

What components contribute to a sensation of pain?

Most back pain occurs in the lumbar spine and lumbosacral transition region, followed by the cervical spine. This is due to the fact that the static loads acting upon the spinal column are greatest in these sections.

Back pain is not a disease per se, but must rather be considered a symptom that is primarily a warning signal.

Pain is a complex sensation with the following individual components:

Sensory components:	“related to perception by the senses”
Affective components:	“related to the emotions”
Cognitive components:	“related to perception”
Sensomotor components:	“related to voluntary muscle movement”
Vegetative components:	“related to the involuntary nervous system”

Which components of a mobile segment can give rise to pain?

In physiological terms, all of the tissue structures of the mobile segment that contain nerves can give rise to pain:

- Vertebral bodies
Nerves radiating in from the nerves controlling the longitudinal ligaments, and from the sympathetic trunk, are found in the vertebral body and its surrounding periosteum.
- Facet joints (vertebral joints)
The facet joints are supplied by several nerves arising from the medial branch of the dorsal ramus of the spinal nerve.
- Intervertebral discs
The rear (dorsal) and rear-side (posterolateral) parts of the disc are mainly innervated by the rami communicantes of the spinal nerves, whereas the front (anterior) and side (lateral) parts of the disc are controlled by branches from the sympathetic trunk.
- Ligamentous apparatus (ligaments)
The posterior longitudinal ligament is supplied by nerve branches from the sympathetic trunk and the rami communicantes of the spinal nerves.
- Spinal nerve roots
A spinal nerve root that is irritated or damaged, mechanically or metabolically, may cause pain.
- Back muscles
The deeper layers of the back muscles are designated as true or autochthonous back muscles. They connect, among other things, the spinous and transverse processes with a complex network of muscle groups. The interplay of all muscle groups makes it possible to extend, flex, rotate and incline the back to the side.

The musculus erector spinae or sacrospinalis is an important muscle group. It is composed of a number of individual muscles and extends from the pelvis to the head.

Additional muscle systems can be differentiated deep in the muscles of the back:

- Spinal system muscles that originate in and are attached to the spinous processes of the vertebrae.
- Muscles of the transversospinal system running from the transverse processes to the spinous processes of the vertebrae.
- Muscles of the intertransversal system that connect the transverse processes of the vertebrae.

What psychological factors can influence pain?

- Factors that exacerbate pain may include:
 - Anxiety
 - Depression
 - Inactivity
 - Isolation
- Factors that improve pain may include:
 - Positive attitude
 - Sense of security
 - Intensive distraction

The body's own pain defense system releases endorphins in the spinal cord and brain to dampen pain sensations.

What different types of pain are there?

- Nociceptor pain (Latin: nocere, harm; capere, take)

This type of pain results from a direct irritation of the pain receptors, the nociceptors, which are the sensory nerve endings of low-velocity afferent nerve pathways. Most nociceptors react to the following harmful stimuli:

- Mechanical stimuli (impact, pressure)
- Chemical stimuli (acids)
- Thermal stimuli (cold, heat)

Nociceptors that react to various different stimuli are called polymodal, while those that react to only one type of stimulus are referred to as unimodal.

The nociceptors in the skin are responsible for surface pain and the pain receptors of the inner organs, bones, muscles and joints, for example, are responsible for deeper-lying pain.

- Neuropathic/neurogenic pain

This type is usually described as a burning or shooting pain.

Neuropathic pain is caused by damage to the central nervous system or the peripheral nerves. The nerve structures can be damaged either mechanically (for example by a herniated intervertebral disc with compression on the spinal nerve roots) or toxically (for example by poisonous substances).

- Deafferentation pain

This is a special case of neuropathic pain involving a partial or complete severance of the afferent connection to the central nervous system. A typical example of this type of pain is the phantom pain experienced following amputation of an appendage, such as a feeling of pain in the toes following a thigh amputation.

- Somatovisceral pain

This type of pain sensation occurs in bones, joints, skeletal muscles and the inner organs of the thorax and abdomen. Visceral pains in the thoracic or abdominal organs are often felt in parts of the body other than the point where the pain actually originates. For example, pain caused by a cardiac infarction or stenosis of the coronary arteries (angina pectoris) can feel like pain radiating through the left shoulder into the left arm. Areas of the skin in which a visceral pain is experienced, distanced from the actual point of origin, are known as "Head's areas."

This mechanism can be explained by the fact that the organic structures where the pain originates (e.g. inner organs) are innervated by afferent nerve pathways that originate in the same spinal cord segment as the nerve supply of the body regions in which the specific pain is experienced.

· Central pain

Damage to the supraspinal and spinal nociceptive systems may cause intense pain, since the damage may raise the stimulation level of these nerve structures.

The pain as it is experienced can consist of various combinations of the above-described types of pain.

How is pain transmitted?

Pain transmission and conscious pain perception take place in an organism's complex „pain system.“

The pain receptors receive the pain stimulus and conduct it in the form of an electric impulse through the afferent (returning) nociceptive nerve pathways to the posterior horn of the spinal cord. In the spinal cord, the pain stimulus is further conducted by biochemical substances called neurotransmitters that pass the pain information from one nerve cell to the next.

Neurotransmitters are excitatory amino acids (such as aspartate or glutamate) or polypeptides (such as calcitonin).

With the help of these neurotransmitters, the pain impulse is transmitted through the spinal cord into the lateral core area of the thalamus (in the midbrain), from where they are then transmitted to the sensorimotor cortex of the cerebral cortex (gyrus postcentralis). This is the region in which conscious pain sensation and processing take place. The localization and intensity of the pain sensation is stored here as a learning process in the form of a “pain memory.”