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AO SPINE Textbook

Comprehensive Overview on Surgical Management of the Spine





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JAYPEE

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Chapter 4

Preoperative Bone Health Assessment and the Potential use of Systemic Osteoporosis Drugs in Select Patients Undergoing Elective Spine Fusion Surgery

Kelly Krohn

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INTRODUCTION

Elective spine fusion surgery in older patients is quite common and likely to increase given the improved technologies and the aging population. More elderly patients want to maintain an active lifestyle and will consider spine surgery to regain function.

There are a number of complications of spine fusion surgery, which are likely in part due to underlying poor bone health. While it is not clear that osteoporosis per se decreases the success of spine fusion there is good evidence that older patients with poor bone health would be more likely to suffer complications such as adjacent segment fracture (proximal junctional kyphosis due to fracture) and failure of the instrumentation such as pedicle screw loosening or interbody cage subsistence. Bone toxins such as chronic glucocorticoid use, smoking, rheumatoid arthritis, and poorly controlled long-standing diabetes contribute to the development of osteoporosis and are potentially associated with reduced spine fusion success and boney complications of spine surgery.

There are several approved systemic drugs used to reduce fracture risk in patients with osteoporosis. This review will summarize the biology of these drugs and highlight the human studies when they are used in the setting of spine fusion. Drugs for osteoporosis should be used in spine fusion surgery patients with documented poor bone health. It is important to consider an evaluation of the patient's bone health in the preoperative period to potentially anticipate bone-related complications and also consider perioperative treatment with osteoporosis drugs. Bone health assessment in patients with severe degenerative changes of their spine may present some challenges. This review will suggest an approach to the evaluation of bone health in patients undergoing elective spine surgery and some of the data to support the use of systemic osteoporosis drugs in select patients.

PATHOPHYSIOLOGY OF OSTEOPOROSIS/BONE LOSS

Peak bone mass is achieved in both men and women at about age 30. A number of factors influence how much bone mass an individual will develop. These include genetic influences, nutrition, mechanical loading of the growing skeleton, hormonal influences, comorbid illnesses, and the exposure to bone toxic drugs such as glucocorticoids.[1] There are studies where interventions such as mechanical loading of the skeleton on children have improved bone mineral density (BMD).[2,3] Once peak bone mass is achieved, there is a slow age-related bone loss in both men and women. However, in women when they go through menopause, estrogen deficiency results in fairly rapid bone loss for several years. Depending on where the woman starts with her peak bone mass, this rapid bone loss can result in bone fragility and associated fragility fractures beginning in her 50's and 60's. Typical early fractures include the distal radius and vertebral fractures. Later in life fractures of the proximal humerus and proximal femur become more common.[4]

Men also achieve peak bone mass at a young age and experience a slow age-related bone loss. Since men generally achieve a higher peak bone mass and do not experience a rapid bone loss related to hormonal deficiency, clinical fragility fracture often do not become significant until their 70's and 80's. If a man survives into his 80's, his risk of fractures including the proximal femur are not rare and can be associated with loss of independence and increased mortality. Men also suffer from vertebral fractures and this increase in prevalence with age. A recent vertebral fracture

prevalence study in men and women over the age of 40 in the US showed that men have higher prevalence rate of vertebral fractures than women beginning in the fifth decade.[5] It is hypothesized that not all of these vertebral fractures are fragility fractures and perhaps some are related to high-risk activities that young men are more likely to participate in. With each decade of life, the prevalence of spine fractures increases in both men and women.

Glucocorticoid-induced osteoporosis impacts both men and women and can result in fragility fractures at a very early age. The pathophysiology of chronic glucocorticoid-induced osteoporosis is primarily low-bone formation.[6] The spine is preferentially impacted by glucocorticoid-induced osteoporosis and planning surgery on someone who has been exposed to chronic glucocorticoids should always be a situation where bone health should be assessed preoperatively.

While there are a number of less common causes of bone fragility, typical patients presenting for spine surgery will be at risk for postmenopausal bone loss, age-related bone loss, and glucocorticoid-induced osteoporosis. A preoperative evaluation of bone health should be considered in patients who may be at higher risk for bone health-related complications of spine surgery. While there is no consensus or guidelines, it seems reasonable to consider a bone health evaluation in women over 60 and perhaps men over 70 prior to spine fusion surgery. Any patient who has had chronic glucocorticoid exposure should be evaluated prior to surgery. Since most spine surgery is elective, it seems reasonable to plan the bone health evaluation with the goal of being able to potentially intervene with nutrition and pharmacologic agents prior to elective spine surgery in select patients.

PHARMACOLOGIC AGENTS USED IN OSTEOPOROSIS

There are currently no systemic drugs that are approved to enhance spine fusion or reduce the bone-related complications of spine surgery. There are currently several drugs approved to treat osteoporosis on the basis of reducing vertebral fractures. Some of the drugs have evidence for reduction of nonvertebral fractures but all approved osteoporosis drugs have data to support a reduction in vertebral fractures.

There are two basic families of pharmacologic agents to treat osteoporosis. The majority of drugs are known as antiresorptive agents. These include estrogen, raloxifene, bisphosphonates, calcitonin, and denosumab. While their biology and potency are different they all target the osteoclast, which is responsible for bone resorption/bone loss/bone remodeling. Reducing osteoclastic driven bone resorption stabilizes the skeleton and with reduced bone turnover there is increased mineralization of the existing bone. This increase in mineralization is responsible for most of the increase in BMD as measured by the dual energy X-ray absorptiometry (DXA) machine. More importantly, these drugs effectively reduce vertebral fractures and in some cases nonvertebral fractures. It is likely that the timing of the drug initiation, the duration of treatment, the potency of the drug, and the methodology of determining the "fusion success" outcome may all impact the potential for spine fusion success in the presence of these drugs. While animal studies may be informative, it requires good human data to potentially understand the impact of these drugs on spine fusion surgery.

The other family of osteoporosis drugs is known as anabolic agents. There are two anabolic agents approved for osteoporosis in the US, teriparatide (TPTD) which is the first 34 amino acids of human parathyroid hormone (PTH) 1-84 and abaloparatide which is also a 34 amino acid analog of human parathyroid hormone-related protein (hPTHrP). When given in a pulsatile fashion with a short daily exposure to the PTH receptor, TPTD increases the maturation of stem cells into chondroblasts and osteoblasts.[7] TPTD is an anabolic which accelerates bone remodeling with net increase in true bone mass with each remodeling cycle.[8] Abaloparatide is a synthetic peptide analog of hPTHrP and has recently been approved by FDA. Abaloparatide has been shown to be effective in fracture risk reduction in postmenopausal women.[9] There are differences in anabolic potency between TPTD and abaloparatide. The study by Miller et al. used 80 μg/d of abaloparatide compared with the approved dose of TPTD i.e. 20 μg/d. Abaloparatide results in less increases in the marker of bone resorption compared to TPTD suggesting less of a remodeling biology. There are no published human studies looking at abaloparatide and spine fusion. The third anabolic agent which has considerable human osteoporosis data is romosozumab, which is a monoclonal antibody against sclerostin, an inhibitor of bone formation. The inhibition of sclerostin results in dramatic anabolism. Romosozumab 210 mg/month has been shown to dramatically reduce spine fractures but there was no statistical difference in the development of nonvertebral fractures.[10] The new bone formed under the influence of romosozumab is primarily a result of bone modeling rather than remodeling. The impact of romosozumab on spine fusion in humans is not well studied to date.

PHARMACOLOGIC AGENTS USED IN PATIENT UNDERGOING SPINE FUSION SURGERY

The most studied drug for spine fusion is TPTD. The anabolic nature of TPTD with primarily a remodeling-based biology

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makes some sense for the biology of promoting successful spine fusion. The fusion mass, much like the callus of fracture healing in long bones, undergoes considerable remodeling and maturation in the several months postoperatively. In addition to the potential impact on the fusion mass, complications such as pedicle screw loosening and adjacent segment fracture would likely benefit from TPTD given the known efficacy of improving bone mass and reducing spine fractures in osteoporosis studies. The preclinical data for the use of TPTD in spine fusion models is robust and generally positive.[11,12] This review will only look at more recent human studies on TPTD and spine fusion.

Ohtori et al. looked at spine fusion success as defined by limited motion on flex/extension X-rays in 57 postmenopausal women with low BMD undergoing posterior lateral fusion of 1–2 levels. Half of the women received daily TPTD 20 μg/d and half received 17.5 mg/week of the oral bisphosphonate, risedronate. The medications were started 2 months before surgery and continued for an average of 8 months postoperatively. The rate of bone union was 82% in the TPTD group and 68% in the risedronate group at 1 year.[13] Ohtori et al. also looked at fusion rates depending upon duration of treatment with TPTD. Those who received TPTD longer (13 months on average) had a higher rate of fusion than the shorter duration of TPTD (5 months on average) or patients who received oral risedronate with fusion rates of 92%, 80%, and 70% respectively.[14]

Ohtori also looked at pedicle screw loosening in postmenopausal women undergoing posterior lateral fusion who received TPTD compared to risedronate and a control group who did not receive any osteoporosis drug. The TPTD group had pedicle screw loosening by X-ray in 7% and by CT in 13% at 12 months. The risedronate and control groups had similar rates of pedicle screw loosening at 12 months with rates of 13% and 15% by X-ray and 26% and 25% by CT, respectively. This data suggests that TPTD may reduce the complications of pedicle screw loosening compared to an oral bisphosphonate and control patients.[15]

In a creative study which supports preoperative use of TPTD for perhaps at least 2 months before surgery, Inoue looked at the insertional torque required to turn in a pedicle screw. Women who received either daily or weekly TPTD (weekly TPTD is approved only in Japan) required a higher torque to turn the pedicle screw than control patients. The women had received TPTD on average of 61 days preoperatively and a minimum of 30 days. This suggests a fairly rapid anabolic effect on the trabecular bone of the vertebral body and the potential for fairly short preoperative treatment with TPTD that may impact the purchase and survival of the pedicle screw.[16]

Yagi et al. studied the vertebral body above the upper instrumented vertebral body in women who received TPTD for 18 months postoperatively compared to controls who did not receive any osteoporosis drugs. As predicted, standard DXA and CT studies showed increases in BMD of the adjacent vertebral body. More importantly perhaps, the patients who received TPTD postoperatively for 18 months had a lower rate of proximal junctional kyphosis due to vertebral fracture compared to controls with 4.6% of the TPTD group and 15.2% in the control group suffering a vertebral fracture.[17]

Since TPTD is limited to 2 year lifetime limit of use, consideration should be given to following a course of TPTD with an antiresorptive drug such as a bisphosphonate. Ohtori and colleagues followed 19 postmenopausal women who underwent posterior lateral fusion (PLF) surgery. All of the women had received TPTD for 2 months preoperatively and at least 8 months postoperatively. Their rate of boney fusion was 95% under the influence of TPTD. After they stopped TPTD, they were given oral risedronate and followed for 3 additional years. The volume of the fusion mass was maintained by the addition of a bisphosphonate after the use of TPTD.[18] This is fairly standard treatment in the field of osteoporosis where TPTD is given for a maximum of 2 years followed by an antiresorptive osteoporosis drug to maintain the gains in bone mass that have occurred with the anabolic drug.

While there is considerable preclinical data on bisphosphonates and spine fusion there is limited human data. Nagahama et al. studied the use of the oral bisphosphonate alendronate in 40 postmenopausal women undergoing single level PLF fusion utilizing an interbody device. The alendronate group was compared to control patients getting calcium and Vitamin D. The fusion success was determined by radiographic bridging across vertebral levels. The alendronate group appeared to have a slight advantage in visualization of the fusion bridging across levels early on but at 1 year there was not much difference. More importantly perhaps, they showed that the alendronate group had fewer adjacent vertebral fractures (zero) compared to the control group (four). The women receiving alendronate had a single patient with cage subsistence into the vertebral body compared to five women suffering cage subsistence in the control group.[19]

In a very similar study, Chen et al. studied the IV bisphosphonate zoledronic acid compared to saline given 3 days postoperatively in 65 men and women with osteoporosis by DXA undergoing single level fusion. After decompression the disk space was packed with allograph and local bone but there was not an interbody device. Fusion was graded by the visualization of bridging across the vertebral bodies. Early on, the patients with zoledronic acid had better visualization of bone bridging across the vertebral bodies but at 1 year there was no difference. There were 6 patients in the saline group who suffered adjacent vertebral fractures and no patients in the zoledronic acid group. The patients in the zoledronic acid

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arm had better Oswestry scores which in part may be due to the reduction in adjacent segment vertebral fractures.[20]

Tu et al. studied IV zoledronic acid in 64 patients with osteoporosis undergoing lumbar interbody fusion surgery. 32 were treated with an IV infusion of zoledronic acid (ZOL) 3 days after surgery and a second injection 1 year later, and the other 32 patients did not receive ZOL. At 2-year follow-up, a solid fusion was achieved in 75% of the ZOL group and only 56% of the control group. At final follow-up, the incidence of final subsequent vertebral compression fractures (19% of the ZOL group and 51% of the control group, P = 0.006), pedicle screw loosening (18% of the ZOL group and 45% of the control group, P = 0.03), and cage subsidence > 2 mm (28% of the ZOL group and only 54% of the control group, P = 0.04) were significantly lower in the ZOL group than in the control group. The ZOL group demonstrated improvement in visual analog scale (VAS) (for leg pain VAS, 2/10 for the ZOL group and 5/10 for the control group; for back pain VAS, 2/10 for the ZOL group and 6/10 for the control group) and Oswestry disability index scores (7/25 for the ZOL group and 16/25 for the control group).[21]

It appears that the use of bisphosphonates does not inhibit fusion when given postoperatively. It is important to think about the biology of bisphosphonates which substantially reduce bone remodeling. When a potent bisphosphonate like IV zoledronic acid is given shortly after surgery it is likely that due to the local increased bone activity of the fusion mass that much of the zoledronic acid may preferentially go to the fusion mass. When potent antiresorptive drugs like zoledronic acid reduce bone turnover substantially there in an increase in local mineral apposition. This contributes to the increase in BMD, by DXA with these drugs, when given for osteoporosis. Perhaps, the increase in local mineralization of the fusion mass may make it appear sooner to the eye on X-ray or CT. The fact that after 12 months the rates of fusion are not much different is consistent with this hypothesis. Probably most importantly we can be comfortable that bisphosphonates given after surgery do not appear to reduce the success of spine fusion and they appear to reduce vertebral fractures in the adjacent vertebra. There were no pedicle screw failures in either group in both the alendronate and zoledronic acid trial by Chen. There was significantly less pedicle screw loosening in the study by Tu suggesting a powerful bisphosphonate may help preserve pedicle screw purchase/survival in a high-risk population. There is also some evidence in long-term survival studies of total joints that the use of bisphosphonates may reduce loosening and revision arthroplasty.[22,23] This may make some sense since once loosening begins there is activation of osteoclasts in part due to bone and metal debris. A bisphosphonate may reduce further loosening of the orthopedic device by reduction of local osteoclastic function with less local bone resorption.

It appears that in high risk patients there is reasonable clinical data to support the use of both antiresorptive drugs like bisphosphonates and anabolic drugs like TPTD in patients with poor bone health and at high risk for complications of spine surgery due to bone-related complications. The challenge may be in how do we decide which patients we should treat with systemic bone active agents.

PREOPERATIVE BONE HEALTH ASSESSMENT IN PATIENTS UNDERGOING ELECTIVE SPINE FUSION

There are currently no guidelines on which patients undergoing elective spine fusion should undergo a bone health assessment. It seems reasonable to draw from our guidance about assessment of fracture risk in the general population and the performance of testing such as DXA by organizations such as the International Society of Clinical Densitometry (ISCD).[24] It seems appropriate to also incorporate an understanding of the type of surgery planned and the number of levels that will be fused. The following are the author's suggestions on who should be considered for bone health evaluations before spine surgery. They are somewhat parallel to the guidance for osteoporosis testing for decisions on treatment for osteoporosis:

- Women over the age of 60 especially if there are other risk factors including early menopause or other clinical risk factors for fracture
- Men over age 70
- Any adult over age 50 who has been exposed to chronic glucocorticoid use which is generally defined as at least 5 mg/d for over 90 days
- These suggestions could be modified based upon the type of surgery planned. For example, a 55-year-old woman who is undergoing 10 level fusion for adult spine deformity should perhaps be considered differently than a similar woman undergoing single level fusion.

The simplest way to evaluate bone health of the adult spine is to look for prevalent fractures of the spine. The literature is full of studies that document that a prior fracture is a very important risk factor for a future fracture. Siris et al. looked at about 2,500 women in the placebo arms of two large osteoporosis studies with baseline and 2 year spine X-rays. They looked at the 2 year incidence of spine fractures based upon the fracture status of their baseline spine X-ray and their baseline BMD by DXA. There was a clear relationship between low BMD and the risk of incident spine fracture. The risk was substantially higher, independent of BMD, in women with baseline fractures. The risk was significantly higher depending on the number of baseline fractures and

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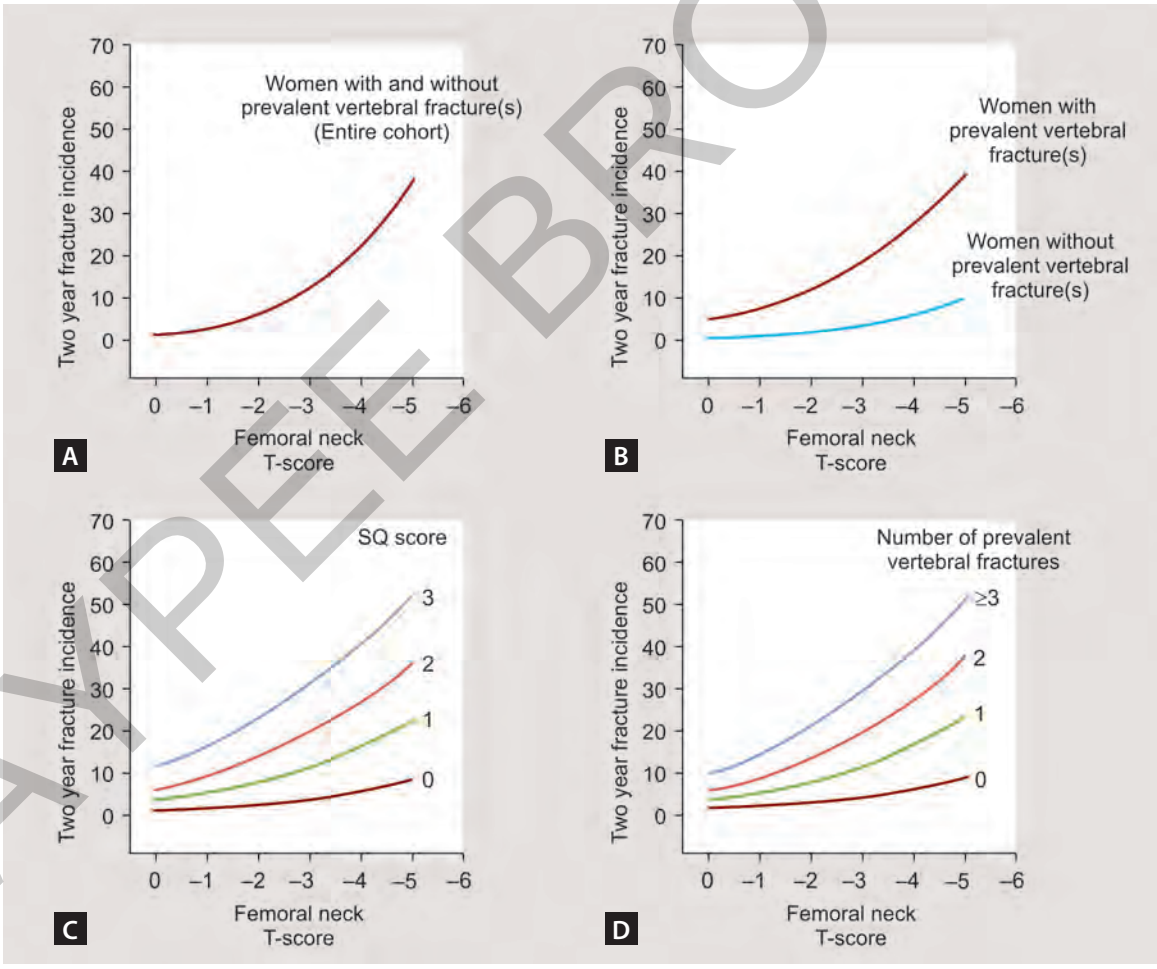
the severity of the vertebral fracture[25] (Figs. 1A to D). The severity of spine fractures on X-ray has also been correlated with the quality of the bone on iliac crest bone biopsy.[26] A recent study by the Center of Disease Control (CDC) National Health and Nutrition Examination Survey (NHANES) group did a population survey of US men and women age 40 and above using the imaging of spine fractures available on the DXA machine, known as vertebral fracture assessment (VFA). This can be done at the point of service when the patient gets a standard BMD assessment by DXA with minimal radiation and just a few extra minutes on the table. The prevalence of spine fractures steadily increases with age in both men and women. Importantly, of patients who reported they had a previous spine fracture, about 80% of them did not have a vertebral fracture on imaging. Of the patients who had a documented vertebral fracture, less than 10% of them were aware of the fracture when asked in a survey before the X-ray was performed.[5] This tells us that spine fractures are very important predictors of bone health of the spine but we must image the thoracic and lumbar spine to identify the fractures.

The technology used most commonly to assess bone health is DXA). Absorptiometry is based upon an X-ray energy emitted below the patient on the table with a detector above the patient. Mineral within bone will block the X-ray from the detector. Based upon a known mineral standard and routine calibration of the machine there is an estimation of bone mineral content in the region of interest, such as a vertebral body. The machine then measures the area of the individual vertebral body and an areal BMD (aBMD) is determined. The machines have a built in normative database of healthy men and women. Adults are compared to the average BMD of healthy 30-year-old and assigned a standard deviation above or below the average BMD of a healthy 30-year-old. This is known as a T-score. The World Health Organization (WHO) established that the definition of osteoporosis by DXA as a T-score of at least 2.5 standard deviations below the healthy



Figs. 1A to D: (A) Relationship of baseline BMD with 2-year fracture incidence; (B) Incidence of incident fractures in women with and without baseline prevalent vertebral fractures; (C) Incidence of vertebral fractures dependent upon the severity of the baseline fracture (0—no fracture, 1—mild fracture, 2—moderate fracture, and 3—severe fracture); (D) Incidence of vertebral fractures dependent upon the number of baseline vertebral fractures.
Source: Adapted from Siris ES, Genant HK, Laster AJ, et al. Enhanced prediction of fracture risk combining vertebral fracture status and BMD. Osteoporos Int. 2007;18(6):761-70.

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30-year-old average. Most clinicians would agree that in the presence of an obvious fragility fracture that a patient can be labeled with clinical osteoporosis even if their BMD does not meet the -2.5 criteria. The advantages of DXA include low radiation, fast acquisition time, low cost, and availability. However, in patients with significant degenerative changes, DXA of the spine has limitations. Significant degenerative changes of the posterior elements will impact the BMD results but the bone from osteophytes does not add to the strength of the vertebral body. Generally, an experienced clinician reading the DXA images will not allow individual vertebral bodies to be included in the analysis of L1–4 if there are significant degenerative changes. The guidelines ask for at least two vertebral bodies to be free of degenerative changes for a lumbar spine DXA to be used to assess fracture risk. The DXA will also assess BMD at the hip and the forearm which is helpful for overall fracture risk assessment at all sites. However, with spine fusion patients it seems logical that we would like to get a bone health assessment of the spine to guide our management.

An additional software to further analyze the DXA images of the spine is known as trabecular bone score (TBS). This software looks at the distribution of the bone within the vertebral body on a two dimensional image acquired by the DXA machine. A low TBS value has been independently associated with increased fracture risk.[27] Two patients may have the same BMD but the patient with a low TBS value will have a higher fracture risk and perhaps be more vulnerable to bone-related complications of spine surgery (Fig. 2). Populations such as patients on glucocorticoids and patients with long-standing diabetes may be good candidates for TBS evaluation prior to spine fusion surgery. One potential advantage of TBS in addition to standard BMD by DXA is that TBS is not impacted by the presence of osteoarthritis of the spine.[28] Cadaver studies have shown that an increased TBS score is related to increased pull-out strength.[29] TBS is FDA approved but generally not well-reimbursed by insurances in the US at this time.

Many patients will have lumbar spine CT scans as part of their preoperative evaluation. CT images may be used to acquire volumetric BMD. Volumetric BMD may be more sensitive to change but there is less epidemiology data to use it routinely for fracture risk assessment. Finite element analysis (FEA) is a technique of using the CT image of a vertebral body

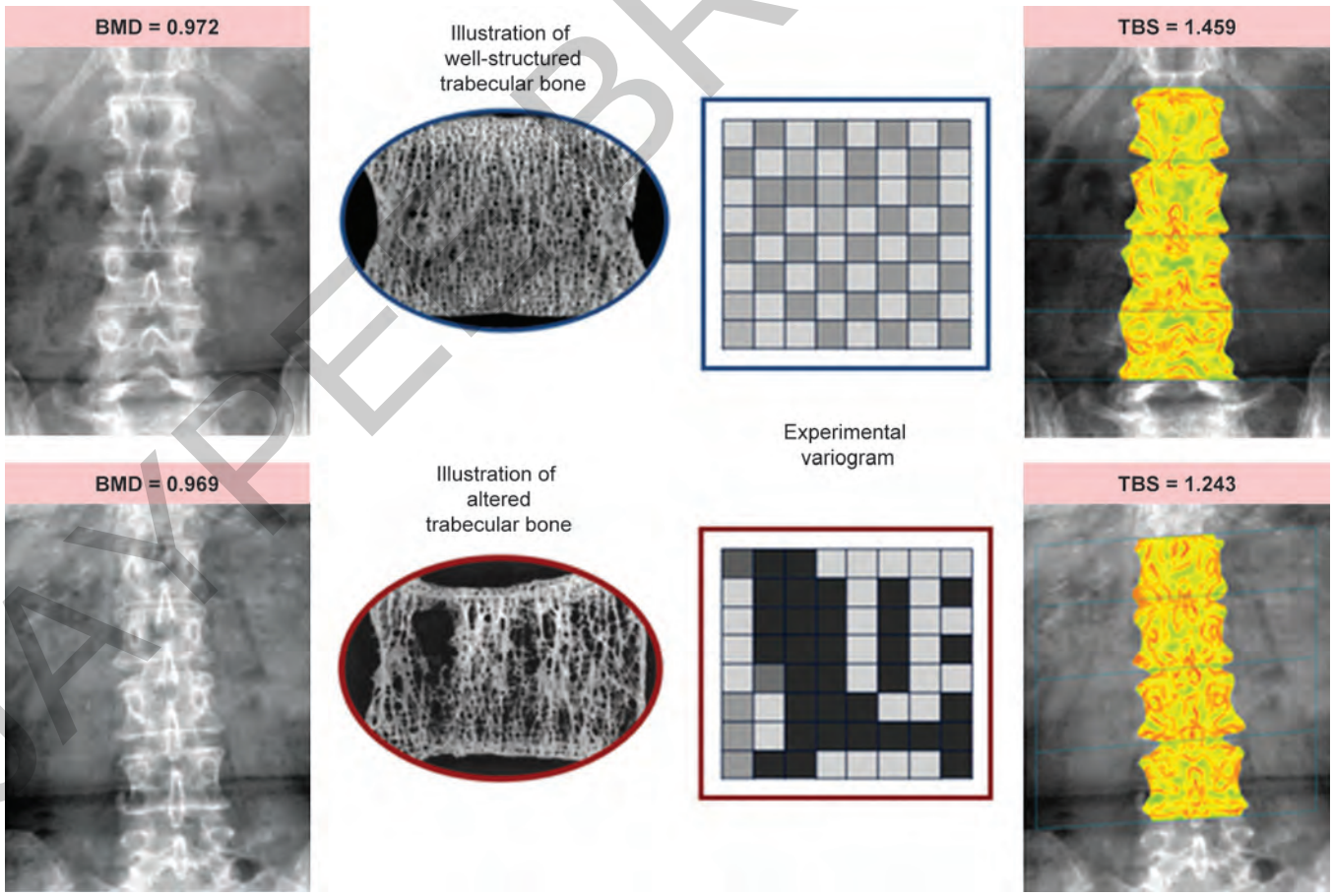

Fig. 2: Trabecular bone score (TBS). These two individuals have essentially the same LS BMD by DXA but due to altered trabecular bone, the patient on the bottom has a significantly lower TBS.

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and assigning individual voxels a material property based upon mineral density. Estimates of bone strength can be done for the proximal femur and the vertebra. An axial load is placed upon the vertebral body to the point of virtual fracture (Fig. 3). The algorithm for the software for this assessment required validation with cadaveric vertebral bodies and biomechanical testing. The output of FEA is strength in Newtons. The software will also give the clinician a volumetric BMD. Low vertebral compressive strength estimates by FEA have been shown to predict fracture risk better than standard DXA BMD in an elderly male cohort.[30] The report produced by the company simply labels the strength as normal, low or fragile (Table 1). This may be much less confusing than the historical use of T-scores with DXA. Burch et al. have looked at bone strength in a population of women of ages 50–70 undergoing elective spine fusion using CT-based FEA. They found that 29% were classified as having poor bone quality (either osteoporosis or fragile bone strength) using pre-established validated threshold values to define the presence of osteoporosis (trabecular BMD of 80 mg/cm^3 or lower) and fragile bone strength (vertebral strength of 4,500 N or lower).[31] Work is ongoing to determine if low bone strength by CT-based FEA is predictive of bone-related complications of spine surgery. This may be an attractive technology especially if the patient has already had a lumbar spine CT as part of their workup for spine surgery. Again, FEA is FDA approved but generally not reimbursed by US insurance.

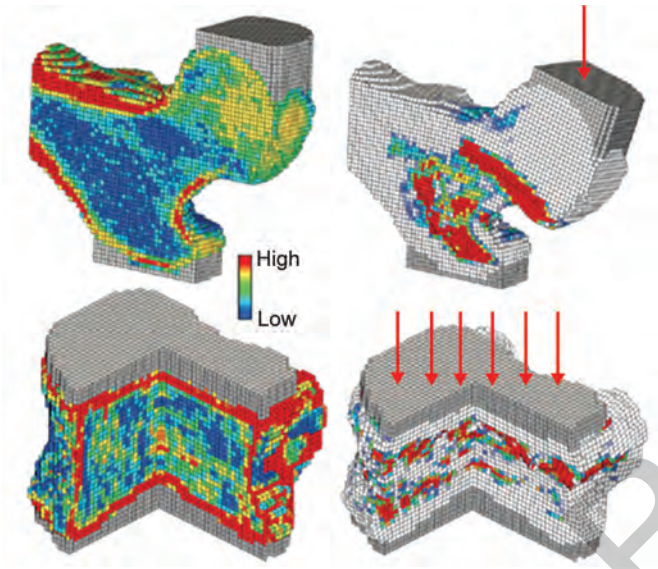

Fig. 3: The VirtuOst bone strength measurements. Left: Sectioned views of finite element models of a proximal femur (sideways fall configuration) and a vertebral body, the colors showing the local material properties as derived from the CT scan. Right: The bones undergo virtual stress testing, the colors depicting where the bone tissue fails (red is more intense failure). *Source*: ON Diagnostics.

DISCUSSION

Spine fusion surgery on older patients is likely to continue to grow with the aging population and the improvements in spine surgery techniques and instrumentation. Older adults often want to remain physically active and successful spine surgery can be life changing in appropriate patients. It appears that poor bone health is associated with increased bone-related complications such as pedicle screw failure, adjacent segment vertebral fractures and perhaps lower success of spine fusion. There is a growing acknowledgement of the importance of bone health in older patients undergoing elective spine fusion surgery.[32]

While the evidence for use of systemic osteoporosis medications appears to be reasonably solid, the studies

Table 1: The VirtuOst interventional thresholds for BMD and bone strength. Together with the BMD and bone strength measurements, these thresholds are used to identify osteoporosis and fragile bone strength, respectively.

Interpreting the VirtuOst Report: Summary			
	Spine	*Bone mineral density (BMD)*	*HIP*
Women and men	BMD ≥ 120 mg/cm^3	Normal	BMD T ≥ –1.0
	80 < BMD < 120	Low (osteopenia)	–2.5 < BMDT < –1.0
	BMD ≤ 80	Osteoporosis	BMDT ≤ –2.5*
			** At either femoral neck or total hip regions*
Bone strength (STR)			
Women	STR ≥ 6000 N	Normal	STR ≥ 4000 N
	4500 < STR < 6000	Low	3000 < STR < 4000
	STR ≤ 4500	Fragile bone strength	STR ≤ 3000
Men	STR ≥ 8500 N	Normal	STR ≥ 5000 N
	6500 < STR < 8500	Low	3500 < STR < 5000
	STR ≤ 6500	Fragile bone strength	STR ≤ 3500

Source: ON Diagnostics.

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were appropriately done in patients with poor bone health and in some studies the patients met the criteria for the diagnosis of osteoporosis. Standard assessments such as DXA are helpful but have limitations in this population of older patients with degenerative changes of the spine. Other imaging technologies such as TBS and CT-based FEA may complement standard DXA. Assessment of prevalent spine fractures in the thoracic and lumbar spine seems to be appropriate to preoperatively assess bone health in these patients. Selective use of both anabolic and antiresorptive drugs has the potential to reduce complications and improve fusion success in high-risk patients. Medical doctors who specialize in bone health need to have basic clinical insights into spine fusion surgery and the unique bone-related issues in this population. Spine surgeons likely do not want to oversee the bone health assessment or the prescribing of systemic osteoporosis drugs. It appears to be a great opportunity for medical and surgical specialists to work together to improve the outcome of their patients undergoing spine fusion surgery.

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