

# Hookworm Infection

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# Hookworm(Ancylostomiasis)

Hookworm disease is one of the most important parasitic diseases of humans.

Number of humans infected is estimated at 1.2 billion with 50,000 to 60,000 deaths each year.

Causative agents: Four species can cause human infection.



**Ancylostoma duodenale (Old World Hookworm)**

**Necator americanus (New World Hookworm)**

**Ancylostoma braziliense (Cause creeping eruptions)**

**Ancylostoma caninum (Cause creeping eruptions)**

# Geographical Distribution(Worldwide Infection)

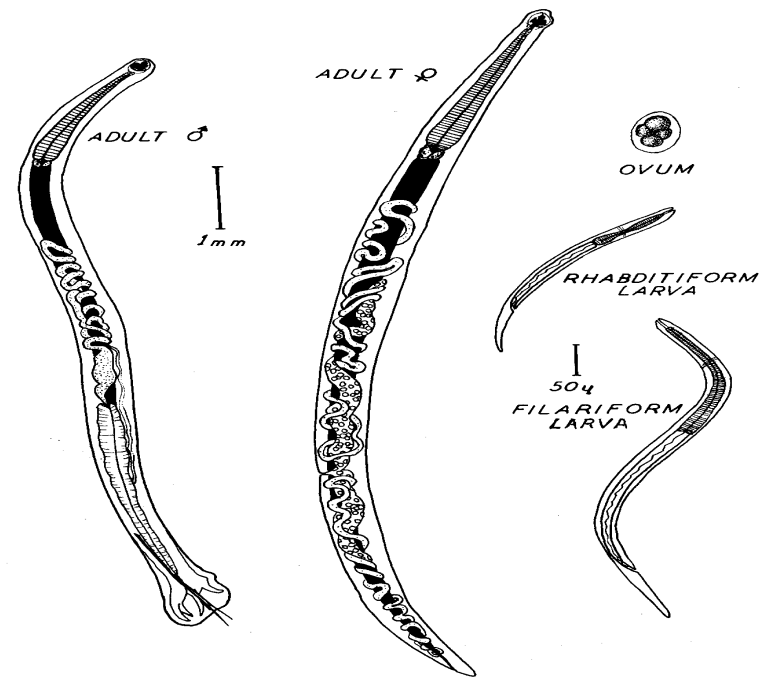


■ Countries where intestinal helminths are a public health problem  
■ Countries where intestinal helminths are transmitted

Source: CTD/SIP  
Map: HealthMap/CTD, 1997

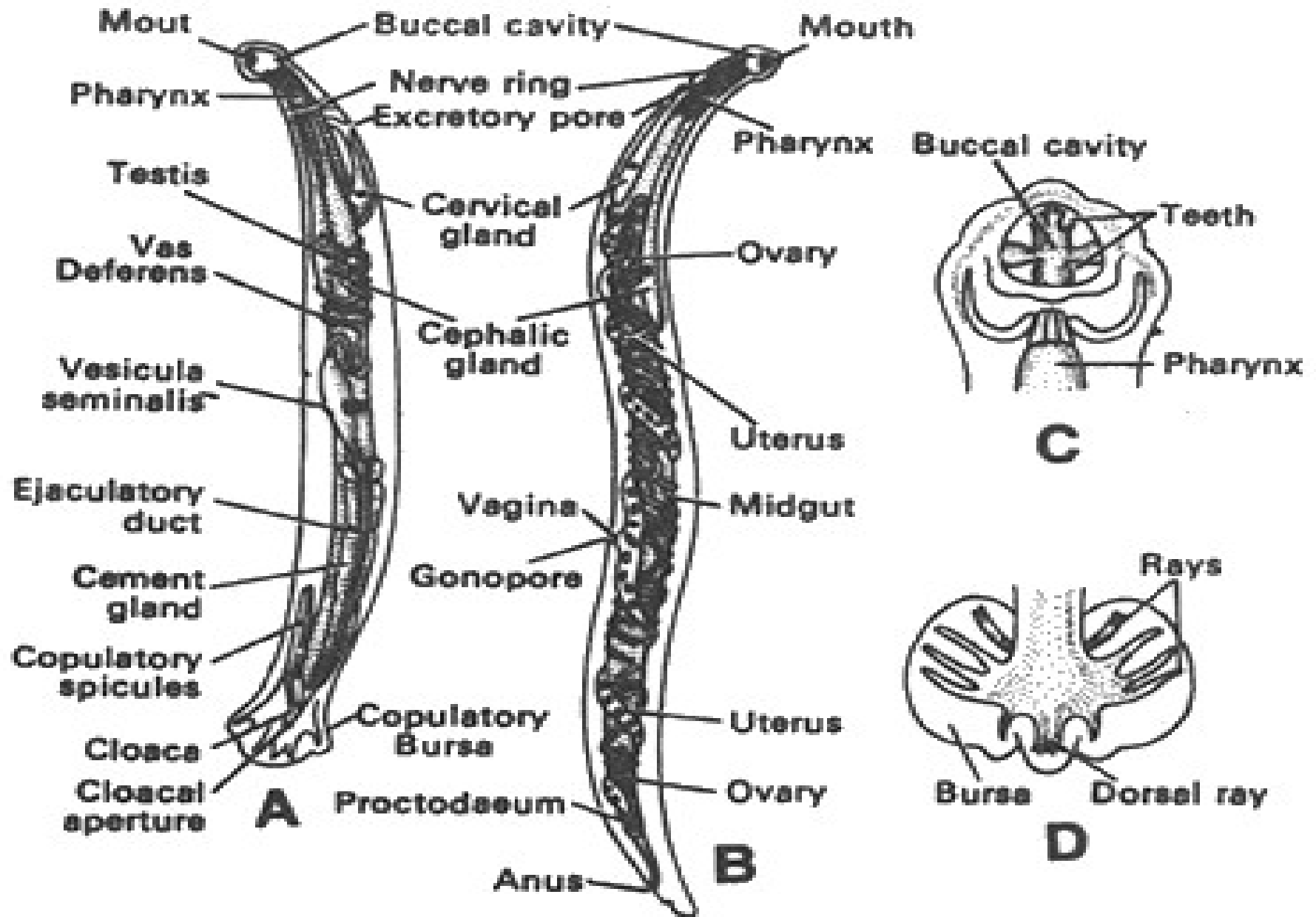
## Morphology:

- Adult worm – Small, greyish white, or brown
- Anterior end bent slightly dorsally (Hence the name Hookworm).
- Oral aperture opens dorsally.
- Species are differentiated by their buccal capsule & arrangement of rays in bursa.



**A. Duodenale 6 teeth (4 hook like on the ventral surface and 2 knob like on dorsal surface).**

**Necator americanus: 2 ventral and 2 dorsal cutting plates**



***Ancylostoma duodenale*. A. Adult male; B. Adult female; C. Anterior end; D. Posterior end of male**

## Male hookworms:

**Size:** Smaller(8-11 mm long X .45mm)

**Posterior end:** Umbrella like expansion

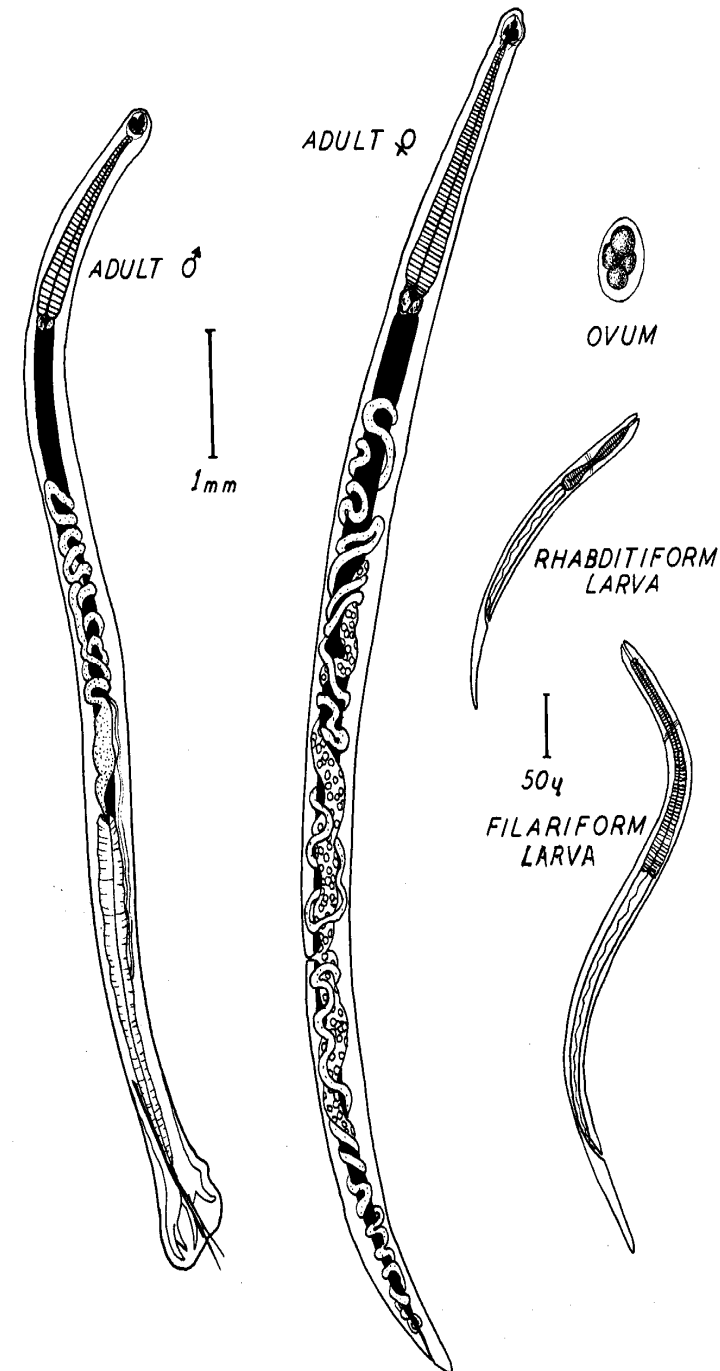
**Genital Opening:** Posteriorly opens with cloaca.

## Females:

**Size:** Larger(10-13 mm long X .6mm)

**Posterior end:** Tapering, No Umbrella like expansion

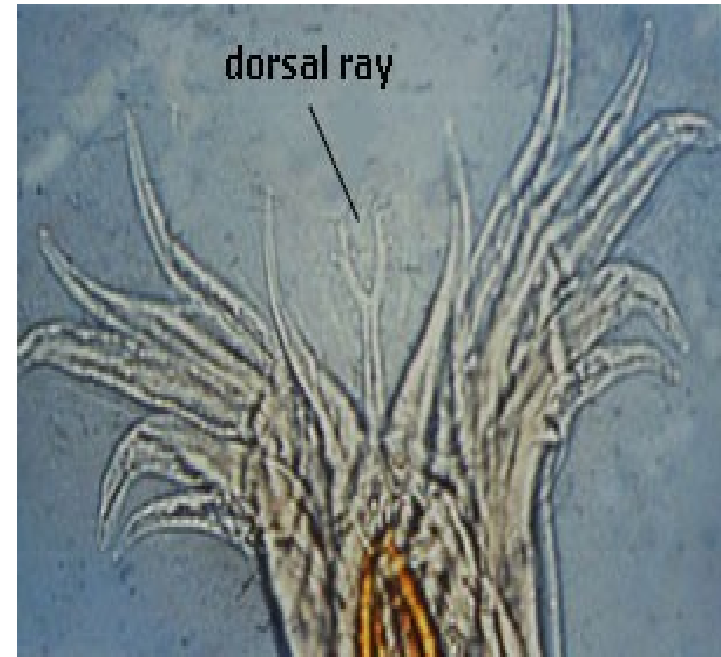
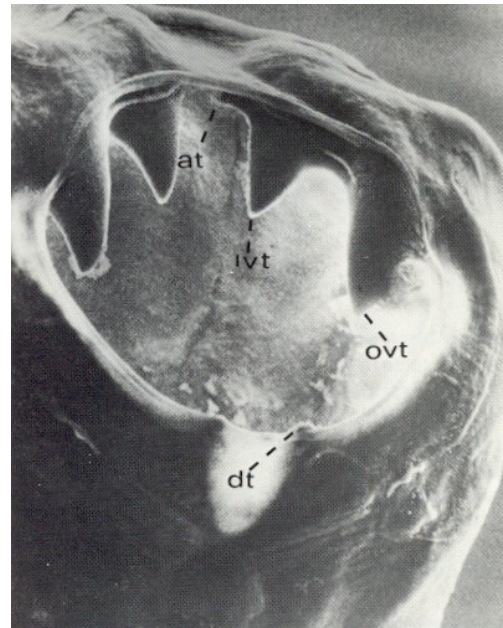
**Genital Opening:** At the junction of posterior and middle third of body



# Morphology of *Ancylostoma duodenale*

Buccal capsule contains 2 pairs of large ventral (anterior) teeth

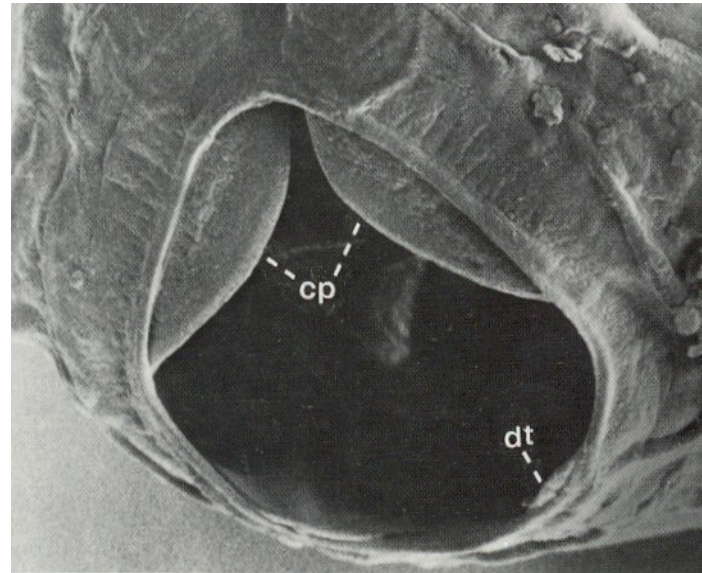
Copulatory bursa is at posterior end and contains 3 lobes supported by 13 chitinous days.



# Morphology of *Necator americanus*

Buccal capsule contains a pair of ventral and dorsal cutting plates.

Copulatory bursa is at posterior end and contains 3 lobes supported by 14 chitinous dactyls.





## Location in the Host:

Small intestine (jejunum, duodenum less often).

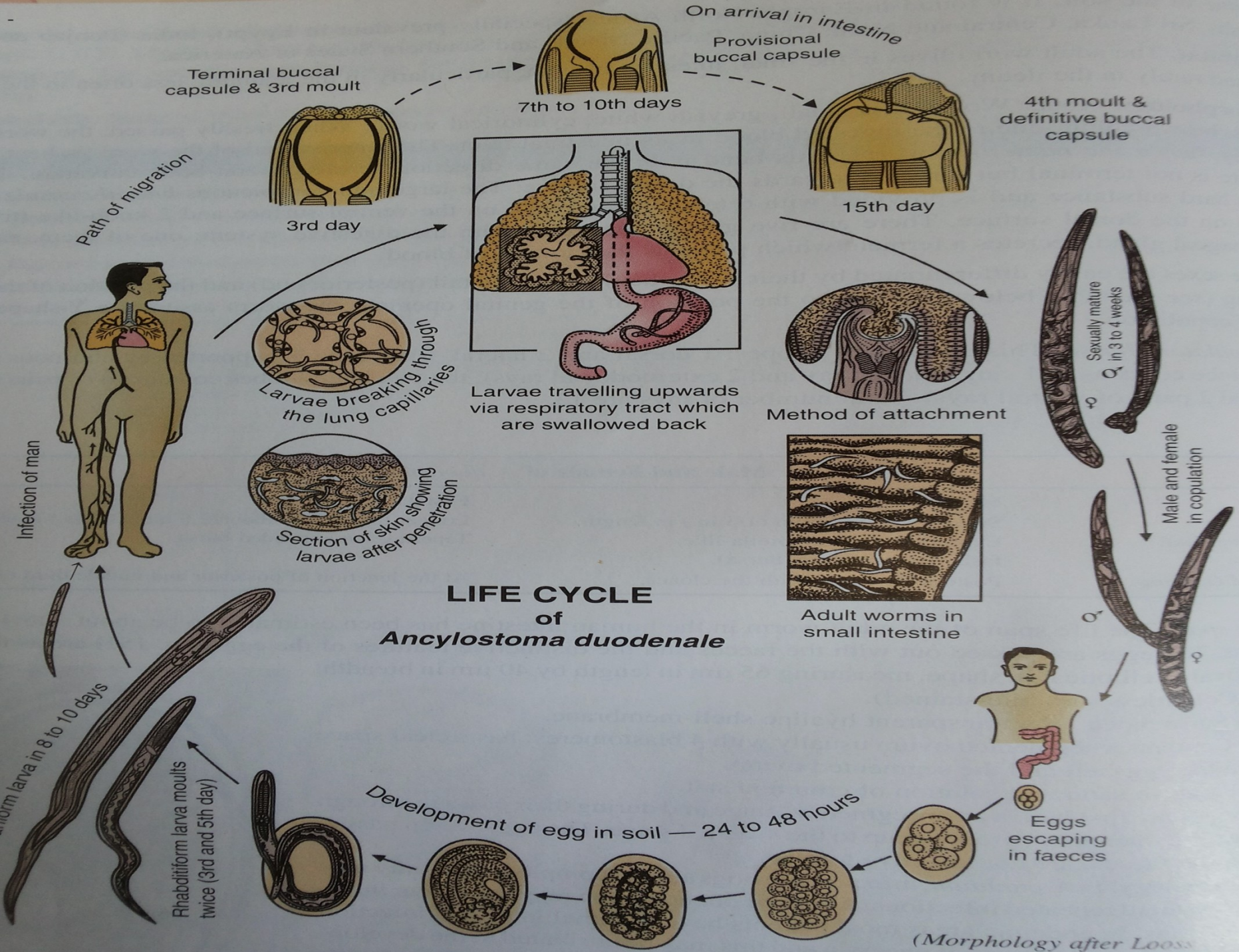
**Life Span: 5-7years**

### *Characteristic of Hookworm eggs*

- 1. Identical in two species.*
- 2. Oval or elliptical in shape*
- 3. Colourless (Not bile stained).*
- 4. Has clear space b/w egg and segmented ovum.*
- 5. Floats in saturated salt solution.*
- 6. Not infective when freshly passed*



Both species show high fecundity: *A. duodenale* produces 25,000 to 30,000 eggs/day..*N. americanus* produces 9,000 eggs/day.



# Pathogenicity & mode of infection

Disease--- Wookworm or Ancylostomiasis.

Characterised by .....

**Anaemia**

Mode of Infection:

Whenever man walks barefoot on the faecally contaminated soil.

Filariform larvae penetrate directly through the skin.

Most common site:

**Thin skin b/w toes**

**dorsum of the feet**

**Inner side of the sole**

Infecting agent:.....

Migration.....

Portal of entry.....

Site of Location.....

# Pathogenic effects caused by Ancylostome Larvae

Lesion in the Skin

Ancylostome Dermatitis or Ground Itch

Creeping eruption:

*Filariform larvae wander about through the skin in an aimless manner for several weeks and months (up to 2 years), producing a reddish itchy papule along the path traversed by the larvae (“Larvae migrans”).*

*More commonly seen with species of parasites (A. braziliense and A. caninum).*

***Lesion in the lungs: Bronchitis and broncho pneumonia.  
Eosinophilia***

# Pathological Problems in Humans:

1. \_\_\_\_\_ (= Creeping Eruption)

*L<sub>3</sub> of dog or cat hookworms enter human skin and wander about in epidermis*

*L<sub>3</sub> are unable to penetrate into the dermis and are eventually killed by our immune system*

*Wandering L<sub>3</sub> cause a red, itchy irritation*

*Treated with thiabendazole ointment*

*Another reason to clean up dog and cat feces!*





# Pathogenic effects caused by Adult worms

*A severe progressive anaemia of microcytic hypochromic type.*

Reason

Blood sucking by the worm.

Average blood loss with *N.americanus*. (0.03ml),  
with *A.duodenale*(0.2

Chronic haemorrhages from the punctured sites.

## Clinical symptoms of Hookworm Anaemia

- Epigastric tenderness simulating duodenal ulcer.
- Dyspepsia, vomiting, Diarrhea.
- Patient may have an abnormal appetite showing a perverted taste for earth, mud or lime(Geophagy). Hypoacidity is more common. Bowels are generally constipated.



*Site of old haemorrhage and recent haemorrhage (Small Intestine in Ancylostomiasis).*

- ❖ ***Skin– Sallow appearance (light yellow colour). Mucous membrane of eyes, lips and tongue show extreme pallor.***
- ❖ ***Face appears puffy with swelling of lower eyelids.***
- ❖ ***Oedema of the feet and ankle.***
- ❖ ***Overall patient looks plumpy with protuberant abdomen and dry lustreless hair. Growth and development in children may be retarded.***
- ❖ ***Cardiovascular system is effected and may lead to circulatory failure.***



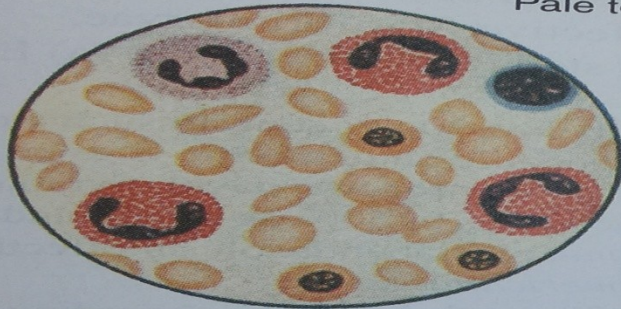
# HOOKWORM ANAEMIA



Pale tongue



Pale conjunctiva



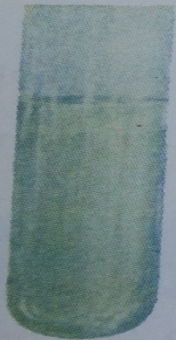
Eosinophilia & hypochromic anaemia



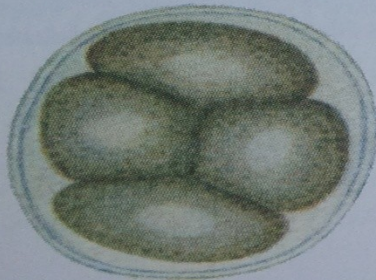
General appearance



Oedema of foot (Pitting on pressure)

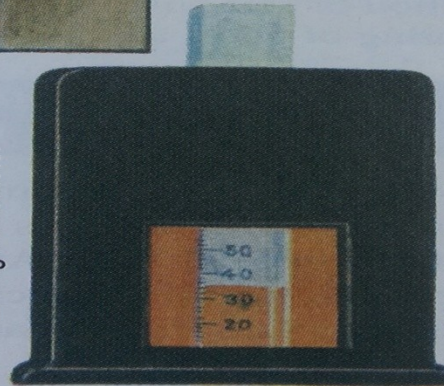


Occult blood test in stool positive

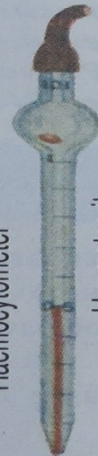


Hookworm egg in stool

Haemoglobinometer



Haemocytometer



Haematocrit



# *Blood changes in Hookworm Infection*

	Hypochromic Anaemia	Macrocytic Anaemia	Dimorphic Anaemia	Normal Range	
Red blood cells in millions per mm <sup>3</sup>	2.9	0.73	1.3	4.8 to 5.5	} For adult male
Haemoglobin in g per 100 ml of blood	4.6	3.48	3.77	15 to 17	
Packed cell volume (PCV) in per cent	21	10	16	43 to 47	
Mean corpuscular volume (MCV) in femtolitres (fl)	72	137	123	75 to 100	
Mean corpuscular haemoglobin (MCH) in picogram (pg)	16	47	24	24 to 33	
Mean corpuscular haemoglobin concentration (MCHC) in per cent	22	34	23	30 to 36	



# Diagnosis

DIAGNOSIS - identify the eggs  
in the feces

All hookworm eggs look the same  
so can't ID species

Eggs are ovoid with thin, smooth  
eggshell.

Size: 55-75  $\mu\text{m}$  x 35-40  $\mu\text{m}$ .

Concentration method is generally  
employed.



# Indirect method

- ❖ *Blood examination to ascertain the nature of anaemia and presence of eosinophilia.*
- ❖ *Test for occult blood in the stool gives a positive reaction.*
- ❖ *Charcot-Leyden crystals found in stool.*

# Treatment

- ❖ *Thiabendazole(25mg/kg for two days), pyrantel pamoate (oral dose of 10mg/kg for 3 days, maximum 1gm).*
- ❖ *Mebendazole(100mg twice daily for 3 days or 500mg once).*
- ❖ *Albendazole(400mg once).*

*For Anaemia- Oral iron (Ferrous sulphate 200 or 400mg thrice daily).*

*Folic acid and Vitamin B<sub>12</sub>.*

## PREVENTION:

### *1. Attack on Larvae*

\_\_\_\_\_ - *stop pollution*  
*of soil with infected feces*

*This could eliminate much of the problem.*

### *2. Personnel protection*

\_\_\_\_\_ - *prevent*  
*penetration of skin.*

### *3. Attack on adult parasite*

.....*Prevent spread of disease (Treatment en masse).*

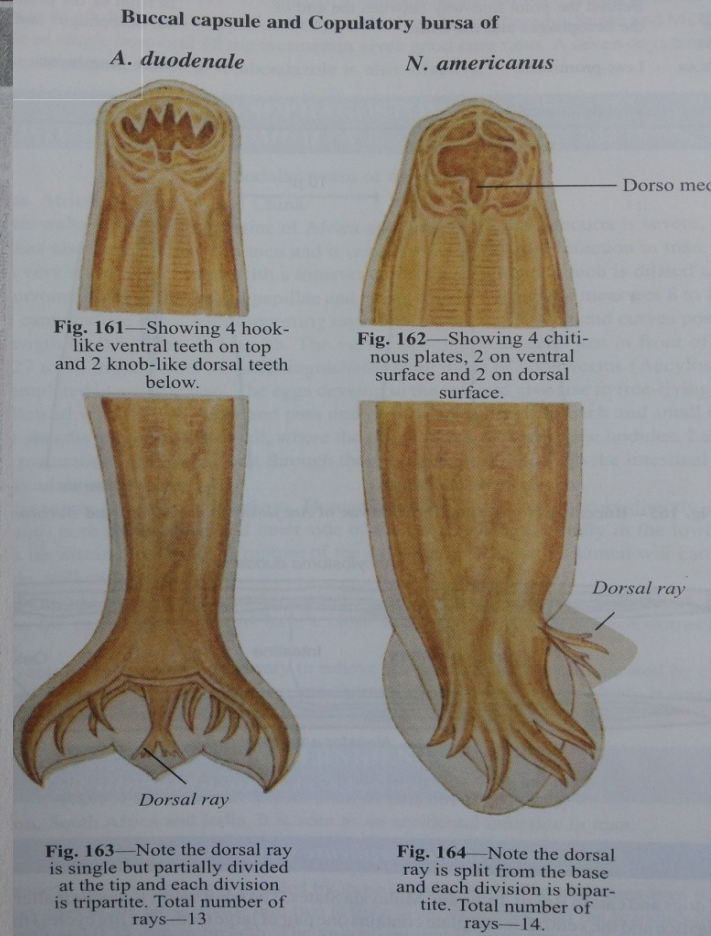
# *Necator americanus* (American hookworm/The New worldhook worm)

*First discovered in America.*

*Most commonly seen in Sri Lanka and India.*

*Differentiating features of two species.*

Feature	<i>A. duodenale</i>	<i>N. americanus</i>
Size	Large and thicker	Smaller and more slender
Anterior end	Bends in the same direction as the body curvature	Bends in the opposite direction to the body curvature
Buccal capsule	Six teeth—4 hooklike on ventral surface and 2 knob like on dorsal surface	Four chitinous plates—2 on ventral surface and 2 on dorsal surface
Copulatory bursa	13 rays present	14 rays present
Posterior end of female	Spine present	Spine absent
Vulval opening	Present behind the middle of the body	Present in front of the middle of the body
Pathogenicity	More pathogenic	Less pathogenic

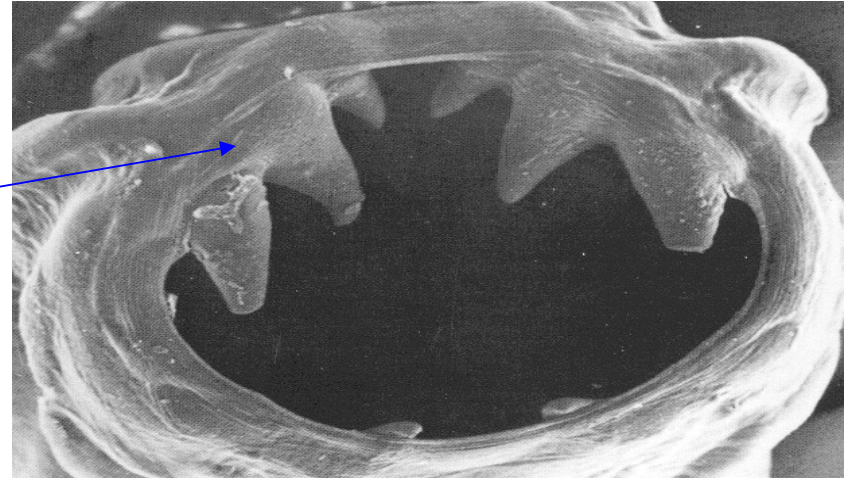




# Dog and Cat Hookworms

Dog hookworm -  
*Ancylostoma caninum* - is easily recognized by its **3 pairs of teeth** in the buccal capsule.

Cat hookworm -  
*Ancylostoma braziliense* - has a **pair of long teeth**.

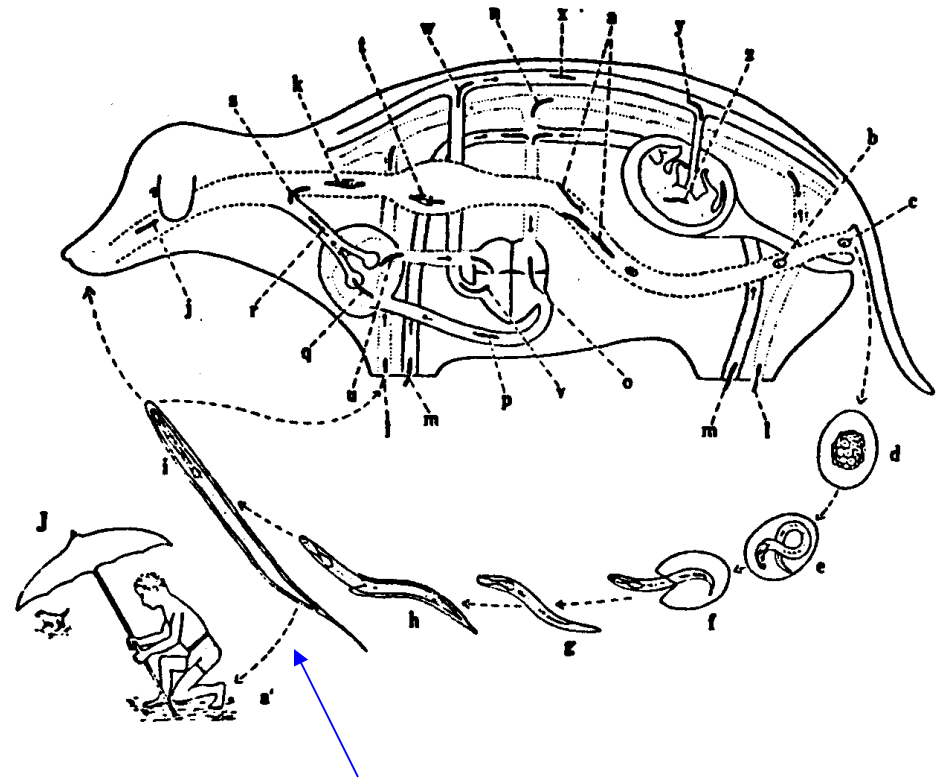


# Dog and Cat Hookworms

Both species inhabit the small intestine of their hosts.

Life cycles and pathology are similar to human species.

HUMANS may serve as accidental hosts of these hookworms when the filariform larvae ( $L_3$ ) penetrate human skin.



$L_3$  penetrates human skin

Thanks