

MOVEMENTS OF GI TRACT

CONTENTS

- **MOVEMENTS IN MOUTH**

Mastication

Deglutition

- **MOVEMENTS IN STOMACH**

Hunger contractions

Receptive relaxation

Peristalsis

- **MOVEMENTS IN SMALL INTESTINE**

Mixing movements

Propulsive movements

Peristalsis in fasting - migrating motor complex

Movements of villi

- **MOVEMENTS IN LARGE INTESTINE**

Mixing movements: Segmentation contractions

Propulsive movements: Mass peristalsis

MOVEMENTS IN MOUTH

1. MASTICATION

Mastication or **chewing** is the first mechanical process in the gastrointestinal (GI) tract, by which the food substances are torn or cut into small particles and crushed or ground into a soft bolus.

Movements of Mastication

1. Opening and closure of mouth
2. Rotational movements of jaw
3. Protraction and retraction of jaw.

Action of mastication is mostly a reflex process. It is carried out voluntarily also. The center for mastication is situated in medulla and cerebral cortex. Muscles of mastication are supplied by mandibular division of 5th cranial (trigeminal) nerve.

2.DEGLUTITION

Deglutition or swallowing is the process by which food moves from mouth into stomach.

Stages of Deglutition

Deglutition occurs in three stages:

- Oral stage, (food moves from mouth to pharynx)
- Pharyngeal stage, (food moves from pharynx to esophagus)
- Esophageal stage, (food moves from esophagus to stomach).

Oral stage

It is a voluntary stage. In this stage, the bolus from mouth passes into pharynx by means of series of actions.

Pharyngeal stage

It is an involuntary stage. In this stage, the bolus is pushed from pharynx into the esophagus.

Pharynx is a common passage for food and air.

Since pharynx communicates with mouth, nose, larynx and esophagus, during this stage of deglutition, bolus from the pharynx can enter into four paths:

1. Back into mouth
2. Upward into nasopharynx
3. Forward into larynx
4. Downward into esophagus.

However, due to various coordinated movements, bolus is made to enter only the esophagus. Entrance of bolus through other paths is prevented as follows:

- Return of bolus back into the mouth is prevented by:
 - i. Position of tongue against the soft palate (roof of the mouth)
 - ii. High intraoral pressure, developed by the movement of tongue.
- Movement of bolus into the nasopharynx from pharynx is prevented by elevation of soft palate along with its extension called uvula.

➤ Movement of bolus into the larynx is prevented by the following actions:

- i. Approximation of the vocal cords
- ii. Forward and upward movement of larynx
- iii. Backward movement of epiglottis to seal the opening of the larynx (glottis)
- iv. All these movements arrest respiration for a few seconds. It is called deglutition apnea.

➤ As the other three paths are closed, the bolus has to pass only through the esophagus. This occurs by the combined effects of various factors:

- i. Upward movement of larynx stretches the opening of esophagus
- ii. Simultaneously, upper 3 to 4 cm of esophagus relaxes. This part of esophagus is formed by the cricopharyngeal muscle and it is called **upper esophageal sphincter** or **pharyngoesophageal sphincter**.
- iii. At the same time, peristaltic contractions start in the pharynx due to the contraction of pharyngeal muscles
- iv. Elevation of larynx also lifts the glottis away from the food passage.

All the factors mentioned above act together so that, bolus moves easily into the esophagus.

Esophageal stage

- It is also an involuntary stage. In this stage, food from esophagus enters the stomach.
- Esophagus forms the passage for movement of bolus from pharynx to the stomach. Movements of esophagus are specifically organized for this function and the movements are called peristaltic waves.
- When bolus reaches the esophagus, the peristaltic waves are initiated. Usually, two types of peristaltic contractions are produced in esophagus.

1. Primary peristaltic contractions

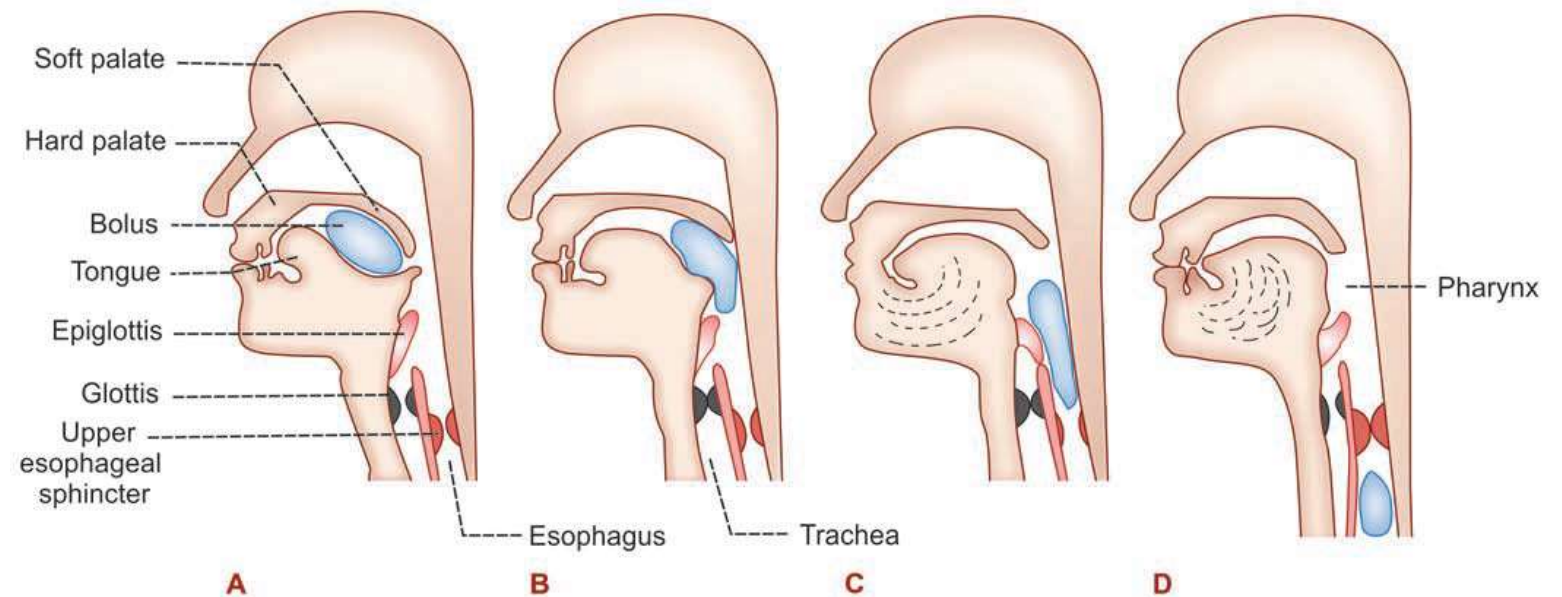
2. Secondary peristaltic contractions.

1. *Primary Peristaltic Contractions*

- When bolus reaches the upper part of esophagus, the peristalsis starts. This is known as primary peristalsis. The peristaltic contractions pass down through the rest of the esophagus, propelling the bolus towards stomach.

2. Secondary Peristaltic Contractions

- If the primary peristaltic contractions are unable to propel the bolus into the stomach, the secondary peristaltic contractions appear and push the bolus into stomach.
- Secondary peristaltic contractions are induced by the distention of upper esophagus by the bolus. After origin, these contractions pass down like the primary contractions, producing a positive pressure.



Stages of deglutition. **A.** Preparatory stage; **B.** Oral stage; **C.** Pharyngeal stage; **D.** Esophageal stage.

MOVEMENTS OF STOMACH

Activities of smooth muscles of stomach increase during gastric digestion (when stomach is filled with food) and when the stomach is empty.

Types of movements in stomach

1. Hunger contractions
2. Receptive relaxation
3. Peristalsis.

1. Hunger contractions

- Hunger contractions are the movements of empty stomach. These contractions are related to the sensations of hunger.
- Hunger contractions are the peristaltic waves superimposed over the contractions of gastric smooth muscle as a whole. This type of peristaltic waves is different from the digestive peristaltic contractions.
- The digestive peristaltic contractions usually occur in body and pyloric parts of the stomach. But, peristaltic contractions of empty stomach involve the entire stomach.

2. RECEPTIVE RELAXATION

- Receptive relaxation is the relaxation of the upper portion of the stomach when bolus enters the stomach from esophagus.
- It involves the fundus and upper part of the body of stomach.
- Its significance is to accommodate the food easily, without much increase in pressure inside the stomach. This process is called **accommodation** of stomach.

3. PERISTALSIS

- When food enters the stomach, the peristaltic contraction or peristaltic wave appears with a frequency of 3 per minute. It starts from the lower part of the body of stomach, passes through the pylorus till the **pyloric sphincter**.
- Initially, the contraction appears as a slight indentation and the contraction becomes deeper while traveling.
- Finally, it ends with the constriction of pyloric sphincter. Some of the waves disappear before reaching the sphincter.
- Each peristaltic wave takes about one minute to travel from the point of origin to the point of ending. This type of peristaltic contraction is called **digestive peristalsis** because it is responsible for the grinding of food particles and mixing them with gastric juice for digestive activities.

MOVEMENTS OF SMALL INTESTINE

Movements of small intestine are essential for mixing the chyme with digestive juices, propulsion of food and absorption.

Types of Movements of Small Intestine

Movements of small intestine are of four types:

1. Mixing movements:
 - i. Segmentation movements
 - ii. Pendular movements.
2. Propulsive movements:
 - i. Peristaltic movements
 - ii. Peristaltic rush.
3. Peristalsis in fasting - migrating motor complex
4. Movements of villi.

1. MIXING MOVEMENTS

○ Mixing movements of small intestine are **responsible for proper mixing of chyme with digestive juices** such as pancreatic juice, bile and intestinal juice.

i. Segmentation movements:

○ Segmentation contractions are the common type of movements of small intestine, which occur regularly or irregularly, but in a rhythmic fashion. So, these movements are also called rhythmic segmentation contractions.

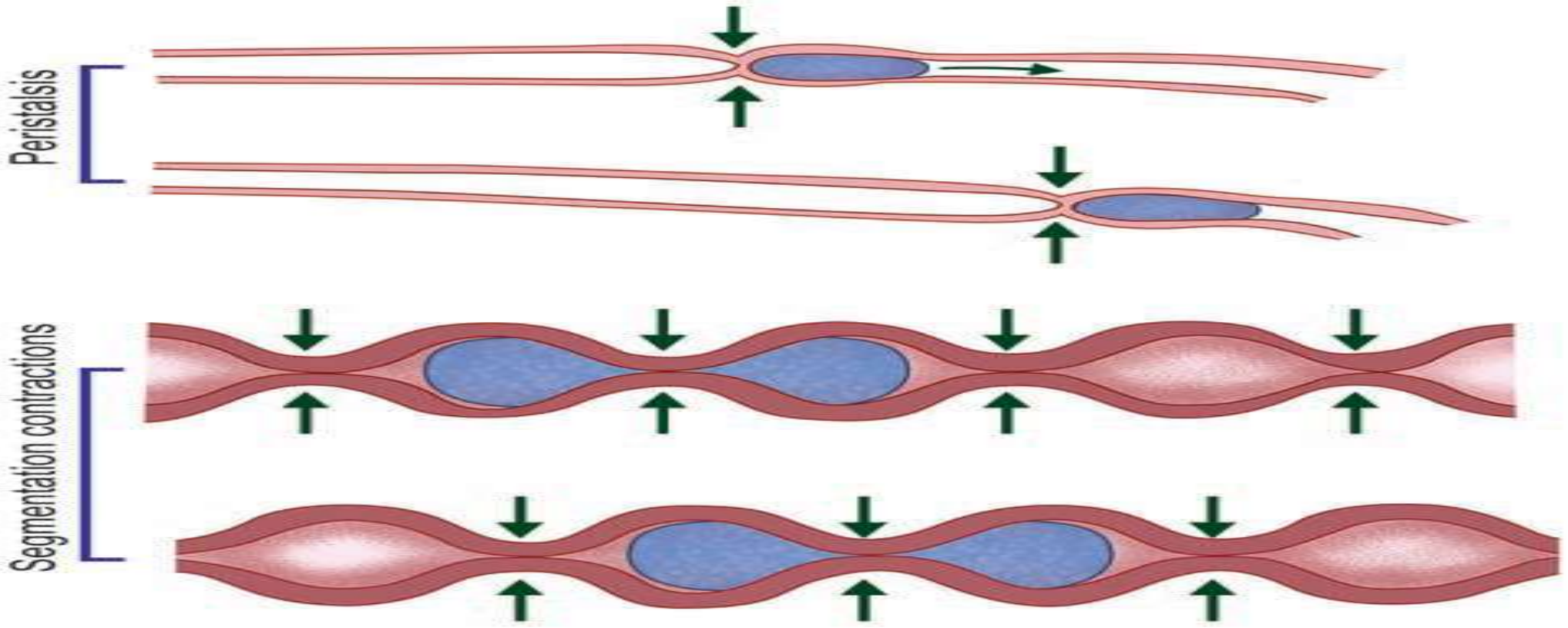
○ The contractions occur at regularly spaced intervals along a section of intestine. The segment of the intestine involved in each contraction is about 1 to 5 cm long.

○ The segments of intestine in between the contracted segments are relaxed. The length of the relaxed segments is same as that of the contracted segments.

○ After sometime, the contracted segments are relaxed and the relaxed segments are contracted. Therefore, the segmentation contractions **chop** the chyme many times.

ii. Pendular movements:

○ Pendular movement is the sweeping movement of small intestine, resembling the movements of **pendulum** of clock. Small portions of intestine (loops) sweep forward and backward or upward and downward.



2. PROPULSIVE MOVEMENTS

Propulsive movements are the movements of small intestine which push the chyme in the aboral direction through intestine.

i. *Peristaltic Movements*

- Stimulation of smooth muscles of intestine initiates the peristalsis.
- It travels from point of stimulation in both directions. But under normal conditions, the progress of contraction in an oral direction is inhibited quickly and the contractions disappear.
- Only the contraction that travels in an aboral direction persists.
- Peristaltic contractions start at any part of the intestine and travel towards anal end, at a velocity of 1 to 2 cm/sec. The contractions are always weak and usually disappear after traveling for few centimeter.
- Because of this, the average movement of chyme through small intestine is very slow and the average velocity of movement of the chyme is less than 1 cm/sec. So, the chyme requires several hours to travel from duodenum to the end of small intestine.
- Peristaltic waves in small intestine increase to a great extent immediately after a meal. This is because of **gastroenteric reflex**, which is initiated by the distention of stomach. Impulses for this reflex are transmitted from stomach along the wall of the intestine via myenteric plexus.

ii. *Peristaltic Rush*

- Sometimes, the small intestine shows a powerful peristaltic contraction. It is caused by excessive irritation of intestinal mucosa or extreme distention of the intestine.
- This type of powerful contraction begins in duodenum and passes through entire length of small intestine and reaches the ileocecal valve within few minutes. This is called peristaltic rush or rush waves.
- Peristaltic rush sweeps the contents of intestine into the colon. Thus, it relieves the small intestine off either irritants or excessive distention.

3. PERISTALSIS IN FASTING - MIGRATING MOTOR COMPLEX

- Migrating motor complex is a type of peristaltic contraction, which occurs in stomach and small intestine during the periods of fasting for several hours. It is also called **migrating myoelectric complex**.
- It is different from the regular peristalsis because, a large portion of stomach or intestine is involved in the contraction. The contraction extends to about 20 to 30 cm of stomach or intestine. This type of movement occurs once in every 1½ to 2 hours.
- It starts as a moderately active peristalsis in the body of stomach and runs through the entire length of small intestine. It travels at a velocity of 6 to 12 cm/min.
- Thus, it takes about 10 minutes to reach the colon after taking origin from the stomach.

4. MOVEMENTS OF VILLI

- Intestinal villi also show movements simultaneously along with intestinal movements. It is because of the extension of smooth muscle fibers of the intestinal wall into the villi.
- Movements of villi are shortening and elongation, which occur alternatively and help in emptying lymph from the central lacteal into the lymphatic system.
- The surface area of villi is increased during elongation. This helps absorption of digested food particles from the lumen of intestine.
- Movements of villi are caused by local nervous reflexes, which are initiated by the presence of chyme in small intestine.
- Hormone secreted from the small intestinal mucosa called **villikinin** is also believed to play an important role in increasing the movements of villi.

MOVEMENTS OF LARGE INTESTINE

Usually, the large intestine shows sluggish movements. Still, these movements are important for mixing, propulsive and absorptive functions.

Types of Movements of Large Intestine

Movements of large intestine are of two types:

1. Mixing movements: Segmentation contractions
2. Propulsive movements: Mass peristalsis.

1.MIXING MOVEMENTS - SEGMENTATION CONTRACTIONS

- Large circular constrictions, which appear in the colon, are called mixing segmentation contractions. These contractions occur at regular distance in colon.
- Length of the portion of colon involved in each contraction is nearly about 2.5 cm.

2.PROPULSIVE MOVEMENTS - MASS PERISTALSIS

- Mass peristalsis or mass movement propels the feces from colon towards anus. Usually, this movement occurs only a few times every day.
- Duration of mass movement is about 10 minutes in the morning before or after breakfast. This is because of the neurogenic factors like **gastrocolic reflex** and parasympathetic stimulation.