The **thoracic duct** usually drains into the:

- Left internal jugular vein
- Left subclavian vein
- Junction of the left internal jugular and subclavian veins
- Superior vena cava
- Junction of the right internal jugular and subclavian veins

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- **Junction of the left internal jugular and subclavian veins**

The thoracic duct is the main duct of the lymphatic system. It begins below in the abdomen as a dilated sac, the **cisterna chyli** *(at the level of the T12 vertebra)* and ascends through the thoracic cavity in front of the spinal column. It is the common trunk of all the lymphatic vessels of the body, and drains the lymph from the majority of the body *(legs, abdomen, left side of head, left arm, and left thorax)*. **Note:** The right lymphatic duct drains much less of the body lymph *(only the lymph from the right arm, right thorax, and right side of the head).*

Important: The thoracic duct empties into the **junction of the left internal jugular and left subclavian veins** *(which is actually the beginning of the left brachiocephalic vein).*

Notes:

1. The thoracic duct ascends through the aortic opening in the diaphragm, on the **right side of the descending aorta.**
2. The thoracic duct contains **valves and ascends** between the aorta and the azygos vein in the thorax.

The **right lymphatic duct** is the right-sided equivalent of the thoracic duct and drains the right side of the head and neck, right upper limb, and the right side of the thorax. It empties into the **junction of the right internal jugular and right subclavian veins** *(which is actually the beginning of the right brachiocephalic vein).*

All of the following statements concerning the lymphatic system are true *EXCEPT* one. Which one is the *EXCEPTION*?

- The **main function** is to collect and transport tissue fluids from the intercellular spaces in all the tissues of the body, back to the veins in the blood system
- **Lymph** is a transparent, usually slightly yellow, often opalescent liquid found in the lymphatic vessels
- It **consists of** the bone marrow, spleen, thymus gland, lymph nodes, tonsils, appendix, Peyer's patches, lymph, and lymphatic vessels
- **Just like the circulatory system,** the lymphatic system has a central "heart-like" organ to pump lymph throughout the lymph vessels
- The chief characteristic common to all lymphatic organs is the **presence of lymphocytes**

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- **Just like the circulatory system, the lymphatic system has a central "heart-like" organ to pump lymph throughout the lymph vessels**

***This is **false; unlike** the circulatory system, the lymphatic system **does not have a pump** *(heart)* to propel lymph throughout the lymph vessels. Instead, the lymphatic system **depends on the contractions of skeletal muscles, the presence of valves in lymphatic vessels** *(similar to those in veins)*, **breathing,** and **simple gravity** to move fluid throughout the body.

Functions of the lymphatic system:

- **Returns tissue fluid to the bloodstream;** when this fluid enters lymph capillaries it is called lymph. Lymph is returned to the venous system via two large lymph ducts → **the thoracic duct and the right lymphatic duct.**
- **Transports absorbed fats;** within the villi in the small intestine, lymph capillaries, called lacteals, transport the products of fat absorption away from the GI tract and eventually into the circulatory system.
- **Provides immunological defenses against disease-causing agents;** lymph filters through lymph nodes, which filter out microorganisms *(such as bacteria)* and foreign substances.

Notes:

1. **Lymph** contains a liquid portion that resembles blood plasma, as well as white blood cells *(mostly lymphocytes)*, and a few red blood cells.
2. **Lymph** is absorbed from the tissue spaces by the lymphatic capillaries *(which is a system of closed tubes)* and eventually returned to the venous circulation by the lymphatic vessels, after it flows through the filtering system *(lymph nodes)*.
3. In the **upper limb,** a hallmark of lymphatic vessels is that they **follow the veins.**

Gluconeogenesis, which occurs mainly in the liver, is the synthesis of glucose from compounds that are not carbohydrates. Which organ below is a **minor contributor** of newly synthesized glucose molecules?

- Appendix
- Gallbladder
- Kidneys
- Pancreas

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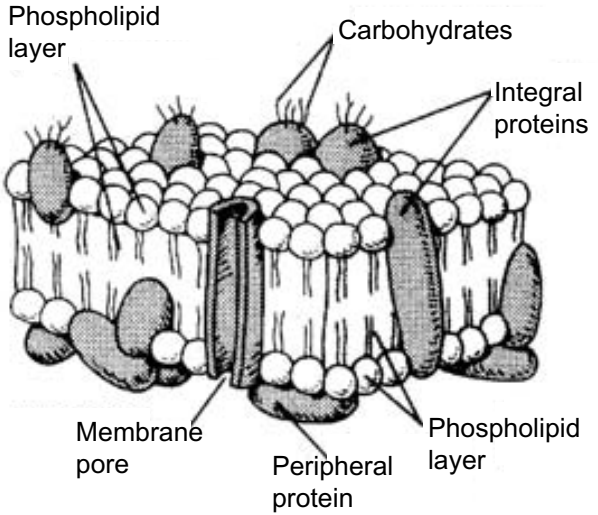
- **Kidneys**

Approximately 90% of gluconeogenesis occurs in the **liver**, whereas the kidneys provide 10% of newly synthesized glucose molecules. **Note: During prolonged starvation** the kidneys become major glucose-producing organs.

In addition to gluconeogenesis, the liver has the following functions:
- Bile formation
- Protein metabolism *(deamination of amino acids, urea formation, plasma protein formation, synthesis of amino acids)*
- Steroid conjugation
- Carbohydrate storage
- Prothrombin synthesis and fibrinogen production
- Detoxification
- Regulation of blood sugar level *(glucose level)*

Note: Glucokinase is found only in the liver and functions at a significant rate only after a meal. This enzyme uses ATP to catalyze the phosphorylation of **glucose to glucose-6-phosphate** during glucogenesis *(the process of glycogen formation).* Other tissues use **hexokinase** to do the same thing as glucokinase.

What is the name of the structure shown below? **Hint:** It is the basic structure of cell membranes.



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• Lipid bilayer

In an **aqueous environment** *(water*), phospholipid molecules form lipid bilayers *(also called bimolecular sheets)*, in which the **polar regions** *(phosphate group which is negatively charged*) are located at the surfaces of the bilayer, where they **interact with water** *(hydrophilic*). The **nonpolar regions** *(fatty acid portion)* are hydrophobic, and orient themselves toward the interior of the bilayer so as to minimize contact with the aqueous portion. In this lipid bilayer, **globular proteins** *(peripheral and integral*) are embedded at irregular intervals, held by **hydrophobic interactions** between the membrane lipids and hydrophobic domains in the proteins.

Notes:

1. Lipids, when suspended in water, spontaneously form bilayer structures **that are stabilized** by hydrophobic interactions.
2. This lipid bilayer serves as a permeability barrier, yet it is **quite fluid**. The membrane mosaic is fluid because the interactions among lipids, and between lipids and proteins, are **noncovalent**, leaving individual lipid and protein molecules free to move laterally in the plane of the membrane.
3. Bilayers arise through the operation of two opposing forces: **(1)** attractive forces between hydrocarbon chains *(van der Waals forces)* caused by the hydrophobic effect forcing such chains together and **(2)** repulsive forces between the polar head groups.

Which index is used to measure **oral debris?**

- Decayed, Missing, and Filled Teeth *(DMFT)*
- Plaque Index *(PI)*
- Sulcus Bleeding Index *(SBI)*
- Decayed, Missing, and Filled Surfaces of Teeth *(DMFS)*

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• **Plaque Index *(PI)***

The **Plaque index of Silness and Loe** is a specific index for scoring plaque *(and oral debris),* which has been adapted from the Papillary, Marginal and Attached Gingival Index *(PMA)*. The PMA index is used for recording the prevalence and severity of gingivitis in schoolchildren. The presence or absence of gingivitis is noted in each of three areas: **1**) the gingival papillae *(P)*, **2**) the gingival margin *(M*), and **3**) the attached gingiva *(A)*.

The PI index is based on an assessment of the severity and location of soft debris aggregates in terms of scores of 0, 1, 2, and 3. A plaque score of 0 is given when the gingival area of the tooth surface is free of plaque. The examination is made by passing a probe over the tooth surface into the gingival sulcus. If no soft material adheres to the probe, the area is considered to be 0. A plaque score of 1 is given when plaque cannot be observed on the tooth but can be observed on the probe. A score of 2 is given when a thin to moderately thick layer of plaque is visible to the eye. A plaque score of 3 is assigned when a heavy accumulation of plaque fills the area between the gingival margin and the tooth surface or fills the interdental area. **In this system,** the most stress is placed on the thickness of the plaque at the gingival margin area on **all four surfaces** of each tooth.

The scores of **all four areas** of all the teeth can then be added and divided by the number of teeth. The plaque index has been exclusively used **but does not** have universal acceptability.

Note: According to some studies, **80-90% of children** have inflammatory periodontal disease *(gingivitis or periodontitis)* by the age of 15. **Localized acute gingivitis** is the most common form. Epidemiologic studies show the strongest relationship between prevalence and severity of periodontal disease with oral hygiene and age.

If the major purpose of an epidemiologist's research is to determine **caries susceptibility** as opposed to immediate treatment needs, the **best** caries index to use would be the:

- TSIF
- DMFS
- DMFT
- CPITN

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• DMFT

The DMFT is an **irreversible** index and is applied only to **permanent** teeth. The results of the DMFT index yield a group's **caries susceptibility.** It has received practically universal acceptance and is probably the best known of all dental indices.

Limitations of the DMFT index:

1. DMF values **are not related** to the number of teeth at risk.
2. The DMF index can be **invalid in older adults** because teeth can become lost for reasons other than caries.
3. The DMF index can be **misleading in children** whose teeth have been extracted for orthodontic reasons.
4. DMF **cannot** be used for **root caries.**
5. DMF **cannot** account for **sealed teeth.**

Note: The primary difficulty in using the **DMF** index to determine dental needs is that it is a cumulative record of an individual's lifetime caries experience.

Which tooth may show **three types** of occlusal surfaces?

- Maxillary first premolar
- Mandibular second premolar
- Mandibular first premolar
- Maxillary second premolar

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• Mandibular second premolar

***The three types are **Y-type, H-type,** and **U-type.**

Buccal **Lingual** **Occlusal** **Mesial** **Distal**

Mandibular Right Second Premolar

Crown → usually develops from **five lobes** *(the Y-type)* and has three cusps, one buccal and two lingual. From the buccal, it is **shorter** and **wider** than the first premolar. From the occlusal, it has a **square** outline. It resembles other premolars from the **buccal aspect** only.

Root → one, apex approximates the **mental foramen.** It is **thicker** and **longer** than the root of the mandibular first premolar.

Cusp → buccal cusp is **shorter,** not as sharp, and the cusp slopes are less steep than the mandibular first premolar. Mesiolingual cusp is **always larger** than DL cusp, which may be absent. Lingual cusps are **functional.** From a distal view, it is usually possible to see the outline of all three cusps.

Pits and grooves → central **developmental groove** is sometimes **"U"-shaped** or looks like a crescent. It ends in the mesial and distal fossae, where it often joins a MB and a DB supplemental groove.

Occlusal pattern → **larger** occlusal surface than first premolar. **Wider** on lingual than buccal. Most frequently has a **single** central pit. There is **no** mesiolingual groove or transverse ridge *(both are common on first premolar)*.

All of the following statements concerning the mandibular lateral incisor are true, *EXCEPT* one. Which one is the *EXCEPTION*?

- The mandibular lateral incisor is a **little larger in all dimensions** than the mandibular central incisor
- The crown of the mandibular lateral incisor is **not as bilaterally symmetrical** as the mandibular central incisor
- The cingulum is **directly in the center** of the lingual surface
- The root is **very narrow mesiodistally**

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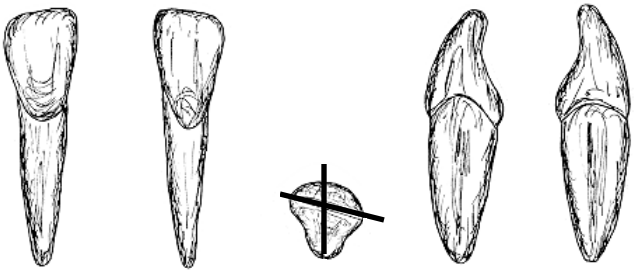
• **The cingulum is directly in the center of the lingual surface** *(see surfaces below)*



Mandibular Right Lateral Incisor

Crown → **not as bilaterally symmetrical** as the mandibular central incisor. The crown is **tilted distally** on the root. The distoincisal angle is **more rounded** than the mesioincisal angle. It is **broader labiolingually** than mesiodistally.
Root → one root, a small percentage will have two canals. It is **very narrow** mesiodistally. Concavities are **evident** on mesial and distal surfaces.
Surfaces → lingual surface is smooth. The **cingulum** is slightly off-center to the distal. Mesial marginal ridge is **slightly longer** than the distal marginal ridge.

Important: The mesial and distal contact areas of the lateral incisor **are not** at exactly the same level, a condition different from that found on the central incisor. The mesial and distal contacts are both in the **incisal third**, however, the distal contact is **slightly cervical** to the level of the mesial contact area.

Note: In an **anterior cross-bite relationship** *(Class III)*, as the mandible retrudes, the maxillary lateral contacts the mandibular canine and lateral.

Hypercementosis is the excessive deposition of secondary cementum on the roots. Any tooth may be involved, however, which teeth are **most frequently** involved?

- Molars
- Incisors
- Premolars
- Canines

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• Premolars

Hypercementosis is often confined to the apical half of the root but, in some instances, may involve the entire root. In a large majority of instances, it affects **vital** teeth, is not associated with any one particular systemic disease and may be regarded as a dental anomaly. It may be seen when a tooth has lost its antagonist or when there is chronic inflammation of the tooth. The **premolars** are most frequently involved. Next in frequency are the first and second molars.

Hypercementosis produces no **significant clinical signs or symptoms** indicative of its presence. It is seen radiographically as a bulbous enlargement that has surrounding it a **continuous and unbroken periodontal membrane space** and a normal lamina dura.

There is a form of hypercementosis which is a common feature in **Paget's disease** that involves the jaws. On the x-ray in this case, there is **complete absence** of the periodontal membrane space and lamina dura surrounding the hyperplastic cementum. **Note:** In addition to Paget's disease, hypercementosis is associated with supraeruption, apical periodontal infection, occlusal trauma, toxic thyroid goiter, acromegaly, and pituitary gigantism.

Hypercementosis: Maxillary premolars

An enamel defect resulting from the **incomplete formation** of the enamel matrix is called:

- Enamel pearls
- Enamel hypocalcification
- Enamel hypoplasia
- Dentinal dysplasia

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• Enamel hypoplasia

Enamel hypoplasia is a developmental defect in which the enamel of the teeth is hard in context but thin and deficient in amount. It results from **incomplete formation of the enamel matrix with a deficiency** in the cementing substance. Enamel hypoplasia affects both the deciduous and permanent teeth. It is usually due to illness or injury during tooth formation or due to a genetic disorder. **Note:** The genetic forms of enamel hypoplasia are generally considered to be types of amelogenesis imperfecta.

The clinical appearance of enamel hypoplasia includes: **1)** the lack of contact between teeth, **2)** the rapid breakdown of occlusal surfaces, **3)** a yellowish-brown stain that appears where the dentin is exposed. **Note:** If only one permanent tooth is affected, it is usually caused by physical damage to the primary tooth that this permanent tooth replaced.

Remember: Enamel **hypocalcification** is a hereditary dental defect in which the enamel is soft and undercalcified in context yet **normal in quantity.** It is caused by the defective maturation of ameloblasts *(there is a defect in the* **mineralization** *of the formed matrix).* The teeth are chalky in consistency, the surfaces wear down rapidly and a yellow to brown stain appears as the underlying dentin is exposed. This condition affects both the deciduous and permanent teeth as well. **See picture #9 in booklet.**

Which of the following is a **major disadvantage** of the **paralleling technique?**

- The image formed on the film will **not** have dimensional accuracy
- Due to the amount of distortion, periodontal bone height **cannot** be accurately diagnosed
- An **increase** in exposure time is necessary due to the use of a **long** cone
- An **increase** in exposure time is necessary due to the use of a **short** cone

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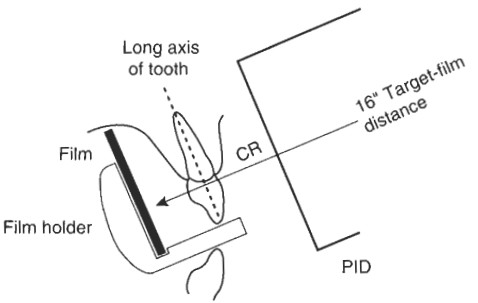
• An increase in exposure time is necessary due to the use of a long cone

The **paralleling technique** is based on the concept of parallelism. Other names for this technique include XCP *(extension cone paralleling technique),* right-angle technique, and long-cone technique.

Basic Principles:

- Film is placed parallel to the long axis of the tooth being x-rayed.
- Central x-ray is directed perpendicular to both the film and the long axis of the tooth.
- A film holder *(XCP)* **must** be used to keep the film parallel to the long axis of the tooth.
- The **object-film distance** must be **increased** to keep the film parallel. This results in image magnification and loss of definition.
- The **source-film distance** must also be **increased** to compensate for the image magnification and to make sure that only the **most parallel rays** will be aimed at the tooth and the film. Using a **long** cone *(16 inch target-film distance)* results in greater definition and less image magnification.



Positions of the film, teeth, and central ray of the x-ray beam in the paralleling technique. The film and long axis of the tooth are parallel. The central ray is perpendicular to the tooth and film. An increased target-film distance *(16 inches)* is required.

Foreshortening and elongation are produced by:

- Incorrect horizontal angulation
- Incorrect vertical angulation
- Either of the above

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• Incorrect vertical angulation

Vertical angulation is directing x-rays so that they pass vertically through the part being examined. This is accomplished by positioning the tubehead and direction of the central ray in an **up-and-down** *(vertical)* plane. **Important: Foreshortening** *(See figure #1)* refers to a shortened image and **elongation** *(See figure #2)* refers to an elongated image. Both are produced by an **incorrect vertical angulation.** Excessive vertical angulation causes foreshortened images, while insufficient vertical angulation causes elongated images.

Figure #1. If the vertical angulation is too steep, the images are foreshortened.

Figure #2. If the vertical angulation is too flat, the images are elongated.

Horizontal angulation refers to the positioning of the tubehead and direction of the central ray in a horizontal or side-to-side plane. **Note:** With correct horizontal angulation, the central ray is directed perpendicular to the curvature of the arch and through the contact areas of the teeth. As a result, the contact areas on the x-ray appear to be "opened." **Important:** Incorrect horizontal tube angulation causes **overlapped** *(unopened)* contact areas.

If the tubehead is directed at the floor, it is called **positive angulation;** if it is directed toward the ceiling, it is called **negative angulation**.

Incidental gingival curettage is performed during:

- Polishing
- Scaling and root planing
- Ultrasonic scaling
- All of the above

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• Scaling and root planing

Incidental *(inadvertent, accidental or coincidental)* **gingival curettage** occurs during scaling and root planing. This incidental curettage includes the debridement of the lining of the sulcus or pocket. Incidental gingival curettage is caused by the outer or unused side of the curet blade. **Note: Non-definitive gingival curettage** may be indicated to improve tissue health in preparation for another definitive procedure.

Gingival curettage removes the diseased soft tissue lining the periodontal pockets. It is a manual procedure and permits a deeper and more complete cleaning than ultrasound. It does not add any significant benefits for shallow pockets. Local anesthesia is often used. Fine scaling instruments, called curets, serve two functions: **(1)** They scrape and clean the root surfaces. **(2)** They also plane the surfaces in an attempt to smooth and remove the outer layer of diseased material.

Objective of gingival curettage: Removal of chronically inflamed connective tissue, diseased sulcular epithelial lining and microorganisms from the pocket in order to reduce edema and pocket depth.

When performing gingival curettage:

- **Instruments & Angulation** → definitive curettage may be performed with a Gracey curet or a universal curet. The angulation of the instrument against the tissue should be 45° to 90°.
- **Digitally support the free gingival / pocket wall** → this increases the effectiveness of the cutting stroke
- **Strokes** → long and horizontal with moderate pressure
- **Irrigate frequently** → while performing procedure
- **Post-operative healing** → most common response is healing by shrinkage of the marginal and papillary gingiva.

The **main objective** of root planing is:

- To remove chronically inflamed tissues
- To change the bacterial microflora
- To provide a root surface that is biologically conducive to the healing process
- To eliminate pockets

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• To provide a root surface that is biologically conducive to the healing process

*******By providing smooth root surfaces there will be a reduced potential for bacterial accumulation, which is done in an attempt to achieve soft-tissue re-attachment.
Scaling and root planing are techniques of instrumentation applied to the root surface to **divest it of plaque, calcified deposits and softened or roughened cementum.** When thoroughly performed, these techniques produce a root surface that is biologically conducive to the healing process. Scaling and root planing are the **primary treatments** for periodontal inflammation. In simple cases, these treatments are useful in reducing shallow pockets and the number of bacteria within, and may be the only treatments necessary. In severely advanced periodontal disease where surgery may not be possible, scaling and root planing may be the only **viable treatments.** Since the removal of plaque and deposits is the **definitive treatment** for periodontal inflammation, scaling and root planing **are more frequently** used than any other type of therapy. Commonly observed clinical changes one week after scaling and root planing include a reduction in bleeding and a reduction in gingival inflammation.

The **most effective instrument** for subgingival scaling and root planing is a **sharp curet.** They are generally smaller than scalers and are designed to permit atraumatic entry to the subgingival space. The tactile sensitivity of most curets is greater than scalers, and, as such, curets are well suited for subgingival calculus detection, calculus removal, and root planing. The **working angulation** with a curet is less than 90° but more than 45°. The best clinical aid in determining whether subgingival calculus has been removed is using an **explorer** and **bite-wing x-rays** *(will show the presence of interproximal calculus).*

Remember: A **chisel** is best designed for removing supragingival calculus deposits in interproximal areas, particularly on anterior teeth. A chisel has a single, straight cutting edge. The end of the blade is flat and beveled at a 45° angle.