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# Anterior cervical discectomy and fusion techniques: Bone graft, biologics, interbody spacers, and plating options

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ABSTRACT

Anterior cervical discectomy and fusion is a highly successful procedure for patients with a variety of cervical pathologies. While autograft bone has been the mainstay for anterior cervical discectomy and fusion since the procedure's inception, there are a host of autograft substitutes to consider in addition to graft adjuncts and disparate fixation methods. In the present article we describe the basic principles, techniques, and latest clinical data on some of the many options available to the treating surgeon.

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## 1. Introduction

Anterior cervical discectomy and fusion (ACDF) is a highly efficacious procedure for patients experiencing cervical radiculopathy and myelopathy. The techniques for the anterior cervical discectomy are well described and generally carried out in a consistent manner. However, to attain fusion, numerous techniques have been developed, each with their unique risk/benefit profile. Successful fusion of bone relies on myriad structural and biologic factors. The graft implemented in ACDF should exhibit some or all of the following properties: osteoinduction, osteogenesis, and osteoconduction. This entails the ability to stimulate production of osteoprogenitor cells, the ability to create new bone, and the ability to act as a scaffold for bone formation, respectively. Bone grafts, interbody spacers, plates, and biologic graft substitutes/adjuncts, attempt to fulfill these requisites for fusion via different means. The purpose of this review is to examine the principles, techniques, and efficacy of each of these techniques in regards to ACDF.

## 2. Bone graft

### 2.1. Principles

The gold standard graft for use in ACDF is the tricortical iliac crest autograft (ICBG). This type of graft is efficacious because the dense cortical bone provides stability to the decompressed disc space, decreasing motion and promoting fusion. Additionally, the cancellous aspect of the graft provides osteoinductive, osteogenic, and osteoconductive properties. Furthermore, as an autograft, there is no risk of rejection or disease transmission. In addition, morcelized autograft is often used in cages or as an adjunct to other structural grafts.

### 2.2. Techniques

Iliac crest bone graft is generally harvested anteriorly given the supine position of the patient during ACDF. A 6–8 cm incision is made over the iliac tubercle in line with the iliac crest followed by subperiosteal dissection to the inner and

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outer wall of the ilium. Various techniques have been described to harvest the graph. The Smith–Robinson type graft is commonly employed for ACDF, where a horseshoe-shaped graft is placed within the decompressed disc space with the cortical surface facing ventrally, and the cancellous surface facing dorsally. The Cloward-type graft is a horizontally oriented, dowel-shaped graft that is impacted between the vertebral bodies. The Bailey–Badgley graft is a vertically oriented semi-dowel that is positioned in a trough on the ventral aspect of the vertebral bodies. Finally, the Simmons and Bhalla graft creates a bevel along the superior and inferior surfaces of the graft that serves as a wedge between the vertebral bodies.[1]

### 2.3. *Efficacy*

Autogenous iliac crest bone graft is considered the gold standard for fusion in ACDF. A long-term follow-up study by Bolhman et al.[2] evaluated outcomes of ACDF completed with the Smith–Robinson ICBG. Overall, 96% of patients had complete restoration of motor function, 92% regained sensation, and 94% had resolution of radicular pain. However, one major drawback of ICBG harvest is the donor site morbidity. A systematic review[3] illustrated a 19% morbidity rate following ICBG, with a 7.75% incidence of chronic pain (>6 months). Other less frequently reported complications of graft harvesting includes infection, hematoma, fracture, lateral femoral cutaneous nerve injury, dythesias, wound dehiscence, and poor cosmesis. In addition, failure of the graft itself (subsidence, dislocation, fracture, and kyphotic deformity) can be problematic. Consequently, numerous other techniques have been developed in an attempt to achieve similar outcomes of ACDF while minimizing the morbidity and complications associated with ICBG harvest.

## 3. Allograft

### 3.1. *Principles*

While cages and plates have been developed to address the structural aspect of fusion, mineralized, and demineralized bone allografts in addition to xenografts are often utilized to address the biology of fusion without the associated complications of autograft harvesting. They also afford shorter operative time given they are pre-prepared. Many types of allograft are now commonly used in ACDF. While allograft does not possess osteogenic properties, some preparations have mild osteoinductive properties and can act as an osteoconductive scaffold for fusion. Shortcomings of allograft include the increased cost, availability, variation in sterilization technique, disparity in structural integrity, and risk of disease transmission and host rejection (Fig. 1).

### 3.2. *Techniques*

Allograft comes pre-prepared and is generally used in a similar fashion as its tricortical autograft counterpart. However, there are many alternate options available such as morcelized allograft, demineralized bone matrix, and fibular strut allograft, the latter of which provides better structural support than tricortical autograft and is often used for corpectomies.

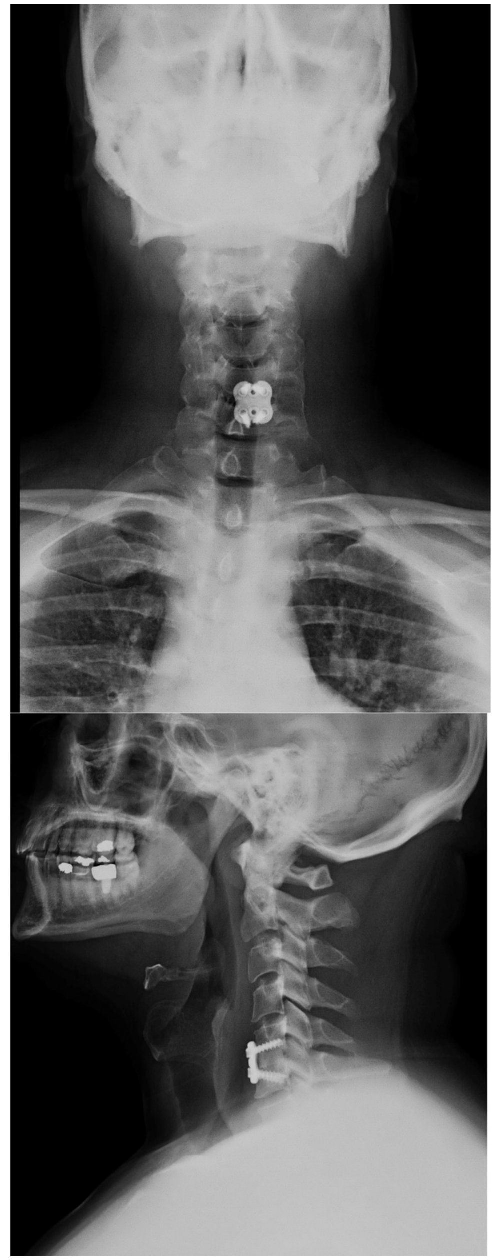

**Fig. 1 – An example of a one-level ACDF with plate and allograft.**

### 3.3. *Efficacy*

Evidence exists showing that allograft without plating has a lower rate of fusion. Bishop et al.[4] showed higher fusion rates in single-level ACDF with un-plated autograft (94%) compared to un-plated allograft (73%). A similar discrepancy was noted in multilevel ACDF in the same study showing a 100% fusion rate with autograft, and 89% with allograft. However, when combined with anterior plating, tricortical allograft has exhibited higher rates of fusion in some studies, with similar