

*Ministry of Defence*

## **Synopsis of Causation**

### **Spondylosis**

Author: Dr Tony Woolfson, Medical Author, Medical Text, Edinburgh  
Validator: Professor S P F Hughes, Charing Cross Hospital, London

September 2008

## **Disclaimer**

---

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

The Ministry of Defence accepts full responsibility for the contents of this synopsis, and for any claims for loss, damage or injury arising from the use of this synopsis by the Ministry of Defence.

# 1. Definition

---

- 1.1 Strictly speaking, **spondylosis** means fusion of vertebrae. In normal usage, however, the word refers to a variety of conditions involving degenerative changes of the spine. These are:-
- [Cervical](#) spondylosis
  - [Lumbar](#) spondylosis
  - Lumbar degenerative disc disease; and
  - Lumbar [facet arthropathy](#)
- 1.2 Related changes in the longitudinal ligaments and the ligamentum flavum are often also included.

## 2. Clinical Features

---

- 2.1 **Clinical features.**<sup>1,2</sup> Degenerative disease of the spine is an inevitable consequence of ageing. Back pain is a frequent complaint, but in general practice it has been reported that a definite cause for the pain is established in only about 15% of patients.<sup>3</sup> Degenerative changes in the vertebrae, intervertebral discs and ligaments becomes increasingly common with age. It is reported that 7% of people in their 20s have annular tears in their lumbar discs. This increases to 20% in the 30s, 41% in the 40s, 53% in the 50s, and 85% in the 60s, whilst 92% of people over 70 have been shown to have these tears.<sup>4</sup> However, a relationship between any of these changes and the patient's symptoms is very difficult to prove. The most clinically important forms of degenerative disease of the spine are the four described below. Overall, lumbar symptoms are more frequent than cervical symptoms, although 60% of patients with low back pain have cervical spondylosis.
- 2.1.1 **Cervical spondylosis** is a common chronic condition of the neck involving the vertebral bodies ([osteophyte](#) formation), intervertebral discs (deformation, disc [herniation](#)), and adjacent ligaments. 80-90% of people over the age of 50 years have radiological evidence of degenerative changes in the cervical spine, but the vast majority of these are asymptomatic.<sup>5</sup> The nerve root [foramina](#) and the spinal canal may be narrowed, and nerve roots and the spinal cord compressed. Symptoms include neck pain and frontal headaches, [paraesthesiae](#) and pain in varying distributions according to which nerve roots are involved, progressive weakness from nerve root compression ([radiculopathy](#)), and even paralysis and bowel or bladder dysfunction if the spinal cord is compressed ([myelopathy](#)).<sup>6</sup>
- 2.1.2 **Lumbar spondylosis** describes the presence of osteophytes arising from the bodies of the lumbar vertebrae. Whereas cervical spondylosis is usually considered as a single entity, some authors make a distinction between the three main components of degenerative disease of the lumbar spine, of which osteophyte formation is one. The other two (disc disease and facet arthropathy) are described below. Osteophytes are usually seen on the anterior and lateral aspects of the superior and inferior margins of the vertebral bodies. They are the result of new bone formation in response to stresses on the ligaments. These changes occur in more than 80% of people over the age of 50 in the Western world, although only a small proportion of these have any symptoms that can be convincingly related to the radiological changes.<sup>7</sup> Osteophytes are not themselves painful. If the nerve root canals are narrowed, this may produce nerve root compression. These patients may experience pain, or there may be numbness, paraesthesiae or ([lower motor neurone](#)) muscle weakness in the distribution of the relevant nerves.
- 2.1.3 **Lumbar degenerative disc disease** occurs as a normal part of the ageing process, although there are other contributing factors (see aetiology). As with all the other components of degenerative disease of the spine, changes can be demonstrated with increasing frequency related to age, but degenerative discs are not necessarily painful and the degree of change cannot generally be related to the presence or severity of symptoms. When symptoms occur, they are often associated with a precipitating event such as sudden flexion or rotation, but some episodes begin without such an event. Pain due to disc damage is usually dull in nature, but can be very severe, and is felt in the low lumbar or buttock

areas. Movements that put a load on the disc precipitate the pain. If there is a prolapse of the disc resulting in impingement on the nerve roots, there will be symptoms and signs according to the site and degree of root compression. Lumbar disc prolapse is usually preceded by previous episodes of pain, but may occur without warning.

- 2.1.4 **Lumbar [facet arthropathy](#).**<sup>8</sup> The ligaments supporting the facet joints between the vertebrae are subjected to a great deal of stress during all spinal movements, particularly rotation and extension. These joints are well supplied by nerves and pain can be provoked by various manoeuvres. Symptoms include local pain and tenderness, pain on extension or rotation (usually toward the affected side), groin or thigh pain and relief from the pain by walking. It has been claimed that patients who do not have damage to these joints demonstrable on magnetic resonance scanning do not have back pain.<sup>9</sup> Injection of local anaesthesia in and around affected joints has been shown to reduce symptoms in certain patients. This condition on its own does not appear to produce any serious consequences, although the pain can limit activities. It is probable that facet joint changes are linked to the whole process of disc degeneration.
- 2.2 The symptom of low back pain is probably caused initially by disc injuries, initially circumferential tears in the [annulus fibrosus](#). The outer part of this structure has a nerve supply, and the pain results from local damage. If there are a number of these tears, they may join to produce one or more radial tears. Herniation of the disc may occur and will produce symptoms depending on the pressure effects of the herniated portion. The [nucleus pulposus](#) undergoes biochemical changes resulting in loss of water, reduction in intrinsic resilience and change in shape. In turn, this can cause stresses on the ligaments and facet joints. Eventually, the discs become dehydrated, smaller and irregular. By this time, they may not themselves produce pain, but disruption of the normal anatomy results in osteophyte formation, and stress, damage and inflammation in the facet joints and ligaments.
- 2.3 Back pain and spinal cord injury may occur with decompression sickness in divers. This is not directly related to spondylosis but may be relevant in individuals presenting with back pain who have been divers. The damage sustained is thought to be due to the formation of gas bubbles or fat in the arteries and veins supplying the spinal cord or in the spinal cord itself. Recovery is usually good, but in some patients there may be long-term consequences.<sup>10</sup>

## 3. Aetiology

---

3.1 There is no general agreement as to the cause of spondylosis. There are several contributing factors.

### 3.2 Environment and genetics

3.2.1 Degenerative disease of the spine was thought for some time to be entirely due to loading stresses and repeated minor trauma to the discs, joints and ligaments. However, the aetiology of degenerative spine disease is now known to be more complex and multifactorial, with family history and childhood environment being of considerable importance.<sup>11</sup>

3.2.2 Family and twin studies have demonstrated the significant role of genetic factors, and various specific genetic features have been shown to be associated with sciatica, lumbar disc degeneration and herniation.<sup>12</sup>

3.2.3 There is also good evidence to link cigarette smoking and other cardiovascular risk factors to degenerative spine disease and to back pain. This is probably due to a reduction in blood supply resulting in anoxia in the intervertebral disc, and leading to cell death. The response to this cell death is inflammation, with ingrowth of blood vessels and nerves into the disc.

### 3.3 Heavy, repeated or abnormal loading

3.3.1 Physical loading of the spine almost certainly plays a part in the causation of back disorders.<sup>13</sup>

3.3.2 The effects on the spine of compression, torsion and shearing have been investigated directly in various studies, both in the workplace and in the laboratory.<sup>14</sup> In general, there appears to be a cause and effect relationship between the magnitude of the forces exerted and the resulting damage, but the relationships are complicated and depend on posture when the forces are applied. In addition, tolerance to the damage and the degree of disability produced varies greatly between individuals.

3.3.3 It may be that heavy loading of certain types can cause more symptoms in some patients who already have age-related degenerative changes in the spine.<sup>15</sup>

3.3.4 The relationships between load and disc degeneration, are however not well established in epidemiological studies, and reviews suggest that other issues, such as [psychosocial factors](#),<sup>16</sup> are important in defining the level of resultant illness and disability (see section 3.4 below).

3.3.5 Associations have been described between back disorders and various work activities. A meta-analysis of 31 studies considered to be of sufficient quality for inclusion found the strongest evidence for heavy repetitive lifting of materials, bending and twisting.<sup>17</sup> Similar results have been found in other studies.<sup>18,19</sup> There is some evidence for degenerative changes and back pain being related to heavy general work and patient lifting (in healthcare workers),

but none for any relationship with any particular static posture such as sitting for extended periods, standing or walking.

- 3.3.6 Military pilots have an incidence of back pain of 13%, reported to be related to the flying role. This is said to be more common in helicopter pilots due to a combination of a forward leaning posture during flight and whole body vibration (see below). There is no good evidence that spondylosis causes the pain nor that flying causes spondylosis.<sup>20</sup>
- 3.3.7 It has been suggested that symptoms occurring in the neck may be exacerbated by the weight of helmets with their attached instrumentation. There is however no good evidence that the pain is due to degenerative cervical spine disease.
- 3.3.8 There is some evidence that whole body vibration (particularly at low frequencies) is associated with degenerative disc disease. This occurs with the use of machine tools and driving motor vehicles, particularly tractors and trucks, which vibrate at 3-6 Hz, the resonant frequency of the spine and whole body. Damage is more likely in those patients who have spent long periods driving.<sup>21</sup> The frequency of vibration in a helicopter is rather higher, and if back pain does occur more often in helicopter pilots, this could be related more to the posture when flying than to the vibration.<sup>22</sup>
- 3.3.9 Obesity may be a contributory cause of degenerative disease of the spine, but the evidence is not convincing.
- 3.3.10 A recent literature review from Canada summarises the change in emphasis in recent years regarding occupational exposure and lumbar degeneration. In exploring the genetic influences on the changes in the disc, Battié and colleagues evaluated the role of occupational exposure and lumbar degeneration. Their summary states that 'physical loading specific to occupation and sport has a relatively minor role' in lumbar degeneration. Instead genetic factors are felt to have a 'dominant' role. They consider genetic influences explain 74% of variance in adult populations and note the identification of several gene forms associated with degeneration.<sup>23</sup>

#### 3.4 Psychosocial factors

- 3.4.1 There is no evidence linking psychosocial factors directly with degenerative disease of the spine.
- 3.4.2 Psychosocial factors have, however, been shown to be of importance in defining the frequency and severity of pain and the degree of disability.<sup>24</sup> The most important of these are age, history of back pain, level of education, employment status and income, and marital status. Patients with severe pain are more likely to have a history of pre-existing anxiety and depression, possibly related to being in more stressful occupations. Associations have been found with worry and with monotonous work.<sup>25</sup>
- 3.4.3 Stress, gender and personality traits have been shown to have significant effects on susceptibility to low back pain following spine loading.<sup>26</sup>

3.4.4 There is increasing recognition of the strong interactions between the biomechanical, physiological, psychosocial, and biochemical components of the human system. Modern research is beginning to consider risk for disability from low back pain at the systems level to include the different dimensions of the physical and mental components of the worker.<sup>27</sup> The US National Research Council has also proposed an explanatory model of this type.<sup>28</sup>

## 4. Prognosis

---

- 4.1 The prognosis of any of the forms of degenerative spinal disease is difficult to estimate with any certainty.
  - 4.1.1 Radiological changes become increasingly prevalent with advancing years, and establishment of a causal relationship with any symptoms is problematic.
  - 4.1.2 While the incidence of back pain seems to have changed little in the last 15 years, the rate of disability from this cause has increased greatly. In the western world, the only more frequent cause of absence from work is upper respiratory infection. This may reflect alterations in societal attitudes.
- 4.2 **Cervical spondylosis** is a slowly progressive condition, but only a small minority of patients reach the point where they develop significant nerve root or spinal cord compression requiring surgical treatment. Of these, a very small number will suffer permanent paralysis or other severe disability.
- 4.3 **Lumbar spondylosis** may advance radiologically, but in most cases this does not cause any real morbidity. In a small proportion of patients, narrowing of the nerve root canals or the spinal canal can produce serious symptoms, and even in some cases, paralysis or bowel and bladder problems.
- 4.4 Most patients with episodes of acute low back pain from **lumbar disc degeneration** are free of symptoms within one week, and almost all are better within 3 months. With patients who have more severe degenerative changes, their symptoms may fluctuate and/or progress at a variable rate. Psychosocial factors may have some influence on the degree of disability. The nerve roots and spinal cord may be compressed as the anatomy becomes more disrupted. Disc herniations may also give rise to pressure effects, usually on the spinal nerves, but occasionally on the spinal cord.
- 4.5 **Lumbar facet arthropathy** is common, but may or may not be responsible for producing low back pain in an individual patient. It may certainly contribute to the overall problem when the normal anatomy and alignment of the spine is disrupted.

## 5. Summary

---

- 5.1 **Spondylosis** describes a range of degenerative conditions of the spine.
  - 5.1.1 **Cervical spondylosis** includes all the changes that occur in the cervical spine.
  - 5.1.2 Disease of the lumbar spine is usually divided into **lumbar spondylosis** (osteophyte formation), **lumbar degenerative disc disease** (deformation, herniation) and **lumbar facet arthropathy**.
- 5.2 Degenerative disease of the spine is an inevitable consequence of ageing. Radiological changes are seen with increasing frequency in relation to age, and are almost universal in later life.
- 5.3 There is a poor correlation between the extent of degenerative disease seen on imaging and the severity of symptoms or disability. Many people are asymptomatic despite advanced radiological changes.
- 5.4 Although the prevalence of degenerative disease of the spine has not changed significantly in the last 15 years, the amount of perceived disability and absence from work has increased greatly. This may be related to alterations in attitudes in society.
- 5.5 The aetiology of symptomatic degenerative disease of the spine is complex and not fully understood. Repeated loading and torsion producing sub-clinical injury certainly plays some part, and associations have been established with certain work-related activities, the most important being repeated heavy lifting, particularly involving bending and twisting, and with exposure to whole body vibration from using machine tools and driving motor vehicles. However spondylosis is common in those with sedentary occupations and research over the past decade, including twin studies, has confirmed the importance of genetics. A recent literature review found that heredity was the dominant influence in disc degeneration with sport- and occupation-associated physical loading playing only a minor part.
- 5.6 Psychosocial factors are important in defining the degree of disability caused, and explanatory models are being developed from a systems perspective which bring together biomechanical, physiological, psychological, psychosocial and biochemical aspects.
- 5.7 A cause and effect relationship for the origin of symptoms can be very difficult to establish in an individual patient.

## **6. Related synopses**

---

Spondylolisthesis

Low Back Pain

Neck Pain

## 7. Glossary

---

annulus fibrosus	The outer fibrous ring of an intervertebral disc.
arthropathy	Pathological process affecting a joint.
cervical	Referring to the neck region. There are seven cervical vertebrae.
facet (zygapophyseal) joint	The part of a vertebra which articulates with a paired part on the next vertebra. Thus there are two facets on the superior aspect and two on the inferior aspect of each vertebra.
foramen (plural <i>foramina</i> )	Channels in bone, through which blood vessels or nerves travel.
herniation	Bulging through a weakness in supporting structures.
lower motor neurone	The nerve cell found in peripheral nerves. Damage causes wasting of muscles and a flaccid weakness.
lumbar	Referring to the lower back region. There are five lumbar vertebrae.
myelopathy	Any pathological process affecting the spinal cord.
nucleus pulposus	The central part of an intervertebral disc
osteophyte	A spur-like outgrowth of bone.
paraesthesiae	Abnormal sensations – burning, prickling, “pins and needles”.
psychosocial	Involving both psychological aspects and social background; e.g. the patient’s age, education, occupation, family and related factors.
radiculopathy	Dysfunction of a nerve root, usually due to compression.
scoliosis	A lateral curvature of the spine.

## 8. References

---

- <sup>1</sup> Canale ST. *Campbell's operative orthopaedics*. 10th ed. Philadelphia, PA: Mosby; 2003.
- <sup>2</sup> Ruddy S, Harris ED, Sledge CB. *Kelley's textbook of rheumatology*. 6th ed. Philadelphia, PA: WB Saunders; 2001.
- <sup>3</sup> Dillane JB, Fry J, Kalton G. Acute back syndrome: a study from general practice. *Br Med J* 1966;2:82-84.
- <sup>4</sup> Miller JA, Schmatz C, Schultz AB. Lumbar disc degeneration: correlation with age, sex, and spine level in 600 autopsy specimens. *Spine* 1988;13(2):173-8.
- <sup>5</sup> Alexander JT. Natural history and nonoperative management of cervical spondylosis. In: Menezes AH, Sonntag VH, editors. *Principles of spinal surgery*. New York, NY: McGraw-Hill; 1996. p. 547-57.
- <sup>6</sup> Young WF. Cervical spondylotic myelopathy: a common cause of spinal cord dysfunction in older persons. *Am Fam Physician* 2000;62(5):1064-70.
- <sup>7</sup> O'Neill TW, McCloskey EV, Kanis JA et al. The distribution, determinants, and clinical correlates of vertebral osteophytosis: a population based survey. *J Rheumatol* 1999;26(4):842-8.
- <sup>8</sup> Leonard TA. Lumbar facet arthropathy. In: Frontera WR, Silver JK, editors. *Essentials of physical medicine and rehabilitation*. 1st ed. Philadelphia, PA: Hanley and Belfus Inc; 2002. p. 240-2.
- <sup>9</sup> Borenstein D. Does osteoarthritis of the lumbar spine cause chronic low back pain? *Curr Rheumatol Rep* 2004;6(1):14-9.
- <sup>10</sup> Dutka AJ, Francis TJ. Pathophysiology of decompression sickness. In: Bove A, editor. *Bove and Davis' diving medicine*. 3rd ed. Philadelphia, PA: WB Saunders; 1997. p. 159-75.
- <sup>11</sup> Videman T, Battie MC. The influence of occupation on lumbar degeneration. *Spine* 1999;24(11):1164-8.
- <sup>12</sup> Ala-Kokko L. Genetic risk factors for lumbar disc disease. *Ann Med* 2002;34(1):42-7.
- <sup>13</sup> National Research Council and Institute of Medicine. *Musculoskeletal disorders and the workplace: low back and upper extremities*. Washington DC: National Academy Press; 2001.
- <sup>14</sup> Marras WS. Occupational low back disorder causation and control. *Ergonomics* 2000;43(7):880-902.
- <sup>15</sup> Snook SH. Work-related low back pain: secondary intervention. *J Electromyog Kinesiol* 2004;14(1):153-60.
- <sup>16</sup> Vingård E, Nachemson A. Work-related influences on neck and low back pain. In: Jonsson E, Nachemson A, editors. *Neck and back pain: the scientific evidence of causes, diagnosis, and treatment*. Philadelphia, PA: Lippincott Williams & Wilkins; 2000. p. 97-126.
- <sup>17</sup> Hoogendoorn WE, van Poppel MN, Bongers PM et al. Physical load during work and leisure time as risk factors for back pain. *Scand J Work Environ Health* 1999;25:387-403.
- <sup>18</sup> Frymoyer JW, Pope MT, Clements JH et al. Risk factors in low-back pain: an epidemiological survey. *J Bone Joint Surg* 1983;65A:213-8.
- <sup>19</sup> Waddell G, Burton AK. *Occupational health guidelines for the management of low back pain at work - evidence review*. London: Faculty of Occupational Medicine; 2000.
- <sup>20</sup> Ward M W. *Orthopaedics*. In: Ernsting J, Nicholson AN, Rainford DJ, editors. *Aviation medicine*. 3rd ed. Oxford: Butterworth Heinemann; 1999. p. 358-63.
- <sup>21</sup> Waddell G. In: *The back pain revolution*. Edinburgh: Churchill Livingstone; 1998. p. 85-99.
- <sup>22</sup> Rollin Stott JR. *Vibration*. In: *Aviation medicine*. 3rd ed. Oxford: Butterworth Heinemann; 1999. p. 177-91.
- <sup>23</sup> Battie MC, Videman T, Parent E. Lumbar disc degeneration: epidemiology and genetic influences. *Spine* 2004;29(23) 2679-90.
- <sup>24</sup> Boos N, Rieder R, Schade V et al. The diagnostic accuracy of magnetic resonance imaging, work perception, and psychosocial factors in identifying symptomatic disc herniations. *Spine* 1995;20:2613-7.
- <sup>25</sup> Svensson HO, Andersson GB. Low back pain in 40 to 47-year old men: work history and work environment factors. *Spine* 1983;8:272-6.
- <sup>26</sup> Marras WS, Davis KG, Heaney CA et al. The influence of psychosocial stress, gender, and personality on mechanical loading of the lumbar spine. *Spine* 2000;25(23):3045-54.
- <sup>27</sup> Waddell G, Main C. In: *The back pain revolution*. Edinburgh: Churchill Livingstone; 1998. p. 223-40.
- <sup>28</sup> National Research Council. *Work-related musculoskeletal disorders*. Washington DC: National Academy Press; 1999.