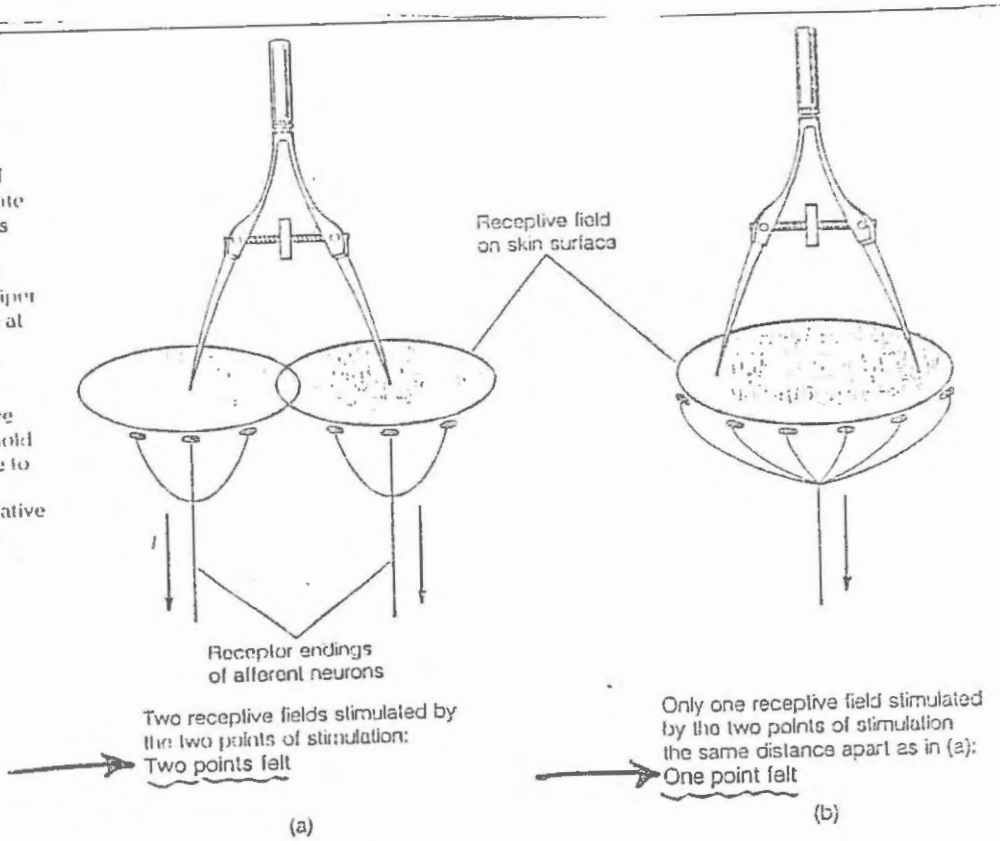
انحكت بعد السلايد رقم (57A)

اجبار

• FIGURE 6–6 **Comparison of Discriminative Ability of Regions with Small versus Large Receptive Fields**
The relative tactile acuity of a given region can be determined by the **two-point threshold of discrimination test**. If the two points of a pair of calipers applied to the surface of the skin stimulate two different receptive fields, two separate points will be felt. If the two points touch the same receptive field, they will be perceived as only one point. By adjusting the distance between the caliper points, one can determine the minimal distance at which the two points can be recognized as two rather than one, which is a reflection of the size of the receptive fields in the region. With this technique, it is possible to plot the discriminative ability of the body surface. The two-point threshold ranges from 2 mm in the fingertip (enabling one to read Braille, where the raised dots are spaced 2.5 mm apart) to 48 mm in the poorly discriminative skin of the calf. (a) Region with small receptive fields. (b) Region with large receptive fields.



Acuity is influenced by receptive field size and lateral inhibition.

Each sensory neuron responds to stimulus information only within a circumscribed region of the skin surface surrounding it; this region is known as its **receptive field**. The size of a receptive field varies inversely with the density of receptors in the region; the more closely receptors of a particular type are spaced, the smaller the area of skin each monitors. The smaller the receptive field in a region, the greater its **acuity** or **discriminative ability**. Compare the tactile (touch) discrimination in your fingertips with that in your elbow by "feeling" the same object with both. You are able to discern more precise information about the object with your richly innervated fingertips because the receptive fields there are small; as a result, each neuron signals information about small, discrete portions of the object's surface. In contrast, the skin over the elbow is served by relatively few sensory endings with larger receptive fields. Subtle differences within each large receptive field cannot be detected (• Fig. 6–6). The distorted cortical representation of various body parts in the sensory homunculus (see p. 119) corresponds precisely with the innervation density; more cortical space is allotted for sensory reception from areas with smaller receptive fields and, accordingly, greater tactile discriminative ability.

بعد سلايد (61)

Pain and temperature (and light touch)
Spinothalamic system
(Anterolateral system)

fast Pain pathway

Somato-Sensory cortex (3,1,2)

Thalamus VPL (Ventrobasal complex)

lateral ← SLTC → Medial

Leg
Trunk
Arm

(Spinal lemniscus)

Medial lemniscus

Spinothalamic tract

Right spinothalamic tract

"Layering" in the spinothalamic tract – lower body afferents pushed laterally by incoming fibers from higher areas to become superficial in the tract.

Spinothalamic tract

(lamina I)
(lamina V)
(Tract neurons)

Lissauer's tract

Nerve fibres that carry { Pain (Nociception), temperature, light touch } form the lateral division of dorsal root and are formed of group III (A delta) fibres → ASCEND within Lissauer's tract for 1-2 segments → synapse with neurons in laminae I & V (These are considered as T or Transmission tract neurons) → Axons of these neurons CROSS at the white commissure of spinal cord → ASCEND through the Anterolateral white matter in medulla → Pons → midbrain → Terminate in VPL (Ventral Posterolateral) part of Ventrobasal complex of thalamus → 3,1,2

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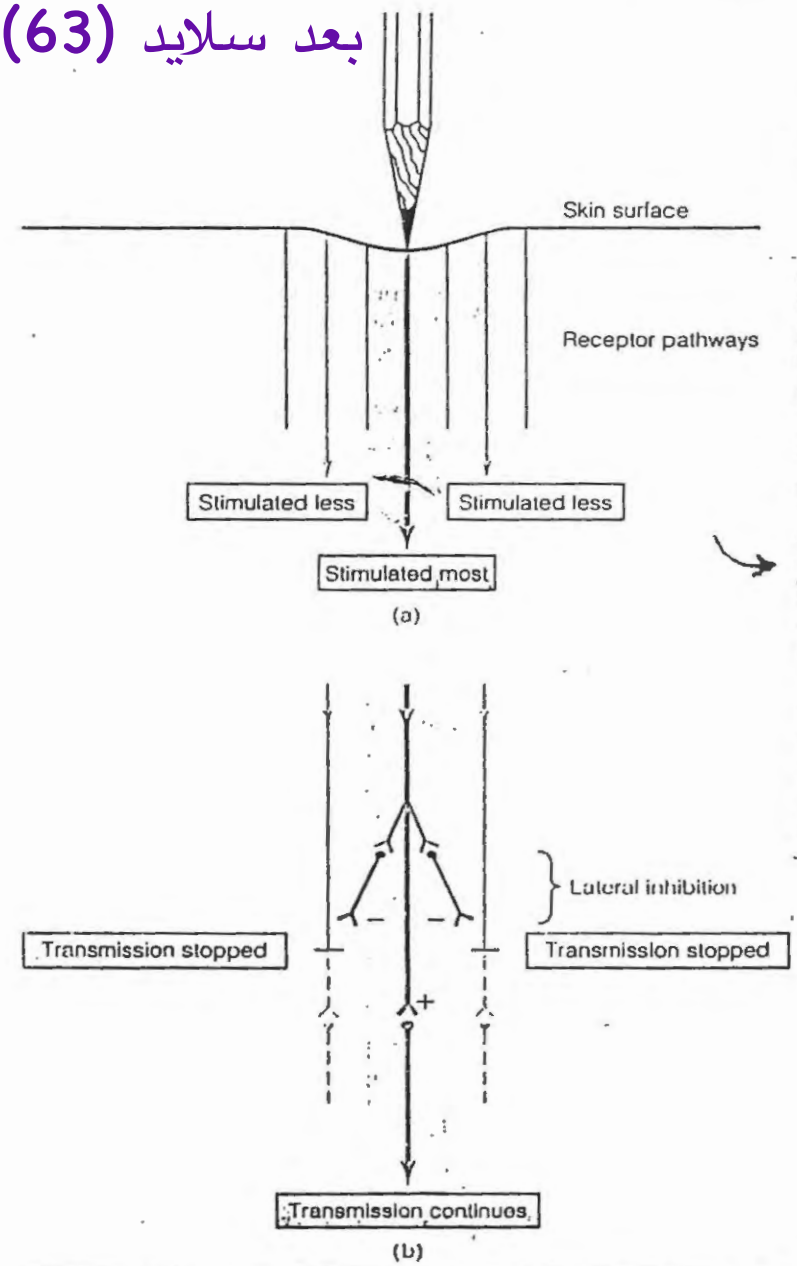

• **FIGURE 6–7 Lateral Inhibition** (a) The receptor at the site of most intense stimulation is activated to the greatest extent. Surrounding receptors are also stimulated but to a lesser degree. (b) The most intensely activated receptor pathway halts transmission of impulses in the less intensely stimulated pathways through lateral inhibition. This process facilitates localization of the site of stimulation.

Besides receptor density, a second factor influencing acuity is **lateral inhibition**. You can appreciate the importance of this phenomenon by slightly indenting the surface of your skin with the point of a pencil (• Fig. 6–7a). The receptive field is excited immediately under the center of the pencil point where the stimulus is most intense, but the surrounding receptive fields are also stimulated, only to a lesser extent because they are less distorted. If information from these marginally excited afferent fibers in the fringe of the stimulus area were to reach the cortex, localization of the pencil point would be blurred. To facilitate localization and sharpen contrast, lateral inhibition occurs within the CNS (Fig. 6–7b). The most strongly activated signal pathway originating from the center of the stimulus area inhibits the less excited pathways from the fringe areas. This occurs via inhibitory interneurons that pass laterally between ascending fibers serving neighboring receptive fields. Blockage of further transmission in the weaker inputs increases the contrast between wanted and unwanted information so that the pencil point can be precisely localized. The extent of lateral inhibitory connections within sensory pathways varies for different modalities. Those with the most lateral inhibition—touch and vision—bring about the most accurate localization.

Properties of receptors

Receptors have the properties of adequate stimulus, excitability and adaptation.

1 2 3

1 *Adequate stimulus* Each type of receptor is most sensitive to a specific form of energy, which is called its adequate stimulus, and is almost non-responsive to the normal intensities of other forms of energy; e.g. light is the adequate stimulus for the rods and cones of the eyes but they do not respond to heat or cold (Fig. 17.10).

Pain receptors are not stimulated by a blunt object touching the skin, but they discharge as soon as the blunt object is pushed with enough force to damage tissues.

The sensation perceived as a result of stimulation of a receptor is called the *modality* of sensation. Thus, cold, warmth, touch and pain are different modalities of sensation.