SOMATIC SENSATION Lecture 7 By Dr. Sarah Dhiaa Objectives: Types Of Somatic Sensations. Mechanoreceptive Receptors Mechanoreceptive Sensations 1. Touch The Two-point Threshold 2. Pressure Sensation Stereognosis 3. Muscle Tension Sensation 4. Proprioceptive Sensations Thermoreceptive receptors Thermoreceptive Sensations Nonspecific Thermoreceptors SOMATIC SENSATIONS Somatic sensations are sensations which are conducted by the somatic nerves and come to conscious perception. [I] MECHANORECEPTIVE SENSATIONS ● These are sensations produced by mechanical stimuli. They include senses of touch, texture of material, vibration, pressure, stereognosis, muscle tension and proprioception. [II] THERMORECEPTIVE SENSATIONS ● These are sensations produced by thermal stimuli. They include warmth and cold sensations. [III] PAIN SENSATION ● These are produced by noxious stimuli MECHANORECEPTIVE SENSATIONS Mechano-Receptors ● Mechano-receptors are receptors which are especially sensitive to mechanical stimuli and they are classified into: 1. Cutaneous mechano-receptors: They are of three types I. Naked nerve endings: The free nerve endings and the basket endings around hair follicles. II. Expanded nerve endings: Merkel discs and Ruffini corpuscles. III. Encapsulated nerve endings: Pacinian and Meissner corpuscles. ● These receptors differ in their excitability, rate of adaptation, and the ability to respond to repetitive stimuli. They are present in the skin all over the body, but highly condensed in the finger tips, lips and other areas which are highly sensitive to touch. 2. Deep mechano-rsceptors: These receptors are of two types I. Muscle spindles: stretch receptors found in the fleshy part of skeletal muscles. II. Golgi tendon organs: tension receptors found in the tendons of the skeletal muscles Mechanoreceptive Sensations 1. Touch or tactile sensation It is the cutaneous sensation produced by light mechanical stimuli. There are two types of touch sensation, crude and fine: I. Crude touch: ● This sensation without accurate identification of the locality or the number of stimuli and it is of two types: a) Tickle: is a sensation produced by mild tactile stimulation of certain areas of skin, usually leading to reflex involuntary laugh. b) Itch: is a sensation of skin irritation which leads to the desire for scratching of the skin (the scratch reflex). ● The receptors for tickle and itch sensation are specialized, highly sensitive, rapidly adapting free naked nerve endings, tickle and itch signals are transmitted by the slowly conducting type IV nerve fibers. ● Scratching relieves itch by removing the irritating stimulus and by presynaptic lateral inhibition of the central terminals of the primary itching conducting fibers(Nerve fibers carrying scratch signals send collaterals inside the spinal cord to inhibit fibers of itch sensation by presynaptic inhibition mechanism). ● Theses sensations are conducted by the anterolateral pathway. II. Fine touch: ● It is a sensation with accurate identification of the locality and the number of stimuli and it is classified into: a) Tactile localization (Topognosis): localization of stimulation point. It is tested by touching the skin of blind-folded subject by the tip of a blunt pointed object, then asking the subject to open his eyes and point out the site where he was touched. b) Tactile discrimination: identification of two tactile stimuli applied simultaneously as two separate points of contact. ● Tactile discrimination is tested by the compass test or using discriminator . The two blunt ends of test compass are applied to the skin. The distance between the two ends of the compass is increased step by step until the subject feels the two ends of the compass as two separate points. ● Acuity of this sensation is inversely proportionate to the two-point threshold, which is the minimal distance at which the two stimuli are felt as two separate points. ● This

sensation is conducted by the gracile and cuneate pathway. the two-point threshold III. Texture Of Material Sensation ● This is the ability to identify the substance from which a textile is made; e.g. silk, wool, cotton, synthetic material ...etc., by touching and without seeing it. ● It is a special type of fine touch sensation which is conducted by the gracile and cuneate pathway. IV. Vibration Sense ● This is a flickering (repetitive) tactile sensation. ● There are two types of vibration receptors; the high frequency, rapidly adapting Pacinian corpuscles which respond to vibration frequency up to 800 Hz, and the low frequency, slowly adapting Meissner corpuscles which respond to vibration frequency up to 80 Hz. ● Vibration sense is tested by putting the base of a vibrating tuning fork on the skin. A sense of buzzing or thrill is felt. ● Vibration sense is conducted by the gracile and cuneate pathway. 2. Pressure sensation ● This is the sensation produced by a strong, blunt, static mechanical stimulus. ● There are two types of pressure receptors: ● The rapidly adapting Pacinian corpuscles, and the slowly adapting Ruffini endings. ● The acuity is tested by applying different weights on a supported hand of a blind-folded subject, then, the subject is asked to identify which weight is heavier and which is lighter. I. Crude pressure sensation. ● This is pressure sensation with low ability to discriminate different weights. This sensation is conducted by the anterolateral pathway. II. Fine pressure sensation. ● This is pressure sensation with high ability to discriminate different weights. This sensation is conducted by the gracile and cuneate pathway STEREOGNOSIS ● This is special type of sensation which is defined as the ability to identify objects by handling them without seeing them. ● This ability depends on two conditions which favor the development of high degree of stereognosis: 1) Intact touch and pressure sensations 2) Intact cortical sensory somatic association area of the parietal lobe. ● This sensation is conducted by the gracile and cuneate pathway. 3. Muscle tension sensation ● This is the sensation produced by traction on muscle tendons. ● The receptors are the Golgi tendon organs. It enables the person to discriminate different weights by lifting them. ● It is tested by applying different weights on an unsupported hand of a blind-folded subject, then, the subject is asked to identify the lighter and the heavier weigh 4. Proprioceptive sensations ● Proprioception is the sensation of the position of different parts of the body relative to each other and the position of the body in space. ● Proprioception is divided into two types: I. Static proprioception (sense of position): ● The receptors are the deep mechanoreceptors (muscle spindles and Golgi tendon organs). ● It is tested by putting a limb in an unusual position and asking the blind-folded subject to put the other limb in a similar position. II. Dynamic proprioception (kinesthetic sensation): ● It is the sense of movement of joints. ● The receptors are the Pacinian corpuscles and Golgi tendon organs in ligaments and synovial membranes of joints. ● This sense is tested by moving a joint and the blind-folded subject is asked to tell when the movement begins and when it stops or when the rate of movement changes. THERMORECEPTIVE SENSATIONS Thermo-receptors ● There are two types of specialized thermoreceptors, one is sensitive to warmth and the other is sensitive to cold which are found in the base of the epidermal layer of the skin. ● The number of cold spots on the skin is (4-10) times as many as those of the warmth spots. ● The highest density of thermoreceptors is found in the skin of the face and hands. ● Cutaneous thermoreceptors monitor the temperature of the skin, not that of the body. ● Thermoreceptors are also found in the abdominal viscera, the spinal cord and around great veins. ● These receptors are concerned mainly with informing the hypothalamic thermostat of any

increase in the body core temperature and do not give rise to warmth or cold sensations. there are two types of thermal receptors and these are: 1. The warmth receptors: they are specialized free nerve endings that respond maximally to temperature slightly above body temperature between 25–50 C° with maximum frequency of discharge at about 40°C ● Warmth sensation is conducted by the thin, type IV fibers. 2. The cold receptors: they are Krause end–bulbs which are specialized, encapsulated nerve endings respond maximally to temperature slightly below body temperature 10–35C° with maximum frequency of discharge at about 25°C. ● Cold sensation is transmitted by type III nerve fibers. Stimulation Of Thermoreceptors The effectiveness of a stimulus depends on two factors: 1. The absolute temperature: In the temperature range of 10 – 50°C, anything warmer than the skin is felt warm and anything colder than the skin is felt cold. 2. The rate of change of temperature; i.e. the rate of warming or cooling. A rapidly changing temperature (rising or falling) is much more effective stimulant to thermoreceptors than a slowly changing or a steady temperature. ● This means that when the temperature of skin is actively falling, a person feels much colder than when the temperature remains at the same level. Conversely, if the temperature is actively rising the person feels much warmer than he would at the same temperature if it was constant. ● Thermoreceptors adapt at temperatures between 20–40°C, giving a feeling of thermeneutrality, but no adaptation occurs outside this range. ● At temperatures below 15°C or above 45°C, thermosensitive pain receptors are activated giving rise to pain sensation (cold pain and heat pain). Pain sensation at temperature ranges of 10–15 and 45– 50 is very mild and masked by the senses of extreme cold or extreme warmth respectively. ● The sense of thermal pain is clearly perceived at temperatures below 10 or above 50 °C. Nonspecific Thermoreceptors ● Some pressure receptors (Ruffini endings) are stimulated also by cold. ● This explains why a colder of two identical weights placed on the hand is felt heavier than the warmer weight (Weber's illusion). ● This is because the colder weight is a stronger stimulant of pressure receptors than the warmer weight because it makes double stimulation of Ruffini pressure receptors, first by its weight, and second by its coldness. ? Thank you