]** in which he also had taken 200 normal subjects with age ranged from 8 to 35 years. Lateral cephalograms was done using digital orthophos XG machine with an equal number of males and females (100 males and 100 females). Radiographs were collected and for the analysis of the morphology of soft palate. Soft palate length and thickness were calculated and found that the length of the soft palate was more in males with mean value of 35.17 ± 4.46 than females with the mean value of 33.28 ± 3.96 and showed variation in different age groups.

Study done by **Santosh et al.(2017)[37]** with a sample size of 100 digital lateral cephalograms with 41 males and 59 females, age ranged between 15 to 25 years to investigate different types of soft palate. Result showed a significant difference in the length of the soft palate between males and females, the length of soft palate in males was found to be more longer and denser than females with a mean values of 34.35 ± 4.13 and 32.24 ± 3.26 respectively.

2.2) Width: The soft palate width of recruited subjects according to gender with equal number of males and females (100 each) was noted and observed that like soft palate length, the mean soft palate width was also comparatively higher in males than females with mean values of 9.49 ± 0.18 and 8.06 ± 0.14 respectively.

Study done by **Verma P et al (2014)[31]** in which he aimed to investigate the variations of the soft palate morphology in different age groups and gender. For this, he took a study sample of 300 normal subjects age ranged between 15 to 45 years with equal number of males and females (150 each). Result showed the width of soft palate was higher in males with mean value of 8.96 ± 0.15 than females with mean value of 7.82 ± 0.13 which was almost similar with the present study.

Another similar study was found which was done by **Tejawathi Nagaraj et al(2016)[29]** in which he had taken 200 digital lateral cephalograms for both 100 males and 100 females. The soft palate length and thickness were calculated and noted that the width of the soft palate was significantly higher in males with mean value of 10.33 ± 1.61 than females with a mean value of 8.95 ± 1.36.

2.3) Shape: In the present study, the distribution of soft palate shape type (leaf shaped, rat-tail shaped, butt-like, distorted/s-shaped and crooked shaped) of recruited subjects according to gender with equal number of males (100) and equal number of females (100) was recorded and observed that in both the genders, the frequency of the "leaf shaped" soft palate was found to be the most common type which was 39.5% (38 in males and 41in females) and "butt-line" type the least which was 4.5% (6 in males and 3 in females).

Comparing our study, a study was done was by **Praveen BN et al (2011)[30]** in which he had taken 80 individuals with equal number of males (40) and females (40) requiring orthodontic treatment without any speech defect, age ranged from 9 to 31 years. Soft palate shape was examined on digital lateral cephalograms and the soft palate was classified into 6 types, and the result showed out of these 6 type of soft palate, rat tail type found to be the most common type in 55% cases (24 females and 20 males) and the least common type was distorted / S – type in 2.5% cases (1 female and 1 male). This difference can be noted due to fact that most of the cases had malocclusion who are in the requirement of orthodontic treatment.

Study done by **Santosh et al.(2017)[37]** in which they had taken a sample of 100 normal subjects and divided them into male and female group as 41 and 59 respectively. His observation showed that leaf shaped type soft palate with 47% (17 males and 30 females) was the most common type followed by butt type, the second most common with 16% (7 males and 9 females) and S – shaped type being the least with only 2% (0 in males and 2 in females).

Study done by **Smriti Komal et al (2015)[32]** in which they had taken a total of 100 digital lateral cephalograms of normal healthy individuals (50 males and 50 females) aged between 15 to 45 years to investigate the_morphology of soft palate between males and females. It was found that leaf type soft palate was the most common type present in both the genders to be 38% (19 in males and 11 in females) followed by the least common type of soft palate to be straight line type with 6% (3 in males and 8 in females) and S- shaped type with 6% (3 in males and 3 in females.

Study done by **Tejawathi Nagaraj et al(2016)[29]** in which he had taken a sample of 200 normal subjects with equal number of males and females (100 each) and result showed that leaf shaped soft palate was the most common type with 39% (42 males and 36 females), second most

common type was found to be rat tail type with 33.5% (31 in males and 36 in females) and the least common type was straight type with only 6% (2 in males and 7 in females).

Another study, done by **Upadhyay Chandan et al. (2017)[33]** in which they had taken a study sample of 263 normal subjects, out of which 92 were males and 171 were females. Digital lateral cephalogram was done and found that the most common type of soft palate was found to be rat tail type with 35% (27 males and 65 females), second most common type was leaf shaped type with 20% (20 in males and 33 in females).

Study done by **Valambhat S et al. (2020)[38]** in which they had taken a study sample 299 normal subjects (110 males and 189 females) and lateral digital cephalograms were taken to assess the morphology of soft palate. Result showed that leaf shape type soft palate was the most common type present with 27% (48 females and 33 males) followed by straight type, the second most common type of soft palate with 22% (26 in males and 40 in females) and crooked type the least common type of soft palate with 6% (11 in males and 4 in males).

In the above mentioned studies as well as the present study showed no correlation between the types of soft palate and any gender specific.

3) SNORING

It is an increasingly common, chronic, sleep-related breathing disorder.[12,13,14] which is characterized by periodic narrowing and obstruction of the pharyngeal airway during sleep. Untreated OSA is associated with long-term health consequences including cardiovascular disease,[15] metabolic disorders, cognitive impairment and depression.

3.1) Age: In the present study, 200 normal subjects were taken with age ranged from 20 to 60 years, further divided into 4 groups. The result showed that there was no trend has been observed in the age groups with snoring habit present as Group C with 40 – 50 years showed the maximum value with 68% than the other groups present.

Study conducted by **F Kauffmann et al (1989)[61]** in which they had taken 457 middle age males to investigate relation between snoring, smoking, body mass index, age, alcohol consumption and respiratory symptoms and found that snoring was most commonly seen in elder age males, which showed similarity with the present study that snoring was majorly found in elder age individuals than younger ones.

3.2 Gender: 200 normal subjects were taken with equal number of males and females (100 each). On observing the result for gender related to snoring habit, we found that males have the habit of snoring (66%) more than females (42%).

Study conducted by **Devi E et al (2016)[62]** in which they had taken a study sample 550 normal subjects to investigate the snoring habit between males and females and found that males have of the habit of snoring more than females with a value of 59.72% and 40.20% respectively, which was quite similar with the present study.

3.3) Length: on further observation, we had found that the soft palate of subjects with snoring habit showed a significant increase in the length with a mean value of 31.46 ± 0.37 than those with no habit of snoring with a value of 30.09 ± 0.41.

A similar study done by **Yuko Shigeta et al (2010)[63]** in which they had taken a study sample of 45 subjects to investigate relation between upper airway length and soft palate between OSA and Non-OSA group and found that the soft palate length was higher in males with a value of 42.5 ± 5.76 than females with a value of 36.4 ± 4.42 followed the upper airway length which was also higher in males than females with values 47.2 ± 8.08 and 43.9 ± 5.15 respectively

3.4 Width: observing the width of soft palate, we had found that no changes were seen in the width of soft palate between snorers and non – snorers and the value was found to be 30.09 ± 0.41 for both the groups.

Study was conducted by **Gokmen Kurt et al (2011)[64]** to investigate pharyngeal airway between snoring and non- snoring patients through lateral cephalogram. He had taken a study sample of 20 simple snoring cases, 20 OSA cases and 20 individuals without any respiration problems. Result showed an increase in the width of the soft palate in OSA patients than the non – OSA patients with a mean value of 37.07 ± 3.1. This finding was not similar with the present study may be due to the specific categorization done by the author [Gokmen Kurt et al (2011)].

3.5) Shape: on further observation, we had found that subjects who are snorers, can show all variants of soft palate than those with non- snorers. There is no positive corelation found between any particular shape and snoring habit.

Similar study done by **Valambhat S et al. (2020)[38]** with a sample size 299 patients age ranged between 5 – 85 years had observed that velar morphology was classified into six types, and an indeterminate type as Type 7, was also proposed in his classification. There was no corelation found between any particular velar morphology with age or gender but showed a positive corelation between snoring and with type of soft palate i.e. Type 6, Type 5, and Type 1 palates. In the present study, snoring habit increases with age and is mainly found in higher age groups than the younger age groups and more in males than females. Here we also had observed an increase in length of soft palate of those subjects who had a habit of snoring than non- snorers. Apart from this, no difference was found in the width of soft palate between snorers and non-

snorers, also not have noticed any particular type of soft palate whether related to snoring habit or not.

Considering snoring as an indicator for Obstructive sleep apnea syndrome, we can conclude that people with snoring habits are less likely to have any particular shape of soft palate, rather have increase in the length of the palate, which can be especially seen in males than females.

The importance of this finding is the fact that a maxillofacial radiologist may be able to play a vital role in the early diagnosis and prevention of OSAS by looking for particular velar morphologies which may be more predisposed for OSAS.

This method of using a digital cephalogram as an adjunct to the clinical examination can help. However, further studies are required on a larger sample size with the aid of apnea plus hypopnea index (number of apnea/ hypopnea episodes/h) which has been considered the gold standard in OSAS assessment. Maxillofacial radiologists may be the first specialists to detect the early clinical and radiographic effects of developing OSAS.

Literature on the morphological assessment of the soft palate corelating with snoring is very less, and we have seen that a digital cephalogram can be a cost-efficient and fast method of assessing the same. It has been routinely used in the specialty of orthodontics and dentofacial orthopaedics as an valuable pre-treatment assessment modality. The different morphological varieties of the soft palate have been largely ignored in the past until **You et al.(2008)[9]** proposed a classification for the same. The morphological and morphometric assessment of the soft palate could not be found in the documented literature in Lucknow population.

The lateral cephalograms taken on the Planmeca Romexis 2.9.2. software equipment allowed the optimization and contrast improvement which allowed better visualization of the soft palate when compared to its appearance on a conventional radiograph.

CONCLUSION

Many radiological techniques are used as an aid in human identification which includes gender determination, ethnic group and age. However, the use of any of the techniques completely depends on its availability of past records for comparison, which is kept by health care professionals.

Advanced radiographic imaging techniques, like computed tomography (CT), magnetic resonance imaging (MRI) and fluoroscopy are the most effective methods for visualizing soft palate, **lateral cephalogram** remains the most commonly used radiographic method because of easy availability and cost effectiveness.

The morphology of soft palate has been categorized into six types radiographically, according to their features on lateral cephalometry. Radiographic analysis of morphological variations of soft palate may help in success of surgical procedures aimed for correcting deformities of soft palate as it is an important structure in velopharyngeal closure and provides information for diagnosis, prognosis and treatment in individuals with cleft palate and in obstructive sleep apnoea syndrome.

Still it is not possible to differentiate between chronic snorers and people with sleep apnea based on a digital cephalogram only. Lateral cephalometric radiograph provides two-dimensional stable images that do not take into account any active functional processes. Despite these limitations, cephalometric can be considered as a positive screening method to study the craniofacial hard- and soft-tissue morphology in snoring patients who are at risk for developing OSAS.

The available literatures on morphology of the soft palate have reported very few studies on morphological assessment of the soft palate and have often reported the shape of the soft palate mainly of one type. However, this study has applied an earlier classification and confirmed significant variations in the morphological patterns among the subjects.

Our study has found a statistically significant association between velar morphology and snoring habits in Lucknow population which further may prove itself as a milestone in researches for early diagnosis and management of velopharyngeal incompetency.

Though our study is quite useful in detecting OSA or other velar deformities, still some improvement can be done to make it more accurate.

To reach up to an exact confirmation regarding the shape of soft palate associating with gender, age and snoring for a better early diagnosis of OSA; this study can be more improved by increasing the sample size along with proper questionnaire set-up regarding snoring habit and

measurement of the upper airway diameter (UAD) and mandibular-to-hyoid bone distance (MP-H). this could be done for reaching to early diagnosis of OSA as there is a reduced UAD measurement for the high risk OSA patients.

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ANNEXURE 1

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES (FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Evaluation of the Morphology of Soft Palate Correlating With Age and Gender: A Digital Cephalometric Study."** submitted by **Dr Himanshi** Post graduate student from the **Department of Oral Medicine & Radiology** as part of MDS Curriculum for the academic year 2018-2021 with the accompanying proforma was reviewed by the Institutional Research Committee present on **27th November 2018** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

ANNEXURE 2

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the VIIth Institutional Ethics Sub-Committee

IEC Code: 07 **BBDCODS/01/2019**

Title of the Project: Evaluation of the Morphology of Soft Palate Correlating With Age and Gender: A Digital Cephalometric Study.

Principal Investigator: Dr. Himanshi **Department:** Oral Medicine & Radiology

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr. Himanshi,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 10th January 2019.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics & Dentofacial Orthopedics, BBDCODS, Lucknow
4.	Dr. Sumalatha M.N. Member	Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 22/01/19

Member Secretary
Institutional Ethic Committee
Babu Banarasi Das College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

(Dr. Lakshmi Bala)
Member Secretary
IEC

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

(Dr. R. Rajkumar)
Principal
BBDCODS

ANNEXURE 3

CASE HISTORY PROFORMA

TO EVALUATE THE MORPHOLOGY OF SOFT PALATE CORELATING WITH AGE AND GENDER: A DIGITAL CEPHALOMETRIC STUDY

DEPARTMENT OF ORAL MEDICINE & RADIOLOGY

Babu Banarasi Das College of Dental Sciences, Lucknow (U.P.)

OPD NO: Case No:

Name: Age: Sex:

Chief Complaint:

Abusive Habits:

General Physical Examination**:**

Extraoral Examination**:**

Intraoral Examination (Hard Tissue Examination)**:**

Soft Tissue Examination:

Provisional Diagnosis:

Radiographic Investigations (Lateral Cephalogram)

Anterio-posterior dimension:

Superio-inferior dimension:

Shape of uvula: History of snoring (y/n):-

ANNEXURE 4

A) CONSENT FORM (ENGLISH)

Title of the Study ……..

Study Number……..

Subject's Full Name…….

Date of Birth/Age ……

Address of the Subject…….

Phone no. and e-mail address……

Qualification ……

Occupation: Student / Self Employed / Service / Housewife/ Other (Please tick as appropriate)

I confirm that I have read and understood the Participant Information Document dated ……..for the above study and have had the opportunity to ask questions.

OR

I have been explained the nature of the study by the Investigator and had the opportunity to ask questions.

2. I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.

3. I understand that the sponsor of the project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.

4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

5. I permit the use of stored sample (tooth/tissue/blood) for future research. Yes [ ] No [ ] Not Applicable [ ]

6. I agree to participate in the above study. I have been explained about the complications and side effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's Information document given to me.

Signature (or Thumb impression) of the Subject/Legally Acceptable

Representative:……..

Signatory's Name……. Date …….

Signature of the Investigator…… Date……..

Study Investigator's Name..... Date……..

Signature of the witness…… Date……..

Name of the witness……

Received a signed copy of the PID and duly filled consent form

Signature/thumb impression of the subject or legally acceptable representative…….

Date…….

ANNEXURE 4

B) CONSENT FORM (HINDI)

सहमति पत्र

अध्ययन का शीर्षक.....

अध्ययन संख्या.....

विषय का पूरा नाम.....

जन्म / आयु की तिथि.....

विषय का पता.....

फोन नंबर और ईमेल पता.....

योग्यता.....

व्यवसाय: छात्र / स्वयं नियोजित / सेवा / गृहिणी / अन्य

1. मैं पुष्टि करता हूं कि मैंने प्रतिभागी सूचना दस्तावेज को पढ़ और समझ लिया है .....उपर्युक्त अध्ययन के लिए और प्रश्न पूछने का अवसर मिला है

या

मुझे जांचकर्ता द्वारा अध्ययन की प्रकृति की व्याख्या की गई है और मुझे प्रश्न पूछने का अवसर मिला है।

2. मैं समझता हूं कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और किसी भी दुविधा के बिना मुफ्त इच्छा के साथ दी गई है और मैं किसी भी समय बिना किसी कारण के और बिना चिकित्सा देखभाल या कानूनी अधिकारों के प्रभावित किए बिना वापस लेने के लिए स्वतंत्र हूं।

3. मैं समझता हूं कि परियोजना के प्रायोजक, प्रायोजक की तरफ से काम करने वाले अन्य लोग, नैतिकता समिति और नियामक प्राधिकरणों को वर्तमान अध्ययन के संबंध में और मेरे आगे के किसी भी शोध के संबंध में मेरे स्वास्थ्य रिकॉर्ड देखने की अनुमति की आवश्यकता नहीं होगी इसके संबंध में आयोजित किया गया, भले ही मैं निशान से पीछे हट जाऊं। हालांकि, मैं समझता हूं कि मेरी पहचान तीसरे पक्ष को जारी या प्रकाशित किसी भी जानकारी में प्रकट नहीं होगी।

4. मैं इस अध्ययन से उत्पन्न होने वाले किसी भी डेटा या परिणामों के उपयोग को प्रतिबंधित नहीं करने के लिए सहमत हूं बशर्ते ऐसा उपयोग केवल वैज्ञानिक उद्देश्यों के लिए है।

5. मैं भविष्य के शोध के लिए उपर्युक्त अध्ययन में भाग लेने के लिए सहमत हूं

हां [] नहीं [] लागू नहीं []

6. मुझे अध्ययन के बारे में समझाया गया है, और उन्हें पूरी तरह से समझ लिया है। मैंने मुझे दिए गए प्रतिभागी / स्वयंसेवक के सूचना दस्तावेज को भी पढ़ और समझ लिया है।

विषय / कानूनी रूप से स्वीकार्य के हस्ताक्षर / अंगूठे की छाप

प्रतिनिधि.....

हस्ताक्षरकर्ता का नाम.....

जांचकर्ता के नाम का हस्ताक्षर.....

अध्ययन जांचकर्ता का नाम .... दिनांक.....

गवाह का हस्ताक्षर.....

गवाह का नाम ..... दिनांक .....

विधिवत भरे सहमति फॉर्म की एक हस्ताक्षरित प्रति प्राप्त की

विषय / कानूनी रूप से स्वीकार्य प्रतिनिधि के हस्ताक्षर / थंप इंप्रेशन

..... दिनांक .....

ANNEXURE 5

MASTER CHART

SNO	Date	OPD No.	Name	Age (yrs)	Gender	SOFT PALATE MEASUREMENT			
						Length (mm)	Width (mm)	Shape	Snoring
1	06-05-2019	27717	Anam Khan	22	F	31.1	7.4	6	Yes
2	06-05-2019	75733	Sadhna singh	20	F	27.2	8.9	1	No
3	06-05-2019	30255	Yasmin	20	F	26.8	8.9	1	No
4	06-05-2019	29560	Shashi rani	50	F	37.2	9.3	5	Yes
5	07-05-2019	30745	Vidhya Prasad	43	M	33.6	9.6	1	Yes
6	07-05-2019	57980	Vidisha singh	20	F	30	2.6	5	No
7	08-05-2019	70825	Aparna Raj	25	F	27.9	8	1	No
8	14-05-2019	25895	Minal Singh	22	M	32.3	8.8	5	Yes
9	14-05-2019	32060	Praveen Raj	25	M	30.1	9.8	1	No
10	15-05-2019	32990	Vaishali singh	35	F	27.9	7.8	2	No
11	15-05-2019	78840	Radha Singh	31	F	27.4	6.7	1	No
12	16-05-2019	33280	Rajesh Thakur	33	M	38.2	9.8	1	Yes
13	16-05-2019	32415	Julfikar	36	M	35.2	9.8	1	No
14	17-05-2019	33580	Ranjeen Singh	28	M	26.6	7.4	5	No
15	17-05-2019	33010	Tauseef	31	M	37.6	8.8	2	Yes
16	20-05-2019	34155	Saumya Singhal	36	F	30.7	6.9	5	Yes
17	20-05-2019	34210	Sarita Negi	36	F	30.3	7.6	1	Yes
18	21-05-2019	30800	Sarojini Singh	30	F	29.2	8.5	1	No
19	21-05-2019	34460	Abhay Raj	30	M	30.7	10.5	5	Yes
20	21-05-2019	34490	Shaleen Bano	42	F	31.5	10.5	1	Yes
21	23-05-2019	15090	Heval Kumari	46	F	32	8.2	2	Yes
22	23-05-2019	35170	Dukhwanti Devi	60	F	32	8.2	1	No
23	24-05-2019	66440	Rashmi Gagnwar	40	F	20.6	5.2	5	Yes
24	24-05-2019	35415	Renu Yadav	45	F	28.8	6.9	1	No
25	24-05-2019	35520	Ashok Sharma	43	M	41	12	6	Yes
26	04-06-2019	8115	A.P.Singh	47	M	28.8	9.4	1	Yes
27	07-06-2019	39100	Meera Singh	40	F	30.7	8	5	Yes
28	11-06-2019	39830	Sachin Sehgal	40	M	37.2	11.5	2	No
29	11-06-2019	39880	Sooraj Sharma	40	M	33.5	10.5	2	Yes
30	14-06-2019	40205	Anshu Mohan	54	F	34.3	9.8	5	Yes
31	14-06-2019	20930	Renu singh	50	F	26	7.5	1	No
32	17-06-2019	1805	Vinay Singh	50	M	33.6	9.5	5	No
33	17-06-2019	41075	Kadambari Devi	41	F	32.2	7.5	6	Yes

34	20-06-2019	42060	KK Srivastava	52	M	20.8	10.3	3	Yes
35	20-06-2019	42100	Pradeep Kumar	53	M	32.3	12.7	1	Yes
36	25-06-2019	47980	Sunaina Sharma	23	F	28.1	8.1	1	No
37	25-06-2019	41660	bindu devi	24	F	29.3	7	2	Yes
38	28-06-2019	44045	Goldie	31	M	29.8	9.8	1	Yes
39	03-07-2019	83845	Lata Verma	40	F	35.9	7.6	1	Yes
40	05-07-2019	45910	Rajpati Patel	54	F	31.3	8.6	5	No
41	11-07-2019	2775	Munni Devi	60	F	32.8	10.4	1	Yes
42	11-07-2019	47400	Harish Rana	40	M	35.1	6.2	2	Yes
43	11-07-2019	47380	Ganika Singh	42	M	28.2	9.5	1	Yes
44	15-07-2019	44905	Sheela Devi	42	F	34.4	6.6	5	No
45	15-07-2019	48005	Meenakshi Yadav	23	F	25.4	6.8	2	No
46	18-07-2019	15305	Vishnu Pratap	20	M	27.1	11.4	1	Yes
47	18-07-2019	49345	Pushpa Yadav	30	F	26.4	7	1	Yes
48	01-08-2019	52965	Suresh Yadav	24	M	28.1	10.7	1	No
49	01-08-2019	50810	Deepak Chandra	20	M	27.2	10	1	No
50	01-08-2019	83480	IndrajeetSungh	50	M	33.7	8.8	5	No
51	02-08-2019	16671	Sunita Singh	50	F	34.7	8.9	6	Yes
52	02-08-2019	53370	Parwati Devi	50	F	23.8	6.2	1	Yes
53	05-08-2019	53840	Rajesh Singh	50	M	34.7	7.8	5	No
54	05-08-2019	53885	Prachi Joshi	52	F	33.4	7.3	6	Yes
55	07-08-2019	54490	Usha Sharma	55	F	27.8	8	5	No
56	07-08-2019	83030	Awantika Singh	20	F	25.9	8.5	6	No
57	07-08-2019	11840	Rishika Yadav	20	F	31.2	7.5	6	Yes
58	08-08-2019	54385	Ankit Yadav	21	M	30.6	9.8	1	Yes
59	08-08-2019	54790	Tauhad	22	M	31	10	1	Yes
60	09-08-2019	17135	Pramod Singh	38	M	23.5	9.4	1	No
61	13-08-2019	37085	Prashant	21	M	32.9	8	2	Yes
62	13-08-2019	55450	Vikram Aditya Singh	32	M	28.5	9.3	1	No
63	14-08-2019	53850	Saumya	31	F	29	8.9	5	Yes
64	14-08-2019	53855	Kadambari	30	F	33.4	8	2	Yes
65	19-08-2019	55455	Golden Panday	20	M	28.3	9.9	3	No
66	19-08-2019	57489	Sunita	43	F	20.8	6.9	3	No
67	19-08-2019	17390	Sushil	40	M	31.8	7.6	2	Yes
68	20-08-2019	51115	Surabhi Singh	24	F	30.1	7.2	2	Yes
69	20-08-2019	33661	Ayushi	22	F	25.1	10.2	1	No
70	20-08-2019	36220	Priya Yadav	45	F	31.4	7.6	1	No
71	21-08-2019	57502	Jitendra Arora	24	M	34.1	9.6	6	Yes
72	21-08-2019	25240	Phool singh	23	M	32.6	9.7	1	No
73	21-08-2019	22650	Ranveer	43	M	33.2	11.1	1	No
74	27-08-2019	15950	Ramawati	52	F	30.2	9.1	6	No
75	27-08-2019	59400	Rachna	21	F	30.7	7.6	6	Yes

76	28-08-2019	37085	Manish	33	M	31.7	8.3	1	No
77	28-08-2019	59710	Sheetla	56	F	29.3	11.8	1	No
78	28-08-2019	59730	Aishwarya	32	F	27.9	8.3	1	Yes
79	28-08-2019	57845	Priya	32	F	32.2	6	5	No
80	29-08-2019	55135	Shubham Mishra	30	M	34	6.3	1	Yes
81	29-08-2019	65740	Bidisha	31	F	25.1	7.8	2	Yes
82	29-08-2019	36160	Maan Singh	35	M	33.3	9.8	6	No
83	30-08-2019	37085	Ramawati	46	F	30.2	9.1	6	No
84	30-08-2019	1925	Manisha	24	F	28.3	8.3	2	No
85	09-09-2019	62200	Aradhana	45	F	32.1	8.4	6	Yes
86	09-09-2019	40705	Siddharth	40	M	30.4	6.5	2	Yes
87	09-09-2019	62485	Divya	23	F	27.7	8.9	2	Yes
88	09-09-2019	61335	Ranjeet	25	M	32.8	9.4	6	Yes
89	13-09-2019	64249	Raghuvendra Singh	20	M	42.2	8.9	2	No
90	13-09-2019	64055	Shambhu	50	M	32.5	8.6	5	No
91	16-09-2019	51170	Sunil	54	M	35.3	8.5	5	Yes
92	17-09-2019	64890	Ashish	30	M	38.4	8.9	2	Yes
93	17-09-2019	64860	Dileep	35	M	29.6	10.7	3	Yes
94	18-09-2019	19905	Suresh	40	M	30.2	10	1	Yes
95	18-09-2019	20008	Ram vilas	50	M	35	10.2	2	Yes
96	19-09-2019	65515	Samreen	34	F	33.3	9.8	1	Yes
97	19-09-2019	65505	Soni Rajput	20	F	27.4	7.2	1	Yes
98	23-09-2019	59042	Kailashwati	42	F	29.6	7.7	2	Yes
99	23-09-2019	55395	Ajay	38	M	29.9	11.5	5	Yes
100	24-09-2019	66715	Ashutosh Rathore	30	M	39.8	12.4	1	Yes
101	24-09-2019	11765	Shivangi	31	M	26.9	9.9	5	Yes
102	25-09-2019	67090	Richa	50	M	31.2	11.4	1	Yes
103	25-09-2019	67035	Sanjeev	40	F	31.6	8.6	1	Yes
104	25-09-2019	61145	Virat Tripathi	20	M	29.4	9.5	1	No
105	27-09-2019	47060	Aparna Verma	26	M	29.8	7.3	2	Yes
106	27-09-2019	7858	Piyush	40	F	28.2	9.6	1	Yes
107	27-09-2019	47065	Sharmawati	40	F	26.2	9.6	1	Yes
108	30-09-2019	68235	Heena	30	F	27.6	9.3	3	No
109	30-09-2019	55394	Hameeda	40	F	23.3	7.8	1	No
110	01-10-2019	68565	Vandana	29	F	30.9	9.6	6	No
111	01-10-2019	68560	Samiksha	26	F	26.6	6.7	1	Yes
112	10-10-2019	52155	Rajesh Kumar	30	F	22.3	6.2	1	Yes
113	10-10-2019	70430	Sudha	39	F	30.2	8.3	6	No
114	14-10-2019	70710	Urmila	55	F	32.4	8	6	Yes
115	15-10-2019	37095	Pinki	50	F	33.6	8	5	No
116	15-10-2019	65190	J P Srivastava	30	M	35.8	10	5	Yes
117	16-10-2019	71945	Divyanshi	30	M	31.2	9.8	5	Yes

118	16-10-2019	71950	Javed	40	F	30.9	8	1	Yes
119	17-10-2019	37085	Aman Verma	40	F	25.5	8.5	1	No
120	19-10-2019	72880	Sanjeev Kumar	56	M	35.5	9.2	2	No
121	22-10-2019	21880	Gopal	58	M	22.6	7.9	5	Yes
122	22-10-2019	73130	Raju	50	M	32.8	11.6	1	Yes
123	22-10-2019	66025	Kuresha Bano	33	F	29	7.7	6	No
124	22-10-2019	71915	S P Pandey	32	F	30.3	7.9	2	Yes
125	24-10-2019	22505	Prabhat Dwivedi	22	M	31.4	10.1	6	No
126	24-10-2019	71955	Prerna	41	M	33.6	9.3	1	No
127	25-10-2019	27717	Richa	42	M	32	10.7	6	Yes
128	05-11-2019	73490	Preeti Raj	46	M	38	9.5	5	Yes
129	05-11-2019	45270	Asma Nazeem	36	M	24	8.5	5	Yes
130	06-11-2019	76800	Akshay Pal	24	M	28.9	8.7	2	Yes
131	06-11-2019	76545	Shweta Verma	59	F	33.4	7.3	2	Yes
132	07-11-2019	77190	Arjun Yadav	50	F	34.7	9.7	1	No
133	08-11-2019	77205	Ayush Gupta	50	F	33.7	9.4	5	Yes
134	08-11-2019	78190	Suraj	31	M	30.8	11	1	No
135	13-11-2019	49050	Pooja	36	M	31.7	8.3	5	Yes
136	19-11-2019	74980	Anjali Verma	40	F	33.7	6.7	5	Yes
137	19-11-2019	79845	Kapil Dev	45	F	26.2	7.6	2	Yes
138	20-11-2019	79695	Divya	21	F	24.4	7.2	2	No
139	21-11-2019	79900	Manju Singh	44	M	28.1	9	5	No
140	21-11-2019	79905	Deepti Gupta	40	M	35	10.5	6	No
141	25-11-2019	23960	Munshi Lal	40	F	31.6	6.4	1	Yes
142	25-11-2019	20340	Sachin Rawat	45	F	29.1	3.9	5	Yes
143	26-11-2019	81020	Priyanka	37	F	28.2	7.1	2	No
144	26-11-2019	81015	Priya Yadav	32	F	31.1	9.7	2	Yes
145	28-11-2019	24645	Chote lal	26	M	29.2	11.5	1	No
146	03-12-2019	82505	Saurabh	23	M	28.3	10.2	1	Yes
147	03-12-2019	24380	Radhika	50	F	30.9	9	6	Yes
148	05-12-2019	83125	Priya Yadav	40	M	37.1	10.1	6	Yes
149	05-12-2019	62280	Rigzing O Lepcha	31	F	32.5	7.7	1	Yes
150	06-12-2019	73100	Noor Zaman	31	F	28.5	7.8	1	Yes
151	10-12-2019	78455	Md. Ahmad	36	M	32.4	11.5	1	Yes
152	10-12-2019	84230	Parshu Ram	60	M	34.3	11.5	5	Yes
153	11-12-2019	83165	Pawan	40	M	32.2	9.9	1	No
154	11-12-2019	28765	Ramu	40	M	25.5	8	1	Yes
155	13-12-2019	84950	Nageshwar	50	M	41.7	9.9	2	Yes
156	13-12-2019	84960	Deepa soni	30	F	27.2	7.7	2	No
157	17-12-2019	60650	Shankar	44	M	33.4	7.3	5	Yes
158	17-12-2019	85870	Kalpati	60	F	34.8	8.3	1	No
159	18-12-2019	86035	Gunjan	53	F	34.3	8.2	5	Yes

160	20-12-2019	48715	Satyanam Verma	53	M	37.4	12	6	No
161	07-01-2020	125	Raju Yadav	50	M	36	12	6	Yes
162	08-01-2020	840	Deep Chand	40	M	35.8	9.4	2	No
163	10-01-2020	1415	Raju maurya	42	M	24	6.2	6	Yes
164	14-01-2020	680	Swati	20	F	28.4	8	1	No
165	14-01-2020	73750	Reeta	40	F	30.9	8	1	No
166	16-01-2020	2740	Mahesh	50	M	34.2	10.5	1	Yes
167	17-01-2020	3010	Ram Singh	52	M	36.7	7.2	5	Yes
168	20-01-2020	3590	Manjeet	21	M	26.3	11.2	3	No
169	22-01-2020	4200	Asma	31	F	28.3	8	1	Yes
170	22-01-2020	4205	Sandeep Pandey	50	M	33.6	8.4	5	Yes
171	24-01-2020	4740	Ravindra	52	M	33.8	11.8	5	Yes
172	31-01-2020	3980	Prakhar	31	M	29.2	10.7	2	Yes
173	31-01-2020	6390	Ram	24	M	32	8.1	2	Yes
174	04-02-2020	2195	Angoori Devi	50	F	28.3	10.6	2	Yes
175	04-02-2020	7190	Azra	58	F	27.5	7.8	2	No
176	06-02-2020	19930	Sudha Kumari	32	F	29.2	8.2	5	No
177	10-02-2020	8415	Ramesh	40	M	33.8	6.4	5	Yes
178	12-02-2020	9000	Ila	30	F	28.1	8.3	1	Yes
179	12-02-2020	3135	Md. Saheyaar	50	M	36.4	13.1	2	Yes
180	14-02-2020	9515	Deepak	31	M	32.5	10.7	1	No
181	18-02-2020	10420	Rajwati	60	F	31.8	10.8	1	Yes
182	20-02-2020	33295	Upendra	42	M	38.6	8	5	Yes
183	24-02-2020	11500	Manoj	34	M	33.3	8.5	1	Yes
184	24-02-2020	10130	Jyoti	20	F	29.4	7.8	2	No
185	26-02-2020	12105	Pammy Bhatia	53	F	38.1	9.1	2	Yes
186	26-02-2020	11540	Abhishek	20	M	30.3	9.6	1	No
187	03-03-2020	37485	Sachin	21	M	28.7	7.9	1	No
188	03-03-2020	13160	Ravi	23	M	27.2	7.6	2	Yes
189	05-03-2020	13800	Veena	54	F	34	12.2	1	Yes
190	14-12-2020	16755	Kiran Mishra	40	F	31.5	8.4	1	Yes
191	14-12-2020	16785	Deshraj	53	M	33.6	9.5	1	No
192	28-12-2020	17580	Prashant	50	M	28.1	10.2	3	Yes
193	05-01-2021	100	Kamini	26	F	27.3	6.2	2	No
194	08-01-2021	510	Ankita	27	F	27.2	7.3	3	Yes
195	11-01-2021	16020	Premnath	40	M	32.6	4.6	5	No
196	14-01-2021	1080	Arnav	21	M	27.7	9.2	2	No
197	18-01-2021	1530	Aarohi	30	F	28.9	8.9	5	Yes
198	18-01-2021	1555	Preeti Raj	25	F	28.7	6.7	2	No
199	25-01-2021	2425	Sipahi Singh	60	M	34	2.3	3	Yes
200	01-02-2021	3090	Kashiram	60	M	39	13.2	1	Yes

ANNEXURE 5

Statistical Analysis

Arithmetic Mean

The most widely used measure of central tendency is arithmetic mean, usually referred to simply as the mean, calculated as

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Standard deviation and standard error

The standard deviation (SD) is the positive square root of the variance, and calculated as

$$SD = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}}$$

where, n= no. of observations. The and SE (standard error of the mean) is calculated as

$$SE = \frac{SD}{\sqrt{n}}$$

Minimum and Maximum

Minimum and maximum are the minimum and maximum values respectively in the measure data and range may be dented as below

Range = Min to Max

and also evaluated by subtracting minimum value from maximum value as below

Range = Maximum value-Minimum value

Median

The median is generally defined as the middle measurement in an ordered set of data. The median (M) of a sample of data may be found by third arranging the measurements in order of magnitude (preferably ascending). For even and odd number of measurements, the median is evaluated as

$$M = [(n+1)/2]^{th} \text{ observation- odd number}$$

$$M = [n(n+1)/2]^{th} \text{ observation – even number}$$

Student's t Test

Student's t-test was used to calculate the differences between the means of two groups

$$t = \frac{\bar{X}_1 - \bar{X}_2}{SE}$$

where,

$$SE = \sqrt{S^2 X \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

S^2 is the pooled variance and n_1 and n_2 are number of observations in group 1 and 2 respectively. The degrees of freedom (DF) is calculated as

$$DF = n1 + n2 – 2$$

Chi-square test

The chi-square (χ^2) test is used to compare the categorical data as

$$\chi^2 = \Sigma\Sigma \frac{(Fij – fij)^2}{fij}$$

where, Fij is the observed frequency while fij the expected frequency. The degrees of freedom (DF) is calculated as

$$DF = (r-1)\ (c-1)$$

Analysis of Variance

Analysis of variance (ANOVA) is used when we compare more than two groups simultaneously. The purpose of one-way ANOVA is to find whether data from different groups have a common or uncommon mean. For more than two independent groups, simple parametric ANOVA is used when variables under consideration follows Continuous exercise group distribution and groups variances are homogeneous otherwise non parametric alternative Kruskal-Wallis (H) ANOVA by ranks is used. The one way ANOVA form is

$$Y_{ij} = \alpha_{.j} + \varepsilon_{ij}$$

where;

- Y_{ij} is a matrix of observations in which each column represents a different group.
- $\alpha_{.j}$ is a matrix with columns for the group means
- ε_{ij} is a matrix of random disturbances.

Tukey multiple comparison Test

After performing ANOVA, Tukey HSD (honestly significant difference) post hoc test is generally used to calculate differences between group means as

$$q = \frac{\bar{X}_1 - \bar{X}_2}{SE}$$

$$SE = \sqrt{\frac{S^2}{2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

S^2 is the error mean square from the analysis of variance and n_1 and n_2 are number of data in Group 1 and 2 respectively.

Statistical significance

Level of significance "*P*" is the probability signifies level of significance. The mentioned P in the text indicates the following:

$P > 0.05$ - not significant (ns)

$P < 0.05$ - just significant (*)

$P < 0.01$ - moderate significant (**)

$P < 0.001$ - highly significant (***)

URKUND

Urkund Analysis Result

Analysed Document: Himanshi thesis 2.docx (D110188101)
Submitted: 7/6/2021 6:16:00 AM
Submitted By: drsaurabh2002@bbdu.ac.in
Significance: 9 %

Sources included in the report:

Monika Rajput.docx (D92776288)
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51