THE SENSE OF TOUCH
PART 2 – PERCEPTION OF TOUCH

FROM THE SKIN TO THE BRAIN
The various tactile receptors are attached to a range of nerve types. Most receptors use the A beta fibres to transmit their signals – these transmit information extremely rapidly. However, free nerve endings and most root hair plexuses (see previous article) use the relatively slower A delta and even slower C fibre groups (Allan, 2005). The receptors responsible for sensing crude touch and pressure have a wide receptive field – that is, they gather information from a relatively large area of the skin. As a result, it is not possible to locate the source of the stimulus very precisely using these receptors, nor to gain much additional information about the stimulus (Martini, 2005). Sensations from these receptors are carried by nerves to the spine and then ascend to the brain using the spinothalamic pathway (Fig 1).

While the anterior spinothalamic tract carries crude touch and pressure sensations, the lateral tract carries pain and temperature sensations. Sensations reach the thalamus where the signals are sorted and processed before being relayed to the primary sensory cortex in the cerebral hemispheres.

FIG 1. PATHWAYS IN THE SPINE

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This article is the second of two on the sense of touch, continuing our series on the special senses.

Last week’s article examined the means by which touch is perceived through a variety of receptors in the skin. This week, we look at how the information is carried to and interpreted in the brain, at the sensations of tickle and itch and at assessment of touch.
The receptors for fine touch and pressure are extremely sensitive and have narrow receptive fields. This enables them to provide detailed information about a source of touch stimulation, including its precise location, shape, size, texture and movement (Martini, 2005).

The sensory information is carried up the spine through the posterior column pathway (Fig 1) to the brain and thence to our conscious awareness. Hancock (1996) describes it as the receptors ‘sending off to the brain and thence to our spine through the posterior column pathway.’

**IN THE BRAIN**

In the brain, all the rich touch information being delivered from all parts of the body is integrated and processed in the primary sensory cortex. The signals are sorted by the nature of the receptors (pain, temperature and so on). Underneath each cell group is a set of columnar brain structures devoted to touch. As a signal moves deeper, it becomes more precise – the brain recognises edges and motion, for example, and pattern recognition occurs (Hancock, 1996).

We use information from the sense of touch to tell us about the world around us – this is known as haptic perception. Haptic perception integrates somatosensory information from touch, which cannot be gained from looking at an object (such as hardness, texture, temperature and weight) and from proprioception, which provides spatial and motor information (Marieb, 2006).

We rely on our sense of touch to enable us to undertake everyday tasks such as typing, cooking or playing a musical instrument. Tactile sensations such as textures, vibrations and bumps, contours, shapes and weight all help to give direction and guide our movements.

**TICKLE AND ITCH**

The sensations of tickle and itch are closely related to touch and pain. The receptors involved in both these sensations are free nerve endings and the information is carried by slow, unmyelinated nerve fibres (type C) in the spinothalamic tract.

Tickle sensations are produced by a light touch moving across the skin. They are usually, but not always, described as pleasurable. There are large differences in people’s sensitivity to tickling, and psychological factors play an important part in interpreting the tickle sensation.

The sensation of itching appears to be produced by stimulation of the same free nerve ending receptors as tickling, although the precise details are not clear. Specific ‘itch spots’ can be mapped in the skin, the inner surface of the eyelids and the mucous membranes of the nose, but itch sensations are absent from other mucous membranes and from deep tissues and viscera (Martini, 2005).

Itch receptors can be stimulated experimentally by the injection of histamine or proteolytic enzymes into the epidermis and superficial dermis. The sensation of itching is usually thought of as extremely unpleasant and people with extreme itching will scratch even when doing so causes them pain.

**ASSESSING TACTILE SENSITIVITIES**

People become less aware of touch sensations as they age because touch receptors are lost during life. At the age of 10, most people have about 50 touch receptors per square millimetre of skin, but by the age of 50 this has declined to about 25, and only about 10 per square millimetre by the age of 70 (Hancock, 1996).

Sensitivity to tactile sensations can be altered by infection, disease or damage to the sensory neurons or pathways. The mapping tactile of responses can sometimes aid clinical assessment.

Sensory losses with clear regional boundaries indicate trauma to spinal nerves. For example, sensory loss along a dermatomal boundary can permit a reasonably precise determination of the affected spinal nerve or nerves (Martini and Welch, 1998).

Sensitivity to light touch in a particular area can be checked using gentle contact with a fingertip or a wisp of cotton wool.

The two-point discrimination test is used to generate a more detailed sensory map of tactile receptors. Two fine points of a drawing compass, a bent paperclip or other object are applied to the skin surface simultaneously and the subject is asked to describe the contact. When the points fall within a single receptive field, the subject will report only one point of contact. A normal individual loses two-point discrimination at about 1mm on the surface of the tongue, 2–3mm on the lips and 3–5mm on the backs of the hands and feet and at 4–7mm over the general body surface (Martini and Welch, 1998).

Vibration receptors can be tested by applying the base of a tuning fork to the skin. Damage to an individual spinal nerve produces insensitivity to vibration along the paths of the related sensory nerves. If the sensory loss results from spinal cord damage, the injury site can typically be located by walking the tuning fork down the spinal column, resting its base on the vertebral spines (Martini and Welch, 1998).

**DEFINING SENSITIVITY**

A number of terms are used to describe the level of sensitivity in an area of the body. Anaesthesia means a total loss of sensation – the individual cannot perceive touch, pressure, pain or temperature sensations from that area. Hypoaesthesia is a reduction in sensitivity and paraesthesia is the presence of abnormal sensations, such as pins and needles when an arm or leg ‘falls asleep’ due to pressure on a peripheral nerve.

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**REFERENCES**


