Anatomy of the Somatosensory   
System   
FROM WIKIBOOKS The following description is based on lecture notes from Laszlo Zaborszky, from Rutgers   
University.   
This is a sample document to showcase page -based formatting. It contains a chapter from   
a Wikibook called Sensory Systems . None of the content has been changed in this article, but   
some content has been removed.   
Our somatosensory system consist s of sensors in the skin and sensors in our muscles, tendons, and joints.   
The receptors in the skin, the so called cutaneous receptors, tell us about temperature ( thermoreceptors ),   
pressure and surface texture ( mechano receptors ), and pain ( nociceptors ). The receptors in muscles and   
joints provide information about muscle length, muscle tension, and joint angles.   
Receptors in the human skin: Mechanoreceptors can be free receptors or encapsulated. Examples   
for free receptors are the hair receptors at the roo ts of hairs. Encapsulated receptors are the   
Pacinian corpuscles and the receptors in the glabrous (hairless) skin: Meissner corpuscles,   
Ruffini corpuscles and Merkel’s disks.   
Cutaneous receptors   
Sensory information from Meissner corpuscles and rapidly adapting afferents leads to adjustment of grip   
force when objects are lifted. These afferents respond with a brief burst of action potentials when objects   
move a small distance during the early stages of lifting. In response to rapidly adapting afferent activity,   
muscle force increases reflexively until the gripped object no longer moves. Such a rapid response to a   
tactile stimulus is a clear indication of the role played by somatosensory neurons in mot or activity.   
The slowly adapting Merkel’s receptors are responsible for form and texture perception. As would be   
expected for receptors mediating form perception, Merkel’s receptors are present at high density in the   
digits and around the mouth (50/mm² of skin surface), at lower density in other glabrous surfaces, and at   
very low density in hairy skin. This innervations density shrinks progressively with the passage of time so   
that by the age of 50, the density in human digits is reduced to 10/mm². Unlike r apidly adapting axons,   
slowly adapting fibers respond not only to the initial indentation of skin, but also to sustained indentation   
up to several seconds in duration.   
Activation of the rapidly adapting Pacinian corpuscles gives a feeling of vibration, whi le the slowly   
adapting Ruffini corpuscles respond to the lataral movement or stretching of skin.   
Mammalian muscle spindle showing typical position in a muscle (left), neuronal connections in   
spinal cord (middle) and expanded schematic (right). The spindle is a stretch receptor with its   
own motor supply consisting of several intrafusal muscle fibres. The sensory endings of a   
primary (group Ia) afferent and a secondary (group II) afferent coil around the non -contractile central portions of the intrafusal fibr es.  
   
Nociceptors   
Nociceptors have free nerve endings. Functionally, skin nociceptors are either high -threshold   
mechanoreceptors or polymodal receptors . Polymodal receptors respond not only to intense mechanical   
stimuli, but a lso to heat and to noxious chemicals. These receptors respond to minute punctures of the   
epithelium, with a response magnitude that depends on the degree of tissue deformation. They also respond   
to temperatures in the range of 40 –60°C, and change their res ponse rates as a linear function of warming   
(in contrast with the saturating responses displayed by non -noxious thermoreceptors at high temperatures).   
Notice how figure captions and sidenotes are shown in the outside margin (on the left or right,   
depending on whether the page is left or right). Also, figures are floated to the top/bottom of the   
page. Wide content, like the table and Figure 3, intrude into the outside margins.   
Pain signals can be separated into individual components, corresponding to differe nt types of nerve   
fibers used for transmitting these signals. The rapidly transmitted signal, which often has high spatial   
resolution, is called first pain or cutaneous pricking pain . It is well localized and easily tolerated. The much   
slower, highly affec tive component is called second pain or burning pain ; it is poorly localized and poorly   
tolerated. The third or deep pain , arising from viscera, musculature and joints, is also poorly localized, can   
be chronic and is often associated with referred pain.   
Muscle Spindles   
 Rapidly adapting Slowly adapting   
Surface receptor / small   
receptive field Hair receptor , Meissner’s corpuscle : Detect   
an insect or a very fine vibration. Used for   
recognizing texture. Merkel’s receptor: Used for   
spatial details, e.g. a round   
surface edge or “an X” in brail.   
Deep receptor / large   
receptive field Pacinian corpuscle : “A diffuse vibration” e.g.   
tapping with a pencil. Ruffini’s corpuscle : “A skin   
stretch”. Used for joint po sition   
in fingers.   
Scattered throughout virtually every striated muscle in the body are long, thin, stretch receptors called   
muscle spindles. They are quite simple in principle, consisting of a few small muscle fibers with a capsule   
surrounding the mid dle third of the fibers. These fibers are called intrafusal fibers , in contrast to the   
 ordinary extrafusal fibers . The ends of the intrafusal fibers are attached to extrafusal fibers, so whenever   
the muscle is stretched, the intrafusal fibers are also stre tched. The central region of each intrafusal fiber   
has few myofilaments and is non -contractile, but it does have one or more sensory endings applied to it.   
When the muscle is stretched, the central part of the intrafusal fiber is stretched and each sensory ending   
fires impulses.   
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Muscle spindles also receive a motor innervation. The large motor neurons that supply extrafusal   
muscle fibers are called alpha motor neurons , while the smaller ones supplying the contractile portions of   
intrafusal fibers are called gamma neurons . Gamma mo tor neurons can regulate the sensitivity of the muscle   
spindle so that this sensitivity can be maintained at any given muscle length.   
Joint receptors   
The joint receptors are low -threshold mechanoreceptors and have been divided into four groups. They   
signal different characteristics of joint function (position, movements, direction and speed of movements).   
The free receptors or type 4 joint receptors are nociceptors.   
Feedback loops for proprioceptive signals for the perception and control of limb   
movements. Arrows indicate excitatory connections; filled circles inhibitory connections.