PREVALENCE OF THYROID CARTILAGE CALCIFICATION AND ANALYSIS OF CALCIFICATION PATTERN IN A SUB URBAN POPULATION OF SOUTHERN INDIA; A RADIOGRAPHIC STUDY USING ORTHOPANTOMOGRAPH AND LATERAL CEPHALOGRAPH

DISSERTATION

Submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of the requirement for the degree of

MASTER OF DENTAL SURGERY

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ORAL MEDICINE AND RADIOLOGY

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CERTIFICATE

This is to certify that this dissertation titled **"Prevalence of thyroid cartilage calcification and analysis of calcification pattern in a sub urban population of Southern India; A Radiographic study using Orthopantomograph and Lateral Cephalograph"** is a bonafide research work done by **Dr. Aravind B.S** under our guidance during his Post Graduate study during the period of 2014-2017 under THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI, in partial fulfillment for the degree of MASTER OF DENTAL SURGERY IN ORAL MEDICINE AND RADIOLOGY, BRANCH IX. It has not been submitted (partial or full) for the award of any other degree or diploma.

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This is to certify that this dissertation titled **"Prevalence of thyroid cartilage calcification and analysis of calcification pattern in a sub urban population of Southern India; A Radiographic study using Orthopantomograph and Lateral Cephalograph"** is a bonafide research work done by **Dr. Aravind B.S** under the guidance of **Dr. Tatu Joy. E MDS,** Professor and Head, Department of Oral Medicine and Radiology, Sree Mookambika Institute of Dental Sciences, Kulasekharam.

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DECLARATION

I hereby declare that this dissertation **"PREVALENCE OF THYROID CARTILAGE CALCIFICATION AND ANALYSIS OF CALCIFICATION PATTERN IN A SUB URBAN POPULATION OF SOUTHERN INDIA; A RADIOGRAPHIC STUDY USING ORTHOPANTOMOGRAPH AND LATERAL CEPHALOGRAPH"** is a bonafide record of work undertaken by me and that this thesis or a part of it has not been presented earlier for the award of degree, diploma, fellowship, or similar title of recognition.

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CT	-	Computerized Tomography
CLIA	-	Chemiluminescence immunoassay
C_3, C_4	-	Cervical Vertebrae 3 and 4
CCA	-	Carotid artery calcification
Ca^{2+}	-	Calcium ions
HT	-	Hashimoto's thyroiditis
Kvp	-	Kilovoltage potential
MRI	-	Magnetic Resonance Imaging
Mg	-	Magnesium
OPG	-	Orthopantomograph
PTC	-	papillary thyroid cancer
PTH	-	Parathyroid hormone
PPi	-	inorganic Pyrophosphate
S-Ca	-	Serum Calcium Concentration
T_3	-	Triiodothyroxine
T_4	-	Thyroxine
TSH	-	Thyroid Stimulating Hormone
USG	-	Ultrasonography

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Prevalence of thyroid cartilage calcification and analysis of calcification pattern in a sub urban population of Southern India; A Radiographic study using Orthopantomograph and Lateral cephalograph

BACKGROUND OF THE STUDY

The larynx is composed of cartilages, ligaments and muscles. Laryngeal cartilage consists of thyroid, corniculate, cricoid and arytenoid cartilage among these cartilages thyroid cartilages is the major one. The main function of the cartilages is the protection of the air way. The laryngeal cartilages undergo calcification especially thyroid cartilage, cricoid cartilage and arytenoids in the end of adolescence age and progress further according to the age. During routine radiographic investigation we have noticed evident thyroid cartilage calcifications even during early adolescence. Serological investigation were done for thyroid profile, calcium, phosphorous and parathyroid hormone (PTH), results revealed thyroid hormone imbalance in subjects with calcification.

AIMS AND OBJECTIVES

- To assess the presence of thyroid cartilage calcification in the sample population.
- To assess the prevalence of thyroid cartilage calcification among genders and various age groups.
- To analyze the co-relation of thyroid cartilage calcification detected on routine radiographic with the thyroid profile.
- To analyze the level (pattern) of thyroid cartilage calcification and its correlation with age, sex, and thyroid profile.

MATERIALS AND METHOD

Radiographic investigations (orthopantamograph and lateral cephalogram), and thyroid profile was carried out among 780 out patients from the Department of Oral Medicine and Radiology, to check for the prevalence and pattern of thyroid calcification and the co-relation with thyroid hormone imbalance. The study population of 780 is divided into three group of 260 each (130 males, 130 females), Group 1 (age between 10 to 22) Group 2 (age between 22 to 40) Group 3 (age above 40). Digital radiographs were taken in the Planmeca Proline X C machine with the help of planmeca Romexis 2.6.0.R software, Exposure criteria (orthopantamograph)- 62 -70 kv, 5-11 mA, 18 Sec, Exposure criteria (lateral cephalograph)-62-70 kv, 5-11 mA, 23 sec. All radiographs were evaluated in a desktop installed with planmeca Romexis software 2.6.0.R. And results are assessed by chi-square statistical test and other softwares (Microsoft excel+ spss 16.0 version).

RESULTS

Our study revealed that the prevalence of thyroid cartilage is more in females, and calcifications begin at the mean age of 16 years. In males, the calcification begins during late adoloscence age. In both the genders the calcification begins in the thyroid lamina and by the third decade of life the calcification progresses to the inferior horn and in the fourth decade the calcification begin starts in the superior horn after calcification of the inferior horn. No significant correlation was noted between cartilage calcification and serum thyroid profile.

CONCLUSION

Thyroid cartilage calcifications are more prevalent in female and begin at around 16 years of age. These calcifications have an important role in age and sex determination, and clinical significance in terms of neurovascular compression, surgical approaches of the region and fracture risks due to trauma. Further research are required to evaluate the triggering and contributing factors of these calcification. Maxillofacial radiologists must be familiar with these calcification and their pattern during interpretation so as to generate a report with a comprehensive goal of accurate diagnosis and value added treatment planning.

Keywords : Cartilages, Ossification, Thyroid, Thyroxine.

Calcification in the human body is a dichotomous process occurring both physiologically and pathologically. In most situations it is a beneficial process; from the remineralization of incipient carious lesions to fracture healing. Pathological calcifications on the other hand could indicate an underlying disease or often soft tissue calcifications provide the underlying clue to an ongoing process. From the calcified nodes of pulmonary Koch's to the age related calcification of cartilages, soft tissue calcifications often have a radiological tale to tell.

During normal physiological process calcium ions are deposited as calcium phosphate which forms an integral part of bone. At the same time, Calcium can also be deposited in an unorganized manner in soft tissues as Pathologic calcifications or Heterotrophic Ossification. Heterotrophic calcification indicates the bone formation in an abnormal location (extraskeletal).[1] The pathologic calcifications are of three types: 1) Dystrophic calcification - the calcifications which occurs in dead and degenerating tissues. 2) Metastatic calcification - the deposition of calcium and other salts in previously undamaged tissue as a result of an increased calcium salts in circulating blood. 3) Calcinosis cutis - calcification occurs in or beneath the skin.[2]

Thyroid hormones performs a lot of metabolic functions including regulation of lipids, carbohydrates, protein and electrolytes and mineral metabolism.[3] Mineral metabolism like calcium, magnesium and phosphorous is frequently altered in thyroid dysfunctions. Thyroid diseases have wide spread systemic manifestations including their effects on bone, by exerting its effects on osteoblasts via nuclear receptors to stimulate osteoclastic bone resorption.[4]

Hyperthyroidism directly increases the serum calcium and phosphorous levels and thereby suppresses the PTH .Opposite effects are seen in Hypothyroidism.[5]

Metastatic calcinosis, usually results from the deposition of calcium in normal tissues as a result of hyperphosphatemia with or without concurrent hypercalcemia.[6] Hypercalcemia in the absence of hyperphosphatemia does not appear to be sufficient to stimulate this form of calcification.[7]These calcifications are often fine and diffuse throughout the soft tissues.

Soft tissue calcifications in the orofacial region are uncommon and most of them are asymptomatic in nature. The common calcifications found in oro-facial region are Tonsilloliths, sialoliths, Triticeous cartilage calcification, Carotid artery calcifications (CAC), lymph nodes calcifications, and thyroid cartilage calcifications. Since the original study by Chievitz in 1882, Ossification and calcification of the laryngeal cartilages has been widely investigated.[7] The thyroid cartilage, greater part of the arytenoid cartilage and cricoid cartilage is made up of hyaline cartilage. During normal physiological ageing process these cartilages undergoes ossification and calcification. The terms “ossified” and “calcified” are frequently used synonymously, although calcification precedes ossification when the cartilage has transformed into the bone.[9]The changes in the process of calcification can be attributed to both the cellular and extracellular component of tissues. Cellular changes include ageing, altered chondrocyte phenotype and their response to cytokines and mediators of normal homeostatic processes. Similarly, alterations in the extracellular matrix, some of which are directly resultant from the cells modify the balance of pro and inhibitory mineralization factors, deregulation of extracellular $Ca2^{+}$, inorganic pyrophosphate (PPi) and inorganic phosphate.[10,11]

Premature calcification of laryngeal cartilage is less common. Thyroid cartilage Ossification normally commences by about 25th year of life followed by cricoid and arytenoids. By the 65th year, most of these cartilages may get completely converted into bone.[12,13] The female thyroid cartilage never ossifies completely, leaving the ventral half cartilaginous.[14] The process involved in ossification and mineralization of thyroid cartilage is controversal.[15] A thorough medical history, physical examination of the patient including review of individual system, blood estimation of serum phosphorus, calcium, and parathyroid hormone (PTH) assay is always required to rule out any metastatic calcification processes in the body.[16] The early cartilaginous ossification could just be an anatomical variation in the absence of hyperphosphatemia, hypercalcemia, or increased level of serum PTH.

Ossification starts either within the lamina or cornua of thyroid cartilage seems visible in cephalometric and lateral neck radiograph. Ossification begins within the laminae, the arytenoid cartilages and cricoids are also well appreciated. Radiographs of head and neck region specifically lateral cephalometric radiograph and cervical spine radiograph series is used to study the growth and development of skeletal structures can also be used for identifying these abnormal calcifications.[12] In order to avoid the disparity between normally occurring radio opacities pathologic foreign bodies, the radiographs helps in differentiating as a prime factor of diagnosis.[17,18] Special low kilovoltage peak (kVp) techniques is used in lateral cephalometry for recording abnormal thyroid and laryngeal calcification which bring its significance in radiographic calibration.[19,20]

The present study attempts to analyze the prevalence of thyroid cartilage calcification, analyze its pattern and explore a possible co-relation between cartilage calcification and thyroid hormone imbalance. Such a co-relation if present would make analysis and noting of cartilage calcifications an important parameter for further endocrinological evaluation and add a new paradigm to panoramic images.

AIMS AND OBJECTIVES

- To assess the presence of thyroid cartilage calcification in the sample population.
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The human respiratory tract is divided into the upper respiratory tract and lower respiratory tract. The upper respiratory tract includes nose, nasal passages, paranasal sinuses, pharynx and the portion of larynx above the vocal cords. Larynx (voice box) is situated in the anterior portion of the neck above the trachea. Larynx is located anterior to the inferior portion of the pharynx and it plays an important role in deglutition. Primary function of larynx is protection of airway from food particles and secretion of oropharynx.

Embryology And Development

According to the Carnegie staging system of human embryologic development, there are mainly two periods of development. The first period is the embryonic period which comprises of first 8 weeks of gestation and is subdivided into 23 stages. The second period is the fetal period which spans the remaining 32 weeks of gestation. The larynx begins to develop during stage11 of the embryonic period (25-28 days).

During the 4th week of intrauterine life development of larynx starts, and is closely associated with the development of trachea. Development of larynx starts as a ventral groove in the pharynx known as the laryngotracheal groove. This groove deepens and its edges fuse to form a septum which separates the laryngotracheal tube from the pharynx and oesophagus.

This process of fusion starts caudally and extends cranially. This tube is lined with endoderm from which the epithelium of airway develops. The cranial end of this laryngotracheal tube forms the larynx and trachea, while the caudal end bifurcates to produce the two main bronchi. This is also the place from which the two lung buds

develop. Since development of larynx, trachea and oesophagus are inter-linked any congenital malformation of oesophagus is always associated with certain degree of malformation of larynx and trachea. Developmentally larynx develops from the cranial part of laryngotracheal groove. It is bounded superiorly by the caudal part of hypobranchial eminence and laterally by ventral folds of 6th branchial arches. Epiglottis develops from hypobranchial eminence. Arytenoids develop on either side of laryngotracheal groove, and as they enlarge they become approximated with each other and to the caudal portion of hypobranchial eminence. This development converts the vertical slit of laryngeal cavity into a T shaped one. The nerves supplying the 4th and 6th branchial arches also supply larynx (superior and recurrent laryngeal nerves).

Thyroid cartilage develops from the ventral ends of 4th arch cartilage. Arytenoids, Corniculate, Cricoid and tracheal cartilages from 6 th arch cartilage. Epiglottis develops from Hypobranchial eminence 6^{th} arch cartilage.[21]

DEVELOPMENT OF THE THYROID GLAND

The thyroid gland develops mainly from the thyroglossal duct. Parafollicular cells are derived from the caudal pharyngeal complex (derived from the fourth and fifth pharyngeal pouches). Separated by a midline swelling called the tuberculum impar. Immediately behind the tuberculum, the epithelium of the floor of the pharynx shows a thickening in the middle line. This region is soon depressed below the surface to form a diverticulum called the thyroglossal duct.

The site of origin of the diverticulum is now seen as a depression called the foramen caecum. The diverticulum grows down in the midline into the neck. Its tip soon bifurcates. Proliferation of the cells of this bifid end gives rise to the two lobes

of the thyroid gland. The developing thyroid comes into intimate relationship with the caudal pharyngeal complex and fuses with it. Cells arising from this complex are believed to give origin to the parafollicular cells of the thyroid which may represent the ultimobranchial body of lower animals.[21]

NORMAL ANATOMY OF LARYNGEAL CARTILAGE

LARYNX

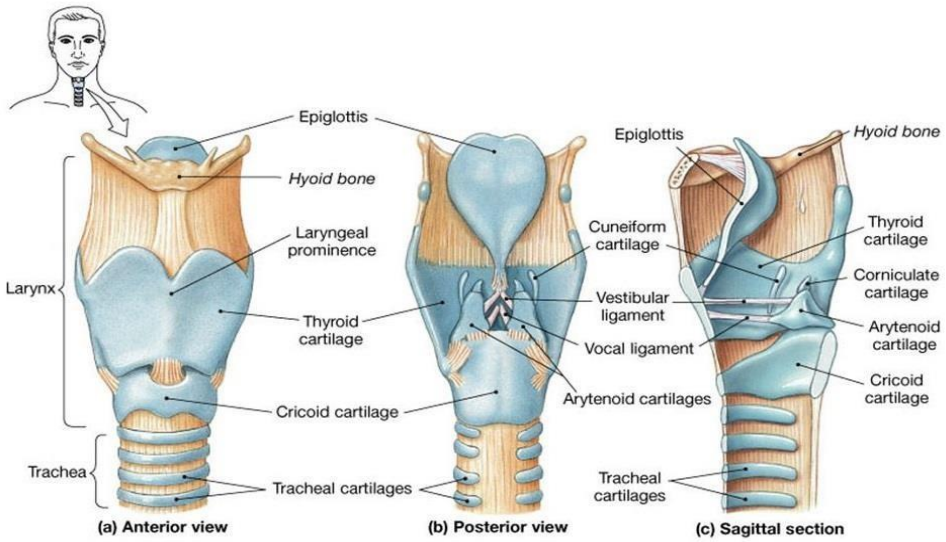


Figure.1 Anatomy of larynx. (Thyroid cartilage, Gender Equality and Adam's Apple. [Image on the Internet].2013 May 3. Available from https://andreacollo.world press.com)

The larynx, which is an air passage, a sphincteric device and an organ of phonation, extends from the tongue to the trachea (Figure.1). It projects ventrally between the great vessels of the neck and is covered anteriorly by skin, fasciae and the hyoid depressor muscles. Above, it opens into the laryngopharynx and forms its anterior wall; below, it continues into the trachea. In adult males it lies opposite the third to sixth cervical vertebrae, although it is somewhat higher in children and adult

females. In infants between 6 and 12 months, the tip of the epiglottis (the highest part of the larynx) is a little above the junction of the dens and body of the axis vertebra.

Until puberty the male and female larynges are similar in size, but afterwards the male larynx enlarges considerably in comparison with the female, all the cartilages increasing in size and the thyroid cartilage projecting in the anterior midline of the neck, while its sagittal diameter nearly doubles during this process. In males, tin-thyroid cartilage continues to increase in size until 40 years of age after which no further growth occurs.

SKELETON OF THE LARYNX

Cartilages form the skeletal framework of the larynx. They are interconnected by ligaments and fibrous membranes, and moved by a number of muscles. The hyoid bone is also intimately associated with the larynx, although it is usually regarded as a separate structure with distinctive functional roles.

LARYNGEAL CARTILAGES

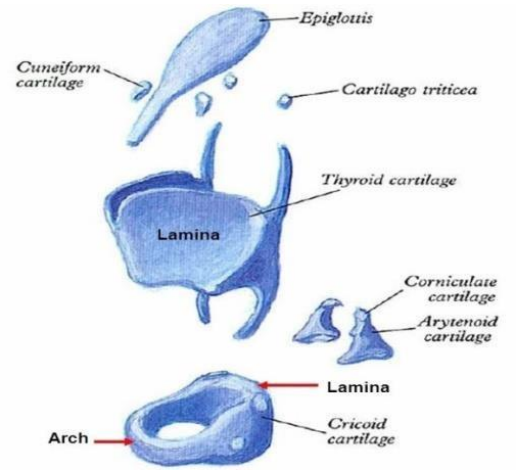


Figure.2 Hsf &d Neck, pharynx And Larynx.cram.[image on the Internet]. Available from www.cram.com/flashcards/hsfd-neck-pharynx-and-larynx-2317606

The laryngeal cartilages comprise of single cricoid, thyroid and epiglottic cartilages, and paired includes arytenoid, cuneiform and corniculate cartilages (Figure.2). Also related to the larynx are the paired tritiate cartilages in the thyrohyoid ligaments on either side.

Cricoid cartilage

The cricoid cartilage can be regarded as the skeletal foundation of the larynx, attached below to the trachea, and articulated by synovial joints to the thyroid cartilage and the two arytenoids. It forms a complete ring around the airway, the only laryngeal cartilage to do so. The cricoid is smaller but thicker and stronger than the thyroid cartilage and shaped like a signet ring (hence its name), with a narrow curved anterior arch, and a broad, Hatter posterior lamina. Together these form the inferior parts of the anterior and lateral walls of the larynx and most of its posterior wall.

Cricoid lamina : This is approximately quadrilateral in outline,2-3cm in vertical dimension. It has a posterior median vertical ridge, to the upper part of which the two fasciculi of the longitudinal layers of oesophageal muscle fibres (muscularis externa) are attached by a tendon. Lateral to this are two shallow depressions for the fibres of the posterior crico-arytenoid muscle.

Cricoid arch : Vertically narrow in from (5-7 mm in height), it widens posteriorly towards the lamina. To the external aspect of its front and sides are attached the cricothyroid muscle and behind this, the cricopharyngeus part of the inferior pharyngeal constrictor. The arch is palpable below the laryngeal prominence, from which it is separated by a depression containing the resilient conus elasticus.

On each side of the cricoid, at the junction of the lamina and arch, a prominent circular synovial facet, facing posterolaterally, articulates with the inferior thyroid cornu. The inferior border of the cricoid is horizontal, and joined to the first tracheal cartilage by the cricotracheal ligament. The superior border of the cricoid runs obliquely up and back, giving attachment anteriorly to the thick median part of the cricothyroid ligament, and laterally to the membranous lateral parts of the cricothyroid ligament; here the lateral crico-arytenoid muscles are also attached. Posteriorly, this superior aspect of the lamina presents a shallow median notch, on each side of which is a smooth, oval, convex facet, directed upwards and laterally, articulating with the base of an arytenoid cartilage. The internal surface of the cricoid cartilage is smooth and lined by mucosa.

Thyroid cartilage

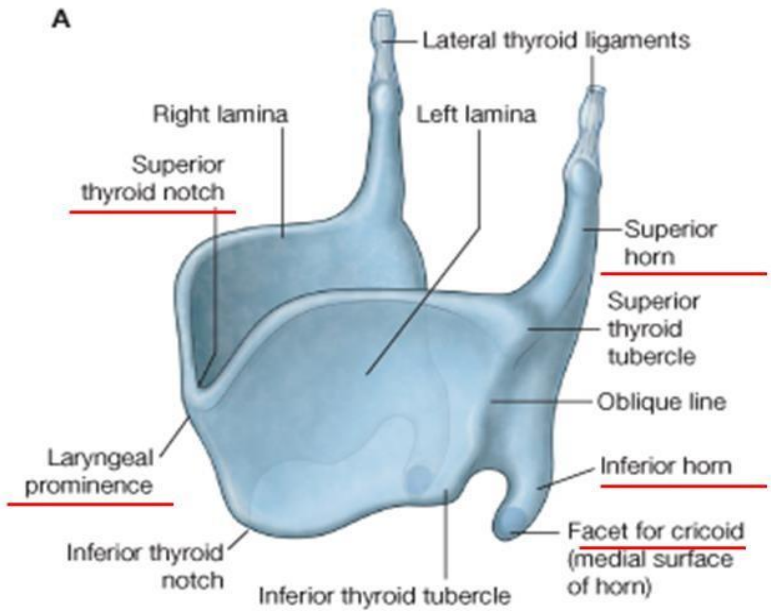


Figure.3 Anatomical landmarks of Thyroid cartilage (Nine cartilages of Larynx. Key Words King.[Image on the Internet] Available from www.keywordsking.com/bmluZSBjYXJoaWxhZ2VZlG9mlGxhcnlueA/)

The thyroid cartilage (Figure.3) is the largest of the laryngeal cartilages. It consists of two quadrilateral laminae whose anterior borders fuse along their inferior two-thirds at a median angle, forming the subcutaneous laryngeal prominence ('Adam's apple'). This projection is most distinct at its upper end, and is well marked in men but scarcely visible in women. Above, the laminae are separated by a V- shaped superior thyroid notch or incisures; posteriorly they diverge, the posterior borders of each being prolonged as slender horns, the superior and inferior cornua. On the external surface of each lamina a shallow ridge, the oblique line, curves downwards and forwards, running from the superior thyroid tubercle lying a little anterior to the root of the superior cornu, to the inferior thyroid tubercle on the inferior border of the lamina. To this line are attached the sternothyroid and t thyrohyoid -muscles, and the thyropharyngeus part of the interior pharyngeal constrictor.

The internal surface of the lamina is smooth; above and behind it is slightly concave and covered by mucosa. In the upper part of the angle between the laminae, the thyro-epiglottic ligament is attached; below this, near the midline, the paired vestibular and vocal ligaments and the thyro-arytenoid, thyro-epiglottic and vocal muscles are attached. The superior border of each lamina is concave behind and convex in front; the thyrohyoid membrane is attached along this edge. The inferior border of each is concave behind and nearly straight in front, the two parts separated by the inferior thyroid tubercle. In and on either side of the midline anteriorly, the thyroid cartilage is connected to the cricoid cartilage by the anterior (median) cricothyroid ligament.

The anterior border of each lamina fuses with its partner at an angle of about 90° in men and about 120° in women. This shallower angle in men is associated with the larger laryngeal prominence, the greater length of the vocal folds and the resultant deeper pitch of voice. The posterior border is thick and rounded; it receives the fibres of stylopharyngeus and palatopharyngeus. The superior cornu, which is long and narrow, curves upwards, backwards and medially, ending in a conical apex to which the lateral thyrohyoid ligament is attached. The inferior cornu, short and thick, curves down and slightly antero-medially; on the medial surface of its lower end, a small oval facet articulates with the side of the cricoid cartilage. Some fibres of Palatopharyngeus, stylopharyngeus and salpingopharyngeus are inserted into the posterior surface of the lamina and cornua. During infancy a narrow, rhomboidal, flexible strip, the intra-roid cartilage, lies between the two laminae and is joined to them fibrous tissue.

Arytenoid cartilages

The paired arytenoid cartilages are placed on the lateral part of the cricoid lamina's superior border at the back of the larynx, Each is pyramidal, with three surfaces, two processes, a base and an apex. The posterior surface, which is triangular, smooth and concave, is covered by the transverse arytenoid muscle The anterolateral surface is convex and rough: on it, near the apex of the cartilage, is an elevation from which a crest curves back, down and then forwards to the vocal process. The lower part of this crest separates two depressions (foveae), the upper being triangular, the lower oblong: to the upper is attached the vestibular ligament, to the lower the vocalis and lateral crico-arytenoid muscles. The medial surface is narrow, smooth, and flat; it is covered by mucosa and its lower edge forms the lateral boundary of the

intercartilaginous part of the rima glottidis. The base is concave, with a smooth surface for articulation with the lateral part of the upper border of the cricoid lamina. Its round, prominent lateral angle, or muscular process, projects backwards and laterally, giving attachment to the posterior crico-arytenoid muscle behind and the lateral crico-arytenoid in front. To its pointed anterior angle (the vocal process), projecting horizontally forward, is attached the vocal ligament. The apex curves backwards and medially to articulate with the corniculate cartilage.

Corniculate cartilages

The corniculate cartilage are two conical nodules of elastic fibrocartilage which articulate with the apices of the artenoid cartilages, prolonging them posteromedially. They lie in the posterior parts of the aryepiglottic mucosal folds, and are sometimes fused with the arytenoid cartilages.

Cuneiform cartilage

These cuneiform cartilages are two small elongated ,club-like nodules of elastic fibrocartilage, one in each aryepiglottic fold anterosuperior to the corniculate cartilages and visible as whitish elevations through the mucosa.

Epiglottic cartilage

The epiglottic cartilage is a thin leaf-like plate of elastic fibrocartilage, projecting obliquely upwards behind the tongue and hyoid body, and in front of the laryngeal inlet. Its free end, which is broad and round, is directed upwards; its attached part, or stalk (petiolus) is long and narrow, and is connected by the elastic thyro-epiglottic ligament to the back of the laryngeal prominence just below the thyroid notch. Its sides are attached to the arytenoid cartilages by an epiglottic folds.

Its free upper anterior surface is covered by mucosa (the epithelium is non-keratinized stratified squamous), reflected on to the pharyngeal aspect of the tongue and the lateral pharyngeal walls as a median glosso-epiglottic and two lateral glosso-epiglottic folds. On each side of the median fold is a depression, the vallecula. The lower part of the anterior surface, behind the hyoid bone and thyrohyoid membrane, is connected to the upper border of the former by an elastic hyo-epigtottic ligament, and separated from the thyrohyoid membrane by adipose tissue. The smooth posterior surface is transversely concave and vertically concavo-convex: it is covered by ciliated respiratory mucosa; its lower projecting part is called the tubercle. The cartilage is posteriorly pitted by small mucous glands and perforated by branches of the internal laryngeal nerve.

Tritiate cartilages (Cartilage triticea)

The tritiate cartilages are two small nodules of elastic cartilage situated one on either side above the larynx within the posterior free edge of the thyrohyoid membrane, about halfway between the superior cornu of the thyroid cartilage and the tip of the hyoid's greater cornu. Their functions are unknown, although they may serve to strengthen this connection.

Microstructure of laryngeal cartilages

The corniculate, cuneiform, tritiate and epiglottic cartilages and the apices of the arytenoids are composed of elastic fibrocartilage with little tendency to ossify or calcify. The thyroid, cricoid and greater part of the arytenoids consist of hyaline cartilage and may undergo mottled calcification or ossification as age advances, com-mencing about the twenty-fifth year in the thyroid cartilage and somewhat later in the

cricoid and arytenoids; by the sixty-fifth year these cartilages commonly appear patchily dense in radiographs.

During prenatal development laryngeal cartilages begin chondrification at about 50 days' gestation, and all the major skeletal components of the larynx are visible as cartilaginous masses by the third gestational month.

LARYNGEAL ARTICULATIONS

The joints between the inferior cornua of the thyroid cartilage and the sides of the cricoid cartilage are synovia, each enveloped with a capsular ligament strengthened posteriorly by a fibrous band. At these joints the cricoid rotates on the inferior cornua around a transverse axis passing transversely through both joints; to a limited extent the cricoid also glides in different directions on the thyroid cornua.

A pair of synovial joints exists between the facets on the lateral part of the upper border of the lamina of the cricoid cartilage and the bases of the arytenoids, each joint being enclosed by a capsular ligament; a strong posterior crico-arytcnoid ligament connects the cricoid to the posterior and medial part of the base of the arytenoid. These joints permit two movement

- Arytenoid rotation about an oblique axis (dorsomediocranial to ventrolaterocaudal),by which each vocal process swings laterally or medially,increasing or decreasing the width of the rima glottisidis
- A gliding movement , by which the arytenoids approach or recede from one another,the direction and slope of their articular surfaces imposing a forward and downward movement on lateral gliding. The movements of gliding and rotation are associated: medial gliding with medial rotation and lateral gliding

with lateral rotation. The posterior crico-arytenoid ligaments limit forward movements of the arytenoid cartilages on the cricoid. Sometimes the synchondrosis between the apex of the arytenoid cartilage and the corresponding corniculate cartilage is replaced by a synovial joint.

Numerous lamellated (Pacinian) corpuscles, some Ruffini and some free nerve endings occur in the capsules of the laryngeal joints. In cats these respond to mechanical stimuli and are involved in the normal co-ordination of laryngeal muscles during respiration and phonation. The human articular supply is chiefly from branches of the recurrent laryngeal nerves, arising independently or from branches of the nerve to the laryngeal muscles.

LARYNGEAL VESSELS AND NERVE

The chief arteries of larynx are branches of the superior and inferior thyroid arteries, their accompanying veins join both the superior thyroid vein, opening into the internal jugular, and the inferior thyroid vein draining into the left brachiocephalic. Lymph vessel form groups above and below the vocal folds: the superior accompany the superior laryngeal artery, traverse the thyrohyoid membrane and end in the deep cervical lymph nodes near the bifurcation of the common carotid artery; some of the inferior group of the inferior group of lymphatics pierce the cricothyroid ligament to reach a Iymph node in front of the ligament or the upper trachea; others pass below the cricoid cartilage to the deep cervical lymph nodes and to nodes along the interior thyroid artery.

Nerves

The nerve supply is from the internal and external branches of the superior laryngeal and from the recurrent laryngeal and sympathetic nerves. The internal laryngeal nerve is probably entirely sensory and autonomic, although special visceral motor fibres to the transverse arytenoid have been reported. This nerve enters postero-inferiorly through the thyrohyoid membrane above the superior laryngeal artery; its branches supply both epiglottic surfaces, the aryepiglottic fold and the laryngeal interior as far as the vocal folds. The external laryngeal nerve supplies the cricothyroid muscle, which it enters via its external surface. Terminally the recurrent laryngeal nerve (with the laryngeal branch of the inferior thyroid artery) ascends medial to the lower border of the inferior pharyngeal constrictor immediately behind the cricothyroid joint, supplying all the intrinsic laryngeal muscles except the cricothyroid and innervating the mucosa below the vocal folds. Before entering the larynx this nerve usually divides into motor and sensory rami, not 'adductor' and 'abductor' rami as is sometimes asserted . Motor units in such skilled musculature might be expected to be small: a ratio of 30 muscle fibers to each motor neuron has been estimated.[22]

SOFT TISSUE CALCIFICATIONS AND RADIOGRAPHIC APPEARENCE OF HEAD AND NECK REGION

A. Dystrophic Calcifications

• General dystrophic calcification of the oral regions

• Calcified lymph nodes

• Dystrophic calcification in the tonsils

• Cysticercosis

• Arterial calcification

- Monckerberg's medial calcinosis (Arteriosclerosis)

- Calcified Atherosclerotic plaque

B. Idiopathic calcifications

• Sialoliths

• Phleboliths

• Laryngeal cartilage calcifications

• Rhinolith/Antrolith

C. Metastatic calcifications

• Ossification of the styloid ligament

• Osteoma cutis

• Myositis ossificans

General Dystrophic Calcification of the Oral Regions

The process of deposition of calcium salts into dead and dying tissue or in the primary sites of chronic inflammation.

It is commonly found in tissues affected by tuberculosis, blood vessels in arteriosclerosis, scars and areas of fatty degeneration. Common soft tissue sites in the oral cavity are; gingiva, tongue, lymph nodes and cheek. Radiographically appear as fine grains of radiopacities to larger irregular radiopaque particles that rarely exceed 0.5 cm in diameter with irregular out line.

Calcified Lymph Nodes

This occurs in chronically inflamed lymph nodes because of various diseases (usually granulomatous disorders). The lymphoid tissue is replaced by hydroxyapatite, like calcium salts and leading to changes in nodal architecture.

The most commonly involved nodes are submandibular and cervical nodes (superficial and deep) and less commonly the preauricular and submental nodes. They are most often detected as an incidental finding during panoramic radiographic examination. On palpation these nodes, may be single or multiple or sometimes chain of nodes, which are found to be mobile, hard, or round masses, whose outline is well contoured and well defined. Radiographically the periphery may be well-defined, irregular and sometimes may be lobulated appearance (cauliflower like). The irregular outline helps lymphnode to differentiate it from other potential soft tissue calcification in the area.

Dystrophic Calcification in the Tonsils (tonsillar calculi, tonsil concretions, tonsilloliths)

When repeated attacks of inflammation enlarge the tonsillar crypts the tonsillar calculi are formed. Dystrophic calcification occurs as a result of incomplete resolution of dead bacteria and pus.

Normally they occur between the 20 to 68 years of age, more in the older age group. Tonsilloliths are usually hard, round, white or yellow objects projecting from the tonsillar crypts. The small calculi may not produce any signs or symptoms. Larger calcifications can cause pain, swelling, fetor oris dysphagia and a foreign body feeling on swallowing. On the panoramic film, tonsilloliths appear as single or multiple radiopacities that overlap the mid portion of the mandibular ramus in the region where the image of the dorsal surface of the tongue crosses the ramus in the palatoglossal air spaces. It appears as clusters of multiple small ill-defined radiopacities.

Cysticercosis

The in the stomach of human, once the egg of tape worm is ingested by human the covering is digested in stomach and larval form (cysticercus cellulosae) are hatched. These larvae penetrate the mucosa, enter the blood vessels and lymphatics and are distributed in the tissues all over the body, but preferentially locate to the brain, muscle, skin and heart. When the larva die, they are treated as foreign bodies causing granuloma formation, scarring and calcification.

They appear as multiple small nodules in the region of the masseter, buccal mucosa, suprahyoid muscles and in the lip. On palpation they are palpable, well circumscribed soft fluctuant swellings, which resemble a mucocele. When alive the

larva is not visible radiographically. But when dies they appear as multiple, well-defined, elliptical, homogeneous, radiopacities, which resemble grains of rice.

Arterial Calcification

Radiographically and histologically there are two different patterns of arterial calcifications; Monckerberg's Medial Calcinosis and Calcified Atherosclerotic Plaque because of the deposition of calcium within the medial coat of the vessel.

Initially most patients are asymptomatic. Due to vascular insufficiency eventually they may develop cutaneous gangrene, peripheral vascular disease and myositis. When the facial or the carotid artery are involved they may be seen on the panoramic radiographs. From the side, it appear as a parallel pair of thin, radiopaque lines, with a straight or tortuous path. In cross section they have a circular ring like pattern.

Calcified Atherosclerotic Plaque

They are commonly found in the extracranial carotid vasculature and is a major source of cerebrovascular embolic and occlusive disease, due to the evolution of plaque (dystrophic calcifications) within the intima of the involved vessel. As a result of increased endothelial damage at the arterial bifurcation these calcification occurs. These lesions may be visible on the panoramic radiograph, adjacent to the greater cornu of the hyoid bone or at level of C3, C4 cervical vertebrae. They appear as heterogeneous radiopacities, which are multiple and irregular in shape and have a vertical linear distribution.

Idiopathic Calcification (or calcinosis)

Despite of normal serum calcium phosphate levels the calcium is deposited in normal tissue.

Sialoliths (Salivary Gland Stone, Salivary Gland Calculus)

Sialolithiasis is the formation of calcified obstruction within the salivary duct, resulting in decreased salivary flow and chronic retrograde infection occurs. Sialoliths may occur in major, minor salivary glands (glandular sialolith) or their ducts (ductal sialolith). Due to the physiochemical characteristics of the gland secretions and mechanical conditions contributing to the slow salivary flow rate, which in turn lead to the formation of a nidus and subsequent precipitation of calcium and phosphate salts.

These are commonly seen in the middle age with slight male predilection. The patient may be asymptomatic or may have history of pain and swelling in the floor of the mouth. Extra glandular and intraductal types are more symptomatic than glandular type, which may intensify when the salivary flow is stimulated. Sialolithiasis of minor salivary gland is rare, the most common site being buccal mucosa either near the commissure or in the proximity to the mandibular mucobuccal fold. The shape may vary from long cigar shapes to oval or round shapes. Radiographically the stones are homogeneously radiopaque, with multiple layers. Because of the low mineral content of parotid secretions less than 40% of the parotid gland sialoliths are radiolucent

Phleboliths

Intravascular thrombi, which arise secondary to venous stagnation. The mineralization begins at the core of the thrombus and consists of crystals of calcium phosphate and calcium carbonate. Phleboliths are calcified thrombi found in veins, venulae, or the sinusoidal vessels of hemangiomas(especially the cavernous type). Phleboliths in head and neck region always indicate Hemangioma. Radiographical appearance is round or oval in shape with smooth periphery. If the phlebolith is viewed from the side it may resemble a straight or a slightly curved sausage. Commonly it has the laminated appearance, giving phleboliths a bull's eye or target appearance or may be homogeneously radiopaque.

Laryngeal Cartilage Calcifications

The laryngeal cartilage consist of thyroid, cricoid, arytenoid and the triticeous cartilages which consist of hyaline cartilage, they has a tendency to calcify or ossify with advancing age. Most of these calcification are incidental radiographic finding. The calcified cartilage is located on a lateral view within the pharyngeal air space inferior to the greater cornu of the hyoid bone and adjacent to the superior border of C4. The calcified thyroid cartilage is visible at the lower edge of a panoramic radiograph. The calcified tracheal cartilages usually present as homogeneous radiopacity.

Rhinolith/Antrolith

The deposition of mineral salts such as calcium phosphate, calcium carbonate, and magnesium around a nidus, in the nose is called rhinoliths and in antrum is called antroliths.

In case of a rhinolith the nidus is usually an exogenous foreign body (coin, beads etc) whereas for an antrolith it is usually endogenous materials (bone fragment, root tip, masses of stagnated mucus, etc.).The patient may develop unilateral purulent rhinorrhea, headache, sinusitis, epistaxis, nasal obstruction, fetor, anosmia, facial pain and fever. It may appear as homogeneous or heterogeneous radiopacities with well-defined smooth or irregular borders.

Ossification of the Styloid Ligament

Ossification of the styloid ligament usually extends downwards from the base of the skull, and is commonly bilaterall. The associated conditions are Styloid Syndrome, Eagle's Syndrome, and Styloid Chain Ossification. Patients are more than 40 years of age and are usually asymptomatic. Clinically it can be detected by palpation over the tonsil as a hard pointed structure. The patient may present with a complaint of a vague nagging to intense pain in the pharynx on swallowing, turning the head or opening the mouth, especially on yawning. The pain may be produced by mechanical irritation of sympathetic nerve tissue in the arterial wall, producing regional carotidynia. In the panoramic image it is seen as a long, linear, thin, tapering, radiopaque process extending forward from the region of the mastoid process towards the hyoid bone.

Osteoma Cutis

Osteoma cutis is a rare soft tissue calcification of the skin. It may develop secondary to acne of long duration or chronic inflammatory dermatosis. It can occur on the face (extraoral) cheek, lip region, tongue (intraoral) where it may be called osteoma mucosae or osseous choristoma. It does not cause any visible change in the overlying skin, except in some cases where the color may change to yellowish white.

An intraoral film placed between the alveolar bone and the cheek gives accurate localization. A posteroanterior skull view with the cheek blown outward using a soft tissue technique of 60 kVp helps localize osteomas of the skin. The osteoma cutis may appears as homogeneous radiopacity with a radiolucent center giving the lesion a dough-nut appearance radiographically.

Myositis Ossificans

The fibrous tissue and heterotopic bone form in the interstitial tissue of the associated tendons ligaments and muscle. It is of two types:

- Localized myositis ossificans

- Progressive myositis ossificans

Localized Myositis Ossificans (post-traumatic myositis, myositis ossificans, Solitary myositis)

This results due to acute or chronic trauma, muscle injury, heavy muscular strain which lead to considerable hemorrhage into the muscle or fascia or associated tendons. During the healing process, heterotopic bone or cartilage is formed. It is more common in young men who engage in vigorous activities. The commonly involved oral sites are lateral pterygoid muscle, the masseter and sterno- cleidomastoid. A radiolucent band may be seen radiographically between the areas of ossification and adjacent bone, and the heterotopic bone may be seen along the long axis of affected muscle.

Progressive Myositis Ossificans

This condition may be a spontaneous mutation affecting the mesenchyma or inherited. It usually affects children below 6 years of age, and occasionally in infants. Males are more affected. It begins as a soft tissue swelling that is painful and tender. It may exhibit signs of inflammation like redness and heat. Advanced stages of the disease result in "petrified man" like appearance.[1]

STUDIES RELATED TO THYROID CARTILAGE CALCIFICATION AND PATTERN

Archer et al (1979) conducted a study using computed tomography for evaluating the laryngeal cancer in 21 patients and 3 anatomic specimens. Special attention was directed to the appearance of the laryngeal cartilage in both the normal and abnormal examinations in order to establish criteria for cancerous invasion. The problem presented by the normal non uniformity of density of the cartilage is discussed in detail.[23]

Vlcek (1980) stated that based on the degree of progression thyroid cartilage ossification an individual's age can be made by bone material estimation as long as the cartilage is kept preserved. Radiographs are taken to determine the extent of ossified parts of the thyroid cartilage and is to be compared with the proposed schema. Based on the respective mean error of estimation the estimated age can be calculated. In paleoanthropology and in forensic medicine the method has become another technique of estimating the age of unknown skeletal remnants, particularly decomposed bodies.[24]

Kirsch T & Claassen H (2000) conducted a study which revealed ossification and mineralization of human thyroid cartilage starts first after the end of adolescence while previously cartilaginous human skeleton has become ossified and the epiphyseal discs are in the process of closing. Ultra-structural analysis of human thyroid cartilage revealed that mineralization started close to cartilage canals in a matrix containing gigantic collagen fibers (asbestoid fibers). Matrix vesicles were detected in mineralized areas and were often associated with needle-like crystals. They isolate matrix vesicles from human thyroid cartilage by mild enzymatic digestions and ultracentrifugation. Immunoblot analysis of these vesicles revealed the presence of annexins II, V, and VI, membrane-associated, channel-forming proteins, which allow influx of Ca^{2+} into the vesicles and intralumenal crystal growth. In addition, the vesicles were associated with types II and X collagen, suggesting that this association not only anchors the vesicles to the extracellular matrix, but also stimulates Ca^{2+} influx into these particles. In conclusion, matrix vesicles isolated from human thyroid cartilage contain all the components, enabling them to initiate and mediate the mineralization process in human thyroid cartilage. [15]

Strauss S (2000) had done a study to determine the distribution pattern of calcification of cricoid cartilage in healthy children. Sonography of the neck was performed with linear array transducer of high-resolution to view the sides of the cricoid cartilage ring in both transverse and sagittal planes. Thirty three girls and twenty-three boys, age ranging from 6 to 17 years were examined. Calcifications in the cartilage were characterized by number and size, side-to-side symmetry and distribution pattern. Calcifications was found in 26 of the 33 girls and 19 of the 23 boys. The earliest cases were in three 7-year-old children. The incidence and number of echogenic foci generally increased with age. The sides of the cricoid cartilage ring

can be seen on sonography in both the transverse and sagittal planes. Calcifications within the cartilage were found in an earlier age than previously reported.[25]

Laurie c carter (2000) in his article describes the radiographic differences between different cervical soft tissue calcifications like atherosclerotic plaque, triticeous cartilage calcification, thyroid cartilage calcification and its presentation. The differential diagnosis of calcified atherosclerotic plaque in the extra-cranial carotid vasculature includes a number of anatomic and pathologic radiopacities. Most of these calcifications can be distinguishable based on the location and morphologic features.[26]

Muralidhar Mupparapu and Vuppalapati A (2002) reported ossification of the thyroid cartilage on a routine lateral cephalometric film and discussed the clinical implications of this finding. Usually, ossification can be visible on radiograph only after the age of 20 years. It is unusual to see these ossification in adolescents or children. A case of thyroid ossification was reported by authors in a 14-year-old patient that was visible on routine lateral cephalometric radiograph. In the same case an incidental limbus vertebra is also noticed situated antero-inferior to the fourth cervical vertebra.[27]

Raza S et al (2004) reported the calcification of the posterior part of cricoid cartilage, posterior aspect of the thyroid cartilage or arytenoid cartilage which can be interpreted or confused as a foreign body. They presented a case of calcification of cricoid cartilage depicting as foreign body in the retropharyngeal space and is associated with features of retropharyngeal cellulitis. For further management plain radiograph of lateral soft tissue neck with CT scan can help in confirming and identity the radio-opaque shadow in the retropharyngeal space.[28]

Fatterpekar GM (2004) conducted a study to detect cartilage invasion in patients with laryngeal carcinoma using MRI even though normal laryngeal ossification pattern had not been studied. The purpose of the study was to examine the normal age-related signal patterns in the thyroid, cricoid, and arytenoid cartilages on T1-weighted images. Two radiologists assessed signal in the cartilages by a blinded fashion using three-point scales for intensity and symmetry. They concluded that cartilages predominantly ossify symmetrically and the extent of high signal from all three cartilage increases with age. The latter may help in detecting cartilage invasion by tumor in older patients. Normal symmetry may be helpful in comparing sides for tumor invasion.[29]

Mupparapu M and Vuppalapati A (2005) undertook a study between 1998 and 2000, to detect the variations in physiologic ossification of human laryngeal cartilages by evaluating the lateral cephalometric radiographs of healthy females and males. Lateral cephalometric radiographs of 359 patients (141 male and 218 female; ages 10 to 59 years) was used for the study. They concluded that thyroid cartilage was more frequently ossified as compared to cricoid. And there was a predominence of laryngeal cartilage ossification in men as compared with women. Radiographically there was a detectable laryngeal ossification which advance with age starting from third decade.[12]

Galline J et al (2005) they present a case of bilateral pseudocystic lesion of the thyroid cartilage that shows progressive calcification. Pathologic analysis revealed features of dystrophic lesion with no evidence of malignancy. They hypothesized that frequent micro-trauma from muscular overuse probably led to inflammatory changes

in the tendinous insertions of the laryngeal cartilage, which may resulted in dystrophic ossification of cartilage.[8]

Garwin HM et al (2008) had done a study to analyze the use of radiographic analysis of laryngeal structures for determination of age-at-death. Isolated human laryngeal structures from individuals aged between 15 and 89, were removed during autopsy and was examined radiographically. The cricoid and individual regions of the thyroid cartilage were scored according to degree of ossification, and the relationship between age and degree of ossification was statistically examined. For accuracy a previously done study by Cerny on age determination from thyroid ossification was assessed. The study concluded that even a consistent sequence of laryngeal structures ossification exists, variations in timing does not help in narrow age range estimation.[30]

A study by **Dang-Tran KD et al (2010)** hypothesized that the recent advances in imaging techniques would help in accurate evaluation of the thyroid cartilage ossification. They examined CT scans of 312 French patients by using post processing software, for evaluating the pattern of thyroid cartilage ossification and there by assessing the ossified volume of the cartilage by 3D reconstructions. Even though there is a correlation between morphological changes and civil age exist, the methods based on thyroid cartilage ossification is not accurate for the assessment of individual age.[31]

Chakravarthi K et al (2013) has undertaken a study to assess the incidence of the ossified thyroid cartilages (Cartilago Thyreoidea) in the human cadavers, to discuss its clinical implications and review of literature of these anatomical variations. This study was carried out on 54 human cadavers by Department of Anatomy in various medical colleges of Manipal, Karnataka. Early ossified thyroid cartilages were

detected in 4 female cadavers out of 54 human [27 male and 27 female] cadavers. In modern literature, early calcified thyroid cartilages observed in this study have not been cited. These partly ossified cartilages frequently create a diagnostic problem for the radiologist while examining for foreign bodies. Proper knowledge and diagnosis of such calcified or ossified thyroid cartilages helps the clinician in diagnosis and appropriate management of the patient.[32]

A retrospective study was done by **Nandita Shenoy et al (2014)**, to assess the prevalence of Laryngeal cartilage calcification among patients attending dental OPD at Mangalore, using lateral cephalometric radiographs. This study included the radiographs of 252 patients (92 male and 160 female) age ranging in from 18 to 59 years. Beyond the third decade various degrees of thyroid and cricoid cartilage ossification were found among both males and females. The frequency of Laryngeal calcification was also altered among genders. The study concluded that ossification of thyroid and cricoid cartilages gradually increased with age in both the sexes.[33]

Golghate TD et al (2014) reported a case with thyroid cartilage ossification that begins after 2nd decade and completed by the end of 6th decade of life. During routine skeleton examination of medico-legal cases, early ossification of thyroid cartilage was observed. The bones were of human male aged about 25 to 30 years. The thyroid cartilage was fully ossified signifying either malignancy or metabolic disorders. Knowledge of this anatomic variation would be helpful for early detection of different pathological conditions.[34]

Hortclaassen et al (2014) had done a study to evaluate differences in the ossification mechanism of larynx in skeleton in comparison to growth plates which is controversial till now. To get in-depth into this process, human thyroid cartilage was

investigated by using X-rays and a series of light-microscopic staining. A statistical analysis of mineralization was done by scanning areas of mineralized cartilage and of ossification. They detected a special mode of endochondral ossification which differs from the processes in growth plates. They hypothesized that throughout life, trabeculae of ossified thyroid cartilage undergo adaptation to different loads due to the use of voice.[35]

Petr Hejna et al (2014) reported a case that revealed that anatomical variation laryngohyoid structures if present will lead to inaccurate postmortem examination. Agenesis of the upper horns of the thyroid cartilage has medico legal significance because it may be mistaken for a fracture or other trauma-related conditions. They presented 3 cases of superior cornu of the thyroid cartilage with different forms of agenesis namely right unilateral, left unilateral, and bilateral agenesis.[36]

In the textbook of **Emerging Trends in Oral Health Sciences and Dentistry** TicianaSidorenko de Oliveira Capote, Marcela de Almeida Gonçalves, Andrea Gonçalves and Marcelo Gonçalves have written a chapter(13) Panoramic Radiography - Diagnosis of Relevant Structures That Might Compromise Oral and General Health of the Patient. The chapter provides information about panoramic radiography, showing the principal indications, advantages and disadvantages of this examination. Some of the anatomical variations that can be detected on panoramic radiographs such as bifidmandibular canal, retromolar canal, and alterations such as calcified stylohyoid complex, arterial calcifications, phleboliths, sialolithiasis and Tonsilloliths are discussed the chapter. Such structures/alterations are not reasons for indication of panoramic radiography is not indicated for identification of these

structures, but they are radiographic findings, indication of more accurate examinations, and even referring to other professionals. Therefore, a literature review was conducted, citing relevant anatomy textbooks and scientific papers, and it was illustrated with panoramic radiographs showing these described structures / alterations.[37]

Studies co-related to thyroid hormone imbalance and serum calcium levels

Szabo ZS et al (1981) had done a study showing hypercalcemia develops with increasing age and in the presence of a special type of hyperthyroid goiter. Total serum calcium, albumin, total protein as well as different parameters of thyroid function namely T_3 RIA, T_4test, ETR and TRH test were determined in a group of 147 patients. The ionized calcium level was estimated from total calcium and albumin. Total calcium was not significantly elevated in hyperthyroidism. In the hyperthyroid group of patients of over 60 years of age with multinodular goiters the incidence of hypercalcemia was about 43.8%. Direct action of thyroid hormone on calcium turnover as well as increasing age and special goiter type seem to be responsible for disturbances in calcium metabolism. A possible calcitonin deficiency in the above mentioned conditions was discussed.[38]

Begic-Karup S et al (2001) had done a study to investigate the influence of various thryroid diseases on serum calcium levels. In addition to screening of thyroid diseases they measured serum calcium concentrations (S-Ca) of 13,387 persons, among them 9017 patients with thyroid diseases and 4370 persons without thyroid dysfunction, were studied. They concluded that , a clinically not relevant influence on S-Ca was demonstrated in patients with hyperthyroidism as compared with other thyroid diseases and individuals with no thyroid diseases.[39]

Suneel B et al (2001) conducted a study over a period of six months in 30 hypo & hyperthyroidism subjects with euthyroidism were selected including both males and females. Blood sample were collected for estimation of TSH, FT3, FT4, serum Ca, serum Po4-, serum Mg2+ & serum Zn+. Mineral status was observed in all the patients, as Ca+ levels were low due to high bone turnover showing prominent phosphorus levels as an influence on paratharmone & calcitonine, Zn+ & Mg2+ levels reflects the influences on GFR and decreased clearance of these minerals.[40]

Al-Hakeim HK (2009) conducted a study to analyze the Lipid abnormalities in hypothyroidism contributing to the disproportionate increase in cardiovascular risk. A possible relationship between serum level of magnesium (Mg) and calcium (Ca) and cardiovascular disease was recorded. In this work, the possible correlation between lipid profile components and serum Ca and Mg was investigated. The study concluded that patients with hypothyroidism exhibited elevated atherogenic parameters (TC and LDL-C) and high risk of cardiovascular diseases.[41]

Shivaleela MB et al (2012) had done a study to evaluate the changes in serum calcium & phosphorous levels in Hyperthyroidism & Hypothyroidism. Forty cases each of Hyperthyroidism & Hypothyroidism were included in the study at the same time 40 healthy euthyroid individuals were taken as controls. The findings suggest that there are significant alterations in the levels of serum calcium and phosphorous in thyroid disorders.[4]

Gohel MG et al (2014) has evaluated the serum total calcium, total magnesium and phosphorous levels in patients with hypothyroidism. A hospital based cross sectional study consisting of 100 cases of hypothyroidism and 100 normal healthy controls meeting the selection criteria. Serum calcium total, magnesium total

and phosphorous level along with thyroid profile was measured. A statistically significant negative correlation between serum TSH with calcium total and magnesium total levels was noticed and statistically significant positive correlation between serum TSH and phosphorous levels was observed.[42]

Shrestha S et al (2015) conducted a study to assess the levels of serum electrolytes and minerals in the 75 patients with thyroid disorders and 30 controls were included. Thyroid hormones (T3, T4, and TSH) were measured by vidasautoanalyser. Serum calcium, phosphorous and magnesium were estimated by kit based method using semiautoanalyser. Serum sodium, potassium and chlorides were estimated using ion selective electrodes. They concluded that patients with subclinical hypothyroidism and overt hypothyroidism showed significant decrease in serum calcium and sodium levels and significant increase in serum phosphorous, magnesium, potassium and chloride levels. In case of subclinical hyperthyroidism significant difference could not be obtained among controls and patients. However for overt hyperthyroid patients, serum phosphorous was significantly decreased and serum sodium was increased significantly. When correlated with TSH, serum calcium and sodium showed negative correlation whereas it was positive for serum phosphorous, magnesium, potassium and chloride in case of hypothyroidism. For hyperthyroid patients, correlation was negative for magnesium and chloride whereas positive for the rest parameters.[43]

Mendez et al (2016) conducted a study to evaluate the effect of thyroid function on the total and ionic calcium levels in women with thyroid dysfunction. The study was concluded that there was an association between the serum calcium levels

and thyroid function. Hence, there was no marked difference between the total and ionic calcium levels in thyroid dysfunction.[44]

Studies Co-Related To Thyroid Hormone Imbalance And Thyroid Gland Calcification

A study done by **Funsho Komolafe (1981)** on 160 unselected patients with thyroid enlargement showed an overall calcification rate of 21.5%. Four patterns of calcification were observed: (i) nodular, (ii) flat, (iii) curvilinear, (iv) cloudy, plus a mixed type consisting of varying combinations of the four basic patterns. Calcification is considered to follow previous haemorrhage, necrosis or epithelial degeneration, and since these can occur in both benign and malignant goitres, it explains why calcification cannot be reliably employed as an index of benignity or malignancy.[45]

A study done by **Shodayu Takashima M D (1995)** to evaluate the efficacy of microcalcification detected by ultrasound scan which can be a reliable source to confirm malignant thyroid tumors. The study was conducted in 259 pathologically identified thyroid nodules. The study concluded that micro-calcification of thyroid shows high specificity, the accuracy for confirming malignancy was low.[46]

Mauro Alini et al (1996) in their study discussed about cellular maturation, extra cellular matrix assembly, and calcification in physis of the bovine fetal growth plate. Isolated prehypertrophic chondrocytes in high density culture will undergo process of cellular maturation, the fully expressed hypertrophic phenotype is capable of X collagen synthesis followed by matrix calcification. Using this compare system authors compared tri-iodothyronine (T_3) with thyroxine (T4) to stimulate hypertrophic phenotype and matrix calcification in 3 sub population. The study concluded that

most immature chondrocytes in prehypertrophic stage are having direct link for T_3, T_4. Both the hormone can induce full chondrocyte hypertrophy from an early maturational stage to matrix calcification.[47]

A retrospective study done by **Liu Hong-Feng and Zhi-Ying T W (2003)** to investigate the significance of thyroid calcification for diagnosis of thyroid carcinoma. The study was done in 817 thyroid nodules cases with pre-operative ultrasonic and post-operative pathologic results. The study concluded that thyroid nodules with calcification especially micro-calcification is considered to be the most specific sign of thyroid carcinoma, so early detection of it is of prime importance.[48]

Yoon et al (2007) had done a study to investigate the association between thyroid malignancy and peripheral calcification in thyroid nodules detected on ultrasonography. They analyzed ultrasonographic features of 65 pathologically proven thyroid lesions which shows peripheral calcification and their correlation with histopathologic results. They concluded that relatively high prevalence of malignancy, and no reliable scale for malignancy in thyroid nodules with peripheral calcification. Fine-needle aspiration or careful ultrasonographic follow-up should be done in these cases.[49]

A rare case report by **Yuzbasioglu M F (2008)** of an 67-year old man with chronic cough and recent dysphagia. On a chest roentgenogram the man was found to have a retrosternal mass which extending into the visceral mediastinum. A computed tomographic (CT) scan confirmed eggshell callcification, The pathological examination revealed intra-thyroidal hemorrhage of the thyroid gland with massive intracystic old bleeding.[50]

A study done by **Lu Z et al (2011)** to determine the clinical usefulness of ultrasound in examining calcification patterns in thyroid nodules, as a predictor of malignancy. Records of 1,498 Chinese patients who underwent thyroidectomy for nodular thyroid disease were examined with ultrasonography. Calcifications, which was detected by ultrasonography, are evident in benign and malignant thyroid nodules. Even though microcalcifications are more common in malignant thyroid nodules than in benign, the clinical importance of accepting the presence of microcalcifications alone as a predictor of malignancy is limited.[51]

Che-Wei WU et al (2012) conducted a study to evaluate the patterns and clinical importance of calcifications in thyroid nodules identified on preoperative computed tomography (CT). CT of 383 patients undergoing thyroid operations were reevaluated with clinical and histopathologic findings to identify thyroid calcification. The study concluded that thyroid calcification found on preoperative CT may represent an increased risk for thyroid malignancy. The risk of malignancy is very high when the pattern shows multiple punctate calcification or the calcification is noted within a solitary nodule.[52]

Shi C et al (2012) had done a study to detect correlation between thyroid carcinoma and thyroid nodule calcifications on ultrasound. Postoperative pathological diagnoses in 4186 patients undergoing thyroid surgery was compared with Micro - calcifications (≤ 2 mm) and macro - calcifications (> 2 mm) on preoperative ultrasound examination of thyroid and lymph nodes. Higher incidences of micro- and macro-calcifications were found in patients with thyroid carcinoma than in those with benign disease. The occurrence of malignant disease was significantly higher in patients with micro - calcifications than those with macro-calcifications. Than other

calcification types, the presence of micro-calcifications should be considered as a precursor of malignant thyroid carcinoma. They concluded that thyroid micro-calcifications are strongly associated with thyroid carcinoma, especially micro-papillary carcinoma.[53]

Ye Z Q et al (2013) has done an evaluative study to confirm whether clinical and biochemical parameters or Hashimoto's thyroiditis (HT) could predict the risks of malignancy among patients who underwent thyroidectomy, and to determine the influence of HT on the biological behavior of papillary thyroid cancer (PTC). A total of 2,052 patients who underwent initial thyroidectomy were include in the study. Serum free T4, free T3, thyrotropin (TSH), thyroglobulin, thyroglobulin antibody, antimicrosomal antibody, tumor-associated status, and thyroid disorders were documented. They concluded that the risk of malignancy increases in patients with higher level TSH within normal range, as well as the presence of HT and micro calcification. No evidence suggests that coexistent HT alleviates the aggressiveness of PTC.[54]

MATERIALS AND METHODS

The study was conducted in the department of Oral Medicine and Radiology, Sree Mookambika Institute of Dental Sciences, Kulasekharam, Kanyakumari district to assess the prevalence of thyroid cartilage calcification in different age groups and gender, to evaluate the pattern (level) of calcification and their co-relation with the thyroid profile.

METHODS OF SELECTION OF DATA:

I. SAMPLE SIZE

1 . Total number of images and thyroid profile of patient : 780

2. Total number of groups : 3 (260 in each group)

3 . Description of group:

Group I - Orthopantomograph, lateral cephalometric radiographs and thyroid profile of patients of between 10 – 21years of age.

Group II - Orthopantomograph, lateral cephalometric radiographs and thyroid profile of patients of between 22 – 40 years of age.

Group III - Orthopantomograph, lateral cephalometric radiographs and thyroid profile of patients above 40 years of age.

SELECTION OF CASES

a. Inclusion criteria:

- Patients of chronological age above 10 yrs.

- Patients willing to go for radiographic as well as thyroid profile investigation.
- Patients with no other systemic diseases affecting normal calcium homeostasis and altered calcification like parathyroidism imbalance, rickets...

b. Exclusion criteria:

- Faulty radiographs
- Developmental anomalies and Syndromes affecting midline structure of neck.
- Age below 10 years.
- Neurological deficits where patient compliance is limited.

PARAMETERS TO BE STUDIED:

- To assess the presence of thyroid cartilage calcification in the sample population.
- To assess the prevalence of thyroid cartilage calcification among genders and various age groups .
- To analyze the level (pattern) of thyroid cartilage calcification and its correlation with age, sex, and thyroid hormone imbalance.
- To analyze the co-relation of thyroid cartilage calcification detected on routine radiographs with the thyroid profile.

MATERIALS:

Armamentarium for obtaining the radiograph:

A. Planmeca digital Orthopantomograph machine (Proline XC) with 2.5 mm Alfiltration, average of 64 kV, 5mA and 18 Seconds exposure sequences.
B. Computer installed with Planmeca Romexis 2.6.0.R software.

C. Thyroid blood profile (T_3 -Triiodothyroxine,T_4 -Thyroxine, TSH- thyroid stimulating hormone is evaluated using Chemiluminescence immunoassay (CLIA) method.

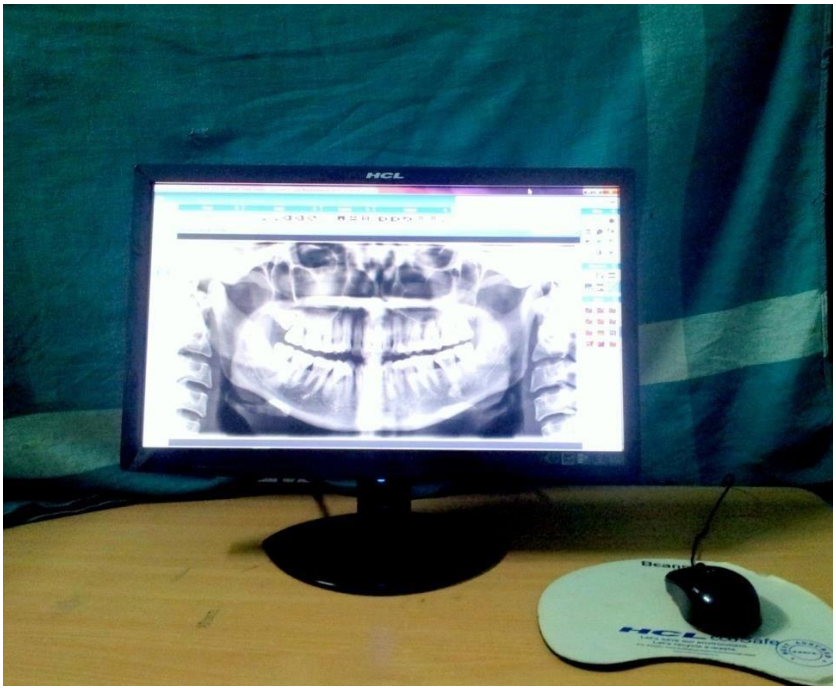
PROCEDURE:

- After obtaining ethical and research committee clearance from the institution, the study was carried out in the Department of Oral Medicine and Radiology using radiographic images and thyroid profile of patients who satisfied the inclusion criteria.
- The radiographic images were acquired with Planmeca Digital Orthopantomograph Machine (ProlineXC) with an average tube voltage range between 60 – 70 Kv; tube current 5-11 m A and exposure time of 18 sec.
- The images were analyzed in a computer with Planmeca Romexis 2.6.0 R for thyroid calcifications and it pattern (level).
- In Orthopantamographs (OPG) the thyroid cartilage if calcified can be appreciated on the left and right lower border of the radiograph, medial to C4. Normally the entire length of thyroid cartilage calcification can't be appreciate on OPG, only the superior cornu and a part of thyroid lamina can be seen.
- On lateral cephalometric radiographs, calcified thyroid cartilage appears within the pharyngeal air space below the inferior border of the greater cornu of the hyoid and adjacent to the superior border of C4 and may be superimposed by the prevertebral soft tissue.

- On the radiograph these calcification may present as homogenous radio opacity or heterogenous ones, only when calcified fully can the morphology can be appreciated.
- Serological investigation was done in the study population for thyroid profile by Chemiluminescence method and serum Calcium, phosphorous and PTH was also checked to rule out other systemic disease.
- The results were analyzed using Chi-square statistical test and other softwares (Microsoft Excel + Statistical Package for the Social Sciences (SPSS) 16.0 version).

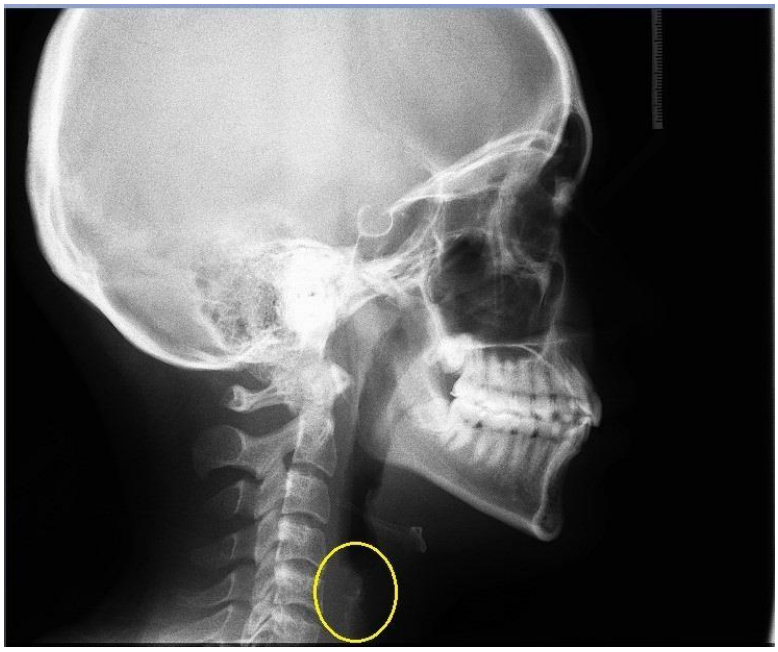
Colour Plate - 1 : Panaromic radiographic machine (Proline XC) for OPG and lateral cephalogram

Colour Plate- 2 : Desktop installed with Planmeca Romexis 2.6.0 R software

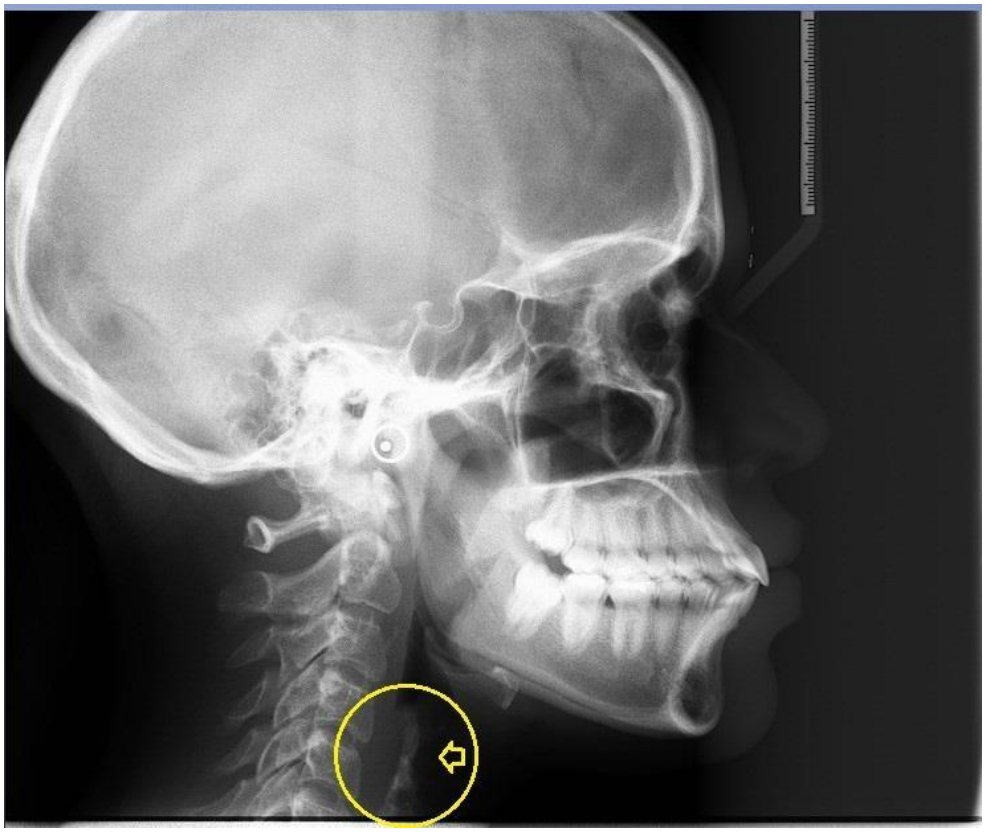


Colour Plate - 3 : Calcification of thyroid lamina and cricoid cartilage seen medial to C4 vertebrae in OPG.

Colour Plate - 4 : Calcification of the thyroid lamina in lateral cephalometric radiograph.

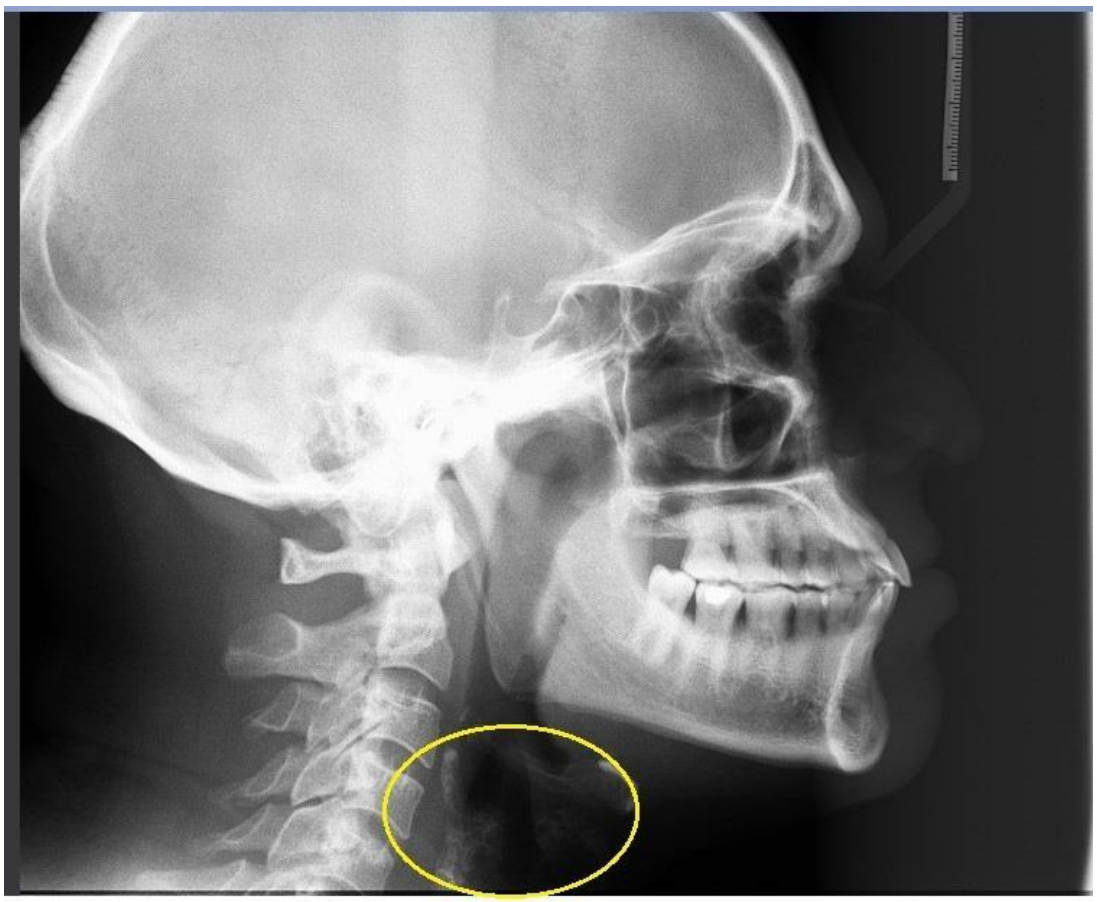


Colour Plate - 5 : Calcification extending from thyroid lamina into inferior cornu in lateral cephalometric radiograph



Colour Plate - 6 : Fully calcified thyroid cartilage in an OPG

Colour Plate - 7 : Calcified thyroid lamina and superior cornu of thyroid cartilage



RESULT AND OBSERVATIONS

The present study was under taken to assess the prevalence of thyroid cartilage calcification in different age groups and gender, to evaluate the pattern (level) of calcification and their co-relation with thyroid blood profile in its clinical stand point.

The data is expressed in number and percentage. Statistical Package for Social Sciences (SPSS 16.0 version) used for analysis. Chi square test applied to find the statistical significant. P vale less than 0.05 ($p<0.05$) considered statistically significant at 95% confidence interval.

Total radiographic images (orthopantamograph and lateral cephalometric radiograph) and thyroid profile (T_3, T_4, TSH) of 780 individuals were taken and analyzed for prevalence, pattern of thyroid cartilage calcification and their co-relation with thyroid hormone imbalance. The total sample population of 780 is divided into 3 main groups of 260 each, with equal male and female distribution. Group 1 consists of patients with age group ranging from 10 to 24 years. Group 2 consist of patient with age ranging from 22 to 40 years. Group 3 includes patients above 40 years of age.

On the basis of number and Percentage of patients with Thyroid cartilage calcification in different age groups is represented in Table 1, Graph 1, 2 and 3. In the age group of 10 to 21 years (group 1), 52.30 % (68) of females have thyroid cartilage calcification whereas only 9.23% (12) of the male had thyroid cartilage calcification. In Group 2 (22-40 years of age group) females have high incidence of calcification of about 90.76 % (118), but males have only 54.61% (71). In the age group above 40 years (Group 3) also shows increase thyroid calcification in females of about 90.76% (118), while males have only 69.23% (90) calcification.

On analyzing the level of calcification with different age group and gender, the details is represented in Table -2 and Graph 4. Group 1 (10 to 21 years) revealed more calcification of middle level (cricoid and arytenoids) in which more calcification is seen in the female population of around 52.31% (68) and males shows only very less percentage of about 9.24% (12). Group 2 shows more calcification of inferior level (inferior horn) followed by middle level calcification with increased incidence in female population of 23.08% (30) while males have only 3.85% (5). Group 3 shows more calcification in the superior level (superior horn) followed by middle and inferior level, in this group also the increase incidence is with female population of about 57.69% (75) at the same time males have only 40.77% (53).

While analyzing Percentage and number of patients with gender and thyroid profile is represented in Table. 3 and Graph 5. Group 1 of 10 to 21 years, female population showed increased incidence of abnormal thyroid imbalance of 2.31% (3), while males have only 0.77% (1) thyroid hormone imbalances. In group 2 (22 to 40 years) also there was also increased abnormal thyroid profile of 6.16% (8), males also showed an increase of 1.54% (2). Group 3 (above 40 years), females showed an abnormal thyroid imbalance of about 5.39% (7), while males presented only with 0.77% (1).

Statistical Analysis

On statistical analysis of prevalence of calcification with genders (Table.1), statistically significant p-value of 0.02 obtained for Group 1 males and females, 0.02 for Group 2 males and females and 0.03 for Group 3males and females.

On Statistical analysis of pattern of calcification between males and females within the group, the results are statistically significant and are illustrated in Table.2. Statistical analysis of the correlation between presence of calcification and thyroid imbalance revealed insignificant values as illustrated in Table 3.

From the statistical analysis, the prevalence of thyroid cartilage calcification is more evident in female, which starts in early adolescence and increases with age than in males. In the late adolescent stage calcification, initially starts in the middle level (cricoid and arytenoids) and in second to third decade of life the calcification extends into the inferior level (inferior horn), by the fourth decade the calcification process starts in the superior level (superior horn). The study also revealed there is no evident direct correlation between thyroid hormone imbalance and thyroid cartilage calcification and is a normal physiological process.

Table-1: Number and Percentage of patients based on gender with calcification

Groups	Male				Female				P value
	Present		Absent		Present		Absent		
	Number	%	Number	%	Number	%	Number	%	
Group-I (10-21 Y)	12	9.23	118	90.77	68$^{\#}$	52.30	62$^{\$}$	47.70	**0.02**
Group-II (22-40 Y)	71*	54.61	59*	45.39	118*,$^{\#}$	90.76	12*,$^{\$}$	9.24	**0.02**
Group-III (above 40 Y)	90*,$^{\#}$	69.23	40*,$^{\#}$	30.77	118*,$^{\#}$	90.76	12*,$^{\$}$	9.24	**0.03**

(*p<0.05 significant compared Group-I with other groups, $^{\#}$p<0.05 significant compared Group-II with other groups, $^{\#}$p<0.05 significant compared present male with present female, $^{\$}$p<0.05 significant compared absent male with absent female)

Table-2: Number and Percentage of patients based on gender with level of calcification of different groups

Level of calcification	Group-I				P value	Group-II				P value	Group-III				P value
	M		F			M		F			M		F		
	No	%	No	%		No	%	No	%		No	%	No	%	
Absent	118	90.76	62*	47.69	**0.03**	59	45.38	12*	9.23	**0.03**	40	30.77	3*	2.31	**0.03**
Middle	12	9.24	68*	52.31	**0.03**	64	49.23	75*	57.69	**0.04**	0	0.00	0	0.00	
Middle+ Inferior	0	0.00	0	0.00		5	3.85	30*	23.08	**0.02**	34	26.15	32	24.62	**0.68**
Middle+ Inferior + Superior	0	0.00	0	0.00		1	0.77	11*	8.46	**0.03**	53	40.77	75*	57.69	**0.04**
Complete	0	0.00	0	0.00		1	0.77	2	1.54	**1.68**	3	2.31	20*	15.38	**0.04**

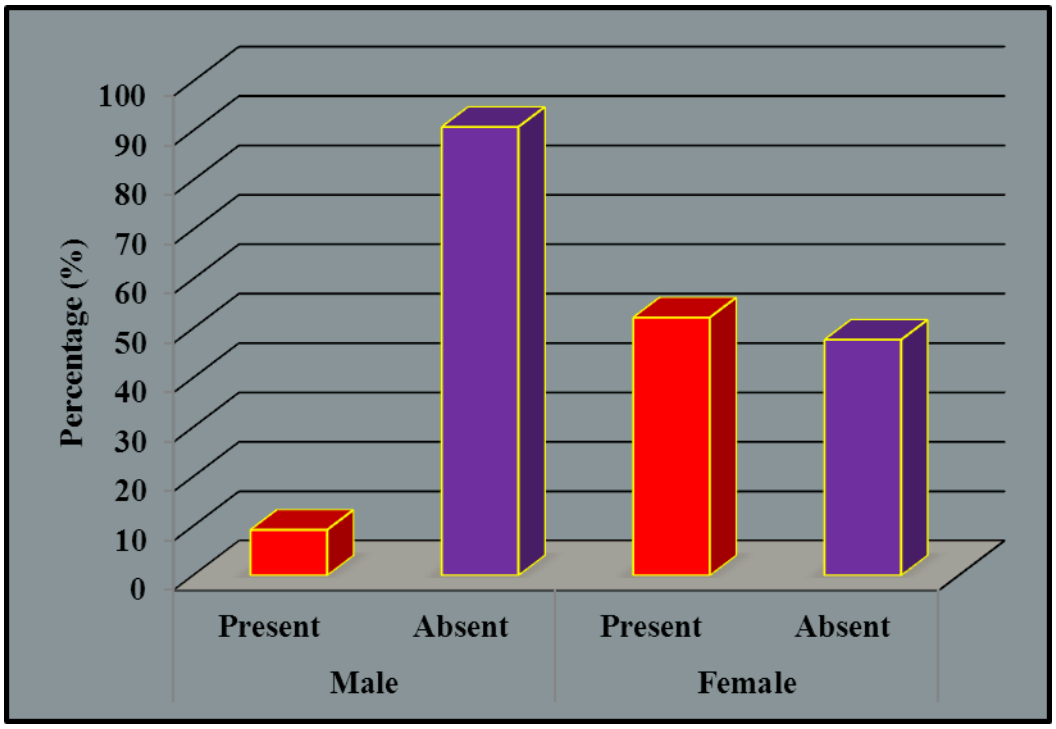
(*p<0.05 significant compared male with female within the groups)

Table-3: Number and Percentage of patients based on gender with thyroid profile

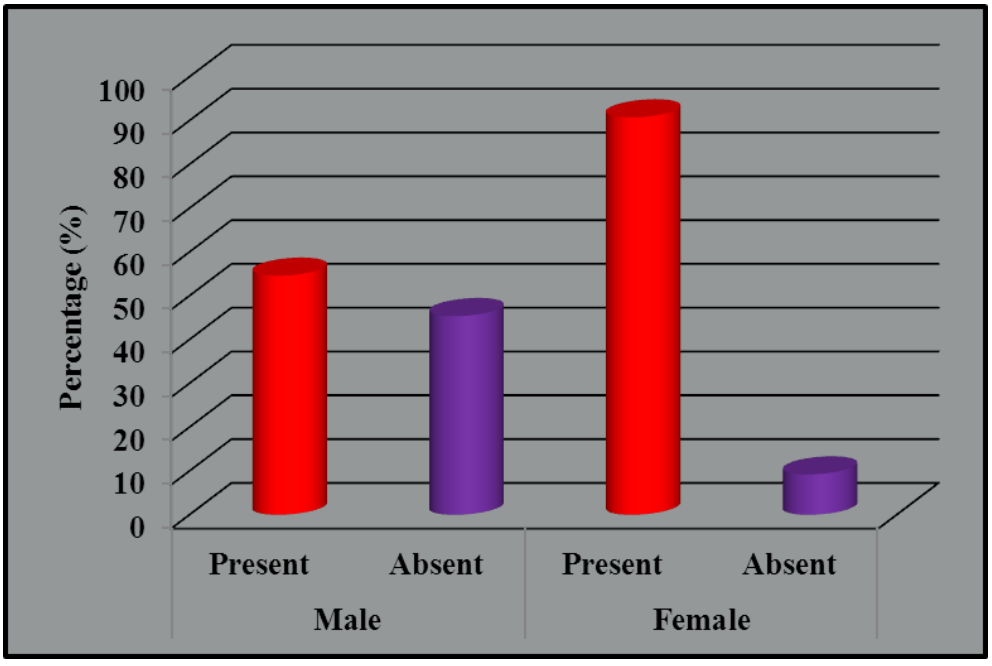
Groups	Male				Female				P value
	Normal		Abnormal		Normal		Abnormal		
	Number	%	Number	%	Number	%	Number	%	
Group-I (10-21 Y)	129	99.23	1	0.77	127	97.69	3*	2.31	**0.04**
Group-II (22-40 Y)	128	98.46	2	1.54	122	93.84	8*	6.16	**0.03**
Group-III (above 40 Y)	129	99.23	1	0.77	123	94.61	7*	5.39	**0.03**

(*p<0.05 significant compared abnormal male with abnormal female within the groups)

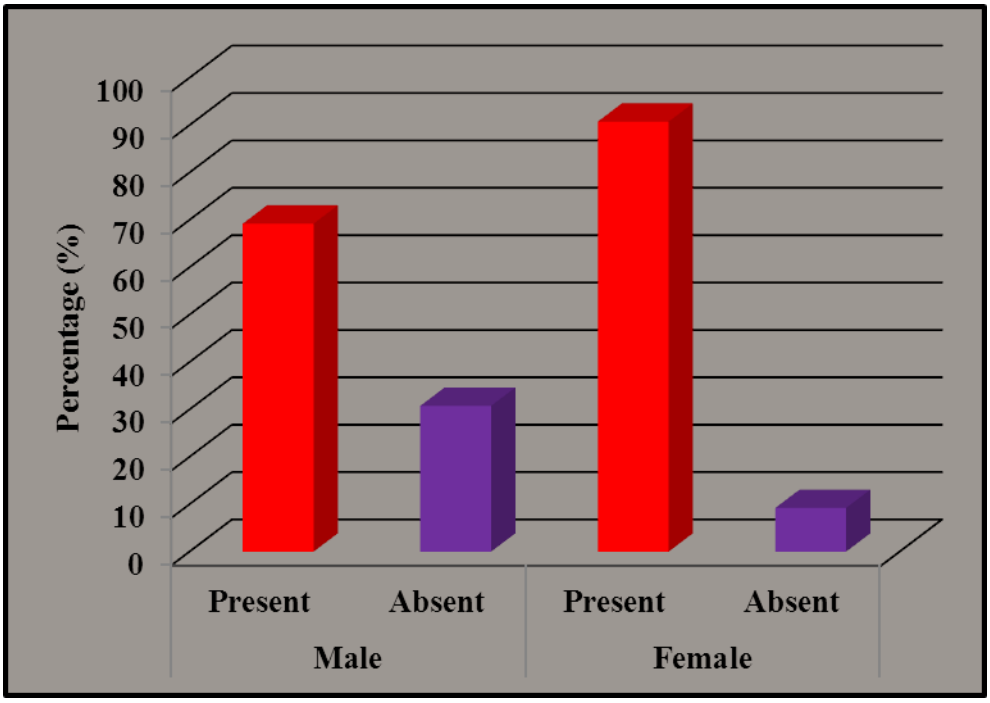
Graph-1: Percentage of patients based on gender with calcification in group-I



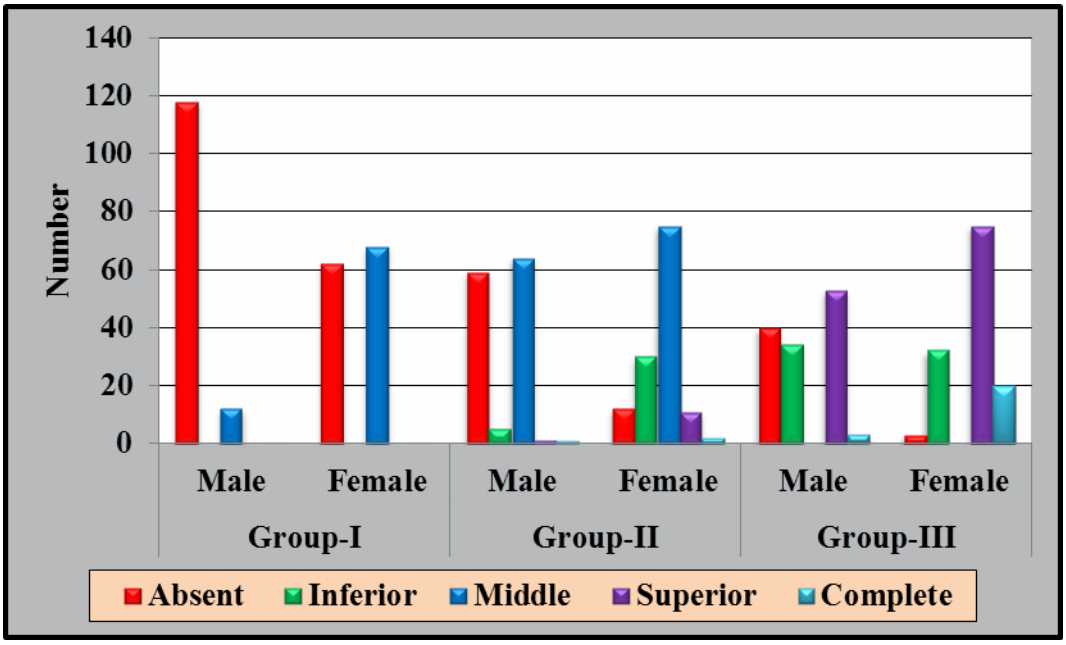
Graph-2: Percentage of patients based on gender with calcification in group-II



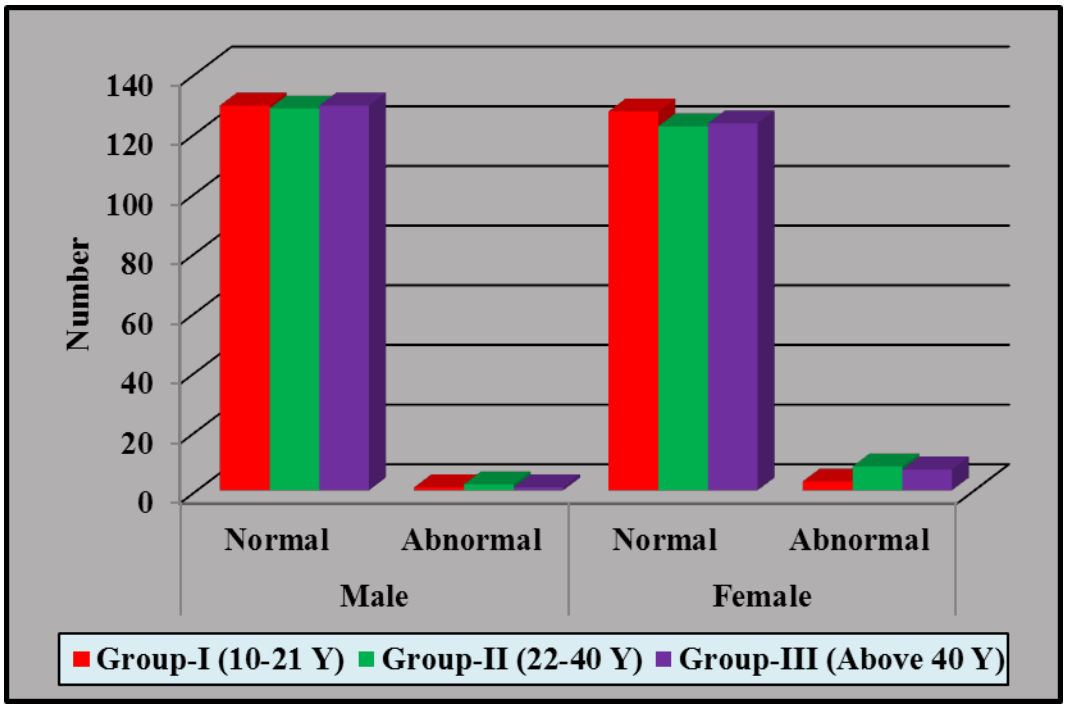
Graph-3: Percentage of patients based on gender with calcification in group-III



Graph-4: Number and Percentage of patients based on gender with level of calcification of different groups



Graph-5: Number and Percentage of patients based on gender with thyroid profile



The larynx is made up of thyroid, cricoid, arytenoids, corniculate, epiglottic and cuneiform cartilages, these cartilages are lined by mucous membrane connected to each other by membranes and ligaments. The movements of the cartilages are facilitated by muscles. Among these cartilages, thyroid cartilage is the major one.[55,56]

All these cartilages are composed mainly of hyaline cartilage. With the normal physiological aging process, the cartilages like epiglottis, corniculate, apices of arytenoids and cuneiform cartilages may get transformed into elastic cartilage. But thyroid cartilage and other cartilages like cricoid, triticeous, and the greater part of the arytenoid cartilages remain as hyaline cartilages and may undergo calcification. When the process starts these calcified cartilages are more evident in head and neck radiographs, like orthopantomograph (OPG), lateral cephalometric radiograph etc.[55,56]

When thyroid cartilage calcifications are noted on head and neck radiographs of younger age groups, further imaging like ultrasound, magnetic resonance imaging or computerized tomography should be carried out to detect pathologies like parathyroid adenomas.[57] During routine radiographic investigations we have noticed multiple evident thyroid cartilage calcification in the early adolescence, even at the age of 14 years. Serological investigations was done and reports revealed evident thyroid hormone imbalance. All these finding were predominant in females. This interesting finding was the basic core to carry out the study.

In our study we observed that the thyroid cartilage calcification are more prevalent in females. Our study differs with worning B et all in which the frequency and degree of calcification of thyroid cartilage is less in females especially in the anterior aspect. [58]

In our study the occurrence of thyroid calcification commences in the early adolescence, females with a mean age of 16 years. Among study group of females between 10 years to 21 years (Group 1), we had 0.51% (4 cases) who had early ossification by the age of 14. In males these calcification starts only in the late adolescence. Our study is in contradiction to studies by Kirch T, Classen H and Fukatsu et al, they studies revealed that in both males and females, the calcification of thyroid cartilage starts around 18 to 20 years of age. And the calcification starts in the posterior aspect which is usually symmetrical.[15,59]

The present study showed that around the age of 70 years thyroid cartilage calcifications are more evident and completely calcified in males (80%), but in case of cartilages in females no subject showed complete calcification. Tillman B, Wustrow F in their study also found that the thyroid cartilage in males ossified completely by the age of 70 years and in case of cartilages in females they are not found to be calcified completely sparing the ventral half of the thyroid cartilage as hyaline cartilage.[60] The pattern of calcification is not standardized, different authors proposed various pattern classification. In contrast to our study, Bannon RP and Grunow followed patterns in describing the progression of ossification in males and females (among 47 cases), they concluded that the calcification in males are homogenous and hazy while in females they are heterogenous and dense.[61]In our study we found heterogeneous type of calcification initially in both males and females which gradually became homogenous calcification as the age progressed. Worning also described cailcification pattern variation in cartilages of males and females based on window formation.[59]

In our study calcification starts in the posterior third of the thyroid lamina followed by cricoid cartilage. During the third decade of life, the calcification

progresses medially and extends to the inferior horn and which has an increased incidence in females, in the fourth decade of life the calcification progresses from thyroid lamina and inferior horn and further calcification starts from the superior horn which extend towards the lamina as the age progressed, Hately et al in their study also found same pattern of calcification and had given a detailed description regarding the stages of ossification of thyroid cartilage. They stated that normally the ossification begins in the inferior portion of the posterior third of the lamina and in the inferior horn.[62]

If calcification of thyroid or cricoid calcification are noted in the early age group, investigation should be done to check for metastasis or underlying systemic disease. To rule out any metastatic changes in the body, starting with a detailed medical history, physical examination of all system of the body, serological investigation for calcium and phosphorous, parathormone assay (PTH) should be carried out.[63] In our study also we have done serological investigation for those who have thyroid cartilage calcification to rule out any systemic conditions, and all the serological values were in normal limits.

Among endocrine disorders, thyroid gland disorders are the most abundant one. These disorders have a wide range of systemic manifestations and their effects in bone and mineral metabolism. In hyperthyroidism the metabolism of calcium and phosphate are altered.[64] Hyperthyroidism directly increases bone resorption and there by increases the level of serum calcium and phosphorous level and suppressing PTH. Hypercalcemia and hyperphosphatemia can result in deposition of calcium salts (bone) in the soft tissues and bones. [7] Hypothyroidism has the opposite effect.[5]

Based on the thyroid profile report of the subjects who participated in our study revealed that, even in euthyroid patients thyroid cartilage calcifications are present and there is no alteration or progression of thyroid calcification noted in cases of thyroid hormone imbalance. Study by Mosekilde L, Melsen F revealed that new bone formation and normal maintenance of serum calcium can be achieved by treating hyper thyroid cases for a period of 4 months there by reducing the osteoclastic activity in bone.[65]Another reprospective study by Senac M O found out 5 cases of costochondral calcification with hyperthyroidism, and concluded that costochondral calcification increases with age and which is associated with aging process, patients with thyrotoxic adolescents calcification are indications of advanced bone maturation which was not previously recognized.[66]

In our study subject of 780 subjects, only one person had clinical symptoms of calcified thyroid cartilage (foreign body sensation in the throat). Kosuri Kalyan Chakravarthi and Potts JT in the book of Harrison's Principles of Internal Medicine described that, thyroid cartilage if calcified may compress neuro vascular structures like recurrent laryngeal nerve, which may cause difficulties in breathing and speech.[67,68] These cartilage may sometime present as radiopaque foreign body in clinical or radiological investigation, so the investigators should be knowledgeable about these normal variants.[63,69]MuralidharMupparapu reported a case of early detection of thyroid cartilage calcification and its clinical and radiological significance.[27]

Vlcek in his study demonstrated that individual's age can be estimated in some cases by evaluating the degree of progression of thyroid calcification as long as the cartilage is preserved. In forensic medicine estimating the age of unknown human

remains can be done by this method.[24]A forensic study by Kosuri Kalyan Chakravarthiin 54 human cadavers, discussed clinical and forensic significance like age estimation, differentiation of males and females etc. from thyroid cartilage calcification and review of literature regarding their anatomical variation.[32] The calcified thyroid cartilage may get fractured if trauma occurs and surgical approach to those areas should be taken extra care while planning itself.[70,71]PetrHejna et al reported three case reports of fracture of calcified thyroid cartilage due to trauma.[36]Radiologists should be well-versed with the soft tissue calcifications of head and neck ,which will be helpful in radio-diagnosis and treatment planning for these anatomical variants.

The famed "Adam's Apple" from Biblical history is about the prominent laryngeal cartilage in Men, which we realize is from the longer and protracted growth of the cartilage in men. Thyroid cartilage is the largest among laryngeal cartilages and its main function is to protect the airway from trauma. These cartilages are primarily made of hyaline cartilage which eventually undergo calcification with age, and these calcification start at the end of adolescence males and females. According to several authors and as found in our study based on the degree of these calcification; age estimation and gender differentiation can be carried out. The exact etiology for these calcifications is not clear. Early calcification of the thyroid cartilages can cause serious clinical situations like neuro-vascular compression of that region leading to hoarseness of sound, dyspnea etc., fracture of cartilage and so on. The hypothesis for our study was based on the observation of calcifications in these regions on routine radiographs which correlated with thyroid imbalance. Based on this we attempted to analyze the prevalence of thyroid cartilage calcification in different age group, its pattern and to check for the co-relation between these calcification and thyroid hormone imbalances. Our study concluded that the prevalence of thyroid cartilages were evident in females, noticed at an initial mean age of 16 years. In males these calcification begin during the late adolescence. The calcifications begin in the thyroid lamina, then extend into the inferior horn by the third decade of life. By the fourth decade of life after the calcification of thyroid lamina and inferior horn, calcification of superior horn of thyroid start which extends into the lamina. Serological investigations revealed, no evident correlation between cartilage calcification and thyroid hormone imbalance, calcifications were present in euthyroid cases as well. Further research is required to evaluate the triggering and contributing factors of these calcifications. Standard, universally accepted classification for the pattern of these

calcifications are to be proposed and agreed upon these as they could be of immense use in forensic investigations and other branches of medicine for age estimation, sex determination and other clinical importance like neurovascular compression, surgical approaches of the region, fracture risks due to trauma etc..In the field of radio-diagnosis, it is imperative that the radiologist be well versed with these anatomical variations and their pathological variations which will be help in identification, diagnosis and treatment plan.

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SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES

(Kulasekharam (K.K District, TN)-629161, Phone No: 04651-280866, Fax No: 280740)

Institutional Human Ethics Committee (IHEC)

{CDSCO Reg No: ECR/446/Inst/TN/2013}

Ref. No: SMIMS/IHEC/2015/A/26 **Date: 17th February 2016**

CERTIFICATE

This is to certify that the Research Protocol Ref. No. **SMIMS/IHEC/2015/A/26** entitled "Prevalence of Thyroid Cartilage Calcification and Analysis of Calcification Pattern in a Sub Urban Population of South India: A Radiographic Study Using Orthopantamograph and Lateral Cephalograph" submitted by Dr. Aravind B.S, Postgraduate of Department of Oral Medicine and Radiology, SMIDS has been approved by the Institutional Human Ethics Committee at its meeting held on 15th December 2015.

17.2.16.

Dr. Rema Menon. N
Member Secretary
Institutional Human Ethics Committee
Professor and HOD of Pharmacology
SMIMS, Kulasekharam (K.K District)
Tamil Nadu-629161

[This Institutional Human Ethics Committee is organized and is operating according to the requirements of ICH-GCP/GLP guidelines and requirements of the Amended Schedule-Y of Drugs and Cosmetics Act, 1940 and Rules 1945 of Government of India.]

SREE MOOKAMBIKA INSTITUTE OF DENTAL SCIENCES

KULASEKHARAM, KANYAKUMARI DIST., TAMIL NADU, INDIA.

INSTITUTIONAL RESEARCH COMMITTEE

Certificate

This is to certify that the research project protocol, ***Ref no. 03/06/2015*** titled, ***"Prevalence of thyroid cartilage calcification and analysis of calcification pattern in a sub-urban population of South India- a radiographic study using Orthopantomograph and Lateral Cephalograph"*** submitted by ***Dr. Aravind B.S., II Year MDS, Department of Oral Medicine and Radiology*** has been approved by the Institutional Research Committee at its meeting held on 15th ***June 2015.***

Convener
Dr. T. Sreelal

Secretary
Dr. Pradeesh Sathyan

CONSENT FORM

PART 1 OF 2
INFORMATION FOR PARTICIPANTS OF THE STUDY

Dear Volunteers,

We welcome you and thank you for your keen interest in participation in this research project. Before you participate in this study, it is important for you to understand why this research is being carried out. This form will provide you all the relevant details of this research. It will explain the nature, the purpose, the benefits, the risks, the discomforts, the precautions and the information about how this project will be carried out. It is important that you read and understand the contents of the form carefully. This form may contain certain scientific terms and hence, if you have any doubts or if you want more information, you are free to ask the study personnel or the contact person mentioned below before you give your consent and also at any time during the entire course of the project.

1. Name of the Principal Investigator:

Dr. Aravind. B.S.
Second Year Post graduate student
Department of Oral Medicine and Radiology
Sree Mookambika Institute of Dental Sciences,
Kulasekharam

2. Name of the Guide:

Dr. Tatu Joy.E MDS
Professor and Head
Department of oral medicine and Radiology
Sree Mookambika Institute of Dental Sciences
Kulasekharam, KanyaKumari, District-629161

3. Name of the Co-Guide:

Dr Eugenia sherubin MDS
Reader
Department of oral medicine and Radiology.
Sree Mookambika Institute of Dental Sciences.
Kulasekharam, KanyaKumari District-629161

4. Institute:

Sree Mookambika Institute of Dental Sciences,
V.P.M Hospital complex, Padanilam,
Kulasekharam, Kanyakumari - 629161 Tamilnadu

5. Title of the study:

"PREVALENCE OF THYROID CARTILAGE CALCIFICATION AND ANALYSIS OF CALCIFICATION PATTERN IN A SUB URBAN POPULATION OF SOUTHERN INDIA; A RADIOGRAPHIC STUDY USING ORTHOPANTOMOGRAPH AND LATERAL CEPHALOGRAPH".

6. Background information:

The thyroid and cricoid have been found to undergo a greater frequency of ossification in female population, but a higher degree of ossification has been noted in male subjects. Early ossification of the thyroid lamina or the cornu is unusual in children or adolescents. The mechanisms involved in mineralization and ossification of human thyroid cartilage are not well understood.[2] In this study I am trying to evaluate the prevalence and pattern of thyroid cartilage calcification in different age group.

7. Aims and Objectives:

- To assess the presence of thyroid cartilage calcification in the sample population.
- To assess the prevalence of thyroid cartilage calcification among genders and various age groups.
- To analyze the co-relation of thyroid cartilage calcification detected on routine radiographic with the thyroid profile.
- To analyze the level (pattern) of thyroid cartilage calcification and its correlation with age, sex, and thyroid profile.

8. Scientific justification of the study:

- Disordered ossification or calcification of ligaments or cartilages may compress neurovascular structures, may be able to cause serious implications in any surgical intervention in the region, may lead to false neurological differential diagnosis or may be benign in nature without any clinical significance. Vlcek5 showed that estimation of an individual's age can in some cases be done by taking advantage of the degree of progression of thyroid calcification so long as the cartilage has remained preserved. This method has been used in forensic medicine to estimate the age of unknown skeletal remains.[1] Worning differentiated a male from a female type of ossification on the basis of this window formation.[3] During routine radiographic investigation in the department of oral medicine and radiology we have noted a lot of thyroid calcification in the early age group.so in this

study I am evaluating the prevalence and pattern of thyroid calcification in patients undergoing routine radiographic investigation (orthopantamograph and lateral cephalograph) in department of oral medicine and radiology.

9. Procedure for the study:

During routine Radiographic investigations (orthopantamograph and lateral cephalograph) in department of oral medicine and radiology, prevalence and pattern of thyroid calcification if present is evaluated and recorded.

lO. Expected risks for the participants:

NIL

11 .Expected benefits of research for the participants:

You will get a better knowledge about your-general health condition and moreover you will get a better about any physiological and pathological calcification to an extend in the neck region .

12. Maintenance of confidentiality:

a. You have the right to confidentiality regarding the privacy of your medical information (Personal details, results of physical examinations, investigations, and your medical history).
b. By signing this document, you will be allowing the research team investigators, other study Personnel, sponsors, institutional ethics committee and any person or agency required by law to view your data, if required.

b. The results of study performed as part of this research may be included in your medical record.

c. The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

13. Why have I been chosen to be in this study?

a. Chosen because of grouping under the inclusion and exclusion criteria

b. Need of good sampling size

c. No invasive procedure that harm your health and helps in diagnosis and helpful for the society

14. How many people will be in the study? 780

15. Agreement of compensation to the participants (In case of a study related injury):

No related injury anticipated. Patient will be taken care in case of complication and medical treatment will be provided .

16. Anticipated prorated payment, if any, to the participant(s) of the study:

Not applicable

17. Can I withdraw from the study at any time during the study period?

- The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during the course of the study without giving any reasons.
- **However,** it is advisable that you talk to the research team prior to stopping information.

18. If there is any new findings/information, would I be informed?

Yes

19. Expected duration of the Participation in the study:

1 day

20. Any other pertinent information?

No other information

21. Whom do I contact for further information ?

For any study related queries,you are free to contact:
Dr.Aravind B.S.
Post graduate student,
Department of oral Medicine and Radiology
Sree Mookambika Institute of Dental Sciences
Kulasekharam,
KanyaKumari District-629161
Phone-9539773484
babudevanaravind007@gmail.com

Place:

Date:

Signature of Principal Investigator

Signature of the participant

PART 2 OF 2

PARTICIPANTS CONSENT FORM

The details of the study have been explained to me in writing and the details have been fully explained to me. I am aware that the results of the study may not be directly beneficial to me but will help in the advancement or medical sciences. I confirm that I have understood the study and had the opportunity to ask questions. 1 understand that my participation in the study is voluntary and that 1 am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected. 1 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). I have been given an information sheet giving details of the study. I fully consent to participate in the study titled:

"PREVALENCE OF THYROID CARTILAGE CALCIFICATION AND ANALYSIS OF CALCIFICATION PATTERN IN A SUB URBAN POPULATION OF SOUTHERN INDIA; A RADIOGRAPHIC STUDY USING ORTHOPANTOMOGRAPH AND LATERAL CEPHALOGRAPH".

Serial no / Reference no:

Name of the participant:

Contact number of the participant:

Address of the participant:

Signature / thumb impression of the participant / Legal guardian

Witnesses:

1.

2.

Date:

Place:

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1. apJy **KthjI³** : **tUm.Achn\m . _n.Fkv.**
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{io aqImw_nI C³Ìnäyq«v Hm^v sUâÂ kb³kv,
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2. **{]m\amÀ¤ZÀin** : **tUm.ämäp tPmbv. C, Fw.Un.Fkv.**
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3. **kIamÀ¤ZÀin** : **tUm. bqPn\nbm sjÀ_n³, Fw.Un.Fkv.**
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6.]T\¯nsâ ASnØm\w ?

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7.]Tt\mt±iyw

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10.]T\w aqew]s¦Sp¡p¶ BÄ¡v D—mIm³ CSbpÅ A]IS km[yX þ
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12. hnhc§Ä clkyambn kq£n¡pta ? AsX

13. Fs¶ F´psIm— Cu]T\¯nÂ DÄs¸Sp¯n ?
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14. F{X BfpIÄ Cu]T\¯nÂ DÄs¸Sp¶p. 771

15. **]T\w aqeap—mIp¶ £X§Ä¡v \ã]cnImc¯n\pÅ k½Xw ?**
]T\IÀ¯mhv NnInÕm sNehv hIn¡p¶XmWv.

16. **GsX¦nepw hn[¯nÂ thX\w e`n ¯ ptam þ** CÃ

17. **Ft¸mÄ thWsa¦nepw F\n¡v Cu]T\¯nÂ \n¶v]n·mdmtam þ** kz´w XmÂ]cy{]Imcw Cu]T\¯nÂ \n¶v Ft¸mÄthWsa¦nepw]n·mdmhp¶XmWv ImcW§Â \ÂImsX Xs¶. F¶ncp¶mepw KthjW kwLt¯mSv]n·mdp¶Xn\pap³]v kwkmcn¡phm³ R§Ä \n§tfmSv A`yÀ°n¡p¶p.

18. **Cu KthjW¯nsâ ^eambn]pXnb Fs´¦nepw Is—¯epIfpsâ¦nÂ AXv Fs¶ Andbn¡ptam ?** AsX

19. **Cu]T\¯nsâ kab ssZÀLyw F{XbmWv ?** Hcp Znhkw

20. **CXnsâ `mKambn Fs´¦nepw IqSpXÂ hnhc§Ä** th−

21. **IqSpXÂ hnhc§Ä¡mbn Xmsg]dbp¶hsc \n§Ä¡v _Ôs¸Smhp¶XmWv.**

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samss_Â \¼À : 9539773484
Cþsabm Â sFUm: babudevanaravind007@gmail.com

Øew: {]Ya At\zjIsâ H¸v

XobXm :]s¦Sp¯p¶ Bfmsâ H¸

k½X]{Xw

`mKw þ 2

Cu]T\s¯]änbpÅ FÃm Imcy§fpw F\n¡v]dªv a\Ênem¡n XcnIbpw AXnsâ Hcp]IÀ¸v F\n¡p \ÂIpIbpw sNbvXn«p—v. Cu]T\w KthjW¯n\mbn DÅXmsW¶pw F\n¡v CXnÂ \n¶v t\cn«v Hcp ^ehpw D—mInsÃ¶pw Rm³ a\Ênem¡p¶p. Cu]T\¯nsâ coXnbpw Dt±ihpw F\n¡v a\Ênem¡n X¶n«p—v. AXp t]mse F\n¡v kwib§Ä tNmZn¡m³ Ahkc§Ä e`n¨n«pap—v. CXnÂ]s¦Sp¡m\pw]s¦Sp¡mXncn¡m\pw DÅ AhImiw F\n¡ps−¶pw AXpt]mse]T\¯nsâ GXp L«¯nepw CXnÂ \n¶v]n³h§m\pÅ kzmX{´yhpw F\n¡ps−¶v Rm³ a\Ênem¡p¶p. Cu]T\¯nÂ]s¦Sp¡p¶Xp sImt—m,]s¦Sp¡m¯XpsImt—m Fsâ aäp NnInÕIsf _m[n¡p¶XsÃ¶v Rm³ Andbp¶p.

Z£nW`mcX¯nse D]\Kc¯nÂ hkn¡p¶ ssXtdmbvUv XcpWmØnbpsS ]pS`mKw sN¿p¶Xnsâ hym]IXzhpw, amXrIbpsS kq£va]cntim[\bpw þ HmÀt¯mt]âtam{Km^v, emädÂ sk^tem{Km^v FIvtdIÄ aptJ\bpÅ Hcp]T\w.F¶ KthjW¯nÂ]s¦Sp¡p¶Xn\pw CXnsâ ^e§Ä imkv{XteJ\¯nÂ {]kn²oIcn¡p¶Xn\pw F\n¡v k½XamsW¶v Rm³ CXn\mÂ Andbn¨psImÅp¶p.

kocnbÂ \¼À / d^d³kv \¼À :

]s¦Sp¡p¶ Bfnsâ t]cv :

taÂhnemkw :

t^m¬ \¼À :

H¸ / hmceSbmfw

km£n :

Øew :

XobXn

JI◊Rp YÙdœÍXm

ÿRp TÙLm

BWônf£«p TeÏùTßúYôÚdLô] RLYp Ï±I×

AuTÙokR Te˙LtTÙ[oL˙[,

CkR BWÙnf£´p ReL˚[D”T”jßd˘LÙs[™œkR BoYj’Pu ÿ›U]’Pu LXk’˘LÙs[YkR YW˙YtTÙ[oL˚[YW˙Yt°˙\u. øeLs CkR BWÙnf£´p Te˘L”j’d˘LÙsYRtœ ÿu CkR BWÙnf£ GRtLÙL SPjRIT”°\’ GuT˚R˘R∞YÙL◊¨k’˘LÙs[˙Yi”m. EeLfidœ ˙R˚YVÙ]A˚]j’ ÆTWeLfim∏˙Z ˘LÙ”dLlTh”s[’. CkR BWÙnf£´u ÍXm HtT”m Su˚ULs, H˙R‡m BTj’Ls Utflm ARtLÙL Utflm GqYÙfl CkR BWÙnf£ ˙Ut˘LÙs[lT”m ÿ°\L˚[Ÿm ˘R¨ÆdLlTh”s[’. Cßp ˘LÙ”dLlTh”s[ÆTWeL˚[˘R∞YÙL T•j’ ◊¨k’ ˘LÙs[˙Yi”m. øeLs BWÙnf£´p Te˙LtTÙ[oL[ÙL JI◊Rp YZeœYRtœ ÿu◊ EeLfidœ HtT”m A±ÆVp NÙokR Nk˙RLeLs Utflm BWÙnf£ NmTkRlThP Nk˙RLeLs A˚]j’m CkR BWÙnf£´u GkR LÙXLhPjß¤m øeLs T•Yjßp œ±l©hP ST¨Pm ˙Lh” ˘R∞‹T”jßd˘LÙs[XÙm.

1. R˚X˚U BnYÙ[o : ***PÙdPo. AWÆkj.*** B.S.
   - Rœß : ÿ’L˚X (MDS)
   - ©¨‹ : K\p ˘U•£u & ˙W•˙VÙ[¥’°\
   - ®flY]m : c ÍLÙm©LÙ Cuv•hÎh Bl ˘PuPp NVu^v,
   - CPm : œX˙NLWm

2. YØLÙh• : ***PÙdPo. PÙh” ˙_Ùn. C***, MDS.
   - Rœß : ˙TWÙ£¨Vo & ’°\˙UXÙ[o
   - ©¨‹ : K\p ˘U•£u & ˙W•˙VÙ[¥’°\
   - ®flY]m : c ÍLÙm©LÙ Cuv•hÎh Bl ˘PuPp NVu^v,
   - CPm : œX˙NLWm

3. C˚QYØLÙh• : ***PÙdPo Î¥≤VÙ ˘¨o©u.*** MDS.
   - Rœß : √Po
   - ©¨‹ : K\p ˘U•£u & ˙W•˙VÙ[¥’°\
   - ®flY]m : c ÍLÙm©LÙ Cuv•hÎh Bl ˘PuPp NVu^v,
   - CPm : œX˙NLWm

4. ***Lpì¨ :*** c ÍLÙm©LÙ Cuv•hÎh Bl ˘PuPp NVu^v, TP®Xm œX˙NLWm¸ 629 161.

5. ***BWÙnf£´u R˚Xl◊***

˘Ru≤kßVÙÆu ◊\SLo Tœß **Ju±p** ˚RWÙn" œ⁄˜R¤m◊ LÙp£V˙Ut\¤dLÙ] ˙SÙn TWÆ⁄**d˚L** Utflm LÙp£V ˙Ut\¤dLÙ] ÿ°\ Bn‹ TW‹Rp TÙu\˙UÙ°WÙl . XÙhPWp ˘NT˙XÙ°WÙl TVuT"jß F"Lßo Bn‹.

6. ***©u]¶ RLYp:***

˚RWÙn" œ⁄˜R¤m◊ G¤mTÙdLm ·"RXÙL ˘TiL∞p LÙQlT"Y˘Ru\Ù¤m œ⁄˜R¤m◊ G¤mTÙdLm ·"RXÙL BiL∞¤m LÙQlT"°\'. C' œ˚Zk˚RL∞¤m °']_˜L∞¤m NÙRÙWQUÙL LÙQÆp˚X. RÙRÙLjß¤m HtTP ·•V'm G¤mTÙ°\'UÙ] G¤mTÙdLm Ei˚UVÙ] LÙWQm ˘R∞YÙdLlTPÆp˚X. CkR T•l©p SÙu Jq˘YÙ⁄YV'˚PVYoL∞¤m HtT"°u\ ˚RWÙnh œ⁄˜R¤m◊ G¤mTÙdLm TWYp YœlTÙn‹ Y¤YÙ] T¨˙NÙR˚]Ÿm SPjRlT"m.

7. ***˘LÙsLs Utflm ˙SÙdLeLs :***

CkR T•l©p SÙu Jq˘YÙ⁄ YV'˚PVYoL∞¤m HtT"°u\ ˚RWÙnh œ⁄˜R¤m◊ G¤mTÙdLm TWYp YœlTÙn‹ Y¤YÙ] T¨˙NÙR˚]Ÿm SPjRlT"m

8. ***BnÆ˚]l Tt±V A±ÆVp Æ[dLm***

G¤m©u R˚NSÙo œ⁄k˘R¤m◊m N¨VÙL CpXÙUp GpXÙ°u\ TWY¤m AkR UiPXjß¤s[Afl˚Y £°h˚N ˘L¸WYUÙ] ©WfN˚]Ls EiPÙ°\'. A'UpXÙUp SWm◊·hPjßu —LU∞jRp ·"°\'. ˘Yp˙Nd Ru‡˚PV TÙPjßp **J⁄** ST¨u YV' œ⁄k˘R¤m©u GpXÙdLm **Y⁄°u\ A[˚Y** LQd°p ˘**LÙi"** NÙjßVUÙœm Gufl ˘R∞´dLlThP'. CkR **ÿ˚** NÙ[Wm E⁄YÙdLm A•lT˚P´p ·•, **J⁄˜Ti** Y˚L **J⁄Bi** Gufl ©¨d°u\]o I.SÙ. A±VlThP G¤m©u Efll◊Ls YV˚R Ußl©"YRtœ RPÆVp **U⁄j'Yjßp** TVuT"jRlT"°\'. ß]m SPj'm **U⁄k'** Utflm Lß¨VdL £°f˚N **'°** YZdLUÙ] LßoY˚W‹L∞p ÆNÙW˚Q´u˙TÙ' SÙm BWmT YVßp Es[˚RWÙn" LÙp£V˙Ut\¤dLÙ] ®°\V œ±l©hPÙo.SÙu CkR T•l©p Jq˘YÙ⁄YVß]¨¤m EiPÙ°u\ ˚RWÙn" œ⁄k˘R¤m◊ G¤mTÙdLjßu Y¤YÙ] **Bn‹** SPjRlT"°\'.

9. ***BnÆu ˘NVpÿ˚***

K\p ˘U•£u & ˙W•˙VÙ[¥ Yœl©p YZdLUÙ] LßoY˚W‹L∞p ÆNÙW˚QLs ˙SÙnjRÙdLm Utflm ˚RWÙn" LÙp£V˙Ut\¤dLÙ] A˚Ul◊dœl ˙TÙ' EP≤⁄kR]o Ußl¿" Utflm Tß‹ Gu\Ùp.

10. ***BnÆp LXk' ˘LÙsTYoLfidœ GßoTÙodLlT"m BTj'Ls*** ?

Gßo˘LÙs[lT"˙m **BTj'Ls** ˙SÙVÙ∞´Pm ˘R¨VlT"j'm.

11. ***Te˙LtTÙ[oLfidœ GßoTÙodLlT"m TVuLs*** ? SpX **J⁄˜j⁄Ym** ˙SÙVÙ∞dœ A∞dLlT"m

12 CWL£VjRu˚U LÙjRp ?

EeL∞Pm C⁄k' ˙NL¨jR GkR ÆTWÿm CWL£VUÙL ˚YdLIT"m. CRuÍXm °˚Pdœm ◊s∞ÆTWm Uh"m ˇY∞´PIT"m. Ut\T• R≤ST¨u ˇNÙkR ÆTWeLs ˇY∞´PITPUÙhPÙ'.

13. . GR]Ùp CkR BnÆp SÙu Te˙LtL ˙RokˇR"dLITh˙Pu ?

A, G]' LpÆ ®flY]jßu ®TkR˚]Lfidœ C' EhThP'.

B. ˙SÙnL∞u Bn‹

C. GkR Y˚L´¤m ˙SÙVÙ∞L˚ [™œkR £WUjßtœ EhT"jRÙ'.

14. CkR BnÆp GjR˚]˙To Te˙Lt°\ÙoLs ? 771

15. CkR BnÆu ÍXm H˙R‡m ©uÆ˚[‹Ls HtThPÙp BWÙnf£VÙ[o ˇTÙflI◊ HtTÙWÙ ?

BWÙnf£VÙ[o ˇTÙ⁄ÙRÙW A[Æp ˇTÙfll˙TtTÙo.

16. CkR BWÙnf£´p Teœˇ Tfl˙YÙ⁄dœ GqÆR ˇRÙ˚LŸm YZeLIT"UÙ ? Cp˚X

17. SÙu CkR BWÙnf£´⁄k' Æ⁄TIThPÙp GkR LÙXLhPjß¤m ÆXLXÙUÙ ? ˙SÙVÙ∞´u GkR J⁄ Lh"lTÙ"/®TkR˚]L∞u⌈rCkR BnÆtœ EhT"jRlTPÆp˚X. AYoL∞u ÿ› Jj' ˚ZI◊ Utflm NmURjßu ˙T¨p Uh"˙U TeˇL"j's[]o.

18. H˙R‡m ◊ßVˇNnß, ◊ßV Li"©•I◊ Tt± SÙu A±ÆdLIT"˙Y]Ù ? Bm

19. BWÙnf£´u GßoTÙodLIT"m TeœLÙX A[‹ ? J⁄SÙs

20. ˙Yfl H˙R‡m ˇTÙ⁄jRUÙ] ÆTWeLs EiPÙ ? Cp˚X

21. CqYÙWÙnf£˚Vl Tt±V ÆYWeL˚[VÙ¨Pm ˙Lh" ˇR¨k'dˇLÙsY'?

R˚X˚U BnYÙ[o : ***PÙdPo. AWÆkj.*** B.S.
Rœß : ÿ'L˚X (MDS)
©¨‹ : K\p ˇU•£u & ˙W•˙VÙ[¥ ' ˚\
®flY]m : c ÍLÙm©LÙ Cuv•hÏh BI ˇPuPp NVu^v,
CPm : œX˙NLWm
Cell: 9539773484 , Email:babudevanaravind007@gmail.com

CPm :

˙Rß : ÿRu˚U BWÙnf£VÙ[¨u

˚LˇVÙlTm

Jl◊Rp T•Ym

TÙLm¸2

CkR BWÙnf£´u RLYpLs A˚]j’m Gu≤Pm ˇR∞YÙL G›j’ÍXm Æ[dLlTh”s[’. CkR BWÙnf£´u ÿ•‹Ls G]dœ ˙SW•VÙL TVuTWÙÆhPÙ¤m U⁄ƒ’Yj’˚\´u ÿu˙]t\jßtœ TVuT”m GuT˚R A±˙Yu. CqYÙWÙn£˚Vl Tt± SÙu ˇR∞YÙL ◊¨k’d ˇLÙi”s˙[u. SÙu RÙ]ÙL ÿuYk’ Cßp Teœl ˇTfl°˙\u. GuT˚R A±˙Yu. Cß⁄k’ GkR ˙SWÿm GdLÙWQÿm ·\ÙUp YkRÙ¤m CkR U⁄ƒ’YU˚]´p G]dœ °˚Pdœm U⁄ƒ’Y ERÆ GqÆRjß¤m TÙßdLlTPÙ’ GuT˚RŸm A±˙Yu. CqYÙWÙnf£´u ÍXm Y⁄m ÿ•‹Ls Utflm RLYpL˚[A±ÆVp’˚\´u TVuTÙ”Lfidœ (Uh”˙U) ET˙VÙLlTh•dˇLÙs[NmUßd°˙\u. G]dœ CqYÙWÙnf£˚Vl Tt±V Æ¨YÙ] RLYpLs APe°V T•Ym RWlTh”s[’.

SÙu “˘***Ru≤kßVÙÆu*** ***◊\SLo Tœß Ju±p ˚RWÙn” œ⁄˘R¤m◊ LÙp£V˙Ut\¤dLÙ] ˙SÙn TWÆ´d˚L Utflm LÙp£V ˙Ut\¤dLÙ] ÿ˚\ Bn‹*** *TW‹Rp TÙu\˙UÙ°WÙl . XÙhPWp ˘NT˙XÙ°WÙl TVuT”jß F”Lßo Bn‹.* ” Gu°\ BWÙnf£´p Te˙LtL ÿ›U]’Pu NmUßd°˙\u.

Teœ ˇLÙsTY¨u ˇRÙPo, U⁄ƒ’Y Gi :

Teœ ˇLÙsTY¨u ˇTVo :

18 YVßtœ ⁄r Es[YoLfidœ TÙ’LÙYX¨u ˚L˘VÙlTm:

ÿLY¨

ˇRÙ˚X ˇRÙPo◊ Gi :

Teœ ˇLÙsTYo TWÙU¨lTYo ˚L˘VÙlTm/˘T⁄ÆWp —Y” :

NÙh£ 1

NÙh£ 2

˙Rß:

CPm: œX˙NLWm

SREE MOOKAMBIKA INSTITUTE OF DENTAL SCIENCES

DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY

"PREVALENCE OF THYROID CARTILAGE CALCIFICATION AND ANALYSIS OF CALCIFICATION PATTERN IN A SUB URBAN POPULATION OF SOUTHERN INDIA; A RADIOGRAPHIC STUDY USING ORTHOPANTOMOGRAPH AND LATERAL CEPHALOGRAPH"

DATA RECORD SHEET

NAME:-

AGE:-

SEX:-

GROUP 1 AGE:-10-21 YRS, GROUP 2 AGE :-22-40 YRS, GROUP 3 AGE :- ABOVE 40 YRS

PATTERN / LEVEL OF CALCIFICATIONS – ABSENT, MIDDLE, SUPERIOR, and INFERIOR

GROUPS	CALCIFICATION PRESENT/ABSENT	PATTERN OF CALCIFICATION
GROUP 1 (10-21 YEARS)		
GROUP 2 (22-40 YEARS)		
GROUP 3 (40 YEARS AND ABOVE)		

INVESTIGATORS SIGNATURE

GROUP 1 : 10-21YEARS : FEMALE (130 SAMPLES)

Age	Gender	Calcification	Thyroid Profile Normal / Abnormal	Level of Calcification
15	F	AB	NORMAL	ABSENT
14	F	AB	NORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
15	F	AB	NORMAL	ABSENT
15	F	AB	ABNORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
10	F	AB	NORMAL	ABSENT
18	F	AB	NORMAL	ABSENT
17	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
18	F	AB	NORMAL	ABSENT
14	F	AB	NORMAL	ABSENT
19	F	P	NORMAL	MIDDLE
17	F	AB	NORMAL	ABSENT
16	F	AB	NORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
21	F	P	ABNORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
21	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
14	F	AB	NORMAL	ABSENT
18	F	P	ABNORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT
19	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE

17	F	AB	NORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
10	F	AB	NORMAL	ABSENT
15	F	AB	NORMAL	ABSENT
17	F	AB	NORMAL	ABSENT
19	F	P	NORMAL	MIDDLE
18	F	AB	NORMAL	ABSENT
16	F	AB	NORMAL	ABSENT
20	F	P	NORMAL	MIDDLE
19	F	AB	NORMAL	ABSENT
20	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
21	F	AB	NORMAL	ABSENT
17	F	P	NORMAL	MIDDLE
16	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
18	F	AB	NORMAL	ABSENT
11	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT
18	F	AB	NORMAL	ABSENT
21	F	P	NORMAL	MIDDLE
15	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
15	F	AB	NORMAL	ABSENT
12	F	AB	NORMAL	ABSENT
14	F	P	NORMAL	MIDDLE
21	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT
14	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT

18	F	P	NORMAL	MIDDLE
16	F	P	NORMAL	MIDDLE
19	F	AB	NORMAL	ABSENT
19	F	P	NORMAL	MIDDLE
19	F	AB	NORMAL	ABSENT
17	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
14	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
16	F	P	NORMAL	MIDDLE
11	F	AB	NORMAL	ABSENT
13	F	AB	NORMAL	ABSENT
20	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
19	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
15	F	AB	NORMAL	ABSENT
21	F	P	NORMAL	MIDDLE
21	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
20	F	P	NORMAL	MIDDLE
16	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
21	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
16	F	AB	NORMAL	ABSENT

15	F	AB	NORMAL	ABSENT
19	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
17	F	P	NORMAL	MIDDLE
13	F	AB	NORMAL	ABSENT
21	F	P	NORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
19	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
16	F	AB	NORMAL	ABSENT
16	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
15	F	P	NORMAL	MIDDLE
15	F	AB	NORMAL	ABSENT
16	F	AB	NORMAL	ABSENT
16	F	AB	NORMAL	ABSENT
18	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
20	F	P	NORMAL	MIDDLE
15	F	P	NORMAL	MIDDLE
17	F	P	NORMAL	MIDDLE
19	F	P	NORMAL	MIDDLE
18	F	P	NORMAL	MIDDLE
14	F	AB	NORMAL	ABSENT

GROUP 1: 10-21YEARS : MALE- 130 SAMPLES

Age	Gender	Calcification	Thyroid Profile Normal / Abnormal	Level of Calcification
20	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
19	M	P	NORMAL	MIDDLE
19	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
17	M	AB	ABNORMAL	AB
19	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB

10	M	AB	NORMAL	AB
11	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
18	M	P	NORMAL	MIDDLE
12	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
19	M	P	NORMAL	MIDDLE
14	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
11	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
20	M	P	NORMAL	MIDDLE
19	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
21	M	AB	NORMAL	AB
21	M	P	NORMAL	MIDDLE
21	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
21	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB

13	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
20	M	P	NORMAL	MIDDLE
13	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
21	M	AB	NORMAL	AB
19	M	P	NORMAL	MIDDLE
13	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
21	M	P	NORMAL	MIDDLE
18	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
12	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
20	M	P	NORMAL	MIDDLE

17	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
19	M	AB	NORMAL	AB
12	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
21	M	AB	NORMAL	AB
21	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
20	M	AB	NORMAL	AB
21	M	P	NORMAL	MIDDLE
13	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
15	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
18	M	AB	NORMAL	AB
13	M	AB	NORMAL	AB
17	M	AB	NORMAL	AB
18	M	P	NORMAL	MIDDLE
19	M	AB	NORMAL	AB
14	M	AB	NORMAL	AB
16	M	AB	NORMAL	AB
21	M	P	NORMAL	MIDDLE

GROUP 2 : 22-40 YEARS: MALE 130 SAMPLES

Age	Gender	Calcification-present/absent	Thyroid profile - normal/ abnormal	Level of calcification-absent/superior /middle/ inferior/complete
22	M	AB	NORMAL	ABSENT
25	M	AB	NORMAL	ABSENT
35	M	P	NORMAL	MIDDLE
38	M	P	NORMAL	MIDDLE
34	M	P	NORMAL	MIDDLE
27	M	AB	NORMAL	ABSENT
29	M	AB	NORMAL	ABSENT
28	M	P	NORMAL	MIDDLE
25	M	AB	NORMAL	ABSENT
36	M	AB	NORMAL	ABSENT
22	M	P	NORMAL	MIDDLE
29	M	P	NORMAL	MIDDLE
33	M	P	ABNORMAL	MIDDLE
23	M	P	NORMAL	MIDDLE
26	M	AB	NORMAL	ABSENT
38	M	AB	NORMAL	ABSENT
35	M	P	NORMAL	MIDDLE
34	M	P	NORMAL	MIDDLE
25	M	P	NORMAL	MIDDLE
25	M	P	NORMAL	MIDDLE
26	M	AB	NORMAL	ABSENT
37	M	AB	NORMAL	ABSENT
24	M	AB	NORMAL	ABSENT
39	M	AB	NORMAL	ABSENT
36	M	P	NORMAL	COMPLETE
23	M	AB	NORMAL	ABSENT
28	M	P	NORMAL	MIDDLE
39	M	P	NORMAL	SUPERIOR

27	M	P	NORMAL	MIDDLE
33	M	P	ABNORMAL	INFERIOR
26	M	AB	NORMAL	ABSENT
26	M	P	NORMAL	MIDDLE
38	M	P	NORMAL	INFERIOR
23	M	P	NORMAL	MIDDLE
36	M	P	NORMAL	MIDDLE
39	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
27	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
22	M	P	NORMAL	MIDDLE
33	M	P	NORMAL	MIDDLE
23	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
22	M	AB	NORMAL	ABSENT
38	M	P	NORMAL	MIDDLE
27	M	AB	NORMAL	ABSENT
30	M	AB	NORMAL	ABSENT
29	M	P	NORMAL	MIDDLE
30	M	P	NORMAL	MIDDLE
38	M	AB	NORMAL	ABSENT
33	M	AB	NORMAL	ABSENT
32	M	P	NORMAL	MIDDLE
25	M	P	NORMAL	MIDDLE
28	M	P	NORMAL	MIDDLE
24	M	P	NORMAL	MIDDLE
36	M	P	NORMAL	MIDDLE
23	M	P	NORMAL	MIDDLE
24	M	AB	NORMAL	ABSENT
27	M	AB	NORMAL	ABSENT
34	M	AB	NORMAL	ABSENT
37	M	P	NORMAL	MIDDLE
22	M	AB	NORMAL	ABSENT

31	M	P	NORMAL	MIDDLE
34	M	P	NORMAL	MIDDLE
23	M	AB	NORMAL	ABSENT
22	M	AB	NORMAL	ABSENT
23	M	P	NORMAL	MIDDLE
22	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
29	M	AB	NORMAL	ABSENT
39	M	AB	NORMAL	ABSENT
38	M	P	NORMAL	INFERIOR
25	M	P	NORMAL	MIDDLE
26	M	AB	NORMAL	ABSENT
27	M	P	NORMAL	MIDDLE
27	M	P	NORMAL	MIDDLE
39	M	P	NORMAL	MIDDLE
24	M	AB	NORMAL	ABSENT
30	M	AB	NORMAL	ABSENT
24	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
32	M	P	NORMAL	MIDDLE
25	M	AB	NORMAL	ABSENT
34	M	AB	NORMAL	ABSENT
23	M	AB	NORMAL	ABSENT
35	M	P	NORMAL	MIDDLE
38	M	AB	NORMAL	ABSENT
35	M	P	NORMAL	MIDDLE
39	M	AB	NORMAL	ABSENT
30	M	P	NORMAL	MIDDLE
26	M	AB	NORMAL	ABSENT
36	M	P	NORMAL	MIDDLE
37	M	P	NORMAL	INFERIOR
36	M	P	NORMAL	MIDDLE
34	M	P	NORMAL	MIDDLE
31	M	AB	NORMAL	ABSENT

31	M	P	NORMAL	MIDDLE
32	M	P	NORMAL	MIDDLE
33	M	P	NORMAL	MIDDLE
26	M	AB	NORMAL	ABSENT
24	M	P	NORMAL	MIDDLE
27	M	AB	NORMAL	ABSENT
37	M	P	NORMAL	MIDDLE
23	M	P	NORMAL	MIDDLE
37	M	P	NORMAL	MIDDLE
29	M	P	NORMAL	MIDDLE
35	M	P	NORMAL	MIDDLE
23	M	AB	NORMAL	ABSENT
32	M	P	NORMAL	MIDDLE
32	M	P	NORMAL	MIDDLE
36	M	AB	NORMAL	ABSENT
32	M	AB	NORMAL	ABSENT
22	M	P	NORMAL	MIDDLE
30	M	P	NORMAL	MIDDLE
37	M	P	NORMAL	MIDDLE
33	M	P	NORMAL	MIDDLE
28	M	P	NORMAL	MIDDLE
28	M	P	NORMAL	MIDDLE
25	M	AB	NORMAL	ABSENT
31	M	AB	NORMAL	ABSENT
34	M	P	NORMAL	MIDDLE
28	M	P	NORMAL	MIDDLE
22	M	AB	NORMAL	ABSENT
24	M	AB	NORMAL	ABSENT
33	M	P	NORMAL	MIDDLE
23	M	AB	NORMAL	ABSENT
26	M	P	NORMAL	MIDDLE
37	M	P	NORMAL	INFERIOR
39	M	AB	NORMAL	ABSENT
35	M	AB	NORMAL	ABSENT

GROUP 2: 22-40 YEARS : FEMALE 130 SAMPLES

Age	Gender	Calcification	Thyroid profile - normal / abnormal	Level of calcification-absent/superior/middle /inferior/complete
23	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
33	F	P	NORMAL	INFERIOR
25	F	AB	NORMAL	ABSENT
27	F	P	ABNORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
27	F	P	NORMAL	MIDDLE
26	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
33	F	AB	NORMAL	ABSENT
34	F	P	ABNORMAL	MIDDLE
34	F	P	NORMAL	MIDDLE
34	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
23	F	P	ABNORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
38	F	P	NORMAL	SUPERIOR
29	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
29	F	P	NORMAL	MIDDLE
23	F	P	ABNORMAL	MIDDLE
25	F	P	NORMAL	MIDDLE
38	F	AB	NORMAL	ABSENT
29	F	AB	NORMAL	ABSENT
30	F	P	NORMAL	MIDDLE

24	F	P	NORMAL	MIDDLE
39	F	P	ABNORMAL	INFERIOR
37	F	AB	NORMAL	ABSENT
22	F	P	NORMAL	MIDDLE
38	F	P	NORMAL	COMPLETE
22	F	P	NORMAL	MIDDLE
27	F	P	NORMAL	MIDDLE
26	F	P	ABNORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
36	F	P	NORMAL	INFERIOR
26	F	P	NORMAL	MIDDLE
33	F	P	NORMAL	INFERIOR
23	F	P	ABNORMAL	MIDDLE
35	F	P	NORMAL	SUPERIOR
31	F	P	NORMAL	INFERIOR
33	F	AB	NORMAL	ABSENT
22	F	P	NORMAL	MIDDLE
23	F	P	ABNORMAL	MIDDLE
30	F	AB	NORMAL	ABSENT
22	F	AB	NORMAL	ABSENT
39	F	P	NORMAL	COMPLETE
31	F	P	NORMAL	INFERIOR
27	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
30	F	P	NORMAL	INFERIOR
22	F	AB	NORMAL	ABSENT
33	F	P	NORMAL	INFERIOR
31	F	P	NORMAL	INFERIOR
39	F	P	NORMAL	SUPERIOR
29	F	P	NORMAL	INFERIOR
22	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
33	F	P	NORMAL	INFERIOR

23	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
25	F	P	NORMAL	MIDDLE
32	F	P	NORMAL	INFERIOR
23	F	P	NORMAL	MIDDLE
31	F	P	NORMAL	INFERIOR
22	F	P	NORMAL	MIDDLE
22	F	AB	NORMAL	ABSENT
23	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
25	F	P	NORMAL	MIDDLE
30	F	P	NORMAL	INFERIOR
29	F	P	NORMAL	INFERIOR
22	F	P	NORMAL	MIDDLE
30	F	P	NORMAL	INFERIOR
28	F	P	NORMAL	INFERIOR
25	F	P	NORMAL	MIDDLE
35	F	P	NORMAL	INFERIOR
33	F	P	NORMAL	INFERIOR
35	F	P	NORMAL	SUPERIOR
30	F	P	NORMAL	INFERIOR
28	F	P	NORMAL	MIDDLE
25	F	P	NORMAL	MIDDLE
31	F	P	NORMAL	INFERIOR
35	F	P	NORMAL	INFERIOR
23	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
34	F	P	NORMAL	INFERIOR
24	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
28	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE

22	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
34	F	P	NORMAL	SUPERIOR
31	F	P	NORMAL	INFERIOR
22	F	P	NORMAL	MIDDLE
23	F	P	NORMAL	MIDDLE
28	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
24	F	AB	NORMAL	ABSENT
33	F	P	NORMAL	INFERIOR
22	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
32	F	P	NORMAL	INFERIOR
27	F	P	NORMAL	INFERIOR
27	F	P	NORMAL	INFERIOR
22	F	AB	NORMAL	ABSENT
38	F	P	NORMAL	SUPERIOR
22	F	P	NORMAL	MIDDLE
24	F	P	NORMAL	MIDDLE
22	F	P	NORMAL	MIDDLE
25	F	P	NORMAL	MIDDLE
32	F	P	NORMAL	INFERIOR
36	F	P	NORMAL	SUPERIOR
33	F	P	NORMAL	INFERIOR
38	F	P	NORMAL	SUPERIOR
27	F	P	NORMAL	MIDDLE
39	F	P	NORMAL	SUPERIOR
37	F	P	NORMAL	SUPERIOR
36	F	P	NORMAL	SUPERIOR

GROUP-3 : ABOVE 40 YEARS:MALE 130 SAMPLES

Sl. No	Age	Sex	Cacification P or A	Thyroid Profile- Normal /Abnormal	Level of Calcification- Absent, Superior, Middle, Inferior
1	52	M	P	NORMAL	SUPERIOR
2	44	M	P	NORMAL	INFERIOR
3	68	M	P	NORMAL	COMPLETE
4	41	M	P	NORMAL	INFERIOR
5	44	M	P	NORMAL	INFERIOR
6	59	M	P	NORMAL	SUPERIOR
7	55	M	P	NORMAL	SUPERIOR
8	45	M	A	NORMAL	ABSENT
9	52	M	A	NORMAL	ABSENT
10	42	M	P	NORMAL	INFERIOR
11	51	M	P	NORMAL	SUPERIOR
12	51	M	P	NORMAL	INFERIOR
13	44	M	P	NORMAL	INFERIOR
14	45	M	P	NORMAL	INFERIOR
15	63	M	P	NORMAL	COMPLETE
16	43	M	P	NORMAL	INFERIOR
17	55	M	P	NORMAL	SUPERIOR
18	69	M	A	NORMAL	ABSENT
19	57	M	P	NORMAL	SUPERIOR
20	46	M	P	NORMAL	INFERIOR
21	40	M	P	NORMAL	INFERIOR
22	41	M	P	NORMAL	INFERIOR
23	48	M	P	NORMAL	SUPERIOR
24	48	M	P	NORMAL	INFERIOR
25	51	M	P	NORMAL	SUPERIOR
26	62	M	P	NORMAL	SUPERIOR
27	47	M	P	NORMAL	SUPERIOR
28	47	M	P	NORMAL	INFERIOR
29	43	M	P	NORMAL	INFERIOR
30	55	M	P	NORMAL	INFERIOR
31	58	M	A	NORMAL	ABSENT
32	76	M	A	NORMAL	ABSENT

33	45	M	A	NORMAL	ABSENT
34	43	M	P	NORMAL	INFERIOR
35	65	M	P	NORMAL	SUPERIOR
36	51	M	P	NORMAL	SUPERIOR
37	57	M	P	NORMAL	SUPERIOR
38	49	M	A	NORMAL	ABSENT
39	67	M	P	NORMAL	SUPERIOR
40	50	M	A	NORMAL	ABSENT
41	53	M	P	NORMAL	INFERIOR
42	50	M	P	NORMAL	INFERIOR
43	60	M	A	NORMAL	ABSENT
44	56	M	P	NORMAL	SUPERIOR
45	49	M	P	NORMAL	SUPERIOR
46	60	M	P	NORMAL	SUPERIOR
47	78	M	A	NORMAL	ABSENT
48	60	M	P	NORMAL	SUPERIOR
49	59	M	P	NORMAL	SUPERIOR
50	43	M	A	NORMAL	ABSENT
51	41	M	P	NORMAL	INFERIOR
52	46	M	P	NORMAL	INFERIOR
53	57	M	P	NORMAL	SUPERIOR
54	54	M	P	NORMAL	SUPERIOR
55	71	M	A	NORMAL	ABSENT
56	45	M	A	NORMAL	ABSENT
57	52	M	A	NORMAL	ABSENT
58	57	M	P	NORMAL	SUPERIOR
59	48	M	A	NORMAL	ABSENT
60	58	M	P	NORMAL	SUPERIOR
61	57	M	A	NORMAL	ABSENT
62	56	M	P	NORMAL	SUPERIOR
63	40	M	A	NORMAL	ABSENT
64	55	M	A	NORMAL	ABSENT
65	55	M	A	NORMAL	ABSENT
66	56	M	P	NORMAL	SUPERIOR
67	52	M	A	NORMAL	ABSENT
68	50	M	P	NORMAL	SUPERIOR
69	46	M	A	NORMAL	ABSENT
70	56	M	P	NORMAL	SUPERIOR

71	40	M	A	NORMAL	ABSENT
72	58	M	P	NORMAL	SUPERIOR
73	54	M	A	NORMAL	ABSENT
74	46	M	P	NORMAL	INFERIOR
75	45	M	A	NORMAL	ABSENT
76	47	M	A	NORMAL	ABSENT
77	55	M	A	NORMAL	ABSENT
78	41	M	A	NORMAL	ABSENT
79	46	M	P	NORMAL	INFERIOR
80	62	M	P	NORMAL	SUPERIOR
81	41	M	P	NORMAL	INFERIOR
82	41	M	P	NORMAL	INFERIOR
83	84	M	P	NORMAL	COMPLETE
84	60	M	P	NORMAL	SUPERIOR
85	47	M	A	ABNORMAL	ABSENT
86	50	M	P	NORMAL	SUPERIOR
87	53	M	P	NORMAL	SUPERIOR
88	48	M	P	NORMAL	INFERIOR
89	66	M	P	NORMAL	SUPERIOR
90	59	M	P	NORMAL	SUPERIOR
91	47	M	P	NORMAL	INFERIOR
92	54	M	P	NORMAL	SUPERIOR
93	68	M	P	NORMAL	SUPERIOR
94	52	M	P	NORMAL	INFERIOR
95	48	M	P	NORMAL	INFERIOR
96	62	M	P	NORMAL	SUPERIOR
97	65	M	P	NORMAL	SUPERIOR
98	56	M	P	NORMAL	SUPERIOR
99	70	M	P	NORMAL	SUPERIOR
100	48	M	P	NORMAL	INFERIOR
101	41	M	A	NORMAL	ABSENT
102	40	M	P	NORMAL	INFERIOR
103	49	M	P	NORMAL	SUPERIOR
104	55	M	P	NORMAL	SUPERIOR
105	50	M	A	NORMAL	ABSENT
106	60	M	A	NORMAL	ABSENT
107	69	M	P	NORMAL	SUPERIOR
108	72	M	P	NORMAL	SUPERIOR

109	60	M	P	NORMAL	SUPERIOR
110	51	M	P	NORMAL	INFERIOR
111	54	M	A	NORMAL	ABSENT
112	59	M	P	NORMAL	SUPERIOR
113	51	M	P	NORMAL	SUPERIOR
114	52	M	A	NORMAL	ABSENT
115	52	M	P	NORMAL	SUPERIOR
116	46	M	A	NORMAL	ABSENT
117	63	M	P	NORMAL	SUPERIOR
118	47	M	A	NORMAL	ABSENT
119	43	M	P	NORMAL	INFERIOR
120	62	M	A	NORMAL	ABSENT
121	62	M	P	NORMAL	SUPERIOR
122	68	M	A	NORMAL	ABSENT
123	42	M	A	NORMAL	ABSENT
124	42	M	P	NORMAL	INFERIOR
125	69	M	A	NORMAL	ABSENT
126	43	M	A	NORMAL	ABSENT
127	48	M	P	NORMAL	INFERIOR
128	54	M	P	NORMAL	SUPERIOR
129	59	M	P	NORMAL	SUPERIOR
130	66	M	P	NORMAL	SUPERIOR

GROUP-3 : ABOVE 40 YEARS:FEMALE 130 SAMPLES

Sl. No	Age	Sex	Cacification P or A	Thyroid Profile-Normal /Abnormal	Level of Calcification-Absent, Superior, Middle, Inferior
1	55	F	P	NORMAL	SUPERIOR
2	47	F	P	NORMAL	SUPERIOR
3	62	F	P	NORMAL	SUPERIOR
4	65	F	P	NORMAL	SUPERIOR
5	48	F	P	NORMAL	SUPERIOR
6	55	F	P	NORMAL	SUPERIOR
7	48	F	P	NORMAL	SUPERIOR
8	40	F	P	NORMAL	INFERIOR
9	45	F	P	NORMAL	INFERIOR
10	55	F	P	NORMAL	SUPERIOR
11	50	F	P	NORMAL	SUPERIOR
12	41	F	P	NORMAL	INFERIOR
13	58	F	P	NORMAL	SUPERIOR
14	49	F	P	NORMAL	SUPERIOR
15	42	F	P	NORMAL	INFERIOR
16	40	F	P	NORMAL	INFERIOR
17	53	F	P	NORMAL	SUPERIOR
18	47	F	P	NORMAL	SUPERIOR
19	53	F	P	NORMAL	SUPERIOR
20	45	F	P	NORMAL	SUPERIOR
21	45	F	P	NORMAL	SUPERIOR
22	61	F	P	NORMAL	SUPERIOR
23	45	F	P	NORMAL	SUPERIOR
24	54	F	P	NORMAL	SUPERIOR
25	55	F	P	NORMAL	SUPERIOR
26	42	F	P	NORMAL	INFERIOR
27	50	F	P	NORMAL	INFERIOR
28	41	F	P	NORMAL	INFERIOR
29	52	F	P	NORMAL	SUPERIOR
30	44	F	P	NORMAL	INFERIOR
31	44	F	P	NORMAL	SUPERIOR
32	49	F	P	NORMAL	SUPERIOR
33	53	F	P	NORMAL	SUPERIOR

34	52	F	P	NORMAL	SUPERIOR
35	52	F	P	NORMAL	SUPERIOR
36	59	F	P	NORMAL	COMPLETE
37	50	F	P	NORMAL	SUPERIOR
38	58	F	A	NORMAL	SUPERIOR
39	55	F	P	NORMAL	SUPERIOR
40	58	F	A	NORMAL	SUPERIOR
41	58	F	P	NORMAL	COMPLETE
42	52	F	P	NORMAL	SUPERIOR
43	48	F	A	NORMAL	SUPERIOR
44	40	F	A	NORMAL	INFERIOR
45	41	F	P	NORMAL	INFERIOR
46	61	F	A	NORMAL	COMPLETE
47	49	F	P	NORMAL	SUPERIOR
48	45	F	P	NORMAL	INFERIOR
49	57	F	P	NORMAL	SUPERIOR
50	42	F	P	NORMAL	INFERIOR
51	56	F	P	NORMAL	SUPERIOR
52	44	F	P	NORMAL	SUPERIOR
53	50	F	P	NORMAL	SUPERIOR
54	49	F	P	NORMAL	SUPERIOR
55	48	F	P	NORMAL	SUPERIOR
56	47	F	P	NORMAL	SUPERIOR
57	60	F	P	NORMAL	COMPLETE
58	40	F	P	NORMAL	INFERIOR
59	60	F	P	NORMAL	COMPLETE
60	52	F	A	NORMAL	SUPERIOR
61	50	F	P	NORMAL	SUPERIOR
62	61	F	A	NORMAL	COMPLETE
63	42	F	A	NORMAL	INFERIOR
64	55	F	P	NORMAL	SUPERIOR
65	40	F	P	NORMAL	INFERIOR
66	47	F	P	NORMAL	SUPERIOR
67	75	F	P	NORMAL	COMPLETE
68	40	F	P	NORMAL	INFERIOR
69	43	F	A	NORMAL	INFERIOR
70	42	F	P	NORMAL	INFERIOR
71	43	F	P	NORMAL	INFERIOR

72	52	F	P	NORMAL	SUPERIOR
73	52	F	P	NORMAL	SUPERIOR
74	51	F	P	NORMAL	SUPERIOR
75	55	F	P	NORMAL	SUPERIOR
76	57	F	P	NORMAL	SUPERIOR
77	46	F	P	NORMAL	SUPERIOR
78	53	F	P	NORMAL	SUPERIOR
79	55	F	P	NORMAL	SUPERIOR
80	43	F	P	ABNORMAL	SUPERIOR
81	47	F	P	NORMAL	SUPERIOR
82	61	F	P	NORMAL	COMPLETE
83	54	F	P	NORMAL	SUPERIOR
84	50	F	P	NORMAL	SUPERIOR
85	46	F	P	ABNORMAL	SUPERIOR
86	42	F	P	NORMAL	INFERIOR
87	44	F	A	NORMAL	ABSENT
88	50	F	P	NORMAL	SUPERIOR
89	68	F	P	NORMAL	COMPLETE
90	60	F	P	NORMAL	COMPLETE
91	47	F	P	ABNORMAL	SUPERIOR
92	54	F	P	NORMAL	SUPERIOR
93	45	F	P	NORMAL	INFERIOR
94	41	F	P	NORMAL	INFERIOR
95	54	F	P	NORMAL	SUPERIOR
96	70	F	P	NORMAL	COMPLETE
97	45	F	P	NORMAL	INFERIOR
98	48	F	P	NORMAL	SUPERIOR
99	40	F	P	NORMAL	INFERIOR
100	55	F	P	NORMAL	SUPERIOR
101	47	F	P	NORMAL	SUPERIOR
102	48	F	P	NORMAL	SUPERIOR
103	47	F	P	NORMAL	SUPERIOR
104	41	F	P	ABNORMAL	INFERIOR
105	60	F	P	NORMAL	SUPERIOR
106	53	F	P	NORMAL	SUPERIOR
107	41	F	P	NORMAL	INFERIOR
108	49	F	P	NORMAL	INFERIOR
109	49	F	P	NORMAL	SUPERIOR

110	51	F	P	NORMAL	INFERIOR
111	75	F	P	NORMAL	COMPLETE
112	58	F	P	NORMAL	SUPERIOR
113	48	F	P	NORMAL	SUPERIOR
114	50	F	P	ABNORMAL	SUPERIOR
115	75	F	P	NORMAL	COMPLETE
116	60	F	A	NORMAL	ABSENT
117	47	F	P	NORMAL	SUPERIOR
118	42	F	P	NORMAL	INFERIOR
119	42	F	P	NORMAL	INFERIOR
120	58	F	P	NORMAL	SUPERIOR
121	49	F	P	NORMAL	SUPERIOR
122	41	F	P	NORMAL	INFERIOR
123	66	F	P	NORMAL	COMPLETE
124	65	F	P	NORMAL	COMPLETE
125	43	F	A	NORMAL	ABSENT
126	58	F	P	NORMAL	COMPLETE
127	59	F	P	NORMAL	COMPLETE
128	61	F	P	ABNORMAL	COMPLETE
129	58	F	P	ABNORMAL	COMPLETE
130	63	F	P	AB	COMPLETE

Level of Calcification – Absent, Superior, Middle, Inferior

Thyroid Profile – Normal / Abnormal

F – Female

M – Male

A – Absent

P – Present