

Controversies about Spinal Fusion Surgery: Allografts, Autografts, and Fusion Levels

While physicians agree on many things about spine fusion surgery, there are some areas that lack consensus. Two such areas are:

- The type of bone used (autograft vs. allograft), and
- How many levels should be fused

What Bone Type Should Be Used with the Fusion?

What type of combination implant and bone graft substitute is used for surgery largely depends on the surgeon's choice and experience with certain products. Cost, risk, availability, safety and postoperative morbidity are all factors that need to be considered.

In some instances, it may be more compelling to use a patient's own bone. There are some situations where it is more difficult to get a solid fusion and using a better bone graft is reasonable. (See Figure 1.) Factors that may make obtaining a solid fusion difficult include:

- Revision surgery (previously failed grafts)
- Smokers/smokeless tobacco product users
- Multiple level fusions
- Disease states that inhibit bone healing or require medications to do so

Autograft Bone for Cervical Spinal Fusion Surgery

Autograft bone (a patient's own bone) is harvested from the iliac crest (hip). This technique has been the gold standard since the 1950s. Autograft bone usually achieves a fusion in 90% to 95% of patients.

The principal disadvantage with using autograft bone is that another incision needs to be made over the hip to harvest the bone graft.

Possible complications associated with taking out bone graft include:

- Graft site chronic pain (with pain lasting anywhere from 12 to 24 months 25% to 30% of the time)^{1, 2}
- Infection
- Bleeding

- Damage to the lateral femoral cutaneous nerve (a sensory nerve that supplies sensation to the front of the thigh)
- Pelvic bone fracture

The chances of a complication increase with the size of the bone graft and patient obesity. For those who opt to use an autograft, many patients find the bone graft harvest site to be more painful than the cervical surgery site itself.

Allograft Bone for Cervical Spinal Fusion Surgery

Allograft bone (a.k.a. ‘bank’ bone or donor bone from a cadaver) eliminates the need to harvest the patient’s own bone. Basically, the donor graft acts as a bone scaffolding onto which the patient’s own bone grows and eventually replaces over years. There are no living cells in the bone graft, so there is little chance of a graft rejection, like with an organ transplant.

However, bone graft healing remains an issue, as there is a somewhat greater likelihood of bone graft failure with allograft bone compared to autograft. With that said, it should be known that certain studies have shown allograft to be comparable to autograft in terms of producing successful fusions.^{3, 4, 5}

With allografts, the speed of healing may be slower than an autograft bone fusion. Additionally:

Allograft yields nearly equivalent fusion rates as autograft bone in one-level spinal fusions

- Anterior cervical instrumentation (plates & screws) are commonly employed with allografts to increase fusion rates
- With increasing numbers of levels to be grafted/fused, the differences in fusion rates between allograft and autograft become more significant

There is a theoretical risk of transmission of an infection from a donor. The risk of contracting a disease such as HIV or hepatitis from an allograft has been estimated to be between 1 in 200,000 to 1 in 1 million. However, with modern procurement and sterilization methods for bone tissue, the risk is essentially moot.

Bone Graft Substitutes for Cervical Spinal Fusion Surgery

There are now multiple commercially available bone graft substitute options available. The advantages include no risk of disease transmission and ready availability.

Many bone graft substitutes, however, are not structural and need to be combined with a manufactured device that holds it in place while the bone graft substitute heals.

Typically, spinal implants are either manufactured out of a metal product (usually titanium), plastic (also known as polyetheretherketone-PEEK), or carbon-fiber.

In 2009, the Food and Drug Administration issued a warning letter concerning the use of bone morphogenic proteins (BMP) in cervical surgery. There have been reports of it causing a large inflammatory reaction postoperatively, which can lead to a subsequent loss of the patient's airway. This is a serious postoperative complication that can be potentially fatal.

How Many Levels of Fusion?

Another controversy includes how many levels should be fused at the time of surgery. This is especially true in patients who are having an anterior cervical discectomy and fusion in the presence of multiple abnormal discs.

Some surgeons prefer fusing all disc levels that look bad, whereas in most cases only one level will have herniated and be symptomatic. The thought is that if another level is bad, it will probably need to be fused in the future.

The dilemma with fusing increasing numbers of levels is that it places more pressure and strain on the unfused segments. On the other hand, trying to 'cherry pick' the one or two bad levels risks inadequately treating the patient's problem.

Other surgeons feel that fusing only the clearly pathological level(s) (e.g. the one with the herniation that is causing the arm pain) is desirable as it maintains more of the normal motion and biomechanics of the neck. There is no definitive answer as to which philosophy is better, and each individual patient is a little different. As a patient, the best way to consider this factor is to realize that the number of levels fused is a balancing act. Saving motion segments is desirable but comes at the cost of either under-treating the original problem or possibly needing another level fused in the near future.

The chance that another level will need to be fused in the future is difficult to quantify. Some studies have suggested that the rate of adjacent disc breakdown requiring further surgery is between 10% to 25% over ten years. More data are required before we will be able to definitely answer this controversy.

References:

1. Anderson DG, et al. Donor Site Morbidity After Anterior Iliac Crest Bone Harvest for Single-Level Anterior Cervical Discectomy and Fusion.
2. Sasso RC, et al. Iliac crest bone graft donor site pain after lumbar interbody fusion: a prospective patient satisfaction outcome assessment.

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