Biochemical markers of bone resorption may help in the prediction of fracture risk, independently of bone density, particularly in older individuals. In women ≥65 years, when bone density results are greater than the usual treatment thresholds noted above, a high level of bone resorption should prompt consideration of treatment. The primary use of biochemical markers is for monitoring the response to treatment. With the introduction of antiresorptive therapeutic agents, bone remodeling declines rapidly, with the fall in resorption occurring earlier than the fall in formation. Inhibition of bone resorption is maximal within 3 months or so. Thus, measurement of bone resorption (C-telopeptide [CTX] is the preferred marker) before initiating therapy and 3–6 months after starting therapy provides an earlier estimate of patient response than does bone densitometry. A decline in resorptive markers can be ascertained after treatment with potent antiresorptive agents such as bisphosphonates, denosumab, or standard-dose estrogen; this effect is less marked after treatment with weaker agents such as raloxifene or intranasal calcitonin. A biochemical marker response to therapy is particularly useful for asymptomatic patients and may help ensure long-term adherence to treatment. Bone turnover markers are also useful in monitoring the effects of osteoanabolic agents such as 1-34hPTH, or teriparatide, which rapidly increases bone formation (P1NP is preferred, but osteocalcin is a reasonable alternative) and later bone resorption. The recent suggestion of "drug holidays" (see below) has created another use for biochemical markers, allowing evaluation of the off effect of drugs such as bisphosphonates.

TREATMENT OSTEOPOROSIS

MANAGEMENT OF PATIENTS WITH FRACTURES

Treatment of a patient with osteoporosis frequently involves management of acute fractures as well as treatment of the underlying disease. Hip fractures almost always require surgical repair if the patient is to become ambulatory again. Depending on the location and severity of the fracture, condition of the neighboring joint, and general status of the patient, procedures may include open reduction and internal fixation with pins and plates, hemiarthroplasties, and total arthroplasties. These surgical procedures are followed by intense rehabilitation in an attempt to return patients to their prefracture functional level. Long bone fractures (e.g., wrist) often require either external or internal fixation. Other fractures (e.g., vertebral, rib, and pelvic fractures) usually are managed with supportive care, requiring no specific orthopedic treatment.

Only ~25–30% of vertebral compression fractures present with sudden-onset back pain. For acutely symptomatic fractures, treatment with analgesics is required, including nonsteroidal anti-inflammatory agents and/or acetaminophen, sometimes with the addition of a narcotic agent (codeine or oxycodone). A few small, randomized clinical trials suggest that calcitonin may reduce pain related to acute vertebral compression fracture. Percutaneous injection of artificial cement (polymethylmethacrylate) into the vertebral body (vertebroplasty or kyphoplasty) may offer significant immediate pain relief in patients with severe pain from acute or subacute vertebral fractures. Safety concerns include extravasation of cement with neurologic sequelae and increased risk of fracture in neighboring vertebrae due to mechanical rigidity of the treated bone. Exactly which patients are the optimal candidates for this procedure remains unknown. Short periods of bed rest may be helpful for pain management, but in general, early mobilization is recommended because it helps prevent further bone loss associated with immobilization. Occasionally, use of a soft elastic-style brace may facilitate earlier mobilization. Muscle spasms often occur with acute compression fractures and can be treated with muscle relaxants and heat treatments.

Severe pain usually resolves within 6–10 weeks. More chronic severe pain might suggest the possibility of multiple myeloma or underlying metastatic disease. Chronic pain following vertebral fracture is probably not bony in origin; instead, it is related to abnormal strain on muscles, ligaments, and tendons and to secondary facet-joint arthritis associated with alterations in thoracic and/or abdominal shape. Chronic pain is difficult to treat effectively and may require analgesics, sometimes including narcotic analgesics. Frequent intermittent rest in a supine or semireclining position is often required to allow the soft tissues, which are under tension, to relax. Back-strengthening exercises (paraspinal) may be beneficial. Heat treatments help relax muscles and reduce the muscular component of discomfort. Various physical modalities, such as US and transcutaneous nerve stimulation, may be beneficial in some patients. Pain also occurs in the neck region, not as a result of compression fractures (which almost never occur in the cervical spine as a result of osteoporosis) but because of chronic strain associated with trying to elevate the head in a person with a significant thoracic kyphosis.

Multiple vertebral fractures often are associated with psychological symptoms; this is not always appreciated. The changes in body configuration and back pain can lead to marked loss of self-image and a secondary depression. Altered balance, precipitated by the kyphosis and the anterior movement of the body's center of gravity, leads to a fear of falling, a consequent tendency to remain indoors, and the onset of social isolation. These symptoms sometimes can be alleviated by family support and/or psychotherapy. Medication may be necessary when depressive features are present. Multiple thoracic vertebral fractures may be associated with restrictive lung disease symptoms and increased pulmonary infections. Multiple lumbar vertebral fractures are often associated with abdominal pain, constipation, protuberance, and early satiety. Multiple vertebral fractures are associated with greater age-specific mortality.

Multiple studies show that the majority of patients presenting in adulthood with fractures are not evaluated or treated for osteoporosis. Estimates suggest only about 20% of fracture patients receive follow-up care. Patients who sustain acute fractures are at dramatically elevated risk for more fractures, particularly within the first several years, and pharmacologic intervention can reduce that risk substantially. Recently, several studies have demonstrated the effectiveness of a relatively simple and inexpensive program that reduces the risk of subsequent fractures. In the Kaiser system, it is estimated that a 20% decline in hip fracture occurrence was seen with the introduction of what is called a fracture liaison service. This typically involves a health care professional (usually a nurse) whose job is to coordinate follow-up care and education of fracture patients. If the Kaiser experience can be repeated, there would be significant savings of health care dollars, as well as a dramatic drop in hip fracture incidence and a marked improvement in morbidity and mortality among the aging population.

MANAGEMENT OF THE UNDERLYING DISEASE

Patients presenting with typical osteoporosis-related fractures (certainly hip and spine) can be assumed to have osteoporosis and can be treated appropriately. Patients with osteoporosis by BMD are handled in a similar fashion. Other fracture patients and those with reduced bone mass can be classified according to their future risk of fracture and treated if that risk is sufficiently high. It must be emphasized, however, that risk assessment is an inexact science when applied to individual patients. Fractures are chance occurrences that can happen to anyone. Patients often do not understand the relative benefits of medications, compared to the perceived risks of the medications themselves.

Risk Factor Reduction Several tools exist for risk assessment. The most commonly available is the FRAX tool, developed by a working party for the WHO, and available as part of the report from many DXA machines. It is also available online *(http://www.shef.ac.uk/FRAX/tool.jsp?locationValue=9)* **(Fig. 425-7)**. In the United States, it has been estimated that it is cost-effective to treat a patient if the 10-year major fracture risk (including hip, clinical spine, proximal humerus, and tibia) from FRAX is ≥20% and/or the 10-year risk of hip fracture is ≥3%. FRAX is an imperfect tool because it does not include