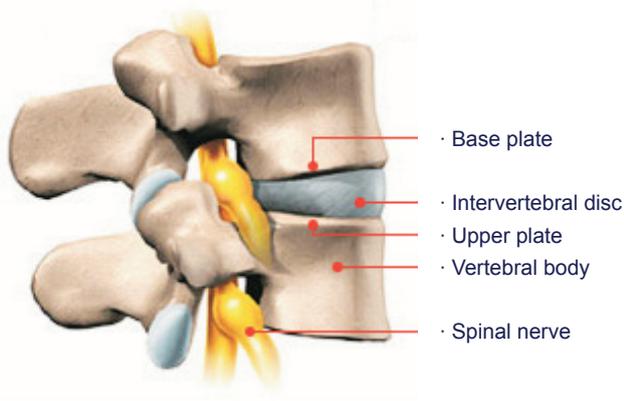


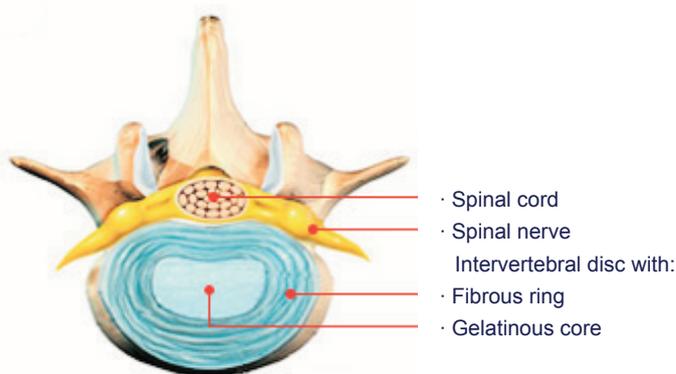
What is spondylodiscitis?

Spondylodiscitis is an inflammation of the base and upper plates of the vertebra as well as the adjoining intervertebral disc and is frequently accompanied by spondylitis (inflammation of the vertebral body). Infectious spondylodiscitis is caused by bacteria, viruses, fungi or parasites and can result in deformed vertebral segments and neurological complications.

- Anatomical structures of the mobile segment



- Vertebra from above, topographic relation to intervertebral disc, spinal cord and spinal nerves



How are spondylodiscites (inflammations of vertebrae and intervertebral discs) classified?

Inflammatory diseases of the spinal column can be classified in the group of non-infectious rheumatic clinical pictures, i. e. with rheumatoid arthritis and spondylitis ankylopoetica, as well as in the group of infectious inflammatory clinical pictures. Known causes of an infectious spinal column inflammation include:

1. Spondylodiscitis caused by bacterial infection

Bacterial infections of the vertebral column can be categorized into specific and nonspecific subgroups. The most important causative pathogens in specific bacterial spondylodiscitis are:

Mycobacterium tuberculosis, the tuberculosis pathogen, is an acid-fast, nonmotile rod bacterium that is usually transmitted by the inhalation of airborne organisms in droplets (aerogenic), less frequently via skin injuries or orally, and occurs worldwide.

Tuberculosis primarily infects the lungs or urogenital system (kidneys and efferent urinary tract). From there, the tuberculosis bacteria can reach the spinal column through the lymph vessels. Infection of the vertebrae results in caseating necrosis (tissue death) with the formation of granulomas, osteomyelitis (inflammation of bone and bone marrow), and abscesses that can penetrate into the spinal canal and there cause compression and paralysis. Destruction of the vertebrae and increasing spread to adjacent vertebrae may result in the formation of a kyphotic malposition of the vertebral column that can be as severe as to cause the typical gibbus (humpback).

Untreated terminal stage tuberculosis is characterized by the typical Pott's triad:

Gibbus formation resulting from vertebral destruction, paralysis (paraplegia) due to penetration of the vertebral abscesses into the spinal canal or, in advanced gibbus, stenosis and compression of the spinal cord, and abscess formation in the area of the psoas muscle due to vertebral abscess progression.

Mycobacterium leprae, the leprosy pathogen, is a gram-positive, acid-fast, rod bacterium, typically transmitted from person to person by airborne droplets.

Leprosy occurs mainly in tropical and subtropical regions and results in a granulomatous inflammation that spreads via the nervous, vascular and lymphatic systems. Nodules develop on the skin and peripheral nerves, resulting in dysesthesias and paralytic symptoms in the arms and legs, as well as a frequent facial nerve paralysis. These pathologically altered areas can lead to the disintegration of entire regions of the body. The vertebral symptoms can be similar to those observed in tuberculosis infections.

Brucella bacteria, the cause of brucellosis (Bang's disease, Malta fever), are small, nonmotile, gram-negative rod bacterium that are transmitted to humans from animals (dog, cattle, pigs, sheep, and goats). In addition to bouts of fever and swelling of the liver and spleen, the vertebra may also be infected and inflamed (spondylitis), as can the bones (osteomyelitis), the synovial bursae (bursitis), the joints, the meninges (meningoencephalitis), the urogenital tract, the heart valves, and the endocardium and pericardium.

Salmonella typhosa are responsible for a severe and contagious bacterial infection of the digestive tract, and belong to a large group of gram-negative rod bacteria that are usually transmitted by direct oral intake of contaminated food or water, less frequently via smear infection. The bacteria enter the body through the mouth, enter the small intestine and, after migrating through the intestinal wall, proliferate in the regional lymph nodes. The bacteria then enter the bloodstream, spreading to the liver, spleen, kidneys, intestine, meninges, joints, bones and bone marrow. The full-blown disease may include symptoms such as the vertebral complications osteomyelitis and spondylitis typhosa (vertebral inflammation), as well as myocardial inflammation, cerebral edema (swelling of the brain), small intestine perforation due to intestinal ulcers with peritonitis (inflammation of the peritoneum), and cardiovascular failure.

The most important causative pathogens of **nonspecific bacterial spondylodiscitis** include:

- Staphylococcus aureus
- Staphylococcus epidermidis
- Streptococcus viridans
- Escherichia coli
- Pseudomonas aeruginosa
- Pneumococci
- Clostridium perfringens
- Proteus mirabilis

In some cases these bacteria can cause purulent inflammations, pulmonary or urinary tract inflammations,

where the pathogens can also infect the spinal column by traveling from the center of inflammation through the bloodstream or lymphatic system. Once the spine is infected, abscesses and a softening of the vertebrae and intervertebral discs may result, and the penetration of the abscesses into the spinal canal can lead to severe neurological complications.

Potential sources of bacterial infections of the spinal column include, in addition to a primary center of inflammation such as pneumonia or an abdominal or pelvic inflammation (endogenous cause), exogenous (external) factors, such as gunshot or stab wounds where the bacteria can enter the body, or infections resulting from surgery (iatrogenic).

2. Spondylodiscitis not caused by bacterial

In immunocompromised patients, the severely ill, or intensive care patients, infections of the vertebrae and intervertebral discs may also be caused by viruses, fungi (*Candida albicans*, *Aspergillus*), or parasitic infection with dog, sheep or fox tapeworms (*Echinococcus*), whereby *Echinococcus* infestation of the spinal column can result in pronounced cyst formation in the spinal column.

How do pathogens reach the spinal column?

There are a number of pathways by which the pathogens can access the vertebra and discs:

- Through the bloodstream (hematogenic)
 - Centers of inflammation far from the spinal column can transmit pathogens to it either arterially through the terminal arteries supplying the vertebrae or through the veins due to a reflux in Batson's plexus caused by a pressure increase.
- Through the lymph stream (lymphogenic)
- Via a center of inflammation near the spinal column that eventually encroaches on it (per continuitatem)
- By way of a postoperative wound infection (iatrogenic)

What are the possible symptoms of spondylodiscitis?

- Pounding, pulsing back pains
- Back pains that result from movement and pressure
- Pressure and compression pain in the spinal column, often accompanied by a change in posture to relieve the pain
- Tissue death in the vertebra and intervertebral discs (necrosis)
- Purulent softening and dissolution (abscess)
- The thoracic and lumbar spine are most frequently affected.
- Destruction of the bony structures of the vertebrae with the development of deformities (gibbus)
- Fever
- Elevated laboratory inflammation parameters (CRP, BSR, leukocytes)
- Severe neurological complications with sensorimotor defects (paraplegia, paralyse) due to the penetration of abscess or necrotic material into the spinal canal, resulting in spinal cord compression.
- Complications due to the continued propagation of abscesses:
 - Psoas abscess
 - Paravertebral (next to vertebrae) soft-tissue abscesses
- Specific symptoms arising from other organ groups not directly related to the spinal column and caused by the primary disease (e.g. tuberculosis, typhus, etc.)

What diagnostic procedures are carried out for spondylodiscitis?**1. Medical history:**

- Has the patient had a recent bacterial infection?
- Has the patient had recent surgery or other therapeutic procedures on the spinal column?
- Is the patient suffering from causative diseases such as tuberculosis or salmonellosis?
- Is the patient suffering from any autoimmune diseases or diabetes mellitus?

2. Physical and neurological clinical examinations:

- Where is the pain located?
- Are radicular or pseudoradicular neurological symptoms present?

3. Laboratory diagnostics:

There are no measurable blood parameters that can be used to confirm spondylodiscitis. Inflammatory process indicator levels may be elevated.

- Are the inflammatory process indicators blood sedimentation rate (BSR), C-reactive protein (CRP) or white blood cell count (leukocytes) elevated?
- Is PMN elastase, a marker for an acute inflammatory process, elevated?
- Is the lymphocyte count high?
- Is the Tine test positive (tuberculosis diagnosis)?

4. Detection of a pathogen:

Spondylodiscitis can be confirmed either by the histological (cellular) or microbiological detection of the pathogen.

If spondylodiscitis is suspected, tissue material from the suspected vertebral segment can be obtained by fine needle aspiration or punch biopsies. This material can then be examined at the cellular level under a microscope. Parts of the material are used to inoculate nutrient substrates on which any germs present can be cultured, and then identified.

Pathogen confirmation can also be based on the bacteriological analysis of blood, sputum (saliva), gastric juice, and urine.

5. Imaging methods:

- Conventional x-rays (AP and lateral views)
 - Are the base plates or upper plates of the vertebrae eroded?
 - Does the vertebral body or arch root show destruction?
 - Is there a paravertebral soft tissue shadow indicating a paravertebral abscess?
 - Is there evidence of wedged vertebrae that would indicate the destructive inflammatory fusion of the affected vertebra?
 - Is the intervertebral space thinner, a sign of reduced intervertebral disc height?
 - Can gibbus formation be confirmed?
- Are sclerotizations, marginal osteophytes or block vertebra formation apparent as signs of the body's attempt to repair itself?

- Skeletal scintigraphy

Since the radiological signs of inflammatory spinal column destruction are not detectable in the initial stage, 3-phase skeletal scintigraphy is a valuable instrument in this initial phase with which the centers of inflammation can be clearly depicted early in the process.

- Computer tomography (CT), magnetic resonance tomography (MRT) with or without a contrast agent

These diagnostic methods depict the affected regions in thin layers, very clearly and in diagnosable detail. Changes in the spongy vertebral tissue, intervertebral discs, spinal cord and nerves can be assessed differentially. Existing abscesses in the epidural space or in paravertebral locations can be located so that their course of development can be followed. Depending on the location of the abscess, CT-controlled lancing or drainage may also be feasible. In case of spondylodiscitis with an unknown primary focus, these methods are useful in the search for the causative center of inflammation.

How is spondylodiscitis treated?

Treatment always depends on the severity of the spinal column findings and any existing primary illness. The objective of treatment is to completely heal the inflammatory spinal column infection and ensure that the spinal column is in a functionally favorable position.

Uncomplicated spondylodiscitis can be conservatively treated with the following methods, depending on the constellation of findings:

- With antibiotic medicines after pathogens have been tested and identified
- Immobilization with bed rest for several weeks, depending on findings
- Corset therapy for several months, depending on findings

Surgery is indicated for complicated spondylodiscitis with neurological complications, pronounced deformities, and malposition of the spinal column, abscesses in the epidural space, or the failure of antibiotic treatment. The objectives of surgery are the radical removal (debridement) of tissue destroyed by the inflammatory process, and the stable reconstruction of the existing defect to ensure a functionally satisfactory spine position. There is no international standard for surgical treatment of spondylodiscitis.

Different surgical methods are used depending on which spinal segment is affected and the specific local findings. Surgical access is either ventral (from the front), dorsal (from the back) or a combination of the two. Reconstruction of existing defects can be done either through the integration of autologous (the patient's own) bone material (chips from the pelvic crest, rib, or fibula) or vertebral body implants. Stabilization is achieved by spondylodesis (surgical immobilization) of the affected vertebral segment.

The following surgical methods are frequently used for the surgical treatment of spondylodiscitis, depending on the specific findings:

- Ventral debridement with partial or complete vertebral body resection with the decompression of the spinal canal and spinal cord, stabilization by means of ventral support employing dorsally instrumented spondylodesis.
- Ventral decompression with fusion can be done in the thoracic spine depending on the specific findings
- Surgery of the lumbar spine is almost always done from the back, especially if the patient's general condition is poor