

# Low Back Pain Accompanying Osteoporosis

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**Abstract:** In osteoporosis, the vertebral body deforms through fracture, causing low back pain at various levels. Osteoporosis with marked acute low back pain is rather infrequent, and in many cases, vertebral body deformation and loss of body height progress with almost no low back pain. Some cases without fracture complain of indefinite pain and a sense of discomfort in the lumbar area, due to hypersensitivity to pain, which is a symptom peculiar to menopause. In the acute phase of low back pain in osteoporosis, pain is alleviated using anti-inflammatory analgesics, etc. For pain in the chronic phase in cases with spine deformity and/or dorsal kyphosis, therapeutic heating of and physical therapy for erector spinae muscles are also effective. The load to the vertebral body significantly changes depending on daily living activities, so the patients should be instructed to engage in activities with good muscular balance. Bisphosphonates, such as alendronate, can reduce the incidence of vertebral fractures in osteoporosis to about half, and they are also effective in preventing body height decrease and dorsal kyphosis. It is necessary to conduct appropriate pain control in respective phases, and to administer therapy to prevent fractures in osteoporosis, in order to prevent spine deformity and height decrease due to new fractures, even after the pain disappears.

**Key words:** Vertebral body deformation; Body height decrease; Hypersensitivity to pain; Daily living activities; Bisphosphonate

## Introduction

Osteoporosis is a condition in which bone mass decreases, causing abnormality in struc-

ture, and reducing bone strength, resulting in an increased risk of fracture. Even when bone mass is decreased and abnormality occurs in its structure, no symptoms are usually caused. In

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osteoporosis, clinical symptoms become clear only after a fracture occurs. However, clinical symptoms of a fracture caused by osteoporosis are considerably different from those of a normal fracture, which is caused by great external force imposed on a normal bone. Therefore, a fracture caused by great external force is called a traumatic fracture, and a fracture in osteoporosis is called a fragility fracture, to differentiate between the two.

### Low Back Pain in Osteoporosis

A fragility fracture occurs when weakened bone is destroyed due to an external force that exceeds the strength of the bone. External force that causes a fragility fracture ranges widely, from a light force caused in daily living activities, to a strong force, as in a normal traumatic fracture. Therefore, a fracture in osteoporosis can be accompanied by acute severe pain, in some cases, and by almost no pain, in some mild cases, depending on the severity of vertebral body collapse.

#### 1. Acute low back pain and clinical fracture of the vertebral body

Fracture in osteoporosis with acute low back pain can be categorized into the type accompanied by rapid deformation, and the type accompanied by gradually progressive deformation. In either type, when vertebral body tissues are destroyed, sharp pain in the low and upper back occurs. Some patients with strong pain cannot even roll over, but many become better after rest in bed for a few weeks. In the acute phase, deformity of the vertebral body is not clear on X rays in some cases. Vague dull pain sometimes continues in the entire low and upper back, after acute pain disappears. For a few months after occurrence of pain, deformation of the vertebral body tends to accelerate.

If sharp pain intensifies over time, other causes, such as metastasis, should be considered. MRI and urinary concentrations of cross-linked N-telopeptides of Type I collagen (NTx),

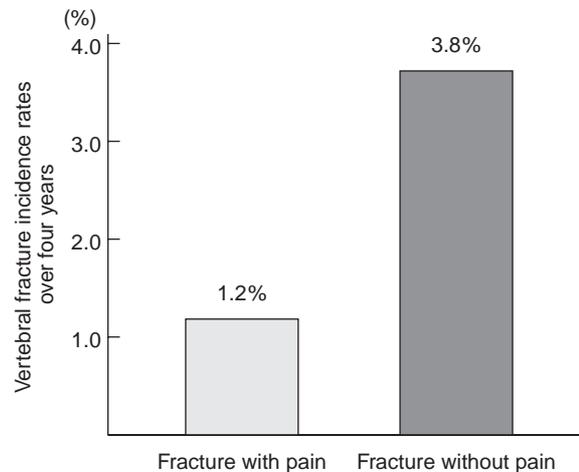


Fig. 1 Pain of vertebral fracture due to osteoporosis. Four-year research on 4,432 osteoporosis cases without fractures in the West. There were three times more cases without pain and with fracture deformity found on X rays, compared with cases with vertebral fracture with pain. (Cited from Cummings, S.R. *et al.*: Effect of alendronate on risk of fracture in women with low bone density but without vertebral fractures: Results from the Fracture Intervention Trial, *JAMA* 1998; 280: 2077–2082)

a marker of bone metabolism, etc., have been helpful in diagnosing bone metastasis from a malignant tumor. A fracture with rapid deformation of the vertebral body accompanied by acute pain is called a clinical fracture.<sup>1)</sup>

#### 2. Chronic low back pain, and vertebral fracture mildly progressing without symptoms

Not every vertebral fracture due to osteoporosis is accompanied by sharp pain. Some cases start with chronic back pain, and have gradually progressing dorsal kyphosis, together with vertebral deformation. Also, in some cases, pressure deformation of vertebral body progresses with almost no low or upper back pain. A U.S. study, in which X rays of the thoracic spine and lumbar spine were taken over three years, on about 7,000 patients with postmenopausal osteoporosis, of about age 65, on average, found an increase of pressure fractures every year in about 1.5% of the subjects.<sup>1)</sup> Among them, about 1/3 felt acute pain; the remaining cases had no clear pain (Fig. 1).<sup>2)</sup>

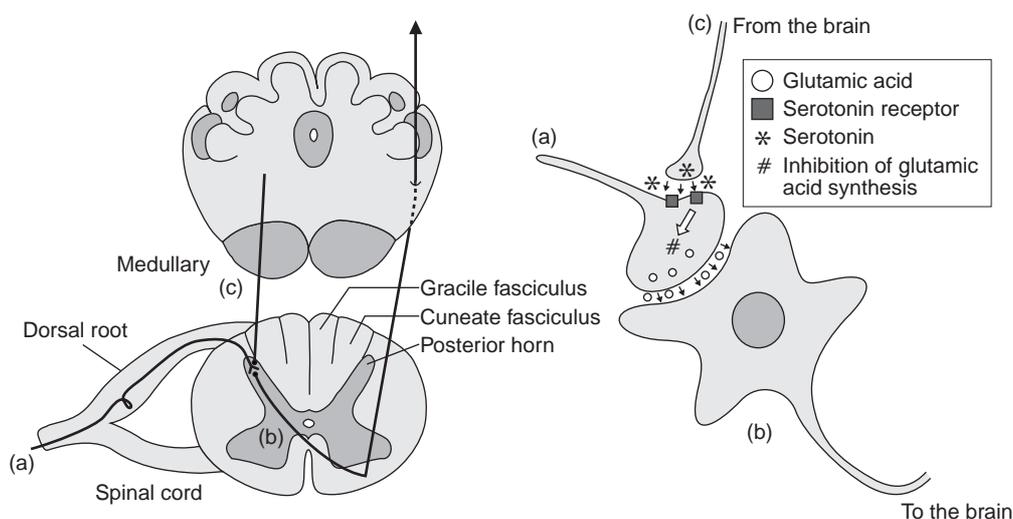


Fig. 2 Conduction route of pain in the spinal cord

(a): Sensory nerve, (b): Conduction route of pain to the brain, (c): Nerve to inhibit conduction of pain descending from the brain. The nerve that inhibits pain from the brain inhibits synthesis of glutamic acid in the sensory nerve, by secreting serotonin. Therefore, pain is alleviated and less pain is transmitted to the brain. When female hormones become reduced, this inhibitory effect is lowered, resulting in hypersensitivity to pain.

A larger number of cases with osteoporosis have only progression of pressure deformation of vertebral body, without acute low or upper back pain, compared with cases with acute pain, which is clinically important. When the spine is being bent, or the height is decreasing, even without pain, it is necessary to consider the possibility of vertebral fracture due to osteoporosis. As such, existence of vertebral fracture without pain (morphometrical fracture), which occurs in the chronic course, has been clarified, and fracture judged only based on X rays has been called morphometrical fracture.<sup>3)</sup> It is necessary to recognize that there are two types of vertebral fractures due to osteoporosis: morphometrical fracture and clinical fracture.

### 3. Hypersensitivity to pain and low back pain in postmenopausal women

Even cases without vertebral fracture in postmenopausal osteoporosis sometimes complain of indefinite pain and discomfort in the low and/or upper back. The sensation is some-

times expressed as “like an insect moving around on my back” and “tingling like an ant crawling.” Chronic low and/or upper back pain due to osteoporosis includes such sensation, which is considered as a type of hypersensitivity to pain, which is a symptom peculiar to menopause.

Transmission of C-fibers of a sensory nerve is inhibitorily adjusted by the nerve fiber descending from the brain in the spinal cord (Fig. 2). The transmitter of this nerve is serotonin, and the terminals of C-fibers have serotonin receptors.

In a rat experiment, estrogen deficiency caused by ovarian resection results in decreased serotonin receptors at the terminals of C-fibers, and an increase of transmissibility of pain stimulus. It has been clarified that administration of calcitonin restores the number of serotonin receptors, and hypersensitivity to pain disappears.<sup>4)</sup> Low and/or upper back pain in postmenopausal osteoporosis can be related to not only bone but also a central effect of estrogen deficiency.

## Dorsal Kyphosis and Body Height Decrease in Osteoporosis

Many postmenopausal women have a rounder back and shorter height as they get older. The deformity and shortening of the backbone in the elderly are caused by two main factors. One is decreased thickness of the interspinal disks, and the other is vertebral fractures. In osteoporosis, the back becomes bent and the body height decreases due to vertebral fractures. Studies in the West clarified that body height decreases by about 1 cm per year due to vertebral fractures in women with postmenopausal osteoporosis in their 60s and 70s.<sup>5)</sup> Vertebral fractures due to osteoporosis are a major cause of bending of the back (dorsal kyphosis) and height decrease in the elderly.

Risk of vertebral fractures in osteoporosis varies greatly depending on the presence or absence of existing vertebral fractures. According to data on Western osteoporosis patients, of ages 60 to 75, cases that have never had a vertebral fracture, experience their first vertebral fracture at a yearly incidence of about 1 to 3%; cases with a vertebral fracture have a new vertebral fracture at a yearly incidence of 11.5%, and the incidence of cases with two or more vertebral fractures reaches 24.0%.<sup>5)</sup>

The incidence of vertebral fractures in Japanese, which is slightly higher than that in Western people, is about 5 to 7% in osteoporosis patients, in their 60s, without vertebral fracture, and about 12 to 14% in cases with one or more vertebral fractures.

An important point here is that, in both Western and Japanese people, the incidence of occurrence of new vertebral fractures due to osteoporosis increases as the number of existing vertebral fractures increases. Once a vertebral fracture occurs, there is a higher risk that many vertebral fractures will occur in the following several years, resulting in back bending. To prevent dorsal kyphosis and chronic back pain due to osteoporosis, therefore, it is important to prevent occurrence of the first vertebral

fracture.

## Management of Low Back Pain in Osteoporosis

As to diagnosis by X rays in cases with deformity of the spine, osteoporosis is diagnosed if vertebral deformity (wedge vertebra, fish vertebra, vertebra plana, etc.) caused by a pressure fracture is found, while osteoarthritis of the spine is diagnosed if degenerative changes of the spine are observed. If both conditions are noted, both diagnoses are made, in some cases. The cause of low back pain in such cases is dorsal kyphosis, and the measures for low back pain are the same. If a pressure fracture due to osteoporosis exists, treatment should be conducted to prevent a new fracture.

### 1. Acute low back pain

For acute low back pain due to a vertebral fracture, bed rest is important, above all. The pain always improves. Both anti-inflammatory analgesics and calcitonin injection are effective to ease pain. In cases with subacutely progressing vertebral deformation, after occurrence of vertebral fractures, a light trunk orthosis, such as a corset, is effective. For hypersensitivity to pain in postmenopausal women, calcitonin, etc., are effective.

### 2. Chronic low back pain

When there is a dorsal kyphosis and the lumbar part is anteflexed, low back pain originates from the intervertebral joints, and from bone, cartilage, and ligament tissues surrounding the interspinal disks, as well as from muscle tissues and fascia that support the spine. Pain from muscle tissues and fascia can be fatigue-induced pain or ischemic pain. Muscle strength lowers according to aging and lack of exercise. When the erector spinae muscles at the back side of the vertebral body decline, muscles easily become overworked, causing low back pain, even from standing and walking for a short time. Especially when the lumbar spine becomes

anteflexed, the erector spinae muscles become stretched, causing constant muscle contraction to cope with the condition, resulting in chronic fatigue. Further, intramuscular pressure increases and fascia becomes tense. Intramuscular blood flow is disturbed, and ischemic pain is added. Therefore, chronic dull pain is likely to occur in cases with an anteflexed lumbar spine.

For chronic low back pain due to deformity of the spine and dorsal kyphosis, not only anti-inflammatory analgesics but also injection of local anesthetics, and such physical therapy as low-frequency therapy, and heating to the erector spinae muscles, in the low and upper back, are effective.

### 3. Instruction on daily living activities to prevent vertebral fractures

Healthy human bones are strong enough to endure the load from daily living activities. When one lifts something heavy, a load several times greater than the body weight is imposed on the lumbar spine, and yet the vertebral body suffers no damage.

In the action of bending the back, 200 to 300kg of force is imposed on the vertebral body, but a normal vertebral body can stand the force of over 1,000kg. When bone mass decreases and abnormality occurs in the structure, strength also declines. In osteoporosis, bone density and strength of the vertebral body decrease respectively to about 70% and 50% compared with a healthy person. As a result, strength of the vertebral body against the load applied to the low back in daily living activities is reduced, increasing vulnerability to fracture. From another viewpoint, however, even if bone mass decreases due to osteoporosis, the vertebral body can still endure up to 3 to 5 times the body weight.

Force imposed on the vertebral body greatly varies depending on daily living activities. Especially when a strong force is imposed on the muscles of the back, the load on the vertebral body tends to increase. The load on the vertebral body can be reduced by avoiding

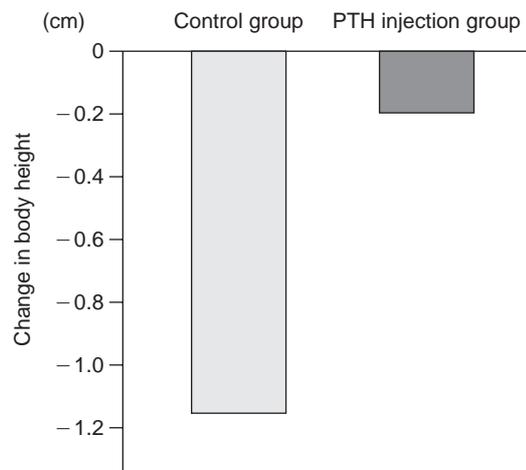


Fig. 3 Effectiveness to prevent body height decrease in osteoporosis treatment

In a large-scale study conducted in about 1,600 osteoporosis cases at age 68, on average, the body height decreased by about 1.2cm per year in the control group. In the group in which the fracture rate lowered due to parathyroid hormone (PTH) injection, the body height decreased only by about 2mm.

(Cited from Neer, R.M. *et al.*: Effect of parathyroid hormone (1–34) on fractures and bone mineral density in postmenopausal women with osteoporosis. *N Engl J Med* 2001; 344: 1434–1441)

sudden movement in stretching or bending the low back, and in lifting something from the floor, and by trying to move gently and in a good muscular balance. To prevent a fracture due to osteoporosis, instruction on daily living activities, in addition to increasing bone strength, is necessary.

### 4. Drug treatment to prevent vertebral fractures

Regarding vertebral fractures due to osteoporosis, it has been confirmed, in large-scale clinical trials, that adjustment of bone metabolism can lower the risk of new fractures.

For example, alendronate, which is a bisphosphonate, has an effect to inhibitorily adjust the increased bone metabolism. This drug begins to show efficacy to prevent vertebral fractures from six to 12 months after the start of treatment, and it can reduce the risk of occurrence of one or more vertebral fractures to about half, compared with a group that does not use

the drug, in four years.<sup>1,2)</sup> Further, this drug prevented occurrence of two or more vertebral fractures by 84%, and three or more vertebral fractures by 100%.<sup>1)</sup>

Another bisphosphonate: risedronate, also inhibited incidence of one or more vertebral fractures by about 40% in three to five years.<sup>7)</sup> In addition, it has been clarified that raloxifene,<sup>8)</sup> which is a female hormone receptor modifier, parathyroid hormone, etc., can assuredly inhibit risk of vertebral fractures.<sup>5)</sup> Respective studies using alendronate, and parathyroid hormone, have clarified that body height decrease also can be prevented<sup>1,5)</sup> (Fig. 3).

Today, risk of vertebral fractures can be certainly reduced by learning the conditions of bone mass and metabolism, and conducting drug treatment if necessary. For low back pain in osteoporosis, therapy to prevent new fractures even after symptoms disappear, in addition to symptomatic treatment, is necessary.

### 5. Instability of the spine due to fractures in osteoporosis

Even in fractures due to osteoporosis, the vertebral body can be severely collapsed, resulting in disturbed stability of the spine, though this is infrequent. This condition is often seen in persons of age 70 or older with the anterior wall of the vertebral body significantly collapsed and deformed into a triangle shape, or those whose central part of the vertebral body is crushed and the entire vertebral body is almost disrupted. There has been minor but apparent traumatic mechanism observed in these patients, such as a fall, immediately followed by rapid collapse of the vertebral body and pain. Subsequently, even after the acute phase, the low back does not become stable and low back pain continues. In these cases, surgical treatment is sometimes necessary to promote bone healing of the collapsed vertebral body and restore stability to the spine, so consultation should be sought with an orthopedist.

## Conclusion

Low back pain due to osteoporosis is diversified, such as pain from fractures in the acute phase, and pain caused by deformation of the spine and dorsal kyphosis in the chronic phase. It is necessary to administer pain control according to respective phases, and to try to prevent bone fractures due to osteoporosis, to prevent deformation of the spine and body height decrease resulting from new fractures, even after the pain disappears.

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