32 Spinal Fracture in the Elderly

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32.1 Introduction

Osteoporosis is the loss of bone mineral density and degraded bone microarchitecture resulting in increased fracture risk. Fractures occur in both the axial and appendicular skeleton with the latter usually associated with falls while the former may be atraumatic. The increased prevalence of osteoporosis in the aging population results in a greater number of elderly patients having fragile spinal fractures, the most common type of fracture. Many injuries are the results of low-energy trauma, although atraumatic fractures and nonclinical fractures are common. Morbidity and mortality of these fractures are similar to that of hip fracture with corresponding cost of treatment and utilization of hospital resources. To maximize outcomes and avoid complications in this frail population spinal fractures in the elderly should be treated with a comprehensive care pathway.

Geriatric spine fractures are distinguished from those in younger patients as they usually result from low-energy trauma such as a ground-level fall or coughing. The fracture patterns are compressive in nature and are stable injuries without neurologic involvement. Neurologic injury occurs when spinal stenosis is preexisting or from retropulsion of bone fragments into the spinal canal. Unlike younger patients, retropulsion can occur late as the fracture collapses over time. Spinal cord injury, although rare, is associated with poor outcome and death in the majority of elderly patients. Osteoporosis is usually a significant causative factor in the development of the fracture and requires assessment and secondary treatment to prevent further fracture in elderly patients.

The purpose of this chapter is to review the epidemiology of geriatric cervical and thoracolumbar fractures. Further, the classification and treatment of the elderly patients with these fractures will be reviewed. Finally, the role of secondary fracture prevention will be emphasized.

32.2 Epidemiology of Osteoporotic Spinal Injuries

In 2015, fragility fractures occur in an estimated 2.3 million people annually in the United States with hip and spine being most prevalent at 14 and 23% respectively [1]. It is estimated that the incidence will increase to 3.2 million over the next two decades [2]. In patients greater than 50 years of age, the 10-year fracture risk of the hip is 0.9% while all fractures are 6.9%, increasing with age and in women [1]. However, spine fractures are underreported as more than half are nonclinical

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(asymptomatic) and the cervical spine is not included in many analyses. In 2018, Lewicki calculated annual cost of caring for osteoporotics as $57 billion [2].

Secondary fractures are common after an initial osteoporotic fracture. The overall incidence in the Medicare population in the first year is 15% for all initial fracture sites with new fractures occurring most commonly in the hip and spine [1]. For patients with an initial spine fracture, additional fractures occurred in the spine in 6% and elsewhere 9% of cases [1].

32.3 Assessment of the Spine in Geriatric Patients

Geriatric patients require the same comprehensive evaluation protocols as other patients. The geriatric patient presents challenges from preexisting cognitive changes, comorbidities, higher pain tolerance, and degenerative changes that may mimic injury. In addition, fractures may be evident but their acuity may be difficult to discern.

Protocols for the evaluation of the cervical spine in geriatric patients have been established, although in general are not as sensitive as in younger adults [3, 4]. Patients may not have pain but when it is present should prompt radiologic evaluation. Patients with evidence of craniofacial trauma need careful evaluation to rule out cervical spine injury. Palpation of the entire spinal column is performed to determine tenderness, kyphosis and gibbous deformity, or any bruising. Spinal tenderness is an important finding to aid in identification of acuity and is used to determine candidacy for vertebral augmentation. A complete neurologic examination is performed including cranial nerve, motor sensory, and reflexes per the ASIA guidelines [5]. Ambulatory patients should have their height measured using a floor-mounted stadiometer. A loss of 2 cm of height from the last measurement or 4 cm from maximum height suggests osteoporosis and vertebral fracture and is an indication for spinal imaging [6].

Patients with pain, tenderness, evidence of craniofacial trauma, or neurologic deficits require radiographic imaging. To evaluate the cervical spine, CT is recommended. Patients with central cord syndrome or other spinal cord injuries should have MRI. Either biplanar radiographs or CT scan can be used to evaluate thoracolumbar injuries. If a thoracolumbar fracture is present then further evaluation to determine severity and acuity is needed and is best performed by MRI. On MRI, increased signal intensity on T2-weighted or fat-suppressed images should be correlated to the level of pain. However, in some patients, fractures at the thoracolumbar junction may have pain localized in the lower lumbar spine.

In the geriatric patient, assessment of bone quality is important. If CT is available, then opportunistic CT can be used where a region of interest (ROI) is drawn in a vertebral body (L1 if possible) and the mean Hounsfield Unit (HU) measured from the PACS elliptical tool [7]. The mean HU provides an estimate of the bone mineral density. Thresholds have been established that rule in osteoporosis at L1 (HU < 100); and rule out (HU > 150) [7]. Other findings are preexisting erosive changes at C2 that predispose to dens fractures, spinal canal narrowing in the cervical spine (less than 10 mm) confirming spinal stenosis, and healing status to determine fracture acuity. Patients at risk of vertebral artery injury such as vertebral displacement or fractures in proximity to the vertebral arteries are assessed using CT angiography.

32.4 Cervical Spine Fractures in the Elderly

The incidence of cervical spine fractures in geriatric patients is increasing 3.5 times faster than the population in general [8]. In geriatric patients, cervical spine injuries have a 1-year mortality of 24% and in those with spinal cord injuries a mortality of up to 44% [9]. Further, geriatric patients returned home after injury in one-third of cases [10].

Falls are the most common mechanism of cervical spine injuries in older patients, occurring in up to 75% of cases. Because of kyphotic posture and the head tilting forward, the face and forehead often hit the ground first creating a hypertension injury to the cervical spine. The hyperextension is often focused at C2 resulting in an odontoid fracture or Hangman's type fracture, the most common injury types. Also, hyperextension can transiently result in spinal cord compression due to a pincer mechanism between infolded ligamentum flava and bulging disc annulus or osteophyte. This becomes critical due to preexisting spinal canal narrowing from degenerative changes and clinically can result in a central cord injury. This spinal cord injury is characterized by more profound weakness of upper extremities than the lower extremities.

Although geriatric patients can have cervical spine injuries typical of other adults, this review will focus on those particular to the older population. The most common cervical spine injuries are of C2 and, in particular, odontoid fractures. In over 50% of patients, there are preexisting erosive changes from degeneration that predispose to fractures, Fig. 32.1a–c [11]. In some cases, the age of the fracture will be difficult to discern. These fractures are unstable, although spinal cord injury is uncommon. Displacement will usually be posterior which is also increased when the patient lies supine due to thoracic kyphosis and the head alignment forward creates a large gap between the occiput and bed/pillow.

Fig. 32.1 (**a**) A 79-year-old male with significant cognitive changes following stroke who had CT angiogram 18 months before sustaining a fall. The odontoid process is intact but there is significant cystic erosion anteriorly (arrow). (**b**) He presented to emergency room after a fall complaining of neck pain. CT shows and a Type 2 posterior angulated odontoid process fracture (arrow). He was treated nonoperatively in soft collar. (**c**) One year later, he had a head CT to evaluate cognitive changes that shows an odontoid fracture nonunion (arrow). He had no neck pain and no neurologic findings that were felt to be from the odontoid fracture. No treatment for his C2 fracture was recommended

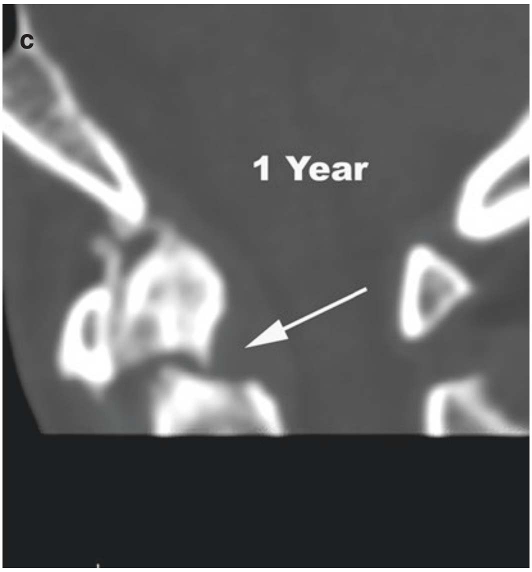

Fig. 32.1 (continued)

32.4.1 Odontoid Fractures

Odontoid fractures are classified as: Type 1 located at the dens tip and associated with alar ligament disruption; Type 2 through the odontoid waist rostral to the atlantoaxial articulation; and Type 3 that extend into the body. These may be associated with other cervical injuries, most commonly a posterior arch fracture of the atlas.

The treatment of Type 1 odontoid fractures is conservative with a collar unless associated with craniocervical disassociation which is treated by occipital cervical fusion [12]. The Type 3 fracture has a good prognosis being in trabecular bone and is also initially treated nonoperatively in a collar [12]. After patient mobilization, an upright radiograph is checked to assure maintenance of alignment. If proven to be unstable then posterior C1-2 fusion can be considered.

The treatment of geriatric Type 2 odontoid fractures remains controversial. A multicenter observational study evaluated 322 geriatric patients with odontoid fracture found a 14% morality rate at 30 days, 18% at 12 months, and by 2 years 44% had died [13]. Surgical treatment was associated with a lower mortality but selection bias may have been present. In the 50 patients treated initially nonoperatively, 22% developed nonunion of whom two-thirds subsequently had surgery [14]. However, no patient treated nonoperatively had late neurologic deterioration. Functional outcomes were better in the operatively compared to nonoperatively treated patients [15].

For geriatric patients with Type 2 odontoid fractures, the author recommends nonoperative treatment for those with severe cognitive disorders, non-displaced fractures, and age indeterminate fractures, Fig. 32.1a–c. The treatment goals should be rapid mobilization and avoidance of complications related to treatment, not necessarily to obtain fracture healing. Decubitus ulcers are prevented by careful fitting of orthosis, proper education, or the use of soft collar instead of any more rigid orthosis altogether. Cognitively-impaired individuals are at greatest risk for skin breakdown. Aspiration is common due to immobilization in an orthosis, retropharyngeal swelling from the fracture, poor gag reflex, and the use of opioid medications. We recommend a swallow evaluation for these patients before allowing feeding. The use of a halo-vest should be avoided in the geriatric patient [16].

Geriatric patients with Type 2 odontoid fractures who are active and have displacement are considered surgical candidates. The authors recommend a posterior C1-2 fusion with rigid instrumentation such as C1-2 transarticular screws or C1 lateral mass-C2 pedicle screws constructs. Careful evaluation of the location of the vertebral artery is recommended when planning surgery to avoid iatrogenic injury. Postoperatively, patients should be rapidly mobilized with as little immobilization as practicable. Odontoid screw fixation is contraindicated as this is associated with greater mortality and potential loss of fixation.

32.4.2 Central Cord Syndrome

Older patients develop loss of disc height, osteophyte formation, and thickening and infolding of the ligamentum flava which all reduce the cros-sectional area of the spinal canal. Transient hyperextension can then cause a pincer force on the cord causing a spinal cord injury. The most common manifestation is a central cord syndrome where the more central aspect of the cord containing the gray matter and the more centrally located white matter tracts to the upper extremities are affected to a greater degree than the lower extremity tracts [17]. Clinically, patients have worse upper extremity than lower extremity function although the clinical deficits can vary considerably. The prognosis of these injuries is generally thought to be good with the return of walking ability in over 85% of cases although hand function may remain poor [17]. However, older patients improve less than younger patients.

CT may not show any evidence of injury although degenerative changes and narrowing of the spinal canal may be present, Fig. 32.2a. The midsagittal diameter between the disc space and ligamentum flavum when <10 mm indicates spinal stenosis. Fractures to the posterior elements such as lamina, lateral mass, and spinous process can be present, as well as avulsion fractures of the anterior vertebral bodies. Displacement is less common but is usually a retrolisthesis consistent with hyperextension mechanism. An MRI is indicated and will show spinal stenosis at one or multiple levels, swelling of the spinal cord, and spinal cord signal changes consistent with contusion or edema, Fig. 32.2b.

The initial treatment of central cord syndrome in geriatric patients should be resuscitation and in particular, maintaining a high oxygen saturation and mean arterial pressure to minimum 85 mmHg [18]. This is continued for 7 days and may require pressor and intensive care unit admission. The

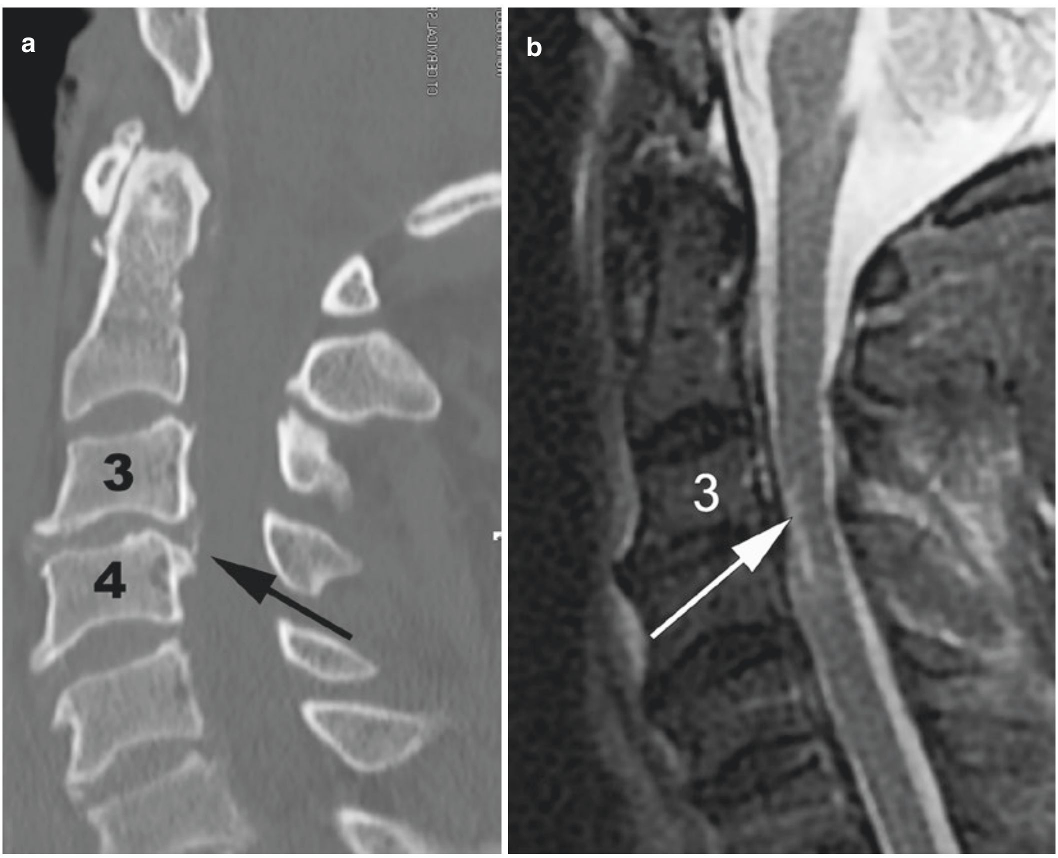

Fig. 32.2 (**a**) A 67-year-old female had a ground-level fall and presented with a central cord syndrome. Her lower extremities had Grade 3-4 motor function, there was no hand function and Grade 2 motor function in deltoid and biceps muscles. The sagittal CT shows no fracture or subluxation. There is ossification of the posterior longitudinal ligament at C3-4 (arrow)and a narrow spinal canal. (**b**) T2 fat-suppressed MRI demonstrates spinal stenosis with increased signal at C3-4 in the anterior aspect of the cord. (**c**) Postoperative lateral radiograph after laminoplasty C3-C6 and reconstruction with plates. (**d**) T2 MRI one year after injury showing bright cord signal changes at C3-4 but resolution of spinal stenosis. She had made significant neurologic recovery except in hands but is living independently

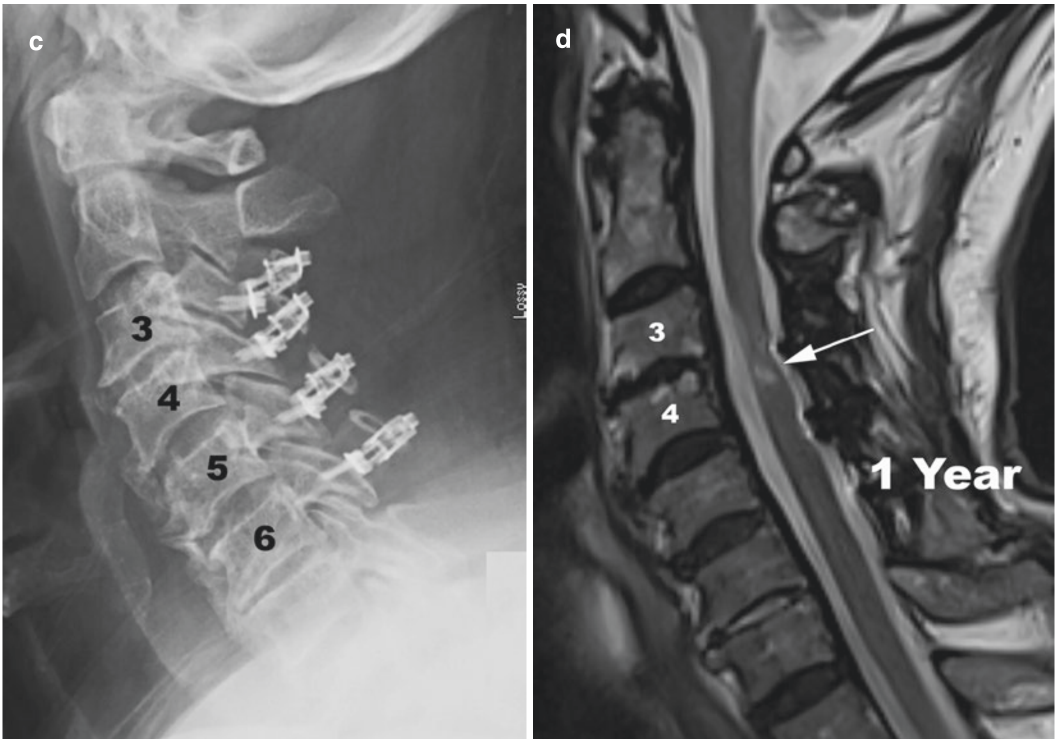

Fig. 32.2 (continued)

role of methylprednisolone in geriatric patients and spinal cord injury remains controversial. Methylprednisolone increases mortality risk in geriatric patients and efficacy has been shown to be only minimal and therefore should be used with caution and only in individuals without other injures or comorbidities [18].

The role of surgery remains controversial. Initially, the prognosis was felt to be excellent and that surgery was not likely to improve outcomes and could be harmful. However, more recently, excellent outcomes in central cord syndrome have been reported with surgical treatment [17–19]. Clear indications for surgery are unstable and/or displaced injuries. Further, patients making rapid recovery and those without ongoing spinal cord compression are best treated initially nonoperatively. Patients with significant deficits and ongoing compression appear to benefit from surgical decompression, Fig. 32.2c, d. The surgical approach varies depending upon pathology, number of levels involved, and presence of any fractures or ligamentous injuries. The authors recommend patients with 1–2 segments of ventral compression undergo an anterior decompression and fusion. In the more common situation of multilevel stenosis, a laminoplasty can be performed. There is no consensus regarding the timing of surgery in the management of central cord syndromes. In a recent narrative review, Divi noted that while strong evidence is insufficient they recommend surgery be performed within 24 h in patients with ongoing cord compression [19].

32.5 Thoracolumbar Fractures

The most common osteoporotic fracture occurs in the thoracolumbar spine, only one-third of which are clinically evident. The consequences of a clinical thoracolumbar fracture are similar to hip fracture with mortality rates up to 25% at 1 year and only 30% of Medicare patients surviving at 5 years [1]. Chen also reported that thoracolumbar compression fractures were associated with a diminution of independent living with fewer than half of patients living at home [20]. In addition, at 6 months pain was still significant and fear of further pain and loss of independence became dominant [21].

Unlike cervical and other fragility fractures, thoracolumbar spine fractures may occur spontaneously without an injury or from lifting, coughing, or Valsalva. The resultant forces cause anterior compression and fracture. The fractures are usually described as compression fractures, which imply loss of vertebral body height and wedging of the vertebrae. Less common is a burst fracture where the posterior vertebral body wall is retropulsed into the spinal canal causing spinal stenosis, Fig. 32.3a. This can occur over time as the vertebral body collapses. Other fracture variants are the pincer fracture where the cranial caudal disc herniated into the intervening vertebral body splitting it into two pieces. Occasionally, clefts will develop likely from the disc or non-union. Stability, the ability to withstand physiologic loads, is most often maintained after compression fractures although should be assessed by upright radiographs [22]. If significant collapse or kyphotic deformity develops, then the fracture is unstable and may be a candidate for an intervention. Genant has provided a classification based on severity of fracture that is useful for epidemiologic purposes but does not aid in clinical care [6].

32.6 Treatment of Thoracolumbar Osteoporotic Vertebral Fractures

32.6.1 Nonoperative Treatment of Vertebral Fractures

The majority of patients with thoracolumbar osteoporotic compression fractures can be treated nonoperatively (Table 32.1). In fact, two-thirds of

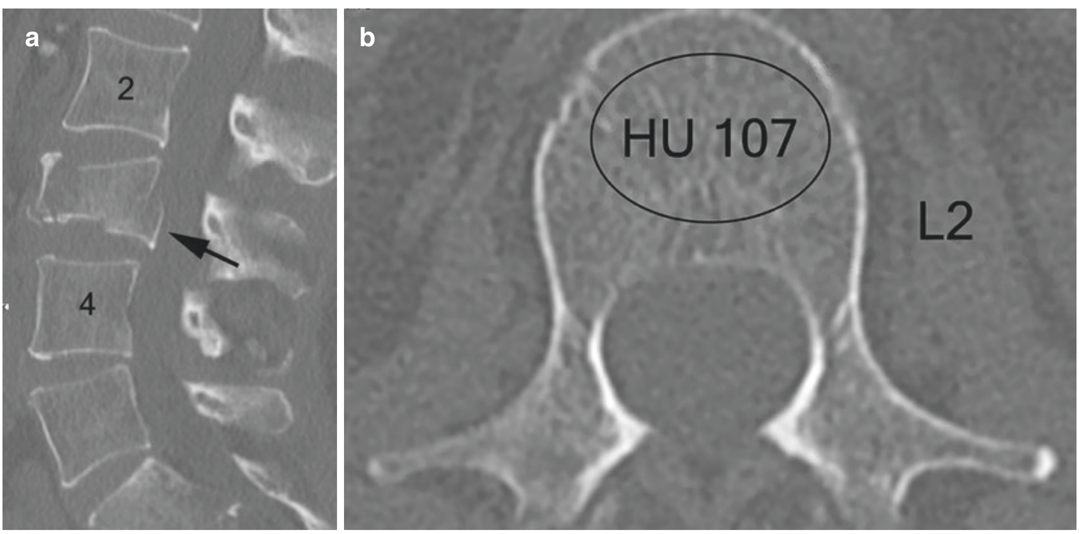

Fig. 32.3 (**a**) A Sagittal CT of 68 year-old female showing L3 burst fracture following a fall. She has history of steroid use and osteopenia. The arrow indicates retropulsed bone from posterior inferior body of L3. (**b**) Axial CT at L2 above her fracture. The mean Hounsfield Unit (HU) in the region of interest (Oval) was 107 indicating likely osteoporosis. (**c**) At 3 months follow-up, she is doing poorly with increasing back and leg pain. Lateral radiograph shows further collapse and increased retropulsion of bone into spinal canal at L3. (**d**) Sagittal T2 MRI at 3 months confirming retropulsion of bone into spinal canal at L3 (arrow). (**e**) Lateral radiograph 1 year after minimally invasive corpectomy L3 and reconstruction with expandable cage from L2 to L4 and second-stage posterior pedicle screw instrumentation. The pedicle screws were augmented with bone cement. (**f**) Anterior posterior radiography one year after surgery

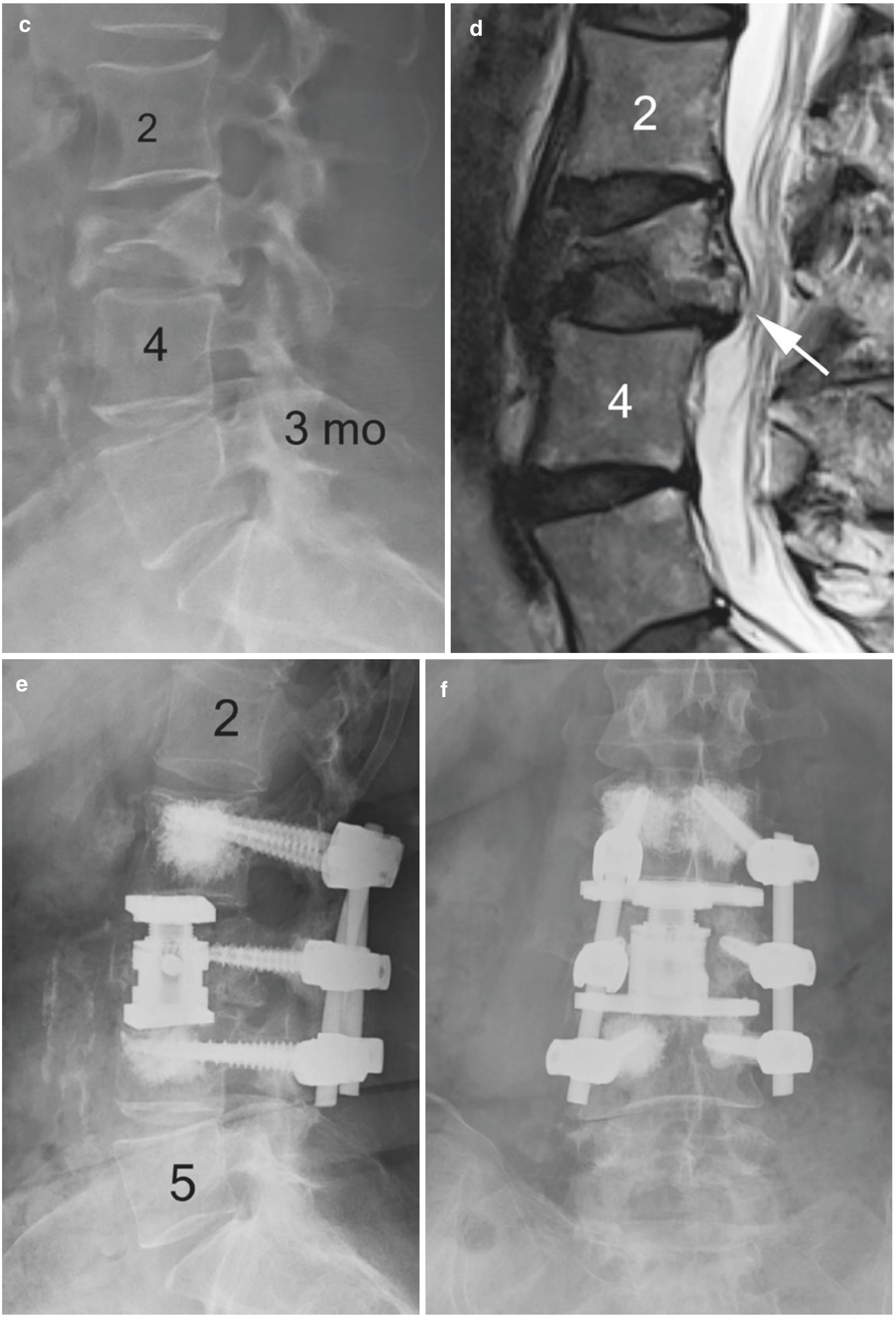

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Table 32.1 Management options for elderly patients with spinal fractures

Treatment	Method	Alternative method
Observation	Serial radiographs	No further imaging
Pain control	Minimize use of opioids	Consider advanced pain control methods
Physical therapy	Short-term mobilization, body mechanics, extension exercises	Long-term strength, impact loading, fall prevention
Orthotic management	Limited benefit Poor tolerance	Avoidance or surgery
Advance pain management	Facet blocks/epidural injections	Rhizotomy
Cement augmentation	Vertebroplasty	Kyphoplasty
Surgical treatment	Stabilization/instrumentation	Decompression and stabilization
Secondary fracture prevention	Fracture liaison services such as own the bone	Primary care

fractures are not even clinically evident although their presence indicates a likelihood of osteoporosis. The goal of treatment is to allow immediate mobilization, improve body mechanics (avoid flexion as much as possible), reduce fall risk, and manage pain. In addition, secondary fracture prevention should be provided.

The authors recommend that stability be assessed in acute fractures by simply obtaining an upright radiograph and measuring angular deformity of the injured segment and comparing to supine images such as CT or MRI if available [22]. This will provide an index of how much instability is present. Patients with minimal collapse are excellent candidates for nonoperative treatment. In hospitalized patients, physical and occupational therapy should be consulted to aid patient mobilization, educate regarding protective body mechanics, assess fall risk, and instruct patients in activities of daily living. A home physical therapy visit after discharge should be considered to assess safety. Exercise is important after osteoporotic vertebral fracture. In a systematic review, Ebling found that exercise had positive effects on mobility, balance, back extensor strength, and may improve pain [23]. No recommendations can be made on a specific type of exercise and will likely be dependent upon individual patient preferences and needs.

Pain control is often a major patient concern. It is best to use multimodal pain management. Opioids should be used judiciously to avoid complications, addiction, and mental status changes. Further, opioids significantly increase the likelihood of future falls.

Bracing is often utilized, although efficacy for management of thoracolumbar compression fractures is lacking. In a randomized control trial comparing no brace, a soft brace, and a rigid orthosis, Kim found no difference in pain, function, and radiographic findings [24]. Similarly, Li found no differences between a custom TLSO and lumbosacral corset [25]. This is consistent with the findings of Bailey that found no differences in any outcome parameter from orthotic treatment of burst fractures (more severe injury) between orthosis and no orthosis [26]. However, Merraciello found that the Spinomed dynamic brace had greater improvement in pain and function than a rigid 3-point brace [27]. Bracing is, in general, poorly tolerated in geriatric patients, reduces mobilization, and has poor compliance and satisfaction. Given questionable efficacy, the author does not routinely use this modality.

32.6.2 Cement Augmentation

Cement augmentation is the installation of a biomaterial, most commonly polymethylmethacrylate (PMMA), to stiffen the fractured vertebrae. Two methods are available vertebroplasty and kyphoplasty. In vertebroplasty, the patient is positioned prone thereby obtaining some postural reduction, and a 12–14-gauge needle is placed transpedicular into the vertebral body and cement is inserted. Kyphoplasty uses a larger cannula placed transpedicular and then reduction is obtained positionally by use of an expandable balloon and cement is then inserted. Both procedures can be done under local anesthesia. In both cases cement polymerizes quickly and there is often rapid improvement and no specific postoperative care or bracing is required.

Controversy exists over the effectiveness of cement augmentation. Multiple randomized clinical trials have been performed comparing outcomes of cement augmentation to nonoperative treatment or sham surgery; however, they report conflicting results [23]. Most of the conflicts reflect differences in control arms with sham-controlled trials showing no or less benefit from cement augmentation. A recent guideline based on a meta-analysis using the sham control studies thus recommended against using vertebroplasty [23]. However, the methodology used to formulate this guideline has been contraindicated [28]. The sham control was a local anesthetic injection down to the periosteum which itself has been shown to be an active treatment. Further numerous flaws in the selected studies were present such as investigator bias, inadequate sample size, lack of consistency of diagnosis, long enrollment periods (averaging over 4 years), enrollment greater than 6 months after fracture, and crossover when sham patients obtain vertebroplasty but for statistical purposes remain in the sham group [29]. In another meta-analysis, Beall reported the opposite results [30]. Balloon kyphoplasty and vertebroplasty had greater pain and functional improvement than nonsurgical management. Although both techniques were associated with higher secondary fracture rate, this was not statistically significant.

A multidisciplinary panel of experts utilized the RAND method to develop a clinical care pathway for the use of cement augmentation based on best available evidence [31]. The panel identified common signs and symptoms and recommended use of advanced imaging such as MRI. Cement augmentation was recommended in patients with persistent symptoms who had two to four unfavorable findings: progression of height loss, severe impact on function, kyphotic deformity, and >25% vertebral height reduction. In addition, the panel recommended all patients receive secondary fracture prevention.

32.6.3 Indications for Cement Augmentation

The indications for cement augmentation are persistent severe pain, unable to mobilize or care for oneself, progressive collapse, spinal instability between supine images and upright radiographs, or a nonunion or cleft in the vertebral body. The timing of intervention in relation to the onset of symptoms or fracture remains controversial. In general, a short period (2–3 weeks) of nonoperative treatment should be attempted if the patient can be mobilized and be cared for at home. However, in hospitalized patients or patients who are failing to care for themselves at home, cement augmentation has been shown to be highly effective with rapid improvement and early discharge.

32.6.4 Technique

Both procedures are done in the prone position either on special tables (Jackson) or by rolls and pillows. Traditionally the procedure can be done under local anesthesia, although in some patients, conscious sedation may be required. Achieving spine extension by judicious use of pillows and rolls can aid fracture reduction and improve alignment. For lumbar vertebrae, a transpedicular approach is used. For thoracic spine, depending on the pedicle size, a transpedicular or paraspinal approach is used [32]. Under biplanar fluoroscopic imaging the starting point for needle placement is identified and local anesthesia down to the periosteum is placed. An 11-gauge Jamshidi needle is then placed onto the lateral edge of the pedicle on the anteroposterior image at its midpoint vertically. The needle is advanced to the posterior vertebral body checking both anteroposterior and lateral images. When the needle is just entering the body the tip should be within or just at the medial edge of the pedicle. Depending on where the fracture is located the needle can be advanced either caudally or cranially into the anterior third of the vertebral body. In most cases bilateral approaches will be used; however, some practitioners may use only a unilateral approach. A recent meta-analysis showed no differences between unilateral and bilateral approaches if at least 4 cc of cement was injected [33]. Liquid PMMA cement is instilled under biplanar fluoroscopic control carefully assessing vertebral body fill and watching for extravasation. The most common sites of extravasation are into the intervertebral disc or into veins and subsequently the vena cava. Most important is to stop cement installation if the cement is tracking posteriorly toward the spinal canal. Best results are obtained when 3–4 cc are used per side and the cement interdigitates into native bone.

In kyphoplasty, a balloon (or more recently other devices) is inserted into the vertebral body which is expanded, thus reducing height loss and correcting kyphosis. The procedure uses a larger cannula than vertebroplasty and is more expensive. Once the vertebra is expanded a cavity has been created that is filled with cement. Because of the use of a larger cannula and creation of a cavity, more viscous cement can be placed with less tendency for extravasation. Clinical results are equal or better than vertebroplasty [34]. Overall small improvements in kyphotic alignments and vertebral body expansion are achieved, although the clinical significance is unknown.

32.6.5 Complications of Cement Augmentation

Complications from cement augmentation are rare with few reported cases of neurologic deficits. In fact, in the ASBMR clinical review, the only case of paraplegia was in an untreated patient [23]. Extravasation can be seen in up to 40% of cases but is rarely clinically significant except when it occurs intradiscally and may be associated with junctional fracture of the next vertebrae [35, 36]. Overall, new fractures occur slightly more frequently but not statistically significantly after cement augmentation.

32.6.6 Surgical Treatment of Osteoporotic Thoracolumbar Fractures

Most patients with osteoporotic fractures do not require surgery since neurologic compromise is rare, and bone quality with patient frailty precludes major spine reconstructions. Thus, only case series involving selected patients with specific indications are reported. The surgical indications are neurologic deficits with spinal canal narrowing, progressive spinal deformity localized to a few segments, and correction of sagittal plane imbalance. Prior to surgery unless an emergency condition, patients should undergo medical and bone health optimization. The latter is similar to the program for secondary fracture prevention includes diagnostic testing, screening for secondary causes of osteoporosis, correction of nutritional deficiencies, and if warranted anti-osteoporotic medication [37]. The authors prefer an anabolic agent for this purpose. Correction of osteoporosis unless dictated by urgency should be for 3–4 months or longer for more complex surgeries such multilevel osteotomies. Insufficient treatment of the osteoporosis will likely lead to further failure and revision surgery.

Thoracolumbar osteoporotic burst fractures can be treated with anterior corpectomy, insertion of cage, and supplemental posterior fixation. Less invasive techniques that use transpsoas approach to the vertebral body and percutaneous screws are appealing in this frail population, Fig. 32.3a–f. Alternatives are posterior instrumentation and decompression, or balloon kyphoplasty combined with posterior instrumentation [38, 39]. In addition cement augmentation of pedicle screws can be used. Sudo reported excellent neurologic recovery and maintenance of alignment in 21 patients treated with posterior decompression and fusion [39]. Marco noted improvement in all patients with neurologic deficits who were treated with balloon kyphoplasty and posterior instrumentation [38]. In patients with multilevel compression fractures with progressive deformity the authors have performed percutaneous posterior instrumentation without fusion successfully. An additional surgery to remove the hardware is required 6–12 months later.

The treatment of osteoporotic-related spinal deformity is complex and associated with significant morbidity and mortality [40]. Usually one or more osteotomies will be required along with multiterminal fixation [41]. Unfortunately fractures at either end of construct in up to 80% of cases [42]. Suh compared two-stage anterior posterior instrumentation to closing wedge posterior osteotomy and found better results with the latter technique although this was technically demanding [43].

32.7 Secondary Fracture Prevention

The goal of secondary fracture prevention is to prevent further fracture that can result in greater morbidity and mortality. The 12-month incidence of a secondary fracture after an initial spine fracture is 15%, with few patients receiving secondary fracture prevention. Barton found that in vertebral fracture patients presenting to the emergency room only 2% had a DXA 2 years before or within 1 year after fracture. Anti-osteoporotic therapy was started in only 7% of patients while the refracture rate was 36% within 2 years.

The initial fracture provides a teaching or sentinel event so that changes can occur to prevent further fracture. This program is called Secondary fracture prevention or fracture liaison service (FLS) [44]. The FLS is a comprehensive program that identifies patients with fragility fractures, provides education, and communication with other providers. Most importantly patients are evaluated for bone status usually with a DXA, screened for secondary cause of osteoporosis, recommended to eliminate toxins such as excessive alcohol intake and smoking, assess fall risk and suggest exercise programs for increase loading and improve muscle strength and reduce fall risk. Nutritional deficits are corrected. Medications if indicated by current guidelines are offered [6, 45]. The American Orthopedic association has developed a comprehensive program that can be adopted that encourages practitioners to take ownership of osteoporosis after fracture and that assures patients receive secondary fracture care [46].

Secondary fracture programs are highly effective and significantly reduce the cost of caring for additional fractures [1]. Wasfie compared refracture rate after spinal fracture before and after instituting a FLS [47]. Refracture at 24 months was reduced from 56% to 37%. Bawa utilized a Medicare database and found that only 10.6% of beneficiaries received anti-osteoporotic medication after fracture; however, this reduced secondary fracture risk by 40% [48]. Beall has shown that teriparatide administration significantly reduces secondary fractures after cement augmentation [49].

32.8 Conclusion

Elderly patients with spinal fractures have similar outcomes to those with hip fracture, including risk of mortality, loss of independence, and destitution. Further, patients become fearful of reoccurrence and lose social interactions. Two cervical injury patterns are seen frequently: odontoid fractures and central cord syndrome. Controversies regarding treatment remain despite large observational trials. Thoracolumbar fragility fractures indicate that patients have osteoporosis and are usually initially treated nonoperatively. Cement augmentation appears useful but is controversial for those who are suffering pain and disability. Surgical treatment is needed rarely and requires preoperative medical and bone optimization as complications are frequent. Finally, all geriatric patients with spinal fractures should receive secondary fracture prevention.

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