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Anterior Cervical Controllable Antedisplacement and Fusion (ACAF)

Improving Outcomes for Severe Cervical Ossification of the Posterior Longitudinal Ligament

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Abstract

Background: Anterior cervical controllable antedisplacement and fusion (ACAF) is utilized for the treatment of symptomatic ossification of the posterior longitudinal ligament (OPLL). The aims of the procedure are to directly relieve ventral compression of the spinal cord, to reconstruct the spinal canal and restore cervical alignment, and to achieve satisfactory clinical recovery.

Description: The detailed steps to perform ACAF have been described previously[1]. Briefly, following induction of general endotracheal anesthesia, a standard right- or left-sided Smith-Robinson incision is made. Discectomies are performed at the involved levels. By measuring the thickness of the OPLL on an axial preoperative computed tomography scan at each compressed level, the amount of each anterior vertebral body to be resected can be calculated preoperatively. This was, in general, equal to the thickness of the ossified mass at the same level. The previously calculated portion of each involved body in the vertebral body-OPLL complex is resected. Following the creation of a contralateral longitudinal osseous trough, the prebent anterior cervical plate is then placed, and the screws are installed after proper drilling and taping on the remaining vertebral bodies. The screws utilized in this procedure should not be too short to achieve adequate purchase in the vertebral body. Subsequently, the intervertebral cages are inserted. Thus, the vertebral body-OPLL complex is temporarily stabilized for the next procedure. Next, an ipsilateral longitudinal osseous trough is created to completely isolate the vertebral body-OPLL complex. Notably, the objective of complete isolation of the vertebral body-OPLL complex is to further anteriorly hoist the complex to decompress the spinal cord. Finally, screws are inserted through the plate and into each vertebral body and are gradually tightened to displace the bodies anteriorly. Allogenic iliac bone graft is placed in the longitudinal bone troughs to promote fusion.

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Alternatives: Nonoperative treatment is frequently ineffective. Traditional surgical interventions have included anterior cervical corpectomy and fusion (ACCF), posterior laminoplasty, and laminectomy[2,3]. ACCF focuses on resecting the ventral ossified mass in order to obtain direct decompression; however, this technique is very technically demanding, with a high risk of complications. In addition, the clinical benefits of ACCF will be limited when the OPLL extends over >3 levels. Posterior decompression can achieve indirect decompression by allowing the spinal cord to float away from the ossified mass. This technique depends largely on the preoperative presence of cervical lordosis and is contraindicated in patients with kyphosis or severe OPLL. In addition, posterior decompression surgery has been associated with a high incidence of late neurological deterioration and even revision surgery[2].

Rationale: ACAF combines the advantages of direct decompression as occurs with ACCF with the limited manipulation of the canal contents as occurs with the posterior approach[4-6]. The procedure considers the ossified mass and the vertebral body as a single unit. Decompression is accomplished by moving the vertebral body with the OPLL ventrally away from the spinal cord. The preserved part of the vertebral body-OPLL complex becomes part of the anterior wall of the spinal canal. Without direct instrument manipulation inside the canal, the occurrence of cerebrospinal fluid leakage, hemorrhage, and intraoperative neural injury can be minimized[5]. Compared with a posterior approach, ACAF can achieve more decompression of the cord, especially in patients with cervical kyphosis and those with >60% of the spinal canal occluded[6].

Expected Outcomes: This procedure can yield satisfactory clinical outcomes with fewer surgery-related complications[1,4-6,9]. A single-center, prospective, randomized controlled study showed significantly better Japanese Orthopaedic Association scores and recovery rates at 1 year for ACAF compared with laminoplasty for the treatment of multilevel OPLL in cases in which the occupying ratio of the canal was >60% occluded or the K-line (i.e., a virtual line between the midpoints of the anteroposterior canal diameter at C2 and C7) was negative[9]. In addition, patients who underwent ACAF had better preservation of cervical lordosis and sagittal balance[9].

Important Tips:

- The cervical segments to be treated should include all of the segments with OPLL that are causing spinal cord compression.
- The uncinate process can be utilized as a safe anatomical landmark for the longitudinal osteotomies in order to avoid vertebral artery injury, even in cases with severely ossified masses.
- Careful evaluation of the vertebral artery on preoperative magnetic resonance imaging or computed tomography is of great importance.
- Appropriately increasing the curvature of the cervical plate can further enlarge the space for the following antedisplacement of the vertebral body-OPLL complex.
- The location of the uncinate processes must be confirmed before the creation of the 2 longitudinal osseous troughs[7,8].
- The preserved superior and inferior vertebral end plates should be made as smooth and mutually parallel as possible.
- The thickness of the anterior part of the vertebral bodies to be resected should be calculated preoperatively.
- The posterior longitudinal ligament behind the involved segments should not be resected.

Acronyms and Abbreviations:

- ACAF = anterior cervical controllable antedisplacement and fusion
- ACCF = anterior cervical corpectomy and fusion
- OPLL = ossification of the posterior longitudinal ligament
- CT = computed tomography
- JOA = Japanese Orthopaedic Association

- MRI = magnetic resonance imaging
- OR = occupying rate of the spinal canal
- VOC = vertebral bodies-OPLL complex
- RR = recovery rate
- CSF = cerebrospinal fluid
- UP = uncinate process
- TF = transverse foramen

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