

# Implications for Patient Risk and Surgical Outcomes

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## Description

The most advanced orthopedic treatment for a variety of spinal disorders, such as deformity, spondylolistheses, and degenerative disc degeneration, is spine fusion surgery. With approximately 400,000 of these procedures carried out annually in the US, its prevalence is rising. However, problems are said to affect about 30% of patients and frequently call for revision surgery, which carries a high risk of morbidity and expense to the medical system. Prospective studies are being encouraged to better estimate patient risk prior to surgery due to the associated morbidity and healthcare expenditures for individuals who have failed fusions. Numerous demographics, including age, sex, menopausal state, and low BMD, have been associated with an increased risk of post-operative problems. Osteoporosis affects 10% to 40% of individuals undergoing these procedures, and the percentage may rise when modalities other than Dual energy X-ray Absorptiometry (DXA) are used. This makes low BMD a significant factor to take into account. Few studies have specifically examined the characteristics of bone materials and how they relate to difficulties in patients following spinal fusion surgery, despite the fact that skeletal health is essential for hardware stability, de novo bone creation, and therefore post-operative outcomes.

## Revision surgeries

Prior research has established a connection between pre-operative skeletal evaluations and post-operative results in individuals undergoing fusion surgery. There are inconsistent results from a few studies linking low Areal Bone Mineral Density (aBMD) values from DXA to problems following fusion. Even though DXA is the gold standard for diagnosing osteoporosis, patients with spinal abnormalities may have an underestimated prevalence of osteoporosis at the spine. The likelihood of problems following surgery has also been associated with low spine volumetric BMD (vBMD) measured by QCT. Furthermore, our team discovered in a recent prospective study that DXA did not predict skeletal difficulties, but patients with low peripheral Volumetric Bone Density (vBMD) and aberrant microarchitecture by high resolution peripheral QCT (HRpQCT) had greater risks of skeletal complications after surgery. The correlation between intrinsic features of bone obtained after surgery and pre-operative imaging has not been thoroughly studied.

The objective of this research was to establish a direct correlation between the mineral properties and collagen of the bone using Fourier-transform infrared (FTIR) spectroscopy and pre-operative imaging using DXA, QCT, and HRpQCT, as well as the frequency of revision surgery and post-operative problems. Fourier-transform infrared spectroscopy is a useful tool for evaluating the quality of bone in various disease stages as well as for studying the material qualities of bone, such as crystallinity, mineral-to-matrix ratio, and collagen maturity. The characteristics evaluated using this method is linked to atypical femur fractures and fragility fractures. We concentrated on postmenopausal women for our study because they have a higher chance of experiencing bone issues. We predicted that patients with inferior microarchitecture, lower vBMD, and aBMD would exhibit FTIR characteristics indicative of aged bone. We also conducted an exploratory analysis to look into the connections between revision surgeries and FTIR indices and post-operative problems.

## Oncologic surgeries

Achieving local control and lowering the chance of recurrence is the main objective of oncologic procedures. One of the most significant indicators of a local recurrence is the surgical margin. Nevertheless, in order to ascertain margin positivity, surgeons have up to now depended on methods like manual palpation and intraoperative frozen pathology, both of which have the potential to be incredibly incorrect. Other instruments have been suggested to assist the surgeon in perioperative margin assessment. Intraoperative Computer-Assisted Tumor Surgery (CATS), ultrasonography, and Magnetic Resonance Imaging (MRI) have all been introduced in orthopedic oncology. However, there are significant drawbacks to each of these choices, including longer operating times and higher expenses. Fluorescent compounds were first used in oncologic surgery in the 1990s, and since then, their application in medicine has spread to many different fields. Although Fluorescent-Guided Surgery (FGS) has been used in many surgical specialties, its research and application in orthopedic surgery have been slower. Perfusion-based evaluation of tissue healing and intraoperative tumor tissue identification is two possible uses in this sector. The use of FGS is particularly interesting in orthopedic oncology because of its potential to offer real-time information about the status of the margin following a large tumor resection. Furthermore,

fluorescent dyes with FDA approval are not too expensive. Although imaging instruments may have a high initial cost, research has shown that this technology is reasonably priced. If this technology were more widely used in surgical specialties, its

availability might increase and could even offset the expense of unintentional margin-positive excisions in patients with sarcoma.