Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Histology of oral structures

[1]Renu Gupta, [2]Manisha Kumari, [3]DivyaVashisht, [4]Sonali Sharma, [5]Alageswaran Vignesh

[1]Professor & Head, [2,4,5]Post Graduate Student, [3]Professor, Dept of Prosthodontics, HP Govt Dental College & Hospital, Shimla, Himachal Pradesh, India

ABSTRACT:
Histology and Histopathology are often discussed and described together. In fact, the concept of histopathology cannot be separated from that of histology since understanding of normal histology is essential for histo-pathological interpretation. It is indeed obvious and necessary to prepare histology slides of a sample or specimen and examine them first in order to find out if the cells or tissue are healthy or diseased.
Key words: Histology, Dentistry

Received: 18 October, 2022 Accepted: 23 November, 2022

Corresponding author: Manisha Kumari, Post Graduate Student, Dept of Prosthodontics, HP Govt Dental College & Hospital, Shimla, Himachal Pradesh, India

This article may be cited as: Gupta R, Kumari M, Vashisht D, Sharma S, Vignesh A. Histology of oral structures. J Adv Med Dent Scie Res 2022;10(12):36-45.

INTRODUCTION

‘‘The objective of a histology is to lead the student to understand the microanatomy of cells, tissues, and organs and to correlate structure with function.’’– Michael H ross

Histology is the microscopic study of animal and plant cell and tissues through staining and sectioning and examining them under a microscope. Histological studies are used in forensic investigations, autopsy, diagnosis and in education. In addition, histology is used extensively in medicine especially in the study of diseased tissues to aid treatment.[1] is the tool for accessing a specific knowledge of the microscopic organization of the organs, microscopic anatomy, which is essential to understand the histopathology for a possible diagnosis.[2]

Histology and Histopathology are often discussed and described together. In fact, the concept of histopathology cannot be separated from that of histology since understanding of normal histology is essential for histo-pathological interpretation. It is indeed obvious and necessary to prepare histology slides of a sample or specimen and examine them first in order to find out if the cells or tissue are healthy or diseased. [2]

Enamel, the hardest tissue in the human body, is a highly organized dental tissue, covering the outer layer of the tooth crown. It possesses unique mechanical and structural properties, relying on its high hydroxyapatite content. Dental pulp is the soft tissue located in the center of the tooth, and it is surrounded by dentin. The primary function of the pulp is formative; it gives rise to odontoblasts that form dentin. Odontoblasts are the most distinctive cells of the pulp and their major function is to secrete the extracellular dentin matrix components (ECM), followed by their mineralization, generating the primary dentin, the main bulk of the circumpulpal dentin matrix, and completing root formation.[3]

The primary function of the periodontal tissues, besides attaching the tooth to the jaw, is gingival protection; that is, to provide a seal against the contaminated environment of the oral cavity.[4] Preservation of a healthy periodontal attachment is the most significant factor in the long-term prognosis of a restored tooth. Preservation of an intact dentogingival unit with the gingival margin slightly coronal to the cementoenamel junction in a state of optimum health is consistent with the normal functioning of a tooth.[5]

The alveolar bone supports the teeth; its inner and outer plates, as well as the lamina dura of the sockets, are composed of compact bone. The remaining interior portion is made up of cancellous bone.[6]

Tissues like skin, which represents the principal barrier between the organism and the environment, are stratified and keratinized. The lining mucosa of the oral cavity is covered by a stratified epithelium and three different types of oral mucosa are recognized these reflect the functional demands put upon different regions of the oral cavity and are classified accordingly.[7]

Fixed partial dentures (FPDs), removable partial dentures (RPDs), complete dentures (CDs), and implant-supported dentures can replace missing teeth comfortably and esthetically, but it is not known whether they differ in their ability to preserve the residual ridge. The volume and contour of remaining alveolar bone and covering mucosa is one key to successful prosthetic rehabilitation. The residual ridge influences gingival esthetics and pontic dimensions for FPDs; it provides support and stability for RPDs and CDs; and the underlying bone is a prerequisite for the placement of oral implants.

The emphasis on tooth replacement has overshadowed the need for preservation of alveolar bone. The best prosthodontic treatment would preserve or even replace missing alveolar bone to provide support for RPDs, esthetically pleasing pontics for FPDs, or to provide stable bone sites for implants. Resorption of alveolar bone seems inevitable when teeth are lost, yet variability exists between persons, both between and within the jaws, and over time. It would seem that bone that has undergone higher rates of resorption initially will continue to resorb excessively compared with bone that has undergone lower rates of resorption.[8]

Under normal conditions and in the presence of teeth, alveolar ridge mucosa is covered by thin non keratinized stratified squamous epithelium. After molars extraction, some patients tend to eat on their edentulous ridges. So, masticatory forces impinging directly on alveolar mucosa induce some changes in its nature and increasing the rate of epithelium turnover which may be followed by further loss of alveolar bone. The purpose of denture construction should not be restricted to teeth replacement, but should maintain the surrounding tissue health.[9]

The histological study focus on the development and structure of cells and tissues, the stages of tooth development and maturation, the different components of a tissue, like cells, intercellular substance and tissue fluids, and the different components of a human tooth, like enamel, dentin, dental pulp, cementum and other oral structures. By better understanding how teeth evolve over time, we can develop superior techniques to prevent caries and other dental problems in advance. It will prepare us to care for patients with abnormalities or dental pathologies.

THE TOOTH

Teeth constitute approximately 20% of the surface area of the mouth, the upper teeth significantly more than the lower teeth. Mastication is the function most commonly associated with the human dentition, but teeth also are essential for proper speech. In the animal kingdom, teeth have important roles as weapons of attack.[10]

The tooth proper consists of a hard, inert, acellular enamel formed by epithelial cells and supported by the less mineralized, more resilient, and vital hard connective tissue dentin, which is formed and supported by the dental pulp, a soft connective tissue. The face and jaws of a human child are small and consequently can carry fewer teeth of smaller size. A large increase in the size of the jaws occurs with growth, necessitating not only more teeth but also larger ones. Because the size of teeth cannot increase after they are formed, the deciduous dentition becomes inadequate and must be replaced by a permanent or secondary dentition consisting of more and larger teeth.[3]

ENAMEL

Enamel has evolved as an epithelially derived protective covering for the crown of the teeth.[11]The enamel is the most highly mineralized tissue in the body, consisting of more than 96% inorganic material in the form of apatite crystals and traces of organic material. The cells responsible for the formation of enamel, the **ameloblasts**, cover the entire surface of the layer as it forms but are lost as the tooth emerges into the oral cavity.[10] The loss of these cells renders enamel a nonvital and insensitive matrix that, when destroyed by any means (usually wear or caries), cannot be replaced or regenerated. The apatite crystals within enamel pack together differentially to create a structure of enamel rods separated by interrod enamel. Although enamel is a dead tissue in a strict biologic sense, it is permeable; ionic exchange can occur between the enamel and the environment of the oral cavity, in particular the saliva.[12]

TABLE 1 HISTOLOGY[11]

Physical Characteristics of Enamel		**Chemical Properties of Enamel**	
Maximum thickness at cusp	2–2.5 mm	Inorganic material	96% (Na, Mg, C, O2 , Ca, and P) Hydroxyapatite crystal Ca10 (PO4)6 (OH4)2
Specific gravity	2.8	Organic substance and water	4%—Unique proteins: Amelogenins and nonamelogenins No collagen, unlike other hard tissues Lipids
Temperature resistance	5–13 Hz	Amelogenins	90%, hydrophobic, low molecular weight proteins Rich in proline, histidine, glutamine

			and leucine
Electrical resistance	10^{15} to 10^{5} ohms	Nonamelogenins	10%Enamelin, ameloblastin, and tuftelin, high molecular weight proteins Rich in glycine, aspartic acid, and serine
Permeability	Semipermeable		
Color	Yellowish white to grayish white		
Transmission coefficient at 525 nm	0.481 mm–1		

TABLE 2 STRUCTURE[14]

Enamel rods	Composed of enamel rods or prisms, rod sheaths, and in some regions a cementing interprismatic substance
Hunter–schreger bands	These are alternating dark and light strips of varying widths, best seen in longitudinal ground section under oblique reflected light.
Incremental lines of retzius	brownish bands in ground sections of the enamel, illustrate incremental pattern of enamel, that is, the successive apposition of layers of enamel during formation of the crown
Surface enamel	much harder, less soluble and has higher mineral content, devoid of enamel prisms (prism-less enamel) and is made up of only apatite crystals which lie parallel to one another.
Perikymata	are transverse, wave-like grooves, believed to be the external manifestations of the striae of Retzius
Enamel lamella and cracks	Enamel lamellae are thin, leaf-like structures that extend from the enamel surface toward the DE junction. **Cracks** are actually the outer edges of lamellae.
Enamel tufts	enamel tuft is a narrow, ribbon-like structure, the inner end of which arises at DE junction and reach into the enamel to about one-fifth to one-third of its thickness.
Dentinoenamel junction	scalloped line formed by a series of dome-shaped elevations arranged closely, the convexities of which are directed towards the dentin
Enamel cuticle	delicate membrane called Nasmyth's membrane, or primary enamel cuticle coversnewly erupted tooth but soon removed by mastication.
Enamel spindle	In some areas, the odontoblastic processes from the dentin pass across the DEJ into the enamel for a short distance, which may be pointed or rounded or may have a noticeably thickened end.

DENTIN

Dentin is a mineralized, elastic, yellowish-white, avascular tissue enclosing the central pulp chamber. The mineral is also apatite, and the organic component is mainly the fibrillar protein collagen. A characteristic feature of dentin is its permeation by closely packed tubules traversing its entire thickness and containing the cytoplasmic extensions of the cells that once formed it and later maintain it. These cells are called **odontoblasts**; their cell bodies are aligned along the inner edge of the dentin, where they form the peripheral boundary of the dental pulp. The very existence of odontoblasts makes dentin a vastly different tissue from enamel. Dentin is a sensitive tissue, and more important, it is capable of repair, because odontoblasts or cells in the pulp can be stimulated to deposit more dentin as the occasion demands. [13]

TABLE 3 HISTOLOGY OF DENTIN[10-11]

DENTINAL TUBULES	Odontoblasts form the dentin matrix and move towards the pulp. Each odontoblast gives rise to one process that traverses the entire thickness of dentin inside a tubular structure known as the dentinal tubule
PREDENTIN	It is the innermost layer of dentin, close to the pulp. Newly laid, yet-to-be mineralized dentin matrix
PERITUBULAR DENTIN	Immediately next to the dentinal tubules, seen in almost the entire dentin except in that portion of dentin close to the pulp
INTERTUBULAR DENTIN	Dentin situated between the dentinal tubules, which forms the major bulk of dentin
ODONTOBLASTIC PROCESSES	Cytoplasmic extensions of the odontoblast which extend into the dentinal tubules.

INCREMENTAL LINES	Deposited incrementally at a daily rate of approximately 4 µm, run at right angles to the dentinal tubules and generally mark the normal rhythmic, linear pattern of dentin deposition in an inward and rootward direction
INTERGLOBULAR DENTIN	Areas of unmineralized or hypomineralized dentin where globular zones of mineralization (calcospherites) have failed to fuse into a homogeneous mass within mature dentin
TOME'S GRANULAR LAYER	Under transmitted light only in ground sections, a granular-appearing area, can be seen just below the surface of the dentin where the root is covered by cementum
DEAD TRACTS	Empty Dentinal tubules following the retraction of the odontoblastic process or death of odontoblast.

PULP

The central pulp chamber, enclosed by dentin, is filled with a soft connective tissue called pulp. Despite distinctive histologic features, dentin and pulp are related embryologically and functionally and should be considered together.

This unity is exemplified by the classic functions of pulp: it is (1) **formative**, in that it produces the dentin that surrounds it; (2) **nutritive**, in that it nourishes the avascular dentin; (3) **protective**, in that it carries nerves that give dentin its sensitivity; and (4**)** **reparative**, in that it is capable of producing new dentin when required.[3]

TABLE 4 ZONES OF PULP [14]

Zone	Major component
Odontoblastic zone	Odontoblast cells
Cell free zone	Relatively acellular accommodate odontoblast
Cell rich zone	Fibroblast, undifferenciated mesenchymal cells
Pulp core	Predominantely fibrous tissue, major vessels and nerves, fibroblast

SUPPORTING TISSUES OF THE TOOTH

PERIODONTAL LIGAMENT

The PDL is a highly specialized connective tissue situated between the tooth and the alveolar bone. The principal function of the PDL is to connect the tooth to the jaw, which it must do in such a way that the tooth will withstand the considerable forces of mastication. This requirement is met by the collagen fiber bundles that span the distance between the bone and the tooth and by ground substance between them.[5] At one extremity the fibers of the PDL are embedded in bone; at the other extremity they are embedded in cementum. Each collagen fiber bundle is much like a spliced rope in which individual strands can be remodeled continually without the overall fiber losing its architecture and function.[10]

CELLS

The principal cells of the healthy, functioning periodontal ligament are concerned with the synthesis and resorption of alveolar bone and the fibrous connective tissue of the ligament and cementum.[15]

The cells of the periodontal ligament may be divided into:

1. Synthetic cells - Fibroblasts, Osteoblasts, Cementoblasts.
2. Resorptive cells - Osteoclasts, Fibroblasts, Cementoclasts.
3. Progenitor cells
4. Epithelial rests of Malassez
5. Defense cells -Mast cells,
6. Macrophages,
7. Eosinophils**.**

FIBERS

Those bundles running between the tooth and bone represent the principal fiber bundles of the PDL. These bundles are:

TABLE 5

Type of fibre	Origin and insertion	Function
Alveolar crest	Extend obliquely from cementum just beneath junctional epithelium to alveolar crest	Resist tilting, intrusion, extrusion and rotational forces
Horizontal group	Extend right angles to the long axis of the tooth from cementum to alveolar bone and parallel to occlusal plane	Resist horizontal and tipping force
Oblique group	Extend into alveolar bone coronal to their attachment to cementum	Resist vertical and intrusive forces
Apical group	Extend from root tip and radiate through the periodontal space into fundus of bony socket	Resist luxation, prevent tooth tipping, protect delicate lymph nodes and blood vessels
Interradicular group	Extend into cementum from the crest of inter	Resist tooth tipping, torque and

	radicular septum of multirooted teeth	luxation

CEMENTUM

Cementum covers the roots of the teeth and is interlocked firmly with the dentin of the root. Cementum is a mineralized connective tissue similar to bone except that it is avascular; the mineral is also apatite, and the organic matrix also contains collagen. The cells that form cementum are called cementoblasts. The two main types of cementum are cellular and acellular. The cementum attached to the root dentin and covering the upper (cervical) portion of the root is acellular and thus is called **acellular, or primary, cementum**. The lower (apical) portion of the root is covered by **cellular, or secondary,cementum**. In this case, cementoblasts become trapped in lacunae within their own matrix, much like osteocytes occupy lacunae in bone; these entrapped cells are now called cementocytes. [14]

TABLE 6 Differences between Acellular Cementum and Cellular Cementum [5]

Acellular cementum	Cellular cementum
Embedded cementocyte are absent	Embedded cementocyte are present
Deposition rate is slower	Depositon rate is faster
Width is more or less constant	Width is variable
Also called primary cementum	Also called secondary cementum
Sharpey fibres are well mineralized	Sharpey fibres are partially mineralized
Found at cervical third of tooth	Mainly seen at apical third
Incremental lines are regular and closely placed	Incremental lines are irregular and placed wide apart

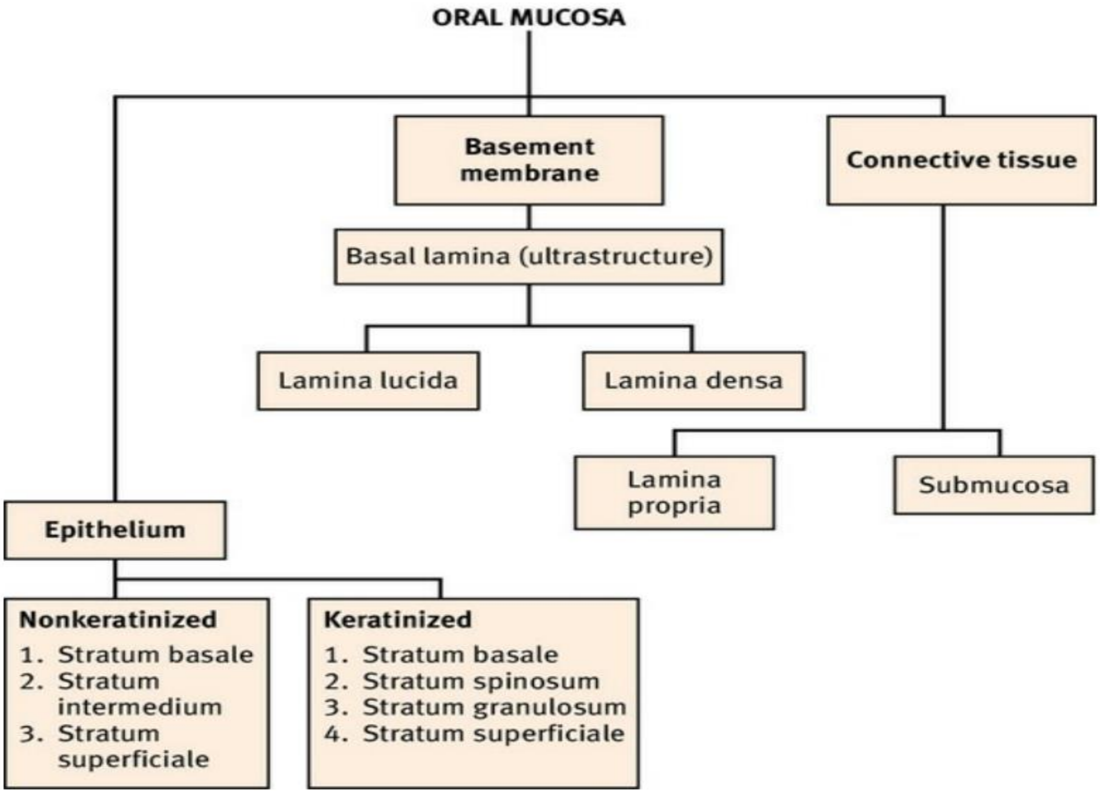
TABLE 7 Differences between AEFC and CIFC [16]

Acellular extrinsic fibre cementum	Cellular intrinsic fibre cementum
Located from cervical to apical third	Located in apical third and furcation
Forms earlier -primary cementum	Formed later and during repair – secondary cementum
Non collagenous protein – tenascin, fibronectin, osteocalcin absent	Non collageneous protein -Present

ORAL MUCOSA

The oral cavity is lined by a mucous membrane that consists of two layers: an epithelium and subjacent connective tissue (the lamina propria). Although its major functions are lining and protecting, the mucosa also is modified to serve as an exceptionally mobile tissue that permits free movement of the lip and cheek muscles.[17]

FIGURE 1 - Structure of oral mucosa



Histologically, the oral mucosa can be classified into three types:
(1) masticatory, (2) lining, and (3) specialized.
Masticatory mucosa - covers the **gingiva and hard palate**, is bound down tightly by the lamina propria to the underlying bone, and the covering epithelium is keratinized to withstand the constant pounding of food during mastication.
Lining mucosa - is flexible to perform its function of protection. The epithelium is not keratinized; the lamina propria is structured for mobility and is not tightly bound to underlying structures. It covers **labial and buccal mucosa, soft palate, alveolar mucosa and vestibular fornix, mucosa of ventral aspect of the tongue, mucosa of the floor of the mouth.**
Specialized mucosa – covers **dorsal surface of the tongue** consisting of a highly extensible masticatory mucosa containing papillae and taste buds.[18]
Based on the type of epithelium divides the oral mucosa into two types:
1. Keratinized oral mucosa
2. Non keratinized oral mucosa

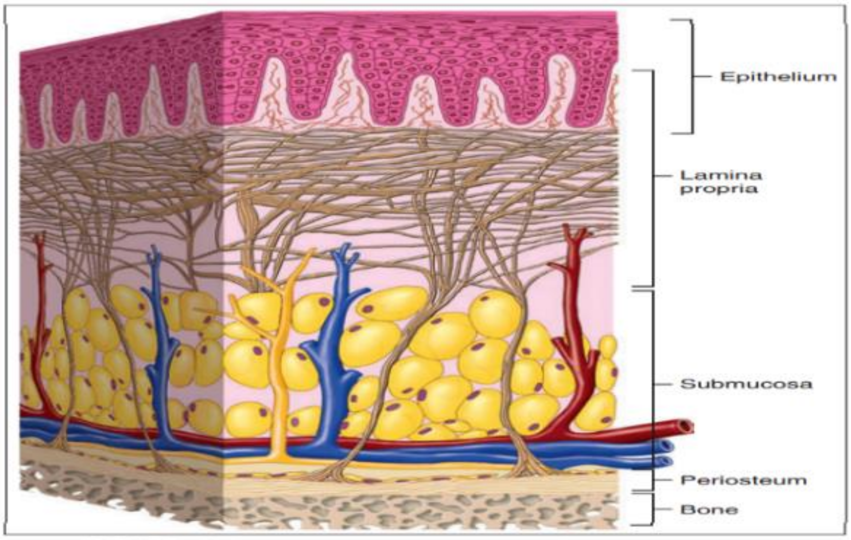
FUNCTIONS OF ORAL MUCOSA

- **Defense -** impermeable to bacterial toxins. It also secretes antibodies and has an efficient humoral and cell mediated immunity.
- **Lubrication-** keeps the oral cavity moist and thus prevents the mucosa from drying and cracking. A moist oral cavity helps in speech, mastication, swallowing, and in the perception of taste.
- **Sensory -** taste sensation of taste is a unique sensation, felt only in the anterior two-thirds of the dorsum of the tongue.
- **Protection-** protects the deeper tissues from mechanical forces resulting from mastication and from abrasive nature of foodstuffs. [17]

COMPONENT

The two main tissue components of the oral mucosa are a stratified squamous epithelium, called the **oral epithelium**, and an underlying **connective tissue** layer, called the lamina propria. The interface between epithelium and connective tissue is usually irregular, and upward projections of connective tissue, called the connective tissue papillae, interdigitate with epithelial ridges or pegs. There is a **basal lamina** at the interface between epithelium and connective tissue that requires special staining to be visible by light microscopy.[7]
The mucosa immediately surrounding an erupted tooth is known as the gingiva. It consists of two parts: (1) the part facing the oral cavity, which is masticatory mucosa, and (2) the part facing the tooth, which is involved in attaching the gingiva to the tooth and forms part of theperiodontium. The junction of the oral mucosa and the tooth is permeable, and thus antigens can pass easily through it and initiate inflammation in gum tissue (marginal gingivitis).[14]

FIGURE 2 - Main tissue components of the oral mucosa.



SALIVARY GLANDS

Saliva is a complex fluid that in health almost continually bathes the parts of the tooth exposed within the oral cavity. Saliva is produced by three paired sets of major salivary glands—-the parotid, submandibular, and sublingual glands—-and by the many minor salivary glands scattered throughout the oral cavity. [10]
A salivary gland may be likened to a bunch of grapes. Each “grape” is the acinus or terminal secretory unit, which is a mass of secretory cells surrounding a central space. The spaces of the acini open into ducts running through the gland that are called successively the intercalated, striated, and excretory ducts analogous to the stalks and stems of a bunch of grapes The ducts and acini constitute the parenchyma of the gland, the whole of which is invested by a connective

tissue stroma carrying blood vessels and nerves. This connective tissue supports each individual acinus and divides the gland into a series of lobes or lobules, finally encapsulating it.[11]

TABLE 8 Differences among Parotid, Submandibular, and Sublingual Gland[14]

	PAROTID	SUBMANDIBULAR	SUBLINGUAL
Development	4-6 weeks IUL	6th weeks IUL	8-12 weeks IUL
Secretion	Purely serous	Mixed (predominantly serous)	Mixed (predominantly mucous)
Contribution to saliva	25%	70%	5%
Amylase activity	Maximum	Moderate	Minimum
Lysozyme activity	Absent	Predominant	less
Excretory duct	Stenson	Whartson	Bartholin
Capsule	Thick,well developed	Thin	Thin/absent
Nerve supply	Glossopharyngeal & Auriculotemporal	Facial nerve - chorda tympani	Facial nerve - chorda tympani
Blopd supply	External carotid artery	Lingual/ facial artery	Sublingual/submental arteries
Lymphatic drainage	Paraparotid/intraparotid drain into deep cervical	Deep cervical, jugular nodes	Submandibular lymph nodes

TABLE 9 COMPOSITION OF SALIVA [19]

Parameter	Characteristics
Volume	600-1000 mL/day
Electrolytes	Na^+ , K^+ , Cl^- , $HCO3^-$, Ca^{2+} , Mg^{2+} , $HPO4^{2-}$, SCN^- , and F^-
Secretory proteins/ peptides	Amylase, proline-rich proteins, mucins, histatin, cystatin, peroxidase, lysozyme, lactoferrin, defensins, and cathelicidin-LL37
Immunoglobulins	Secretory immunoglobulin A; immunoglobulins G and M
Small organic	Glucose, amino acids, urea, uric acid, and lipid molecules
Other components	Epidermal growth factor, insulin, cyclic adenosine monophosphate–binding proteins, and serum albumin

Flow Rate (ml/min)	Whole	Parotid	Submandibular
Resting	0.2–0.4	0.04	0.1
Stimulated	2.0–5.0	1.0–2.0	0.8
pH	6.7–7.4	6.0–7.8	

TABLE 10 FUNCTIONS OF SALIVA[10,11&14]

Protection	washing action that flushes away nonadherent bacteria and other debris,
Buffering	Bicarbonate, phosphate, ions protect the teeth from demineralization caused by bacterial acids
Pellicle Formation	salivary proteins bind to the surfaces of the teeth and oral mucosa, forming a thin film, Several proteins bind calcium and help to protect the tooth surface.
Maintenance of Tooth Integrity	Saliva is supersaturated with calcium and phosphate ions, at tooth surface these these result in posteruptive maturation of the enamel increasing surface hardness and resistance to demineralization.
Antimicrobial Action	spectrum of proteins with antimicrobial activity such as the lysozyme, lactoferrin, peroxidase, and secretory leukocyte protease inhibitor. secretory (IgA) causes agglutination of specific microorganisms, preventing their adherence to oral tissues
Tissue Repair	variety of growth factors, biologically active peptides and proteins promote tissue growth and differentiation, wound healing, and other beneficial effects.
Digestion	actions of enzymes such as amylase and lipase begin the digestive process
Speech	keeps the oral tissue moist and well lubricated, which facilitates speech
Taste	solubilizing food substances which is sensed by taste receptors located in taste buds. minor glands in the vicinity of the circumvallate papillae contains proteins that are believed to bind taste substances and present them to the taste receptors.

BONES OF THE JAW

Teeth are attached to bone by the PDL. This bone, the alveolar bone, constitutes the alveolar process, which is in continuity with the basal bone of the jaws. The alveolar process forms in relation to teeth. Although the histologic structure of the alveolar process is essentially the same as that of the basal bone, practically it is necessary to distinguish between the two. [6]

BONE CELLS

Two cell lineages are present in bone, each with specific functions: [20]

(1) osteogenic cells - which form and maintain bone, and
(2) osteoclasts - which resorb bone.

TABLE 11 DIFFERENCES BETWEEN WOVEN BONE AND LAMELLAR BONE

Woven bone	Lamellar bone
Immature	Mature
Collagen fibres intertwined	Collagen fibres orderly arranged
Enriched in BAG 75	Enriched in osteocalcin
Interfibrillar space is more	Interfibrillar space is less
Hematoxyphillic matrix	Eosinophilic matrix
Rate of deposition rapid	Rate of deposition slow
Osteocytes isodiametric	Osteocytes flat and oblate
Mineral density lower	Mineral density higher

ALVEOLAR BONE

The alveolar process is defined as that part of the maxilla and the mandible that forms and supports the sockets of the teeth. The PDL pierces through the lamina dura and anchors to the alveolar bone, with the other end connected to the cementum. [6]

Functions of alveolar bone are as follows:

- Houses the roots of teeth.
- Anchors the roots of teeth to the alveoli, by the insertion of Sharpey's fibers into the alveolar bone proper.
- Helps to move the teeth for better occlusion.
- Helps to absorb and distribute occlusal forces generated during tooth contact.
- Supplies vessels to the periodontal ligament.
- Houses and protects developing permanent teeth, while supporting primary teeth.
- Organizes eruption of primary and permanent teeth. [6]

AGE CHANGES IN ORAL TISSUES[13,14,21-22]

Aging is a continuous, detrimental, and innate phenomenon in an organism. It is a time-related process, which happens in a constant and steady manner right from birth and continues till death.

TABLE 12

Enamel	Attrition of occlusal surfaces and proximal contact points; become more brittle and susceptible to chipping, cracking and fracture; less permeable with age; darken due to absorption of organic material; increase in nitrogen and fluoride content and size of the enamel crystal
Dentin	Continued growth referred to as **secondary dentin,** dentinal sclerosis associated with the gradual production of peritubular dentine; development of dead tracts, sclerosis, and the addition of reparative dentin.
Pulp	Pulp volume decreases due to continuous deposition of secondary dentin; accumulations of both diffuse fibrillar components as well as bundles of collagen fibers usually appear; blood flow decreases due to formation of atherosclerotic plaques and formation of the pulp stones.
Periodontal ligament	Decrease in cell density, fibrous component, vascularity, and mitotic activity or proliferation rate of periodontal ligament cells, increase in the number of elastic fibers and a decrease in the number of epithelial cell rests of malassez
Cementum	Increase in thickness to compensate for interproximal and occlusal attrition and in response to trauma, caries and periodontal disease. Diminish tooth sensitivity and reduce perception to painful stimuli. Cementum triples its thickness from 10 to 75 years, clusters of cementicles known as cementoma is more commonly apical region of the tooth.
Alveolar bone	Gradual decrease in bone formation; marrow spaces show fatty infiltration; fibronectin damaged by oxygen-free radicals during the aging process; alveolar bone loss is rapid and more extensive in mandible compared to maxilla
Oral mucosa	Becomes smooth and dry due to reduction in the thickness of epithelium and decrease in the salivary secretion ; taste buds decreses with loss of (or) altered taste perception ; decline in the immunologic responsiveness with langerhans cells becoming fewer ; mucosa loses its elasticity because cellularity decreases and collagen content increases ; ability to repair is reduced and the length of the healing time is increased.
Salivary glands	Saliva secretion decreases, earliest manifestations is xerostomia or dry mouth ; acinar

	atrophy, ductal dilatation, and callus formation ; increased fibrosis and fatty infiltration ; oral defense mechanism is compromised: decrease in the concentration iga& mucin.

CONCLUSION

Histology is the microscopic study of animal and plant cell and tissues through staining and sectioning and examining them under a microscope (electron or light microscope). Histology is the tool for accessing a specific knowledge of the microscopic organization of the organs, microscopic anatomy, which is essential to understand the histopathology for a possible diagnosis. Histological studies are used in forensic investigations, autopsy, diagnosis & education and is used extensively in medicine especially in the study of diseased tissues to aid treatment.

Oral histology and embryology touches on the development and growth of teeth and oral cavities, as well as the structure and development of salivary glands and more. It will help us to understand normal facial development and will prepare us to care for patients with abnormalities or dental pathologies. The study focus on the development and structure of cells and tissues, the stages of tooth development and maturation, the different components of a tissue, like cells, intercellular substance and tissue fluids, and the different components of a human tooth, like enamel, dentin, dental pulp and cementum. By better understanding how teeth evolve over time, we can develop superior techniques to prevent caries and other dental problems in advance.

Histological techniques have long been an integral part of dental research. High-quality histology of teeth can only be achieved after optimal tissue preparation and accurate staining. Dental tissues pose particular challenges to the experimenter striving for high-quality histologic preparations due to the close proximity of various different soft and mineralized tissues. Therefore, standard histological procedures had to be modified accordingly.

Complex structure and intimate association of different soft and mineralized tissues, human teeth raise particular challenges for histological processing, in every step of the procedure from fixation to demineralization, sectioning and staining. Thus, the main goal of this work was to optimize histological staining methods particularly with regards to their applicability and relevance to dental tissues. Histology can add value to work and give us a deeper understanding of the tissue architecture and function and how it changes with disease.

Finally, traditional histological techniques remain indispensable in modern research due to their reproducibility, practicability and comparatively low cost. However, more comprehensive methods such as immunohistochemistry or molecular techniques can be used to complement traditional methods and to show specific structures.

REFERENCES

1. Alturkistani HA, Tashkandi FM, Mohammedsaleh ZM. Histological Stains: A Literature Review and Case Study. Glob J Health Sci. 2015;8(3):72–9.
2. Musumeci G. Past, present and future: overview on histology and histopathology First paragraph. 1906;12–4.
3. Ahmed GM, Abouauf EA, Abubakr N, Dörfer CE, El-Sayed KF. Tissue Engineering Approaches for Enamel, Dentin, and Pulp Regeneration: An Update. Stem Cells Int. 2020;2020.
4. Schupbach P, Glauser R. The defense architecture of the human peri-implant mucosa: A histological study. J Prosthet Dent. 2007;97.
5. Maynard JG, Wilson RDK. Physiologic Dimensions of the Periodontium Significant to the Restorative Dentist. J Periodontol. 1979;50(4):170–4.
6. Hammarström L, lindskog S. General morphological aspects of resorption of teeth and alveolar bone. Int Endod J. 1985;18(2):93–108.
7. Squier CA. The permeability of oral mucosa. Crit Rev Oral Biol Med. 1991;2(1):13–32.
8. Wyatt CCL. The effect of prosthodontic treatment on alveolar bone loss: A review of the literature. J Prosthet Dent. 1998;80(3):362–6.
9. Rostom D, Abdul Aziz M. The Impact of the Flexible Partial Denture Base on the Alveolar Mucosa in comparison to metallic denture: RCT and Histological Study. Adv J. 2020;0(0):22–8.
10. Berkovitz BKB, Holland GR, Moxham BJ. Oral Anatomy, Oral Histology and Embryology 4th ed. St Louis: Mosby. 2009.
11. Nanci A. ORAL. Ninth Edition. Ten Cate’s Oral Histology. Elsevier Inc.
12. GWINNETT AJ.Study IVM. Histology of Normal Enamel. 2015;870–3.
13. Gunji T, Kobayashi S, Kobayashi S. Distribution and Organization of Odontoblast Processes in Human Dentin. Arch HistolJpn. 1983;46(2):213–9.
14. Kumar GS. Orban’ s oral histology and embryology - 15th edition.
15. Bartold PM. Bone and tooth interface: periodontal ligament. Biology of the Periodontal Connective Tissues 2012; 219-230.
16. Yamamoto T, Hasegawa T, Yamamoto T, Hongo H, Amizuka N. Histology of human cementum: Its structure, function, and development. Jpn Dent Sci Rev. 2016;52(3):63–74. 21
17. Sawada A, Wakabayashi N, Ona M, Suzuki T. Viscoelasticity of human oral mucosa: Implications for masticatory biomechanics. J Dent Res. 2011;90(5):590–5.
18. Ciano J, Beatty BL. Regional quantitative histological variations in human oral mucosa. Anat Rec. 2015;298(3):562–78.
19. Kumar B Kashyap N, Avinash A Chevvuri R, Sagar MK Shrikant K. The composition, function and role of saliva in maintaining oral health: A review. Proteins. 2017; 220:140-640.
20. Mohamed AM. An overview of bone cells and their regulating factors of differentiation. Malaysian Journal of Medical Sciences. January 2008; Vol 15(No. 1):4-12.

21. Mckenna G, Burke FM. Age-related oral changes. Dent Update. 2010;37(8):519–23.
22. Adams D. Age changes in oral structures. Dent Update. 1991;18(1):14–7.