Basics of Mental Health and Clinical Psychiatry
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Lecture 05
Cerebral Cortex

Hello everyone. So, today we will start the 5th lecture that is cerebral cortex.

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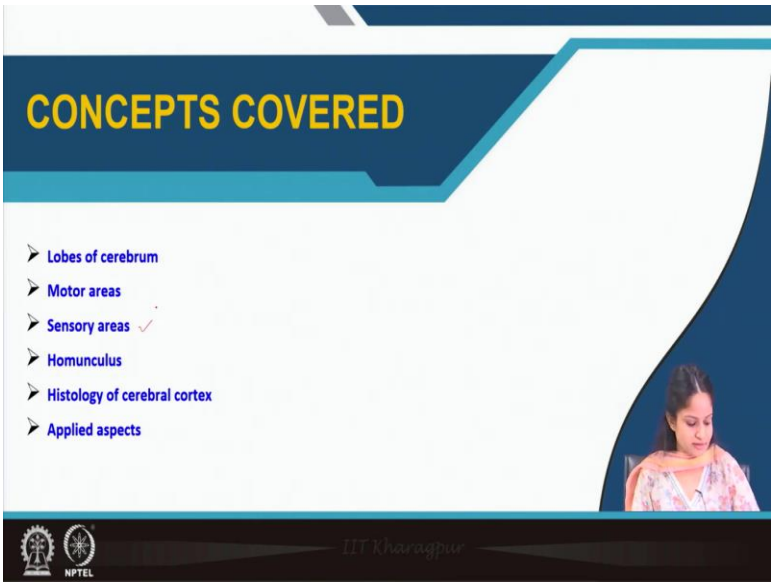

So, in cerebral cortex, the concepts will cover the lobes of the cerebrum, motor areas, sensory areas. The homunculus, histology of the cerebral cortex, that is the cortical cells and the applied aspects. The applied aspects I will cover along with the functions of each areas.

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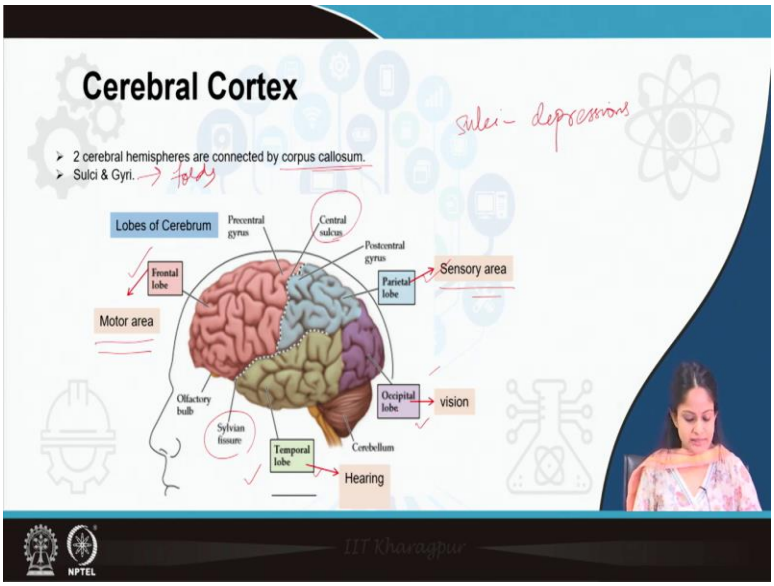

So cerebral cortex. Now, as I had told you in the my first lecture, that the cerebral cortex consists of two cerebral hemispheres. Now this 2 cerebral hemispheres are connected by the white commissural fibers that is corpus callosum. Now, there are sulci and gyri, present all over throughout the cerebral cortex, what is sulci? Sulci is the depressions or the fissures like central sulcus, this is the depressions now whenever you have depression in the side you have some elevations, those elevations and folds are the Gyri.

So, the elevations are the folds Gyri depressions is the sulci. So this is very important. The lobes of cerebrum consists of mainly 4 lobes, frontal lobe, parietal lobe, temporal lobe and occipital lobe. This is seen from the superior lateral surface if I show you so the central sulcus divides this frontal lobe from the parietal lobe, the sylvian fissure, this divides the frontoparietal lobe from the temporal lobe and there is an occipital lobe each are having their different specific functions. Now, we will see what are the functions present in the all this 4 lobes mainly we are concerned with the motor area and the sensory area.

So the frontal lobe is concerned with the motor area. The parietal lobe is concerned with the sensory area, the occipital lobe concerned with the vision and temporal lobe is concerned with the hearing. So, auditory or functions or audition that is said temporal lobe vision occipital lobe parietal lobe is sensory and motor area is frontal lobe, we will come to the motor area.

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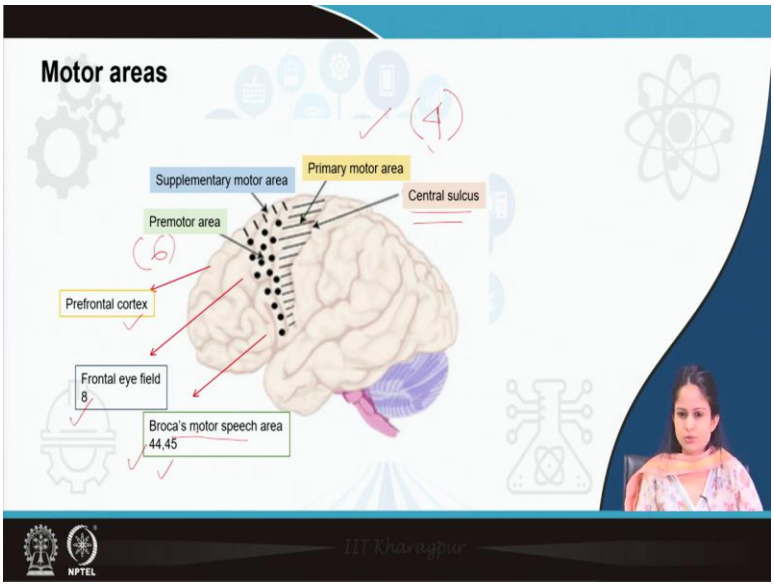

So motor area this is the central sulcus. In front of the central sulcus we have the pre central gyrus. So pre central gyrus forms the major part of the main or the very important part of the motor area that is the primary motor area or area number 4, primary motor area is the area number 4, then we have pre motor area or supplementary motor area in front of the primary motor area. This premotor area is area number 6.

Then we have the prefrontal cortex. This is the prefrontal cortex or the prefrontal lobe, we have frontal eye field that is area number 8 mainly responsible for the movement of the eyes. Then we have the Broca's motor speech area. Now, motor speech area we have a sensory speech area we have a motor speech area.

So the motor speech area which is also known as Broca's area that is area number 44 and 45 is present in the frontal lobe. So these are the motor areas primary motor area number 4 supplementary motor area pre motor area number 6 prefrontal cortex, frontal eye field area number 8 and the broker's motor speech area this this many areas motor areas you have to remember.

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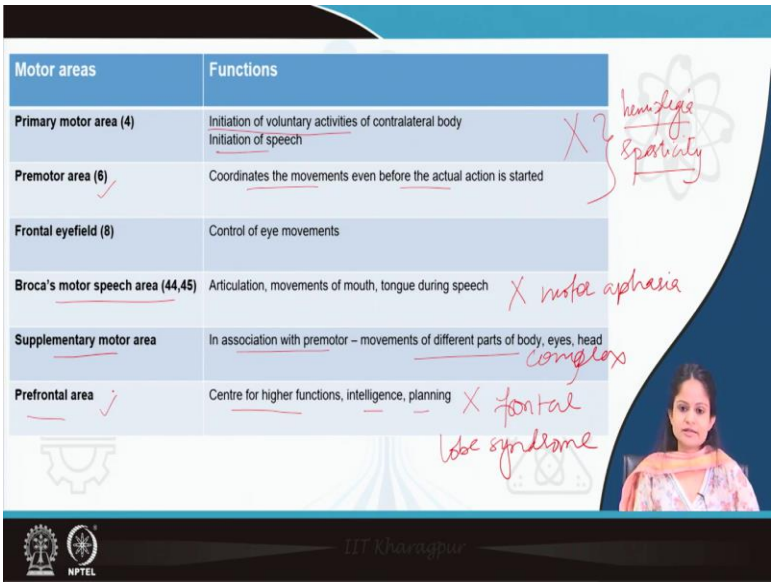

Now coming to the functions of these areas one by one a primary motor area. Area number 4 is mainly responsible for the initiation of the voluntary activities of the contralateral part of the body. I told you cerebellum and cerebrum, the major difference is the cerebellum, your controls the ipsilateral formation control of the body whereas cerebrum, the cerebral cortex controls the contralateral part of the body that means if my right if my left cerebral cortex is damaged, my right side of the body will get paralyzed there will be disturbance in my right side of the body so contralateral control is there.

So primary motor area is mainly responsible for initiation of the movement and simple movements. Simple movements means if I want to just flex the fingers, if I just want to flex one finger, so, this is done by primary motor area also it helps in initiation of the speech. Now pre motor area is area number 6 pre motor area coordinates the movements even before the actual movement has started.

Suppose, if you ask me to flex my hand I will flex my hand because of this pre motor area before even before I flex my hand the premotor area will coordinate obviously, it will coordinate with cerebellum as well as basal ganglia that this is the position of the hand. So, now is it has to get flexed. So, even before the action has started the programming is done or in the pre motor area that is area number 6.

Now, if this primary motor area and pre motor area gets damaged, there it will result in hemiplegia. That means not no lack of movements of one side of the half of the side of the body and this half is definitely the contralateral side of the body and spasticity. So, spasticity means hypertonia that means increased tone of the body that the tone of the muscles will be very, very much increased. So you cannot easily flex or you cannot easily extend the arm. So there will be hemiplegia and spasticity.

So, if this to region gets destroyed, now frontal eye field controls the movement of the eyes, brokers motor speech area 44, 45 It usually helps in the articulation, the movement of the tongue mouth how I am speaking. Now, if this area gets destroyed, there will be motor aphasia. Motor aphasia means I know what I have to speak, but I am not able to speak the word. So, that is motor speech area broker speech area. Now, supplementary motor area supplementary motor area usually works in association with the premotor area movements of the different parts of the body movements of different parts like head eyes.

So, this is mainly done by the supplementary motor area or in short the complex movement are done by the supplementary motor area. Like if you ask me to flex my finger or flex my hand this will be done by the primary motor area, but if you ask me to flex both the hands or do some movements like this, so definitely this for this you require the association motor area or the supplementary motor area, pre frontal area pre frontal area or the pre frontal lobe it is the center of higher functions learning planning, intelligence controlling decision making. So this prefrontal area is mainly responsible for this type of functions.

Now, if pre frontal area gets damaged, the person usually suffers from what is known as frontal lobe syndrome. What is this frontal lobe syndrome? The person will not be able to plan anything there will be flight of ideas. Suppose I am having frontal lobe syndrome, I want to plan something I will get one idea suddenly I will move on to another idea then I will move on to another idea.

So there is no fixed planning I can do difficulty in planning that is see in frontal lobe syndrome along with difficulty in judgment effective behavior, emotional behavior, difficulty in calculations there will be dyscalculia then learning problems memory problems. So, this will all be affected in case of person who is suffering from frontal lobe syndrome or the pre frontal area gets damaged. So, these are areas motor areas you have to remember.

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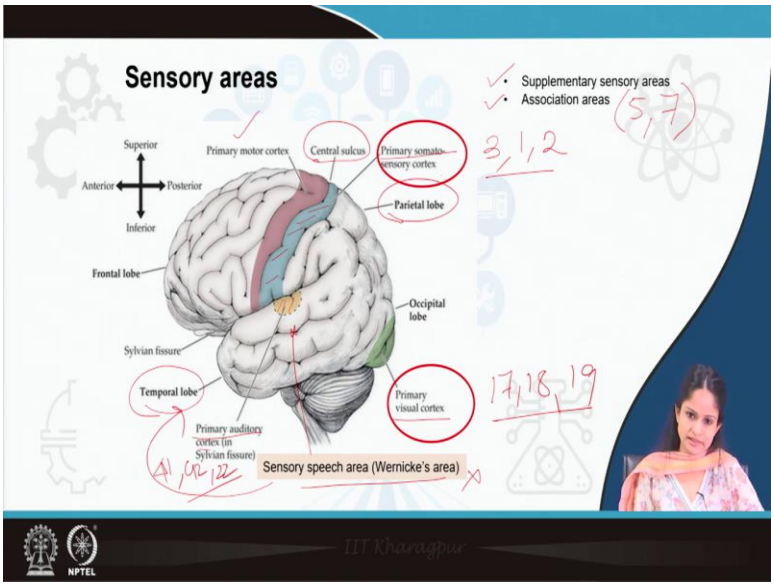

Now coming to the sensory areas, sensory areas lies post or literal are behind the central sulcus. Now this is the central sulcus. In front of the central sulcus we have the motor area usually and the behind the central circus we have the or the lateral to the central sulcus we have this this area is the primary somatosensory cortex.

This area is very important because it receives all the sensory input sensory inputs obviously from the other half of the body because the cerebral cortex control is contralateral. So this primary somatosensory area is usually area number 3 1 and 2 besides this, we have supplementary sensory areas we have other associations sensory areas. This association sensory areas are area number 5 and 7.

Besides this we have temporal lobe temporal lobe is the primary auditory cortex. Now, I told you temporal lobe consists of the auditory area. So, the primary auditory cortex, you can see this area area number 41, 42 and 22. So, this is the primary auditory cortex region along with that we have a sensory speech area, the motor speech area was present in the frontal lobe, the Wernickes next area or sensory speech area is present in the temporal lobe okay it is present in the temporal lobe.

So, what happens in the sensory speech area or Wernickes speech area? This area is mainly responsible for understanding what you were speaking, what I am speaking is making sense because my sensory area or Wernickes speech area is intact, I am able to comprehend what I am speaking, if this area gets destroyed, obviously, I will speak nonsense, I mean I will speak certain

words which have no meaning. If I am not able to speak then my motor area is destroyed. If I am, I do not know what I am speaking or I am speaking nonsense, that means my sensory speech area is destroyed.

And obviously the primary visual cortex that is the occipital lobe, we have the visual area that is 17, 18 and 19 for the vision. So, we will discuss mainly the sensory areas of the parietal lobe, because occipital lobe is mainly concerned with the vision and temporal lobe is mainly concerned with the sensory speech area and the auditory area.

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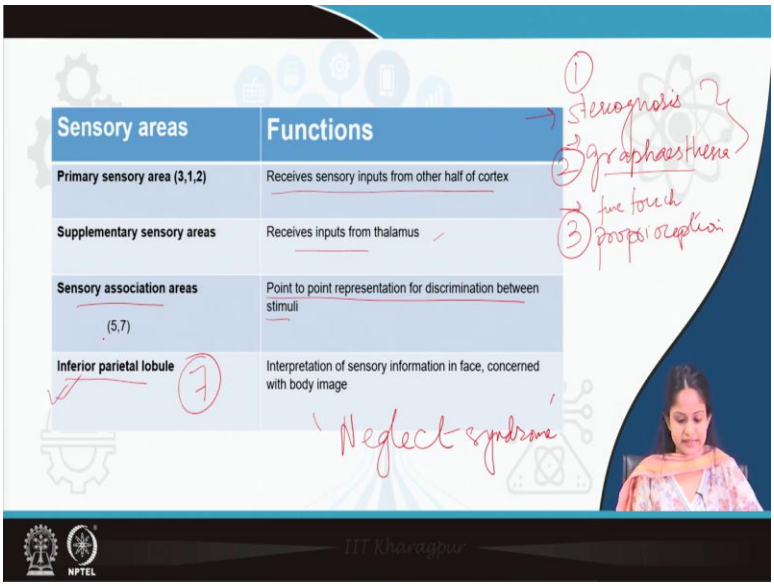

So, the sensory areas primary sensory areas 3 1 2 This is the primary somatosensory area which receives sensory inputs from other half of the cortex. Now, what will happen if this primary sensory area gets destroyed, now obviously, all the sensations on the other half of the body will get destroyed. So this what is the first sensation on what the first sensation which gets destroyed? The first sensation getting destroyed is stereognosis.

First sensations stereognosis then, graphesthesia. These 2 sensations will get destroyed first, when my primary somatosensory area is having any problem. Now, what is theory of stereognosis? Suppose my eyes are closed and you have given this pain to hold. If you asked me what I am holding, I will tell it as a pen, because it looks like a pen. Obviously, when my eyes are closed.

So this is known as stereo of stereognosis a person who is not able to identify the object given to him, when his eyes are closed, that is a stereo of Gnosis which happens when the sensory area gets destroyed. The second sensation is graphesthesia. This you must be aware of, if I if somebody's eyes are closed on if you are writing something on the palm or on the hand, the person will be able to say which letter you are writing.

So, this is known as graphesthesia. So, these 2 sensations are lost, when primary somatosensory area is affected. These are the initial loss followed by fine touch and proprioception. Obviously, when you are if somebody is touching, you will not be if somebody is giving a fine touch, you will not be able to say which portion of the body is getting touched. So fine touch and proprioception.

So at first this stereognosis graphesthesia gets lost followed by fine touch and proprioception. Supplementary sensory areas receives input from the thalamus. So, when some when thalamus is giving input, that means the discrimination is there that which sensations you are receiving, whether you are is suppose warm water, you dip your hand in warm water, the water is warm or cold, you can discriminate.

So, this discriminatory function is because of this thalamus. So, the supplementary sensory areas are receiving inputs from the thalamus. Now, coming to the association areas, association areas area number 5 and 7 is mainly responsible for point to point the representation for discrimination between stimuli.

So, what is point to point representation? That means my body image is appreciated relative to other parts of the body. So I will am able to appreciate my body image relative to other parts of my body. What will happen if this area gets destroyed to be very specific if inferior parietal lobule this is area number 7. If this gets destroyed, the person will suffer from a syndrome known as amorphosynthesis or neglect syndrome. This is known as neglect syndrome now, what is this neglect syndrome? I told you cerebral cortex usually controls contralateral half of the body.

So, if my inferior parietal lo lobule is getting affected whichever side the one half of my body, I will appreciate the other half of the body I will not appreciate specifically the face in this person, typically it is seen the one half of the face the person will shave clean, but the other half of the

face that person will neglect as if it is not there. So, that is known as neglect syndrome or amorphous synthesis, it is specifically seen when the sensory association area that means a person is not able to associate his body image relative to the other body parts. So, this happens when there is destruction of the sensory association areas specifically, inferior parietal lobule that is area number 7. So, this much sensory areas you have to remember and their functions.

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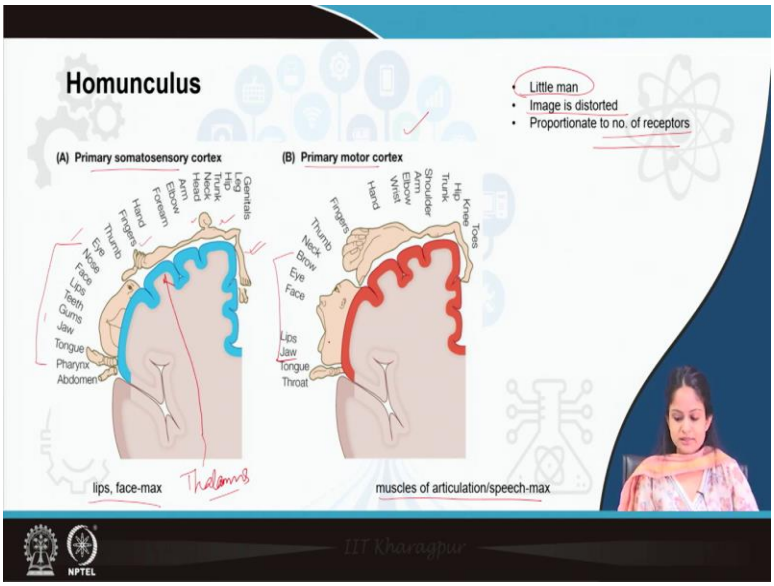

Now, coming to the homunculus. The meaning of homunculus is little man, our body map is represented both in the cerebellum as well as in the cerebral cortex, now in the cerebral cortex in a miniature form obviously, so, how it is represented in the cerebral cortex in the image is distorted. If you see this image, this image is for the sensory area that is sensory cortex and this image is for the motor cortex.

Now, you can see these are the legs, these are the legs, then this is the head, this is the finger and the hand and this is the face portion you can see. So, that means when if I give you example, suppose, if you are touching my hand, so, what will happen that touch sensations will come to thalamus as I have discussed, the thalamus will take the sensations and bring to the cerebral cortex. So, this thalamus will take this (())(17:09) to the hand that means here is my hand. So, whenever it will take this input to the hand I will okay receive this okay my hand is being getting touched.

So, in this way the sensations are distributed accordingly based on the body parts. Our body parts are also distributed in our cerebral cortex, but not accordingly like our body parts it is distributed distorted distortedly you can see the image is distorted the hands are big the legs are a bit small the head is very small, but the face mainly the mouth portion is very big, why? Because it is based on the use of your body part and the use of your body part is mainly based on the number of receptors present. Suppose my mouth is of maximum use usage, my hands are of maximum usage.

So, that is why I have many many receptors present in the hand present in the mouth, my trunk is of not that much use. So, that will I have least number of receptors present in my trunk. So, my trunk is represented very least form in the homunculus but my face, hands limbs are represented in a large form, same is the motor cortex. The motor areas are also represented in the similar fashion.

So if you are asked, what is a maximum representation is done by which parts? So, in case of sensory somatosensory cortex, the lips and the face as you can see, this is the lips and of the face area is maximum in case of motor area we talk much. So that is why the muscles of articulation speech, this portion, you can see this portion is represented very much in the motor homunculus. So, this is the homunculus which has been distributed in the cerebral cortex according to the proportionate of the receptors.

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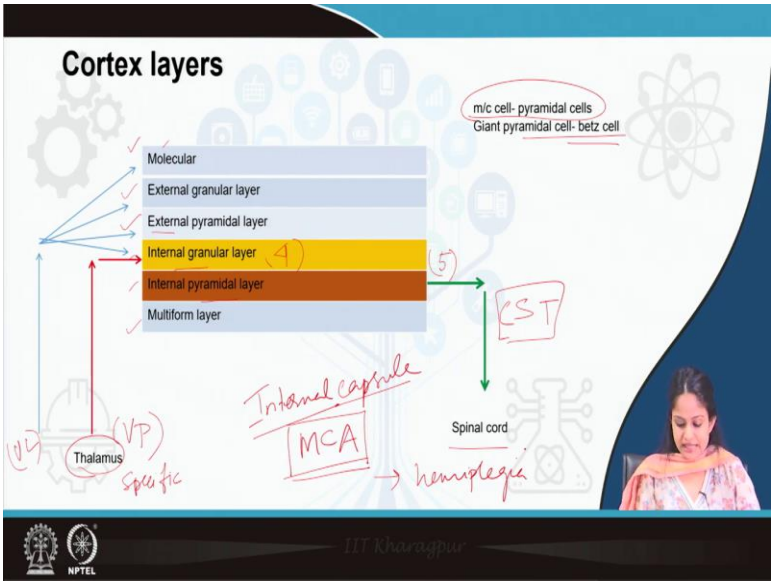

Now, coming to the cortical layers or the structure the histological structure of the cerebral cortex. The cerebral cortex consists of 6 layers, the molecular layer, the external granular layer, the external pyramidal layer, then you have internal granular layer, then you have internal pyramidal layer and multi form layer. So, there are 6 layers. So, all the layers except molecular layer consists of the pyramidal cells most common cells they consist of other cells also but the most common cells present in the cerebral cortex are the pyramidal cells. If these pyramidal cells are larger in size, they are known as betz cents.

Now, we will see, thalamus is taking the input whatever inputs we receive the sensory inputs we are receiving, this thalamus will take this input mainly to which layer this internal granular layer that means layer number 4, there is a very important question which is asked to which layer thalamic will relay it inputs.

Now, this thalamus is relaying it inputs, this input is coming from the specific sensations, these are very specific sensations through somatic sensations that means, if you remember which nucleus I told you this I told you about the ventral posterior nucleus both medial and lateral ventral posterior nucleus which is a sensitive thalamus.

And the other information's again which come to the thalamus that means to the ventral lateral group of nuclei that is from the basal ganglia or cerebellum or substantial Niagra this input will move to the other layers molecule layer external granular layer external pyramidal layer as well as to some extent to the internal granular layer, but the most important thing is this, the somatosensory input mainly is taken to the internal granular layer from the thalamus. Now, input is taken, afferent is taken. So, obviously, there has to be some afferent.

So, mainly the afferent is from the internal pyramidal layer the afferent is mainly from the internal pyramidal layer this is area number 5. From the area number 5 the afferent are taken to the spinal cord and this mainly constitute the pyramidal tracts or the cortical spinal tract. So, this is the main afferent you have to remember the afferent is to the fourth layer, the efferent is to the from the fifth layer of the cerebral cortex.

Besides this, what you have to remember is the internal capsule. Now, I told you this I had already told you that the internal capsule lies between the thalamus and the basal ganglia. Now,

this internal capsule consists of the projection fibers like white commissure fibers are present in the corpus callosum. Corpus callosum usually joins 2 cerebral hemispheres.

Now, this projection fibers usually joins or connects cerebral cortex with other parts of the brain like basal ganglia, Thalamus, whatever. So, this projection fibers consists of the internal capsule. So, any damage occurring to this internal capsule mainly the branch because of stroke say hemorrhagic stroke the middle cerebral artery gets destroyed.

So, at that time, what will happen there will be dysfunction of all the cortical functions mainly resulting in paralysis or hemiplegia. So, which are artery the striate the minder branches of the middle cerebral artery which supplies the internal capsule those are the projection fibers if they get destroyed, there will be hemiplegia of the contralateral side.

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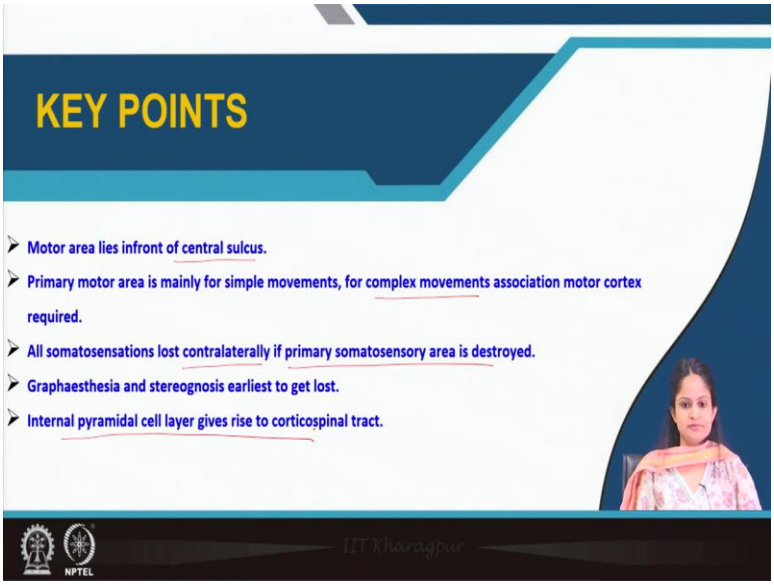

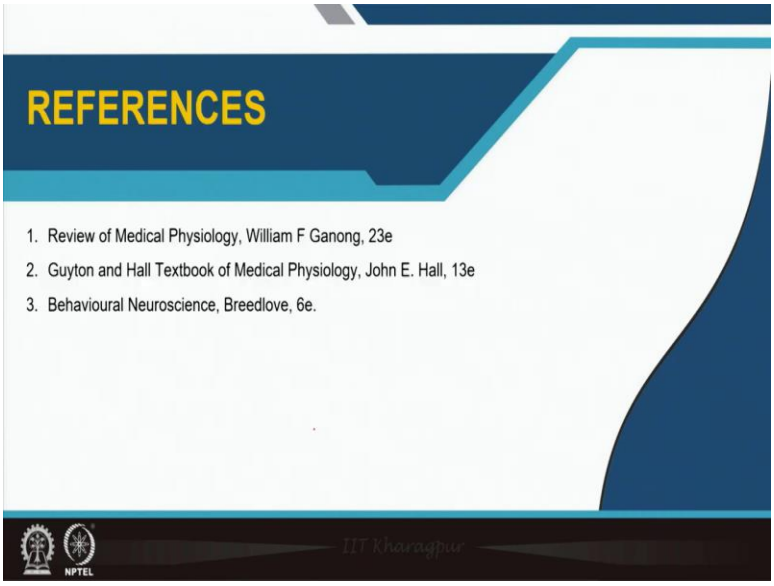

So, the key points you have to remember is the motor area lies in front of the central sulcus, the primary motor areas mainly for the simple movements, as I told you, and the complex movements are mainly for the supplementary the association motor area. The somatic sensations all are lost contralaterally if primary somatosensory area is destroyed and the initial loss is for the graphesthesia and stereognosis followed by fine touch and proprioception and internal pyramidal cell layer gives rise to that is the layer number 5 corticospinal tract or pyramidal tracts. So this you have to remember of cerebral cortex. Thank you.