RESEARCH ARTICLE

RUGOSCOPY: FOR ESTABLISHING INDIVIDUALITY- A RIVIEW

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Manuscript Info	*Abstract*

The study of palatal shape or rugae pattern is known as rugoscopy. Rugae are anatomical folds that are present on anterior third of palate of upper jaw behind the incisive papillae which are used in forensic odontology for individual identification.They are unique and remain unchangeable throughout the life of a person from birth.Rugae pattern is an unique to a human as his or her fingerprints.

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Introduction:-

Teeth are the most hardest and robust tissues of the human body.[1]Dentition of a person is useful for individual identification and comparison, if records exist for the purpose.[2]It focuses primarily on identifying a person's identity by analyzing the distinctive anatomical structure of the oral cavity.[3]

Forensic odontology can be defined as a branch of dentistry which deals with the appropriate handling and examination of dental evidence and with the proper evaluation and presentation of dental findings.[4]Dr. Oscar Amoedo was considered as the father of the forensic odontologist. The thesis done by him entitled 'L' Art Dentaireen Medicine Leagale' to the faculty of medicine earned him adoctorate.This book is the first comprehensive text on forensic odontologist.[5] Keiser-Neilson defined forensic dentistry as "that branch of forensic dentistry that in the interest of justice deals with the proper handling and examination of dental evidence and the proper evaluation and presentation of dental findings".[6]

The first reported case of dental identification was that of an 80-year-old English warrior John Talbot, Earl of Shrewsbury, who fell in the battle of Castillon in 1453.[7] According to Keiser-Nielsen, forensic dentistry is defined as the "proper handling and examination of the dental evidence, in the interests of justice, so that the dental finding may be properly presented and evaluated.[8]

Human identification is based on scientific principles mainly involving fingerprints, dental records and DNA analysis.[9]Palatal rugae are irregular, asymmetric ridges of mucous membrane extending lateral from the incisive papilla and the anterior part of the median palatal raphe, which is just behind the maxillary central incisor teeth.[10] In the literature there is consensus opinion that palatal rugae remains fairly stable in number and do not undergo any change due to growth, ageing, tooth extraction and diseases.[11]

Rugoscopy:
Palatoscopy, or palatal rugoscopy, is the study of palatal rugae in order to establish a person's identity.[12,13]Lund(1924) observed a connective tissue core is embedded deeply between the sub mucosal fatty tissue and the stratum reticulum of the palate.[14] Palatal rugae are irregular, asymmetric ridges of mucous membrane extending lateral from the incisive papilla and the anterior part of the median palatal raphe[15,16].Palatal rugae appears

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in 3rd month of intrauterine life & its development is controlled by epithelial mesenchymal interactions.[17,18] The pattern is formed by12-14th week of intrauterine life from the hard connective tissue.x[19]

Caldas et al.1 have reported that palatal rugae were first described by Winslow in 1753; however, Kuppler, in 1897, was the first person to study palatal anatomy to identify racial anatomic features. They have also cited in their article that palatal rugoscopy was first proposed in 1932 by a Spanish investigator named TroboHermisa. In 1937, Carrea developed a detailed study and established a way to classify palatal rugae.[20]Lysell[21] developed the first classification system for palatal rugae pairs. Lysell as well as Sassouni[22] (1957), believed that, the palatal rugae are unchanged throughout life, but found, this does not apply in every aspect. Fiene[23] (1958) discovered that the palatal rugae could be helpful in anthropological paternity investigations**.**

Analysisof Rugae Pattern:
The utilization of digital photography, personal computers and specific software's to edit and use digital images allow a significant improvement.Other techniques like stereoscopy for obtaining a three-dimensional image of palatal rugae anatomy, stereo photogrammetry which allows for an accurate determination of the length and position of every palatal rugae can also be used.[24.]
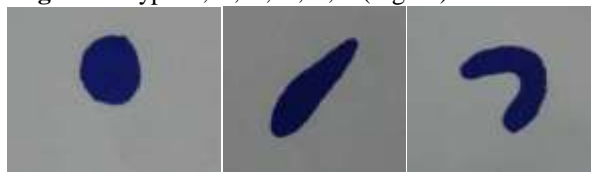
Classification[25]:
1.By Goria (1911) rugae pattern was divided into two types-
· Specifying the number of rugae
· Specifying the extent of rugal zonerelative to the teeth
· Further distinguished rugae into 2 types-Simple or Primitive& More developed
2. By Trobo (1932)Palatal rugae were divided into two groups:
· **Simple rugae:**As Type A, B, C, D, E, F (Figure)

Type A   Type B   Type C

Type D   Type E   Type F

-**Compound rugae:** Rugae areformed by the union of two or moresimple rugae and were classified as"Type X" or Polymorphic type.

Classification Rugae type

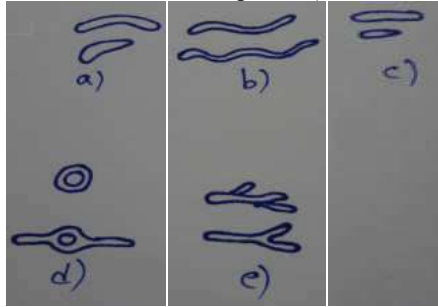| Classification	Rugae Type
Type A	Point
Type B	Line
Type C	Curve
Type D	Angle
Type E	Sinuous
Type F	Circle

3. According to Lysell (1955): Palatalrugae were classified depending on itslength
· Primary: 5mm or more
· Secondary: 3-5mm
· Fragmentary: 2-3mm (Rugae smaller than 2mm aredisregarded)
4. By Kapali et al(1997):Based on shape of Palatal rugae
· Curved, Wavy, Straight, Circular

5. Modification of Kapali's:a) Curved; b) Wavy; c)Straight; d) Circular; e) Furcated

6. Carrea classification: based on form of the palatal rugae
Type I: Posterior-Anterior directed rugae
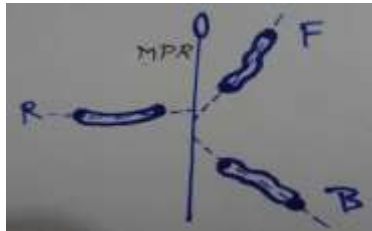Type II: Rugae perpendicular to raphe
Type III: Anterior-Posterior directed rugae
Type IV: Rugae directed in several direction
7.Rugae unification pattern classification :a) Diverging; b) Converging

8.Classification based on orientation ofrugae in relation to mid palatal raphe:

F- forward, R- right angle, B- backward, MPR-Mid palatal Raphe

Advantages of palatoscopy:
1. Palatal rugae are used in human identification due to their singularity and unchangeable nature.
2. Low utilization costs.
3. Antemortem datasuch as records found in dental practice (dental casts, old prosthetic maxillary devices and intraoral photographs) to compare with post mortem data.
4. Rugoscopy is rather simple technique not requiring any complex instrumentation.

Problems With Palatoscopy:
1. Palatoscopy might not be so useful in crime scene investigations in the linking of suspects to crime scenes.
2. Possibility of rugae pattern forgery. In a case report, Gitto et al described a method where palatal rugae were added to a complete denture in order to improve speech patterns in some patients. This process can lead to false identity.

Discussion:-
Palatoscopy or palatal rugoscopy, is the study of palatal rugae in order to establish a person's identity.[26] It is stable and resists decomposition for up to seven days after death.[26]The use of palatal rugae in forensic identification is preferred because of their low utilization cost, simplicity and reliability and mostly used technique.

There are several ways to analyze palatal rugae such asintraoral inspection, oral photography and oral impressions. Calcorrugoscopy, stereoscopy method gives three dimensional image of palatal rugae anatomy. In comparison of palatal rugae pattern among family members (Father, Mother, Child A and Child B) showed different individual

patterns. Although in one of the family few forms were similar but the rugae pattern was not identical which suggests that the role of heredity is uncertain in determining the orientation of rugae pattern.[27]

On analyzing the post orthodontic casts, rugae patterns remained consistently stable and unaltered at the end of treatment which suggests that rugae pattern remain unchanged during an individual'slifetime and also following action of force. This is in consistent with the study conducted by Sabet and Abdel.The main structural element contains glycosaminoglycans which by its hydrophilic nature causes the tissues to swell and contributes to themaintenance of the shape of rugaethrough out life. Fibroblasts and collagen fibers beneath thethickened epithelium contribute to the stability of palatal rugae. In light of these results, we strongly suggest that palatal rugae pattern can be used in forensic science and also for antemortem and postmortem identification. Also a standard and uniform procedure needs to be put forth for the collection, recording and computerized analysis of the palatal rugae.[27]

Conclusion:-
Identification of living or dead people is often a difficult, challenging and time-consuming process. Palatal rugae have been shown to be highly individualistic and consistent in shape throughout the life.[14]Human identification of unknown individual has always been of paramount importance to society. It is well established fact that the rugae pattern is as unique to a human as or her fingerprints. It is stable and resist decomposition for up to seven days after death. The use of palatal rugae in forensic identification is preferred because of their low utilization cost, simplicity and reliability. Thus, it is sufficiently characteristic to discriminate between individuals because no two palates are alike in their configuration. Based on this premise, palatal rugae can emerge as one of the tools for personal identification in forensic science. In view of these significant findings that palatal rugae possess unique characteristics as they are absolutely individual, stable, permanent and unique.Therefore could beused as a personal print for identification and deserves further investigation with larger samples.[27]

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