61 Cervical Skip Corpectomy

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SUMMARY OF KEY POINTS

- Cervical spondylotic myelopathy may be multilevel.
- Three- and four-level cervical plated corpectomy has a high rate of failure, partially because there are only four contact points for fixation of the plate to the cranial and caudal intact vertebrae. Such a construct is also associated with lower fusion rate.
- Leaving the intermediate vertebral body intact for additional fixation points reduces this problem while still allowing dural sac decompression. This chapter reviews the advantages, and disadvantages of the skip corpectomy technique.

The ventral approach to the cervical spine was first suggested by Dr. Leroy Abbott in 1952. The approach was used and subsequently described by Bailey and Badgley.[1] During the late 1950s and 1960s, many approaches and techniques were defined to obtain a successful neural decompression and cervical spine arthrodesis.[2] All of these frontier studies focused on anterior cervical discectomy and arthrodesis.

The evolution of new techniques facilitated the complex surgical procedures, leading surgeons to use more aggressive techniques in cases with traumatic, degenerative, infectious, and neoplastic disorders. As a result, the first cervical corpectomy procedures were performed in 1970s. With time, cervical ventral and dorsal plating techniques were developed.[3]

Cervical corpectomy is an effective procedure for decompressing the ventral spinal cord. The existing literature indicates that the success rate usually is good for single-level or two-level cervical corpectomy, but not for multilevel corpectomy.[4-15] On the other hand, although this surgery is associated with good results in terms of neurologic recovery, many complications—such as strut graft fracture, graft pistoning, graft dislodgement, hardware failure, and pseudarthrosis—are also part of its history.

Vaccaro and colleagues demonstrated high rates of early construct failure in multilevel fusions: 9% for two-level corpectomy and 50% for three-level corpectomy.[15] A similar high rate of construct failure after multilevel corpectomy was reported by others as well.[6,7,10,11,15-19] The reported high rate of failure indicates that reconstruction of a multilevel corpectomy defect in the cervical spine remains a challenge.

BIOMECHANICS OF CERVICAL CORPECTOMY

The evidence of the failure of long constructs has been investigated in biomechanical studies.[20-22] Cadaveric biomechanical studies showed that the longer plate generates greater motions at the fusion sites under physiologic loads because of its longer lever arm,[23] and that the stabilizing potential indices significantly decrease after fatigue for the three-level corpectomy, but not for the one-level corpectomy.[16,17,23-25] This explains the lesser rate of construct failure in one-level cervical corpectomies.

Cervical corpectomy results in a posterior shift of the center of rotation, as the anterior aspect of the spine is cut. Addition of an anterior cervical plate shifts the center of rotation to the anterior, thus changing the loading pattern.[16,17,24] In other words, whereas the stand-alone strut graft is loaded in flexion and unloaded in extension,[16,17] the addition of a plate completely reverses the loading pattern. The outcome is reversal of the loading pattern in anterior-plated long-strut grafts so that loading of the graft does not occur under flexion moments, and excessive compression of the graft occurs under extension loads, resulting in the graft pistoning into the caudal vertebral end plate and, subsequently, in plate kicking.[16,17]

Alternative Solutions

Based on clinical experiences and biomechanical facts, many alternative techniques have been developed to avoid graft plate-related problems in cases of multilevel corpectomy.[4,6,8,13,26-30] Based on the evidence of the high stress in the lower end of the construct, the use of a buttress (junctional) plate alone was recommended. However, Riew and colleagues[27] and MacDonald and associates[8] reported high rates of complication after the use of a buttress plate alone in multilevel corpectomy. They recommended that the buttress plate be supplemented with posterior fixation.[8,27,30] Others focused on the 360-degree fixation using long plates.[4,6,13,26] However, the 360-degree procedure is a lengthy, sometimes staged procedure.

Different combinations of multilevel anterior cervical discectomy and fusion (ACDF) with or without corpectomies are other alternatives. As ventral alternative approaches to three-level corpectomy, Rhee and Riew[31] proposed (1) multilevel ACDF, (2) single corpectomy combined with additional ACDFs, and (3) two single-level corpectomies separated by an intact intervening vertebra. As another alternative, Ozer and colleagues described an open-window corpectomy technique.[32]

INDICATIONS OF SKIP CORPECTOMY

The skip corpectomy is indicated and is applicable in compressions extending from C3-4 to C6-7, particularly when the area of compression at the C5 level is confined to the adjacent disc spaces (Fig. 61-1A). This is so because skip corpectomy allows optimal decompression of the C3-4, C4-5, C5-6, and C6-7 intervertebral disc levels and C4 and C6 vertebral body levels (Fig. 61-1B). However, the limited work angle does not allow for optimum decompression of the posterior aspect of the C5 vertebral body, as seen in continuing ossification of the posterior longitudinal ligament (OPLL) cases. Note, however, that the surgeon may change strategy during the procedure and can add a C5 corpectomy if the decompression behind the C5 vertebral body is not satisfactory. Such an additional C5 corpectomy means a three-level corpectomy and should be combined with a posterior stabilization procedure.

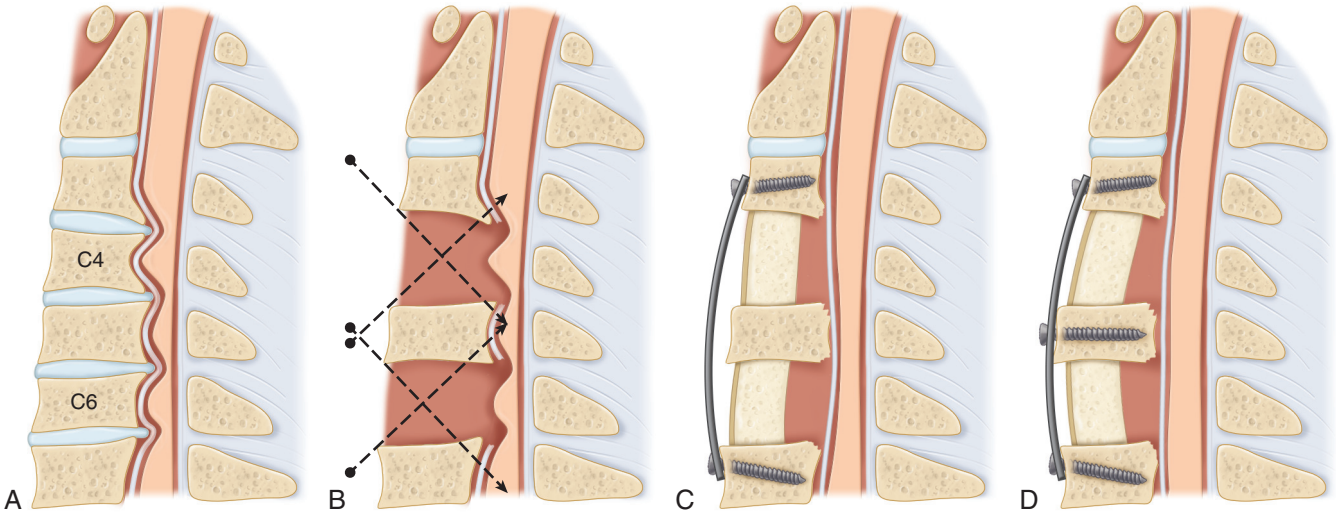

Figure 61-1. An illustration of a case indicative for skip corpectomy. **A,** Spondylotic and ossification of the posterior longitudinal ligament; compression is confined to the level of the C3-4, C4-5, C5-6, and C6-7 intervertebral discs and posterior to the dorsal wall of the C4 and C6 vertebral bodies. **B,** The best surgical view for optimum decompression in skip corpectomy. **C,** The illustration shows the placement of grafts and fixation of caudal and rostral vertebrae. **D,** Final fixation of the cervical spine after skip corpectomy. Note that the screw placement into the middle vertebra brings the C5 vertebral body to the plate.

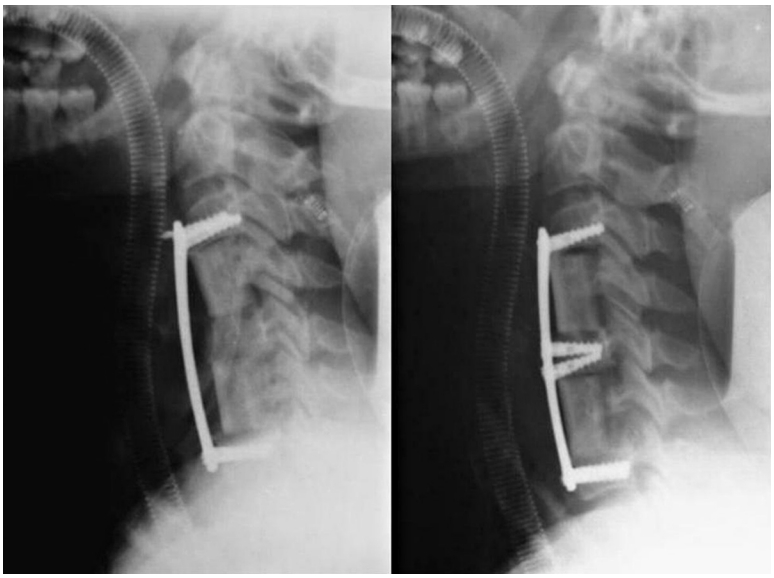

Figure 61-2. Radiograph indicating placement of screw into the middle vertebra, bringing the C5 vertebral body to the plate during the surgery.

Skip Corpectomy Technique

The skip corpectomy technique is exemplified by a C4 and C6 corpectomy, C5 osteophytectomy, and decompression of dorsal-rostral and dorsal-caudal aspects of the C5 vertebra. Preservation of the C5 vertebral body and the use of this vertebra for screw fixation are the most important aspects of this technique. Reconstruction can be performed using either iliac crest autograft or fibula allograft. After placement of the C3-5 and C5-7 bone grafts, a fixed rigid ventral cervical spine plate is placed (Fig. 61-1C). The plate is contoured in lordosis. The intervening vertebral body that is left after C4 and C6 decompression (i.e., the C5 vertebral body) serves as an intermediate point of construct fixation. The plate is first secured at the rostral and caudal ends (the C3 and C7 vertebral bodies). Next, screws are placed into the intervening vertebral body (the C5 vertebral body). As the C5 vertebral body screws are tightened, the spine is "brought to the cervical plate" (Figs. 61-1D and 61-2). Figure 61-3 shows preoperative and postoperative images of a patient who underwent skip corpectomy.

Advantages of Skip Corpectomy

The skip corpectomy technique achieves four healing surfaces, representing fewer than an equivalent number of multilevel ACDFs (eight surfaces), while avoiding problems with long-strut grafts. The fixation is obtained at the top, bottom, and middle of the constructs. The technique was suggested in recent years.[31,33,34] Ashkenazi and coworkers reported results after skip corpectomy, what they called hybrid decompression, in 13 cases.[34] They noted fusion in all cases and experienced mechanical failure of the construct in only one case (4%). Using this technique, Agbi and Paquette[33] reported successful

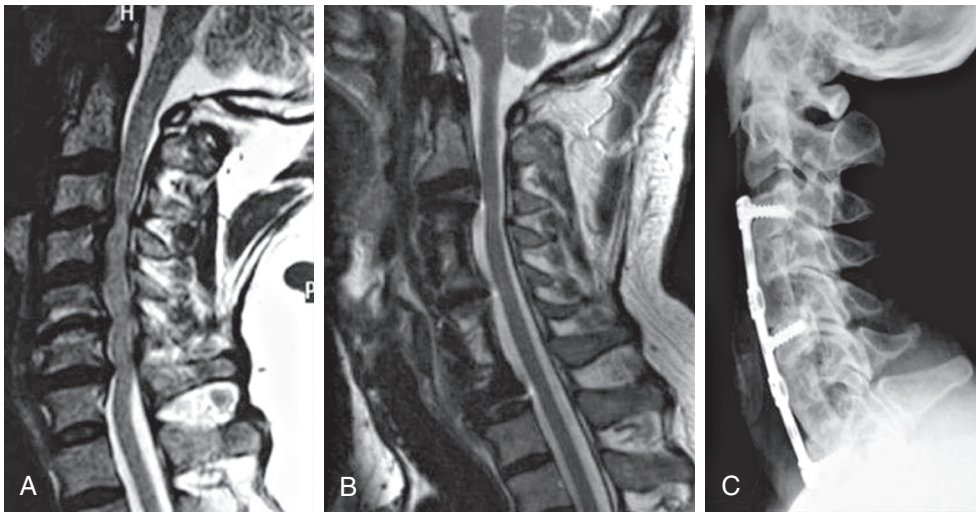

Figure 61-3. A, Preoperative T_2-weighted sagittal cervical spine magnetic resonance imaging (MRI) showing the multiple ventral compressions. **B,** Postoperative T_2-weighted sagittal cervical spine MRI showing decompression of the spinal cord. **C,** Postoperative lateral cervical spine plain radiograph showing the position of the grafts and screws.

outcomes in four cases. The results of the current series are in line with those reported by Ashkenazi and colleagues.[34] Dalbayrak and associates reported a high fusion rate (100%) and a low graft hardware-related complication rate (3.4%) using skip corpectomy.[35]

Lin and coworkers, compared clinical and radiologic results of ACDF (57 cases), two-level corpectomy (51 cases), and skip corpectomy (12 cases) in cases with three- to four-level cervical spondylotic myelopathy. They reported no significant clinical differences among the groups. They also reported 9.5% graft-related complication in all corpectomy groups. However, it is not clear from the report that this is the complication rate to which the corpectomy group belongs.[36]

Similarly, Quian and associates reported operative results of 198 patients with four-level cervical spondylotic myelopathy who underwent skip corpectomy (43 cases) or posterior decompression (155 cases). They reported temporary axial pain in 5 cases, temporary hoarseness in 2 cases, cage subsidence in 2 cases, and plate screw displacement in 1 case. They reported bony fusion in all cases (100%). The concluded that skip corpectomy displays safety comparable to that of posterior decompression and better efficacy for treating four-level cervical spondylotic myelopathy.[37]

The technique is biomechanically superior to ventral plating alone for three-level corpectomy. Singh and colleagues[38] compared the biomechanical aspects of different hybrid discectomy and corpectomy models and reported that the increased rigidity afforded by segmental fixation may significantly decrease the likelihood of plate dislodgement in the setting of anterior instrumentation alone. Addition of intermediate points of fixation also provided a better translational stability.

In a biomechanical study, Yüksel and associates compared the skip corpectomy with standard three-level corpectomy.[39] They reported that skip corpectomy allowed a slightly smaller range of motion during lateral bending and axial rotation than did standard three-level corpectomy. However, high pullout forces still occurred at superior and inferior vertebral screws during axial rotation. They concluded that skip corpectomy provided a better stability during lateral bending and axial rotation movements of the neck, and because of the high pullout forces seen in the superior and caudal screws during the axial rotation, the patient's axial rotation should be restrained.

The size of the grafts is another advantage of the skip corpectomy. Whereas one-level or two-level corpectomy can be reconstructed using an iliac crest graft, a three-level corpectomy requires a long fibular graft. Skip corpectomy allows the use of two short iliac crests or fibular grafts.

The technique also has the advantage of adding stability to the construct without requiring an additional surgical approach. Although the addition of a second approach provides the greatest stability for the construct, it comes at the expense of increased operative time and the potential for higher surgical morbidity.

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