Surgical treatment for irreducible pediatric subaxial cervical unilateral facet dislocation: case report

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Unilateral facet dislocation at the subaxial cervical spine (C3–7) in children younger than 8 years of age is rare. The authors describe a surgical approach for irreducible subaxial cervical unilateral facet dislocation (SCUFD) at C3–4 in a 5-year-old boy and present a literature review. A dorsal unilateral approach was applied, and a biodegradable plate was used for postreduction fixation without fusion after failed conservative treatment. There was complete resolution of symptoms and restored cervical stability. Two years after surgery, the patient had recovered range of motion in C3–4. In selected cases of cervical spine injury in young children, a biodegradable plate can maintain reduction until healing occurs, obviate the need to remove an implant, and recover the motion of the injured segment.

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SUBAXIAL cervical unilateral facet dislocation (SCUFD) occurs in only 2 of every 167 cervical spine injuries (CSIs) in children younger than 8 years.13 The most common causes of pediatric subaxial CSI are motor vehicle accidents (50%) and sports-related activities (25%).6 Optimal management and treatment strategies for pediatric SCUFD remain unclear. In previous reports of pediatric SCUFD, conservative therapy and surgery were successful.5,6,10,14,18,21 Most patients recovered well after management, and neurological symptoms disappeared. Only 1 patient experienced postoperative recurrence of dislocation and intervertebral instability.14 However, anterior or posterior reduction and fixation with fusion resulted in complete loss of range of motion (ROM) in the involved segments.5,6,14,21 Here, we report a surgical approach for pediatric SCUFD that preserves ROM in the dislocated segment. We treated SCUFD at C3–4 in a 5-year-old boy. At the 2-year follow-up visit there was no recurrence of dislocation or intervertebral instability, and the patient had fully recovered his preinjury quality of life.

Case Report

History and Imaging

A 5-year-old boy was hospitalized for head and neck pain and restricted cervical activity. Two days earlier he had sustained severe head and neck injuries while playing under a motor vehicle that suddenly started. Admission CT scans confirmed a left parietal-occipital bone depressed fracture and C3–4 unilateral facet fracture-dislocation. The patient’s head was turned slightly right in a forced position. He had normal strength and reflexes in the upper and lower extremities. Cervical radiography (Fig. 1A), 3D CT scans (Fig. 1B), and 3-T MRI sequences (Fig. 1C) showed a right-sided facet fracture-dislocation at C3–4, and no obvious disc damage.

Conservative Treatment

Because the skull fracture was accompanied by cervical dislocation, it was not treated with skull-tong traction. Instead, mandibular-occipital–bandage traction was applied, with the neck bending at 20°, and a trailing load of 2 kg. After 1 week, radiographic reexamination showed that the reduction had failed. The patient underwent manual reduction under general anesthesia with somatosensory evoked potential (SSEP) and motor evoked potential (MEP) monitoring. However, there was a warning change in SSEP and MEP signals each time the reduction was nearly complete. Due to anticipated adverse outcomes, attempts at manual reduction were abandoned.
Surgical Technique

A median posterior cervical incision was made, the C3–4 paraspinal muscle was subperiosteally stripped at the dislocation side, the lamina and lateral mass of C3–4 were exposed, and a periosteal detacher was used to poke the facet joint to reduction. This approach was a failure. A distraction pin was inserted at C-3 to distract the lateral mass while poking the C-4 lateral mass until it was restored. There was incomplete reduction of the facet joint and facet subluxation. A towel clamp was used to clamp the superior border of the C-3 lamina and the inferior border of the C-4 lamina to maintain the reduction. A 2.5-mm biodegradable plate (Inion CPS) was chosen for immobilization (Fig. 1D). The plate was tailored and molded into the required shape after immersion in a water bath, and approximated to the lateral mass. A 1.5-mm high-speed round bur drill was used to create an entry point 1 mm medial to the midline of the lateral mass. A depth-limited hand drill was applied to drill holes 15° cranially and 30° laterally. A bone tunnel was created. The length of the bone tunnel was continuously monitored to ensure that it did not penetrate the contralateral cortical bone. The bone tunnel was measured and an appropriate screw was selected. The bone holes were taped and the plate was fixed without a bone graft. The clamp was removed, and there was no subluxation; the plate immediately immobilized the reduction. The wound was closed in layers, and a Hemovac drain was inserted. There were no obvious warn-
ing changes in SSEP or MEP during the operation. The patient was transferred to neurosurgery for repair of the skull fracture and was immobilized with cervicothoracic orthosis for 3 months.

Postoperative Course

Reexamination at 1 week postoperatively with radiography (Fig. 1E) and CT scans (Fig. 1F and G) revealed a normally aligned cervical vertebra. The visual analog scale for neck pain improved from a score of 8 before the operation to a score of 2 at 1 week after the operation, and a score of 0 at 2 weeks after the operation. The Neck Disability Index improved from a score of 40 before the operation to a score of 12 at 1 week after the operation, and a score of 4 at 2 weeks after the operation. Two years after the operation, radiography (Fig. 2A–C) demonstrated normal cervical alignment. The ROM in C3–4 was measured by the posterior tangent method, and the value was normal at 14° (Fig. 2D and E). A follow-up 3D CT scan demonstrated recovery of the fractured facet at C-3, with no bony fusion at the C3–4 dislocated facet joint (Fig. 2F). A 1.5-T MRI sequence showed a normal signal in the C3–4 disc. At the 2-year follow-up visit, the patient had no neck discomfort or other complications, was able to freely participate in sports, and had fully recovered his preinjury quality of life.

Discussion

Studies on pediatric SCUFD are rare (Table 1). Although several reports focus on fusion with instrumentation, evidence suggests that cervical fusion causes complete loss of ROM in the involved segment and may lead to spontaneous fusion of adjacent joints or increase the rate of herniation on the superior disc. As a consequence, fusion should only be applied when there is no alternative. Interestingly, among the previously reported cases, only 2 (involving a 22-month-old and a 9-year-old child) used cervical MRI, and both patients had no obvious disc injury. This was similar to the current case; therefore, we performed unilateral fixation after reduction without fusion.

One study reported that the use of degradable suture fixation of C2–3 bilateral facet joint dislocation without fusion in a child restored ROM in C2–3 after 40 months. In the current case, we used a degradable plate (Inion CPS)
to immobilize the reduction. The plate kept its initial tensile strength for at least 6 weeks, and the screw maintained shear strength for 12–16 weeks. Other biodegradable plates with similar attributes may also be suitable for use in pediatric SCUFD. It was also reported that the average radiological union of CSIs in a series of 188 patients (age range 15–40 years) was 11.5 weeks following immobilization with a Halo vest and satisfactory restoration of bone and ligament stability. In a 5-year-old patient, the healing process of injured tissues should be faster. We took a cervical radiograph 3 months post-surgery and found no dislocation. We believed that the injured tissue was healing. We removed the orthosis, and the patient began a rehabilitation program. The implant degraded 26 weeks after surgery, fragmented at 52 weeks, and was completely absorbed at 104 weeks. A flexion-extension cervical radiograph obtained 2 years postoperatively revealed that ROM was restored in the involved segment.

To avoid delayed cervical pain and intervertebral instability, the cervical facet should not be left in the dislocated position during healing. In the current case, we immobilized the reduction through internal fixation, but there was no specialized pediatric cervical internal fixation available for the patient. Because an adult-sized metallic implant for a child may create the need for an enlarged surgical incision and then for a second surgery to remove the plate, we used a biodegradable fixation after reduction. The biodegradable fixation is available in a variety of lengths and can be tailored and molded for use in pediatric patients. Biodegradable anterior cervical plates have no stress-shielding effect, do not interfere with imaging examinations, and do not need to be removed. In recent years, biodegradable plates have been increasingly applied in cervical surgery in adults. Evidence suggests that both biodegradable and metallic anterior cervical plates allow bone healing and have a similar intervertebral fusion rate. However, compared with metallic anterior cervical plates, the biodegradable ones have a higher failure rate after anterior fusion. In pediatric and adult mandibular fractures, the Inion CPS provides significant stability and favorable bone healing and bears the load adequately; the plate is equivalent to a 2-mm titanium plate. However, data describing the use of this plate in pediatric cervical surgery are limited. In the current case, outcomes in the follow-up postoperative period confirmed that our approach was satisfactory; the biodegradable plate reliably sustained the reduction until healing and allowed ROM to be fully restored in the involved segment.

### Conclusions

The management of pediatric SCUFD should be individualized. In case of minimal cervical disc injury, the nonfusion technique may be a good choice. The technique involves stripping of the adjacent tissues at the dislocated side, restoration of the facet joints, and fixation with a biodegradable plate without fusion of the facet joint. In our case, this method restored the full ROM in the dislocated segment. The patient showed no obvious cervical discomfort or intervertebral instability at the 2-year follow-up visit. However, longer follow-up and more cases are required to verify this approach for the management of pediatric SCUFD.

### References

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Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions
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