

INTRODUCTION

A Reflex is defined as an involuntary consistent reaction to a stimulus. This reaction is due to a number of neuro-pathways which ultimately make up a Reflex Arch.

The Reflex Arch involves impulse reception, integration and interpretation and finally an automatic involuntary response. This reflex arch is what provides for quick response towards harmful stimulus which would otherwise result in injury if disturbed in any way.

Reflexes of the ~~to~~ body can be classified on various factors, and are thus classified based on:

(A) Function : aimed at describing the movement of an organ due to the reflex.

(B) Degree of Complexity : describes nervous organisation and how complex the neuron is; hence divided into (i) Monosynaptic Reflex
(ii) Polysynaptic Reflex.

(C) Development : divided also into either (i) Innate Reflexes
(ii) Acquired Reflexes.

(D) Response : (i) Somatic Reflexes
(ii) Visceral (Autonomic) Reflexes.

This Lab will be based on Reflexes categorised according to ~~the~~ response. These responses are further either due to Cranial or Spinal nerves and the Arch in complete encompasses fibre structures to bring the response to a stimulus to completion and these are.

(A) Somatosensory Receptor

⇒ Receives information and generates impulses due to stimulus.

(B) Afferent Nerves

⇒ Transmits information from the receptor to the spinal cord or brain.

(C) Integrating Centre

⇒ For Response generation by effectively processing the information

(D) Efferent Nerve [Spinal and Cranial Nerves]

⇒ Carries the respective information from the spinal cord to the effector organ.

(E) Effector Organ

⇒ Receives information from effector neurons and participates in generating appropriate response (Reflex)

The Reflexes, as mentioned earlier, which will be investigated in this lab belong to the category based on Response.

These reflexes include

Deep Tendon Reflexes

- (i) knee jerk
- (ii) Biceps jerk
- (iii) Achilles reflex
- (iv) Jaw jerk

Superficial Reflexes

- (i) Abdominal Reflex.
- (ii) Plantar Reflex.
- (iii) Corneal Reflex.

Autonomic Reflexes

- (i) Accommodation Reflex.
- (ii) Pupillary light Reflex.

These Reflexes are important to clinicians in that they help to (a) distinguish between upper motor neuron lesion (UMNL) and lower motor neuron lesions

- (b) Assessing the progression and severity of neurologic disorders.
(c) Assessing the effectiveness of treatment of neurologic disorders.

AIMS AND OBJECTIVES

- ⇒ demonstrate and record the findings of reflexes of the human body.
- ⇒ describe the components of the reflex arch.
- ⇒ distinguish amongs deep, superficial and autonomic reflexes.

MATERIALS AND METHODS.

- (A) MATERIALS - Patellar hammer
- ~~Pen~~ torch.
- Ruler (Blunt object).
- Pin / Needle.
- Cotton wool
- Test Subject

(B) METHOD

⇒ DEEP TENDON REFLEXES

- (i) Knee jerk reflex : ~~the~~ Subject set on a high stool with legs hanging freely without touching the floor.
→ The knee is gently hit on the patellar tendon and the results recorded.
→ The subject ~~was~~ then told to clench both hands tightly with closed eyes and the knee ~~was~~ hit again and results recorded.

(i) Calcaneal Reflex: Subject was made to kneel on a stool with foot freely hanging [Ankle Jerk].
- The Achilles tendon was tapped and the results recorded.
- The procedure was repeated but this time with the subjects hands clenched tightly and the results recorded.

(ii) Biceps Reflex: The operator made the subject place his left bent arm (subject) at an angle of about 90° over the ^{left} arm of the operator.
- The operator then located the Biceps tendon with his thumb and hit it with ~~hand~~ the patellar hammer and the results were recorded.

(iv) Jaw Jerk: Subject was made to slightly open the mouth ~~the~~ the operator then placed two fingers horizontally above the chin and below the lower lip.
- The finger where tapped by patellar hammer and the results recorded.

SUPERFICIAL REFLEXES

(i) Upper abdominal Reflex: The Subject was made to lie down without the shirt.
- The abdominal margins were scratched moving towards the umbilicus.
- The results were recorded as observed.

(ii) Lower Abdominal Reflex - Subject in same position as upper abdominal Reflex.
- Scratched from abdominal margin

Lower Abdominal Reflex: Scratched from lower margins of abdomen below umbilicus towards umbilicus.
- Observations are made & the results recorded.

(B) Plantar Reflex: Subject was made to lie down with his feet exposed or made bare.
- The feet are scratched with blunt end of patellar hammer firmly along the outer edge of the sole of the foot from the heel all the way to base of the small toe.
- Observations were made and the results recorded.

(C) Withdraw Reflex: The subject was made to sit and relax on the stool.
- The operator then pricked him with a needle on the dorsum of the hand.
- Observations were made and the results recorded.

(D) Corneal Reflex: - The operator gently touched the periphery of the cornea with a clean piece of cotton wool.
- Results were recorded.

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PUPILLARY REFLEXES.

- (i) Pupillary light Reflex. :- Subject is made to stand opposite looking at operator
- The subject is told to hold one of his hands inbetween his eyes in the vertical direction crossing the vision
 - The operator shines light into one eye and observes its reaction
 - The operator shines light in same eye as before and observes the other eye
 - Observations were made and the results recorded.

- (ii) Pupillary Accommodation :- Subject stands opposite operator
- Reflex
- The operator held his index finger about 30cm from the subjects eyes and slowly moved it towards the subjects vision.
 - Observations were made & the results recorded.

RESULTS

Reflex	Observation	Spinal Segment	Conclusion
STRETCH REFLEXES (DEEP TENDON REFLEXES)			
Patellar Reflex	(i) No Reinforcement - Slight jerk/kicking movement (ii) Reinforcement - Greater kicking movement & observed.	L2 - L4	Normal Reflex.
Ankle Reflex	(i) No Reinforcement - Slight plantar flexion. (ii) Reinforcement - Greater plantar flexion reaction.	S1 - S2	Normal Reflex
Biceps Reflex	- Slight flexion of forearm and contraction of Biceps felt by thumb	C5 - C6.	Normal Reflex.
Jaw Jerk	→ Slight upward movement of lower jaw (Mandible)	C1/V3 Mandibular of Trigeminal nerve.	Normal Reflex.
SUPERFICIAL REFLEXES.			
Withdraw Reflex	- Quick withdraw of hand & forearm		Normal/Positive Response.
Plantar Reflex	→ Plantar flexion of all the toes		Negative Babinski Sign Normal Response.
Upper Abdominal Reflex	→ Contraction of Abdominal muscles.	T6 - T11	Normal Response
Lower Abdominal Reflex	→ Contraction of Abdominal muscles but less evident as upper abdominal Reflex.	T9 - T12	Normal Response.

REFLEX	OBSERVATION	SPIRAL / CRANIAL SEGMENT	CONCLUSION
Corneal Reflex	⇒ closing / quick blinking of subject as cotton wool approached cornea	Trigeminal nerve (CN V) and Facial nerve (CN VII)	Normal Response
PUPILLARY REFLEXES			
Pupillary Light Reflex	⇒ direct and consensual pupillary constriction when light shone in one eye.	Optic nerve (CN II)	Normal Response.
Accommodation Reflex			
(i) Convergence	⇒ Eyeballs adduct as finger draws closer to vision.	Oculomotor Nerve (CN III)	Normal Response.
(ii) Pupil Size	⇒ Bilateral Constriction of pupil as finger draws closer to vision.	Optic nerve CN II	
(iii) Shape of lens (iii) Shape of lens	⇒ not observed.		

DISCUSSION

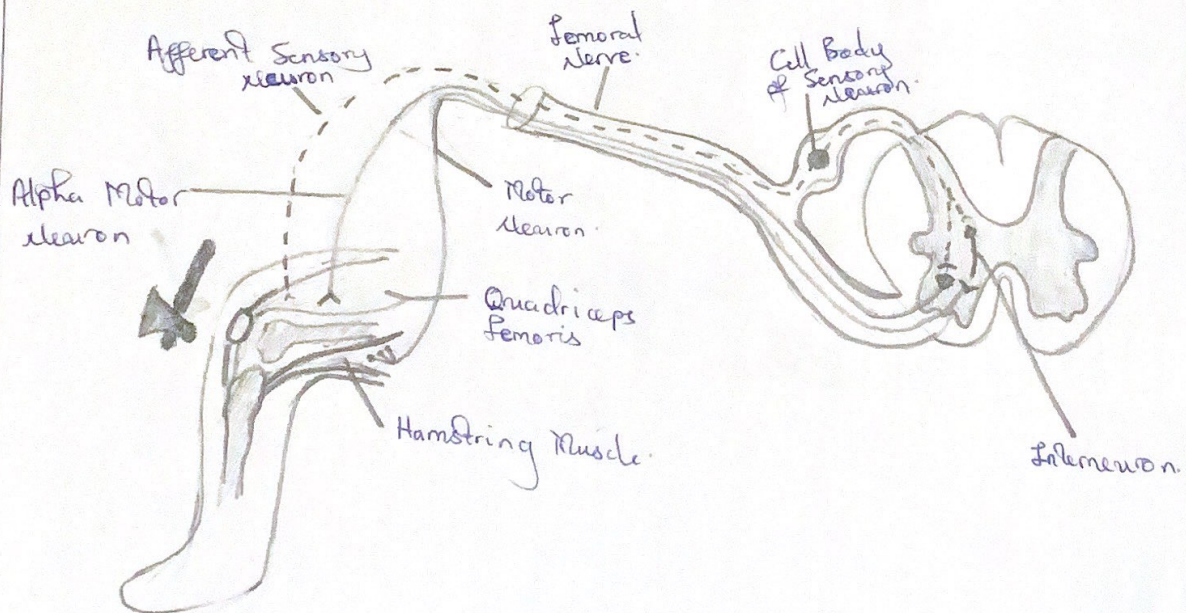
DEEP TENDON REFLEXES

* PATELLAR REFLEX

This Reflex belongs to the deep tendon Reflexes. On tapping on the patellar tendon, there was a slight kicking motion observed.

The response was indicative of proper function of the Reflex Arch associated with the knee joint. When the tendon is tapped upon, muscle spindles pick up the stimulus and ~~pass~~ excite the sensory afferent neuron which then synapse with efferent motor neurons in the Anterior Grey horn. The Motor neuron (Alpha Motor neuron) then stimulates the Quadriceps femoris to elicit the kicking reflex.

This whole pathway happens through the femoral nerve via the segments L2, L3 and L4.



The Reflex was exaggerated (increased) when the subject was told to close his eyes and tightly pull on his fingers, which was indicative of increased muscle tone on distracting the subject. Reinforcement thus increased both the strength and speed of the Reflex.

③ ANKLE REFLEX.

This reflex tests for spinal segments S_1 and S_2 by tapping on the strongest tendon of the human body. During examination a tap on the Achilles tendon there was a slight plantar flexion observed.

This response showed normal reflex arch of the calcaneo reflex. The plantar flexion resulted from involuntary contraction of muscles in response to tapping of the Tendon by the patellar hammer.

Pathway.

Muscle Spindle \rightarrow Afferent (sensory) Neuron \rightarrow Synapse in Anterior Grey Horn.



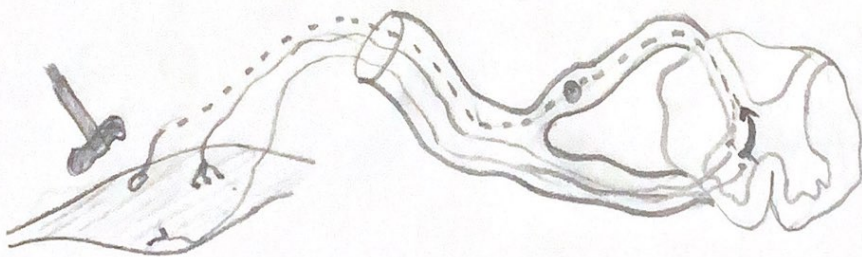
Alpha Motor Neuron



Triceps Surae.



Contraction (Response).



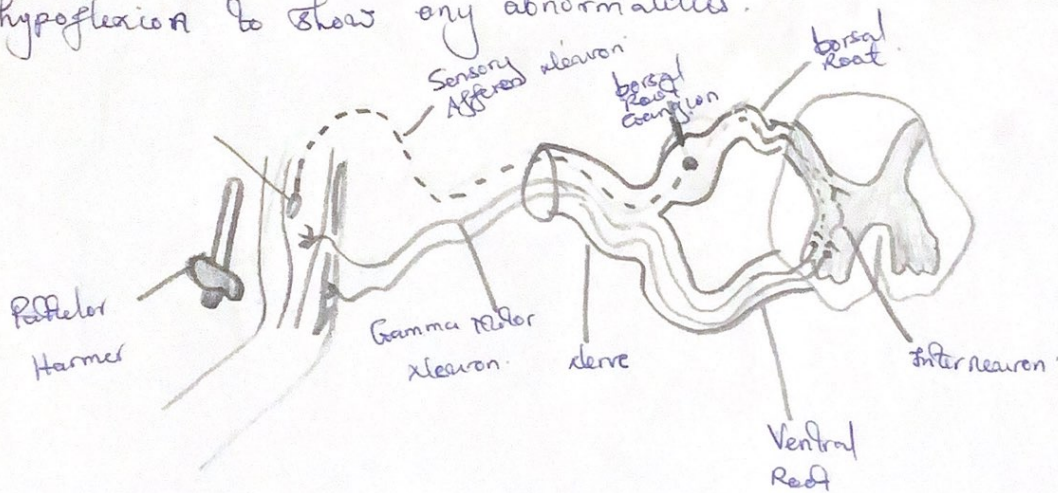
(C) BICEPS REFLEX.

It is another deep tendon that was done to test the spinal segments C5-C6. In the exam, there was slight flexion of forearm but tendon contraction was strongly felt by examiner which indicated normal response to tapping on biceps tendon.

Pathway:

Muscle Spindle In → Afferent (Sensory) Neuron → Alpha Motor Neuron in Anterior Grey Horn
↓
Biceps Brachii Muscle
↓
Contraction of Muscle [Response felt].

There was no evident indication of hyperflexion or hypoflexion to show any abnormalities.

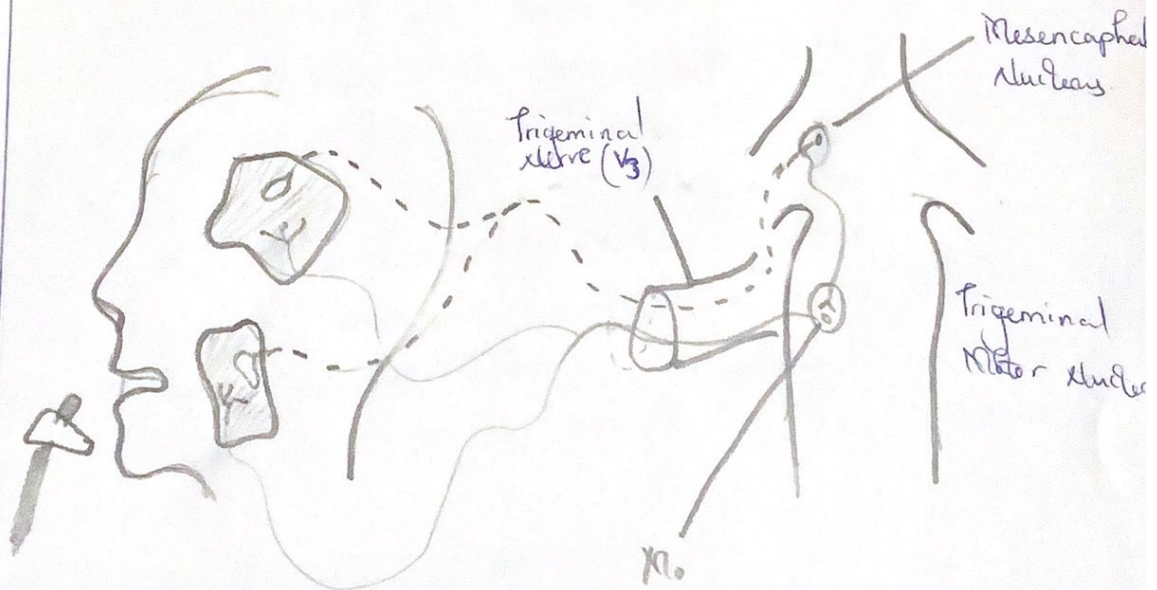


(H) JAW JERK REFLEX.

Deep tendon reflex for testing the 3rd division of the trigeminal nerve, the Mandibular nerve. On tapping on the mental, the space between the chin and ~~upper~~ lower lip, with mouth of subject slightly opened, there was a slight upper movement of the lower jaw.

The response was indicative of normal reflex arch associated with the trigeminal nerves third division.

This reflex differs from other stretch reflexes in that it lacks the reciprocal inhibition on jaw opening motor neurons and contains much lesser muscle spindles as compared to other stretch reflexes.



In the examination and investigations carried out on deep tendon reflexes all the reflexes were normal and graded 3 on the MMS Myotic Reflex scale. MMS Scale helped in assessing for any abnormalities in the reflexes from Absent to hyperexpression.

The deep tendon reflexes provide the physician with a clear picture of what could be affecting the patient and as such provide the relevant treatment. As no abnormalities were recorded, the subject was healthy and fit.

On the other hand, had the subject elicited hyperreflexia on any of the reflexes it would have been a clear indication of an upper motor neuron lesion (UMNL) and would have warranted further investigation.

If reduced or hyporeflexia was observed, then it would have been an indicator of a lower motor neuron lesion (LMNL) and also warranted further medical examination. Any disease or disruption to the lower motor neuron would have also resulted in absent reflexes depending on the extent of the injury.

SUPERFICIAL (CUTANEOUS) REFLEXES.

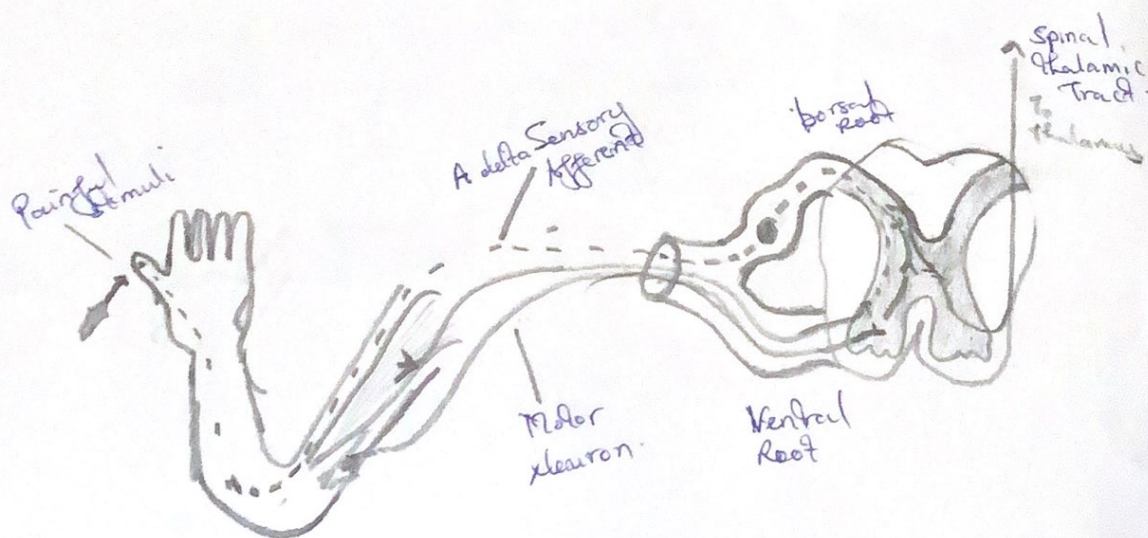
These are reflexes that are elicited by stroking the skin or mucous membranes. These were done in the experiment which include.

(A) WITHDRAW REFLEX.

This is an automatic response to pain, it is critical in protecting the body from painful or harmful stimuli. In the experiment, the subject was pricked with a needle on the hand to which he responded by quickly flexing and pulling back of the hand.

The Reflex of withdraw, the reflex arch, involves neural pathways that permit the spinal cord to integrate and offer stimuli as response before impulses could reach the brain. This permits for faster action by activating spinal motor neurons from the spinal cord rather than transmitting information all the way to the brain and awaiting response.

This Reflex can occur on either the upper or lower limbs and hence has various spinal segments associated to it depending on the area stimulated.



(B) ABDOMINAL REFLEX.

A Reflex used to assess spinal segments T₆ - T₁₂. In the experiment the Subject was made to lie down and he was Stroked from the margins of the abdomen to the umbilicus in two different way. Firstly only the part above the umbilicus and secondly only the part below the umbilicus [Above: T₈ - T₉ Below T₁₀ - T₁₂]

In both instances light muscle contractions were seen with those above the umbilicus being more pronounced. The umbilicus deviated towards the area of stimulation on each stroking.

The Response recorded was a normal positive response indicative of no neurological deficits in the Abdominal reflex arch.

An Absent Abdominal Reflex would be indicative of a number of conditions, including an Upper Motor Neuron lesion, Brown Sequard Syndrome, Chiari Malformations and multiple sclerosis. In addition to these it could also be due to psychological causes such as obesity and tolerance.



(C) PLANTAR REFLEX.

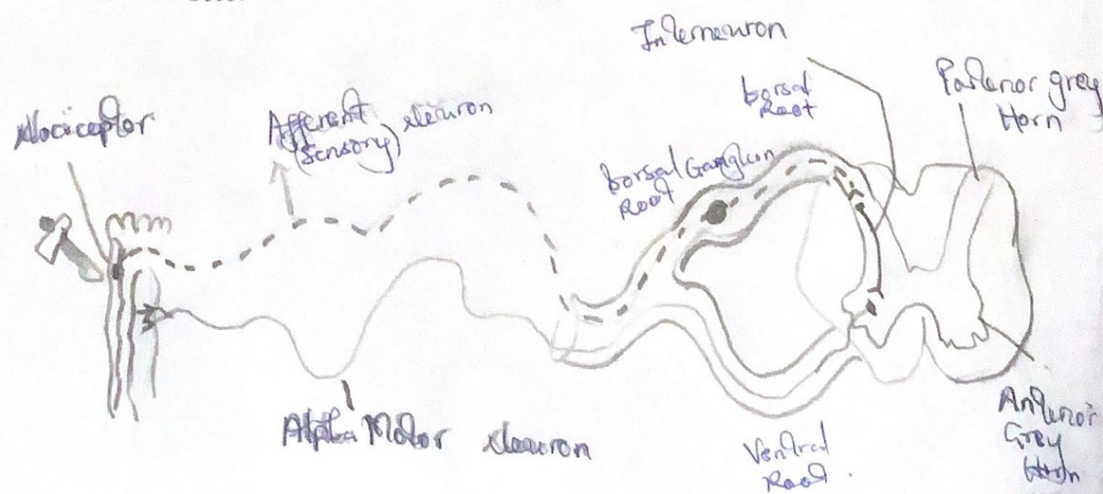
The plantar reflex is a nociceptive segmental spinal reflex that serves the purpose of protecting the plantar surface of the foot.

In the experiment the subject was shocked by the blunt end of the patellar hammer from margins of the sole to the base of the small toe. The subject on shocking the foot plantar flexed all ~~his~~ her toes. This was a direct indication of a positive normal response.

This reflex is important to a physician as it helps determine whether a patient has an upper or lower motor neuron lesion. This test is called the Babinski test and when positive ~~the~~ for an upper motor neuron lesion (UMNL) is elicited by flexion of the big toe and extension ~~of~~ or fanning out of the other toes.

It is important to note though that the Babinski sign is positive in new borns as a result of incomplete neurological development.

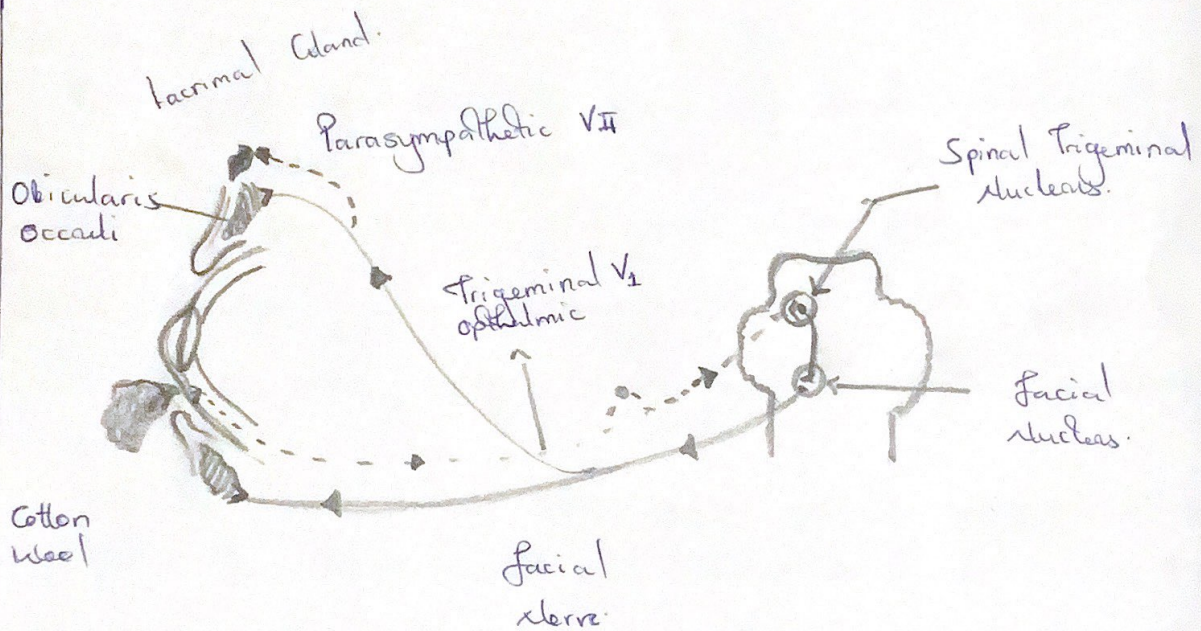
The spinal segment involved in this segment involve L5 and S1 and includes the Tibial and Sciatic nerves.



⑤ CORNEAL REFLEX

This reflex deals with eyes, substances that come in contact with the cornea irritates it and immediately initiates a blink reflex.

In the experiment, a piece of cotton wool was used to touch the cornea which resulted in blinking of the eye and slight tear production. This response was a normal response and is indicative of normal corneal reflex.



Damage to either the Ophthalmic division of the Trigeminal or facial nerves would cause damage to the blink reflex either to the sensation or motor nerve to the obicularis.

All Superficial Reflexes are important in identification of various neurological issues including Upper Motor Neuron lesions, and decreased pain sensation.

(3) PUPILLARY REFLEXES

(i) PUPILLARY LIGHT REFLEX

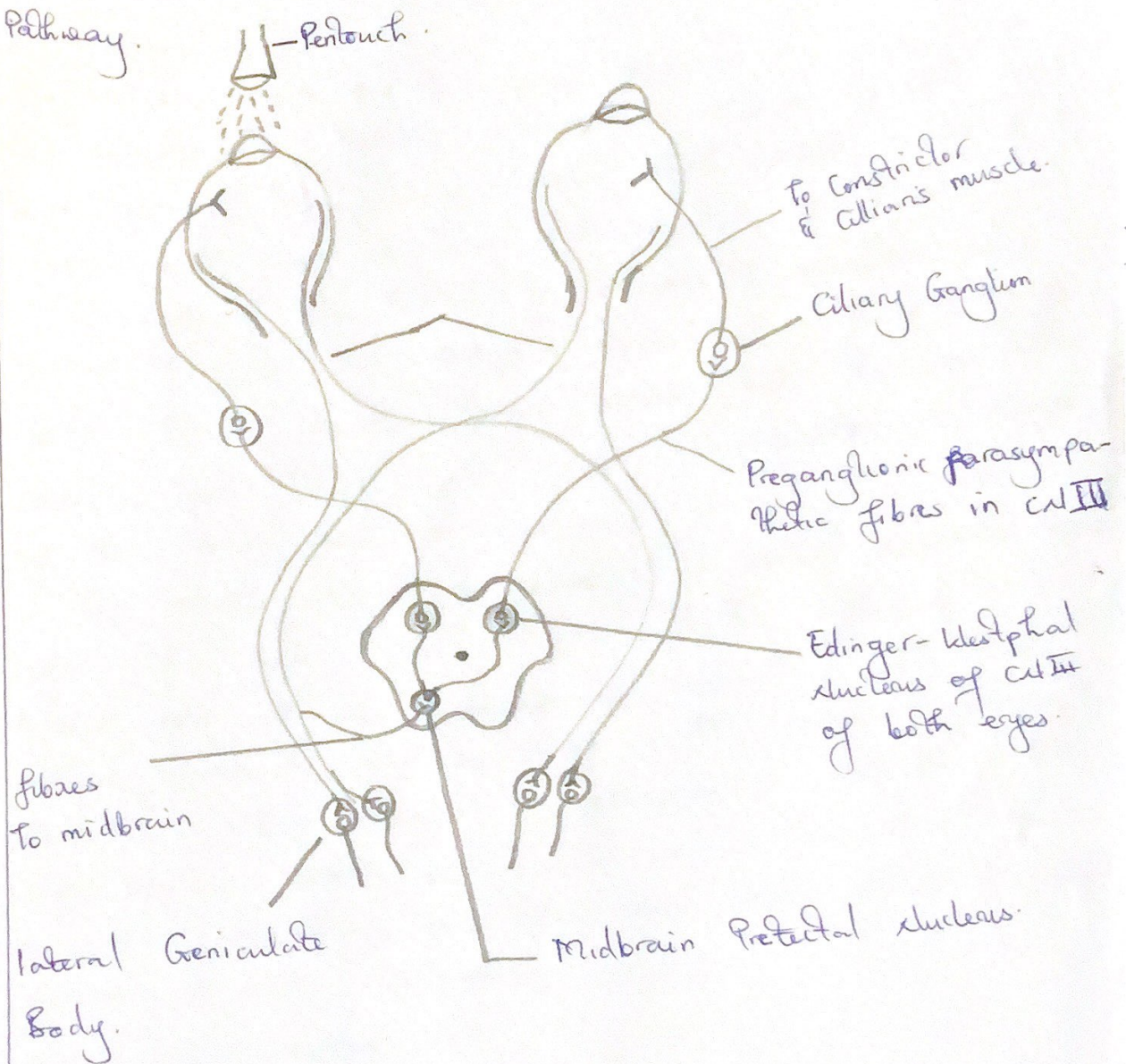
This Reflex involves shining light into one eye and observing the reaction of both pupils to the light.

The subject was made to place one hand inbetween the eyes to prevent light from entering the other eye and both the eye where light was shone and not shone were observed for pupillary response. It was noted that there was both direct and consensual pupillary constriction.

Observing reaction of both pupils permits for examination of both the Optic (CNII) and Oculomotor (CNIII) nerves and the appropriate neurological pathway and function of these nerves. In the subject the response was normal which showed no evidence of a lesion at any point of the light pathway.

Apart from lesions various other things could cause either dilation or constriction of the pupils and these include diseases, drug toxicity, trauma, increased intracranial pressure, Brainstem damage and arousal.

Pathway.



(1) ACCOMMODATION REFLEX.

This reflex focuses on the visual response for focusing on near objects. The reflex involves convergence of both eyes, contraction of the ciliary muscle which results in change of shape and pup of lens and pupillary constriction.

The subject was tested by moving the operator index finger towards the subjects vision from a distance of about 30 cm. As the finger draws closer the eyes (both) adduct and the pupils constrict. Observation of shape of the lens was not observable.

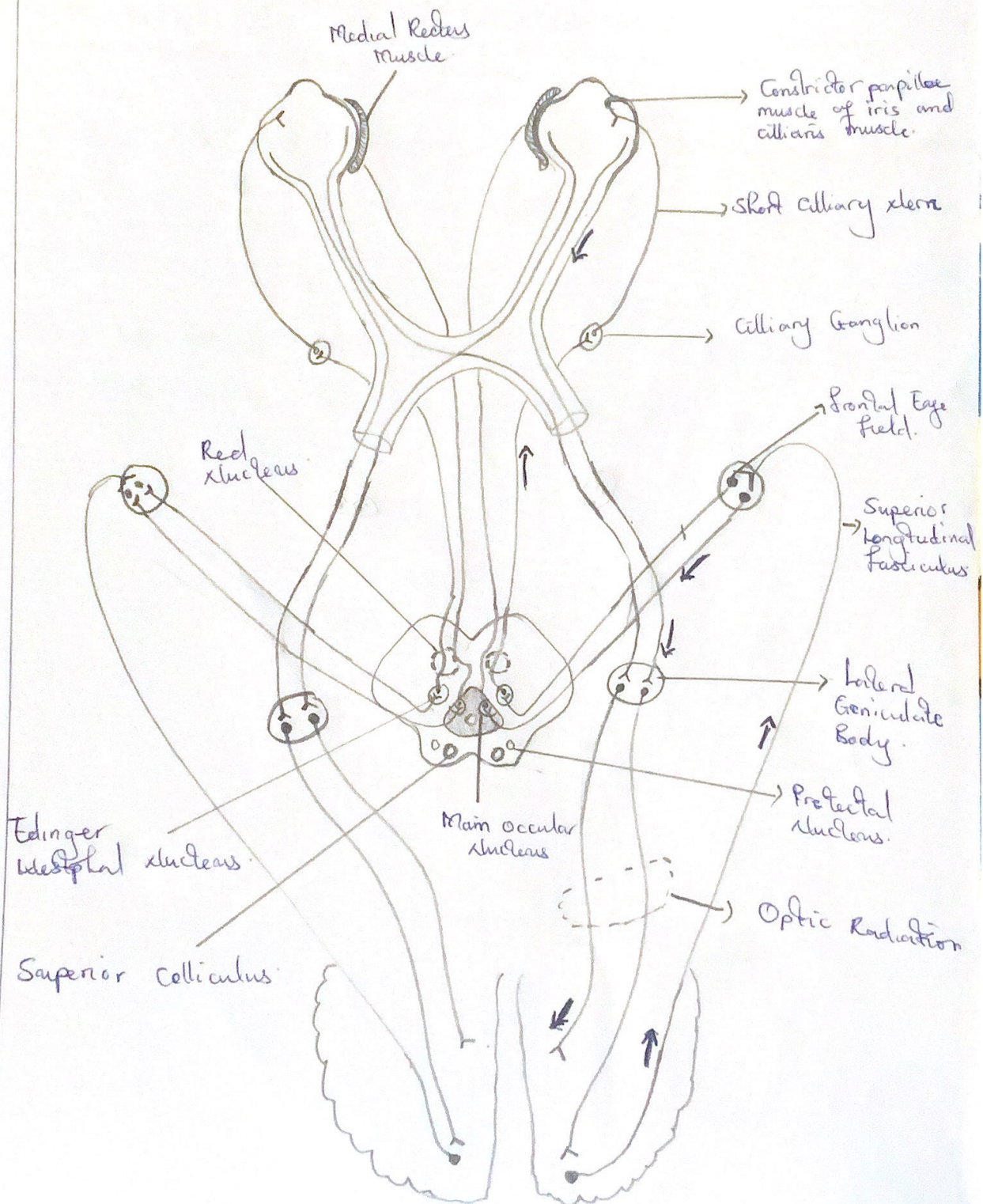
The results recorded ~~are~~ indicated normal accommodation reflex. Any damage or disruption to this pathway and either one of the ~~pt~~ nerves associated with this pathway results in disruption to the reflex. Neurological conditions that result in accommodation deficits include Supranuclear lesions, encephalitis, pineal tumours or neuromuscular disorders like myasthenia Gravis, others include glaucoma and viral diseases.

Accommodation Reflex arch



[Turn Over].

*Accommodation Reflex Arch.



REFERENCES

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EXERCISE

QUESTION 1.

⇒ Possible Paraplegic Injury.

⇒ Paralysis from this injury indicates a lower motor neuron lesion, this would cause hyporeflexia thus reduced or absent Patellar Reflex.

PATHOPHYSIOLOGY : ⇒ A Lower Motor Neuron Lesion is indicative of damage to the spine below the pyramidal decussation or the peripheral nerves innervating the muscles.

→ Within the Spinal Cords descending Cortical Spinal Tract are the Alpha (α) and Gamma (γ) Motor Neurons.

* Alpha motor neurons carry impulses which mediate muscle contraction.

* Gamma motor neurons carry impulses which mediate the stretch reflex.

⇒ Damage to these nerve in the spinal cord or anywhere along their path to the effector organ is what results in the following symptoms:

- (i) Muscle weakness
- (ii) Flaccid Paralysis
- (iii) Atrophy.
- (iv) Hypotonia
- (v) Fasciculations
- (vi) Fibrillations
- (vii) Hyporeflexia.

⇒ Mr Kasonde has reduced patellar reflexes / Absent patellar reflexes which is consistent with lower motor neuron lesions.

QUESTION 2.

⇒ Four nerves which participate in eye function may be affected by a neurodegenerative diseases namely.

- (i) Abducens [CN VI] (ii) Optic nerve [CN II]
- (iii) Trochlear [CN IV] (iv) Oculomotor nerve [CN III].

⇒ Mostly the Optic and oculomotor nerves are affected when it comes to the pupillary light reflex as they are the primary mediators of these reflexes.

⇒ There are many ~~big~~ neurodegenerative disease that affect the eyes and they all affect the nerves in different ways. Among the disease and their effects are.

(A) Alzheimers : Causes gradual damage to optic nerve which can ultimately result in blindness.

(B) Multiple Sclerosis : An autoimmune demyelinating disease of the central nervous system, this can damage the optic nerve which is an extension of the forebrain to result into blindness and also the oculomotor nerve resulting in eye movement problems such as nystagmus, double vision and optic nerve neuritis.

(C) Parkinsons disease : Mainly affects the oculomotor nerve by damaging dopamine producing neurons of the basal ganglia. The basal ganglia plays important role in control of eye movement through the oculomotor nerve.

⇒ Depending on the disease that one has, any damage or inflammation to either the optic nerve or oculomotor nerve will result in loss of direct & consensual light response as well as the accommodation reflex by ei