Spine Injuries in the Elderly

38

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38.1 Introduction

In the elderly the risk of traumatic fractures is rising due to an increased risk of falls caused by cerebrovascular and cardiac diseases. Another problem is the altered bone metabolism leading to increased bone fragility and fracture tendency. Thus even minor trauma such as domestic falls often leads to significant spine injuries.

Both most common fracture types in the elderly are osteoporotic vertebral body compression fracture in the thoracolumbar spine and Anderson and D'Alonzo type II odontoid fracture in the upper cervical spine [3].

Due to operative difficulties caused by the loss of the bone mineral density on one hand, and perioperative complications caused by medical comorbidities on the other, the decision in favor of surgical procedure is usually restrained. In contrast to the clearly evident benefits of surgical treatment of a for instance hip fracture, definitive guidelines for treatment of spine fractures in the elderly are missing.

The chapter will elucidate the existing dilemma between surgical therapy for osteoporotic fractures in elderly patients harboring high perioperative morbidity, versus conservative treatment potentially leading to an insufficient healing and neurological impairment. The rationale for both, conservative options and surgical approaches is discussed in this chapter based on the two most common types of geriatric spine fractures.

38.2 Case 1

38.2.1 Case Description

A 95 y/o female patient with a history of apoplexy and dementia stumbled and fell down on the back of her head. The externally performed CT scan and the MRI showed an Anderson and D'Alonzo type 2 odontoid process fracture (Figs. 38.1 and 38.2). After diagnostics and fixation in a Miami-J collar, the patient was transferred to our clinic. The patient suffered from strong neck pain. The neurological examination showed no deficits.

The patient underwent C1-C2 posterior by C1-C2 arthrodesis using the Goel and Harms technique (fixation of the C1 lateral masses and C2 isthmus using polyaxial screws) (Fig. 38.3).

No new deficits occurred after surgery. A perioperatively-acquired pneumonia was successfully treated by systemic application of a calculated antibioticum for 1 week. The patient was

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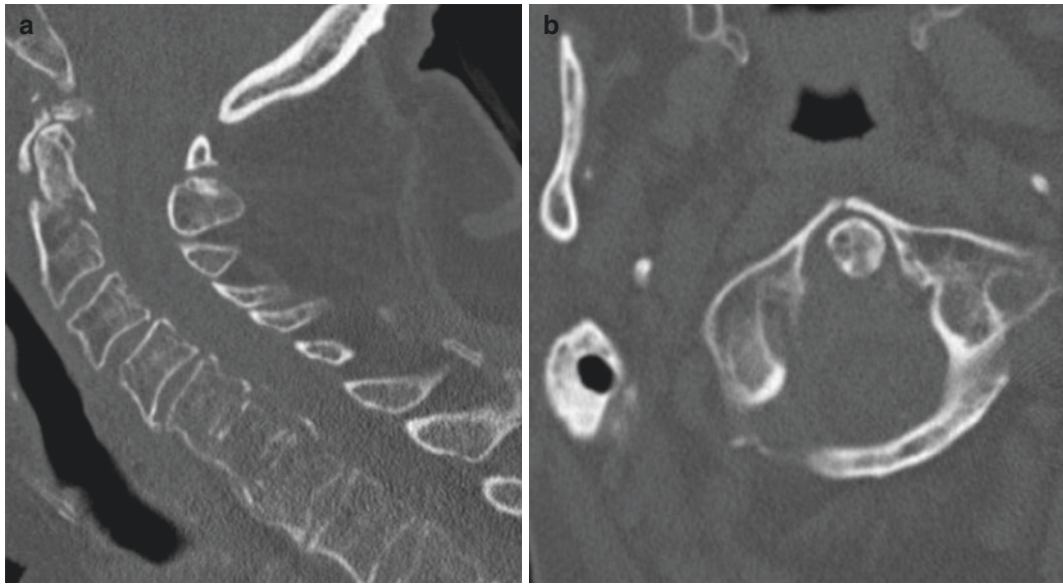

Fig. 38.1 Initial CT Scan. Sagittal (**a**) and axial (**b**) CT scan rendering type II odontoid fracture

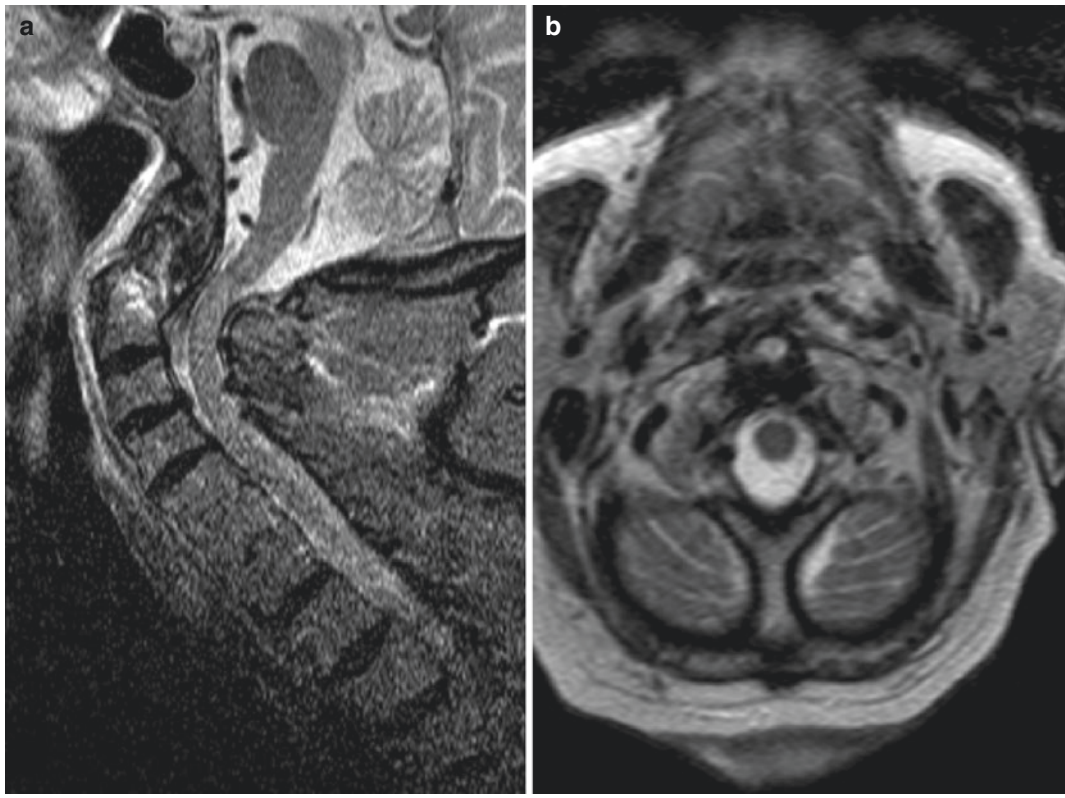

Fig. 38.2 Preoperative MRI. Sagittal STIR MRI (**a**) showing pathological signal enhancement along the C1/C2 complex; the sagittal and additionally axial images (**b**) are indicative for the disruption of the transverse ligament of the atlas

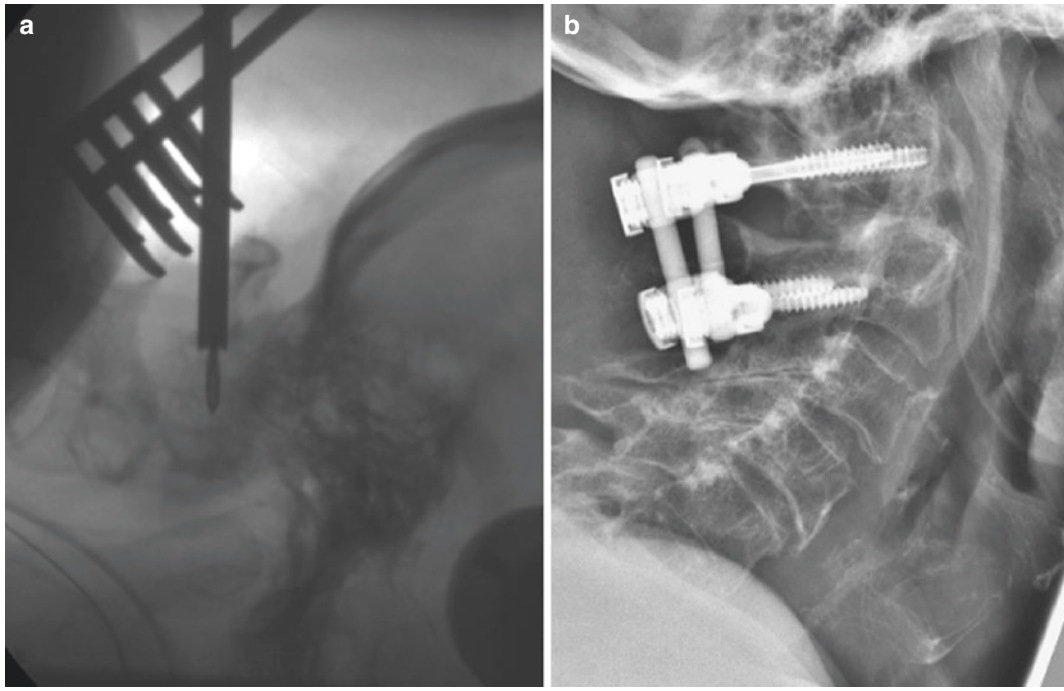

Fig. 38.3 Posterior screw-rod C1-C2 fixation. (**a**) Posterior C1-2 fixation is performed with lateral mass screws placed in C1 (**a**) and isthmic screws in C2. Drilling is guided by anatomic landmarks and lateral fluoroscopy. (**b**) X-ray check showing appropriate results after surgery

discharged back to her nursing home in a clinically and neurologically stable state 2 weeks after the surgery.

38.3 Case 2

38.3.1 Case Description

A 77 y/o female patient with a known history of osteoporosis presented to our outpatient department with progressive lumbar pain. The patient had fallen about 2 months ago. Additionally the patient reported to suffer from chronically back pain and claudication symptoms since about 9 months. Her complaints were progressive despite conservative treatment with high-dose morphine-derived analgetics. CT and MR-imaging revealed a consolidated osteoporotic compression fracture of the L1 with a consecutive kyphotic deformity (Fig. 38.4). Based on the imaging findings and the clinic described above, the patient was then offered surgical therapy.

The patient underwent a two-stage surgery: percutaneous dorsal correction sponylodesis with augmented pedicle screw fixation Th10-11-12 and L2-3-4 and pedicle subtraction osteotomy at the level of L1 in the first step, followed by a vertebral body replacement of the L1 2 days later (Fig. 38.5).

No postoperative neurological deficits or medical complications were observed. The patient was transferred to a rehabilitation clinic 10 days after the second surgery. At discharge, the patient presented with residual wound pain, she was able to walk short distances without assistance.

38.4 Case Discussion

38.4.1 Indication

38.4.1.1 Odontoid Fractures

Independent of the applied treatment these injuries are associated with high morbidity and mortality. The fracture-associated mortality is

Fig. 38.4 Initial diagnostic. Sagittal CT in (**a**) and T2 STIR MR-imaging (**b**) revealed a consolidated osteoporotic compression fracture of the L1 with a consecutive kyphotic deformity

increased especially in the first 12 weeks after the injury, at 1 year the mortality rate is still at 37.5% [34].

Osteoporotic changes, a poor blood supply of the fracture gap, and degeneration-associated impaired biomechanics lead to a disrupted healing of the fracture resulting in an increased rate of pseudoarthrosis of up to 85% [8]. Especially patients with dislocated odontoid fractures seem to be predisposed to a nonunion and an increased risk of mortality [12].

The optimal management for type II fractures remains controversial. No Level A evidence-based guidelines are available so far.

Overall, four different options for the treatment of type II odontoid fractures have been described: the conservative regimes include rigid and non-rigid immobilization, and the two surgical approaches are anterior screw fixation of the odontoid and posterior fusion of the C1/2 complex.

According to larger retrospective series and metaanalyses, mortality rates with conservative

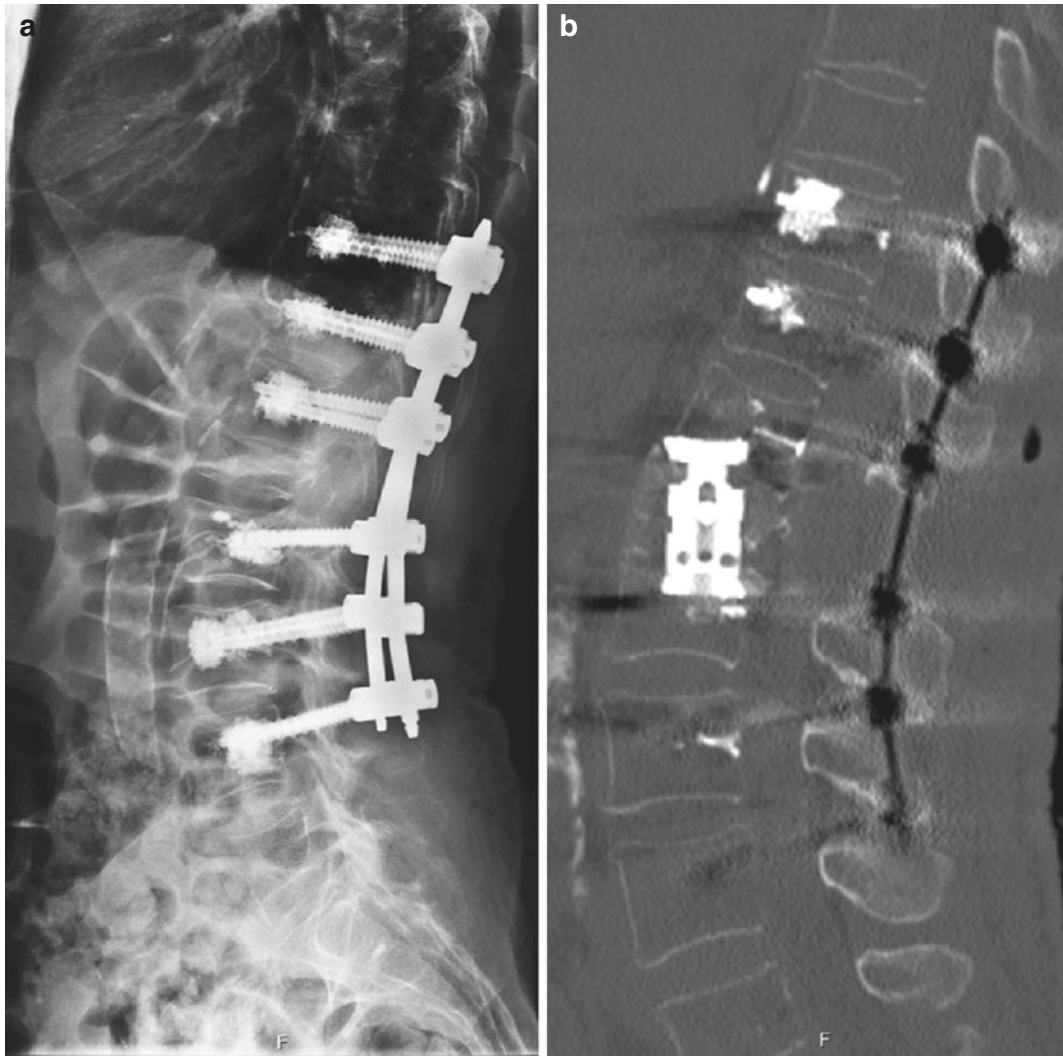

Fig. 38.5 (**a**) Postoperative Image. **a** Sagittal control X-Ray after cement augmented pedicle screw fixation Th 10-11-12 and L 2-3-4 and correction of kyphotic deformity; (**b**) Sagittal CT scan shows the final result after anterior spinal fusion performed in a second step

treatment by an immobilization in collars or halo-thoracic bracing vary between 33% and 45% [25]. Conversely the perioperative mortality rates are reported to be significantly lower ranging between 6% and 41% [8, 9, 13, 29, 35]. Chapman et al. could demonstrate in their large retrospective multicenter study a significant 30-day survival advantage (7% vs 22%) and a trend toward improved longer-term survival (38% vs 51%) for operatively treated over non-operatively treated patients [5]. The fusion rates by non-operative techniques are reported to reach 70%, however precisely in the elderly the risk of osseous non-union is highly increased with conservative immobilization, as found by a case-control study based on Class II data [19]: The odds ratio of this study indicated that the risk of failure for halo immobilization was 21 times higher in patients aged 50 years or more. Regarding the fusion rates, surgical treatment may provide significantly more beneficial results, than conservative options, leading in up to 100% to osseous union [8, 35]. Stable non-union – or fibrous union – could be an adequate aim in the treatment of odontoid fractures, if

the patient is asymptomatic and the dynamic X-rays show no instability at the site of the fracture [18, 25]. The main concern in these cases is the risk of a delayed myelopathy in patients with established osseus non-union of the odontoid [7]. Indeed, it is unclear over what period of time the myelopathy would develop: in most cases it takes several years for the relevant clinic to appear. This theoretically would make this problem negligible in the elderly population. However, the majority of elder patients with non-union after conservative treatment still require delayed surgery within 90 months after trauma because of their clinically relevant symptoms [31].

This data together suggests a trend toward more favorable outcomes of surgically treated patients.

38.4.1.2 Vertebral Body Compression Fracture

Osteoporotic compression fractures, mostly A-fractures according to the AO classification, are very frequent in the elderly affecting 117 in 100,000 people. The thoracolumbar junction is the most commonly involved site. Typical signs are acute back pain, motor and vegetative deficits, claudicatio spinalis, imobilization, and substantial decrease in quality of life. Conservative treatment includes analgesia, bed rest, and a concomitant medical treatment of osteoporosis. Although most fractures heal well with nonoperative procedures, up to 30% of fractures can develop painful nonunion, progressive kyphosis, and neurological deficit. For patients who develop severe pain not responding to nonoperative measures and painful nonunion, percutaneous cement augmentation procedures including vertebroplasty or kyphoplasty have been suggested in acute stages. However, in case of healed (old) osteoporotic fractures with established kyphotic deformity and sagittal imbalance, as well as relevant symptoms such as disabling pain or neurological deficits, more extensive intervention including dorsal pedicle screw-rod fixation and decompression by one- or multilevel laminectomy may be considered [17]. If indicated, the surgery should proceed as a minimally invasive percutaneous approach to minimize the blood loss, duration of the procedure, and perioperative complications in elderly patients. In cases with additional relevant deformity and/or burst fracture, a corporectomy of the fractured vertebral body should be performed for the ventral decompression. Spinal instrumentation and fusion may be combined with an osteotomy in order to achieve a correction of the segmental kyphosis. There is no clear evidence of the advantages and disadvantages of these complex interventions in the elderly. The indication is given rather as an ultima ratio in case of progressive deformity and symptoms despite intensive conservative therapy. Only few case series and expert opinions reporting on this subject are available [2, 11, 23, 27]. Fortunately, complex instrumented procedures are only needed in about 5% of all symptomatic osteoporotic compression fractures [30].

38.4.2 Surgical Approach

38.4.2.1 Odontoid Fractures

Amongst different surgical techniques, posterior fixation of the C1/2 complex using C1 lateral mass and C2 istmus screws by Goel/Harms is the most effective option for treatment of odontoid fractures with fusion rates approaching 100% [10, 20].

A higher failure rate with the direct anterior screw fixation technique has been claimed in the elderly population, mainly due to the advanced osteoporosis leading to increased rates of screw-loosening and non-union [1]. Additional arguments against this technique are a higher risk for postoperative pneumonia and dysphagia after surgery, insufficient healing and reposition in cases with transverse atlantal ligament injuries or fracture dislocation. These facts together allow to provide strong recommendations against anterior fixation in the elderly [14].

38.4.2.2 Vertebral Body Compression Fracture

Osteosynthesis in patients with consolidated compression fractures can result in high complications rates due to the osteoporosis, comorbidities and commonly increased risks of mechanical failures of implants and rates of pseudarthrosis in the elderly. Pedicle screw loosening and adjacent-level vertebral body fracture are common

sequela among patients with osteoporosis. In order to decrease these operative risks, it is necessary to keep the surgery as less invasive as possible. Performing a percutaneous osteosynthesis can be a reasonable option, which would minimize surgical time, blood loss, muscle trauma, and infection risks leading to shorter in-hospital stay and rehabilitation [27, 28]. Additionally, the use of fenestrated pedicle screws with PMMA cement augmentation allows to increase the pull-out strength of the screws to more than double of the non-augmented fixation and to prevent the above-mentioned osteoporosis – associated risks [6].

In cases with considerable thoracic kyphosis, correction of the deformity may become necessary. Different surgical techniques have been discussed for the correction of the osteoporotic spine including anterior spinal fusion, posterior fusion alone, PSO, and combined anterior and posterior surgery [26, 28, 32]. Still, there is no consensus and no evidence regarding which is the most appropriate approach. The indication should be put in place very carefully and tailored individually depending on patients comorbidities, severity of symptoms, and extent of osteoporotic changes.

Even if the surgery was performed perfectly, one should be aware of the not uncommon late complications, such as loosening of pedicle screws or subsequent vertebral compression fractures within adjacent segments.

38.4.3 Conservative Treatment

38.4.3.1 Odontoid Fractures

In patients who are not suitable for surgery, non-operative fixation should be considered as an alternative treatment option. The described conservative therapy includes non-rigid external immobilization using a hard cervical collar and/or the rigid external fixation by halo vest.

The halo vest associated morbidity, particularly in the elderly, has been increasingly highlighted by several authors with mortaity of 40% and morbidity of more than 50% [15, 25]. Based on a series of 50 patients, Tashjian et al. have found that the mortality and morbidity rates in patients with halo vest were 42% and 66% while that in the patients treated by surgery or collars were 20% and 36%, respectively [33]. Another study by Majercik et al. found that old patients with halo vest had a significantly higher mortality than old patients treated with surgery or collar (6 and 12%) and a 20 times higher mortality than young patients (40% vs 2%) [21]. This makes the use of halo today nearly obsolete.

The non-rigid external immobilisation using a hard cervical collar is an in exceptional cases acceptable form of treatment for type II odontoid fractures for old patients with inappropriately high surgical risks. The osseous fusion rates are described to reach up to 70%, the rates of stable fibrous union are approximately 90% [24]. However, not to forget is that the conservative management with cervical collars also bears addtional specific complications, such as decubital ulcers, which may occur in up to 10% of cases [18].

38.4.3.2 Vertebral Body Compression Fracture

Most pain-related symptoms from vertebral compression fractures in acute stages are resolved with conservative management comprising of analgesic medication, physical therapy and short bed rest [22]. In case of a fracture healed in a deformity without signs of instability or neurological deficits, conservative therapy can be attempted. The role of bracing in treatment of osteoporotic compression fractures is not quite clear. There is some concern regarding the placement of increased stress on the posterior elements of the spine when extension bracing is used. Furthermore, bracing bears additional risks, particularly in the elderly population, such as decubitus ulcers with subsequent soft-tissue infections, diminished pulmonary capacity and weakening of the axial musculature [4].

Level of Evidence

Odontoid Fractures: C

The level of evidence available to date is relatively low. Due to the lack of class I studies, no definitive conclusions can be drawn regarding the optimal treatment of type II odontoid fractures or consolidated thoracolumbar compression frac-

tures in the elderly. There are no comparative studies prospectively comparing surgical options. An international cooperative registry study (INNOVATE) is underway to prospectively assess fracture healing and clinical outcome after surgical versus conservative treatment of odontoid fractures in the elderly patient, with a specific emphasis on the very old patient [16].

Instrumentation for Vertebral Body Compression Fracture: **D**

The evidence is extremely low. No prospective studies and only a few small retrospective series have evaluated benefits and harms of complex reconstruction surgeries for osteoporotic compression fractures. Therefore, the indication for these approaches should be very strict and reserved for selected patients with progressive deformities and disabiling symptoms.

38.5 Conclusions and Take Home Message

Regardless of the applied treatment, osteoporotic fractures in the elderly bear per se a high risk of poor outcome and death due to increased rates of preexisting comorbidities and immobilization-associated impact. The primary goal of the fracture treatment in the elderly is to achieve the fastest possible restoration to the degree of the pre-traumatic mobilization.

The most common two types of spinal fractures in the elderly are the type II odontoid fracture in the cervical spine, and the vertebral body compression fracture in the thoracolumbar spine.

The surgery of the type II odontoid fracture is advocated in the majority of cases because of the increased risk for the development of an unstable pseudarthrosis, morbidity and and mortality in case of an insufficient treatment. The dorsal fixation of the C1/C2 complex provides the most appropriate surgical approach in terms of fusion and comparably low perioperative risks for failure or complications.

Osteoporotic compression fractures in the thoracolumbar spine may be treated conservatively with pain medication and moderate immobilization if the pain level is low, neurological deficits are absent, and the patient appears to benefit from conservative measures. Spinal deformities in patients with osteoporosis are complex to treat because of their disabling and progressive nature. For fractures with severe collapse that leads to neurological deficit and increasing deformity, instrumented stabilization and decompression can be considered. Using minimally invasive approach including percutaneous fixation with cement-augmented screws may provide acceptable results.

Pearls

- The earliest possible mobilization is the main goal of the therapy
- Keep in mind the increased risk of nonfusion and high fracture associated mortality rates especially with conservative treatment regimes
- Odontoid fracures: dorsal fixation of the C1/C2 complex provides the most appropriate surgical approach in terms of fusion and perioperative risks
- Dorsal intrumentation for osteoporotic compression fractures is reserved for selected patients with progressive symptomatic deformities, disabiling symptoms and neurological deficits

Editorial Comment

Surgical treatment of the 2 most common fractures in the elderly is outlined in this chapter. There is basically no reasonable evidence for the management described in case 2, so indication should be restricted to the ones outlined below. My personal opinion for odontoid insufficiency fractures in the elderly is that a posterior C1-2 construct is the treatment of choice. If conservative treatment is considered, a soft collar is sufficient to have the fracture heal in a rigid pseudarthrosis. A Halo is obsolete and has higher risks than surgery.

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