Original Article

# Neglected dislocation in sub-axial cervical spine: Case series and a suggested treatment protocol


## ABSTRACT

**Context:** Approaches suggested for treatment of neglected dislocations in the subaxial cervical spine (SACS) include only anterior approach (a), only posterior approach (b), posterior-anterior approach, posterior-anterior-posterior approach, and anterior-posterior-anterior-posterior approach. No protocol is suggested in literature to guide surgeons treating neglected dislocations.

**Aim:** To describe a protocol for the treatment of neglected dislocation in the SACS.

**Settings and Designs:** Retrospective case series and review of literature.

**Materials and Methods:** Six consecutive patients of neglected dislocation (presenting to us more than 3 weeks following trauma) of the SACS were operated as per the protocol suggested in this paper. A retrospective review of the occupational therapy reports, patient records, and radiographs was performed. Only cases with time lapse of more than 3 weeks between the time of injury and initial management have been included in the review.

**Results:** Closed reduction (CR) was achieved in three patients following cervical traction and these were managed by anterior cervical discectomy and fusion (ACDF). Open reduction via posterior approach and soft tissue release was required to achieve reduction in two patients. Following reduction posterior instrumented fusion was done in them. One patient with preoperative neurological deficit needed a facetectomy to achieve reduction. Following short-segment fixation, ACDF was also performed in this patient. None of the patients deteriorated neurologically following surgery. Fusion was achieved in all patients.

**Conclusions:** Preoperative and intraoperative traction have a role in the management of neglected dislocations in the cervical spine. If CR is achieved the patient may be managed by ACDF. If CR is not achieved, posterior soft tissue release may be done to achieve reduction and partial facetectomy must be reserved for cases in which reduction is not achieved after soft tissue release. A treatment protocol for management of neglected dislocation in the SACS has been suggested in this paper.


**Key words:** Cervical spine; dislocation; neglected dislocation; sub-axial cervical spine; treatment protocol.

## Introduction

Neglected spinal injuries are frequently encountered in the developing world. Overlooked diagnoses, poor accessibility to healthcare and socioeconomic factors are the major reasons for such occurrences.[1] Often these injuries cannot be treated with conventional surgical techniques and require innovative ideas. Various approaches have been suggested for the treatment of neglected dislocations in the subaxial cervical spine (SACS) including only anterior approach,[2] only posterior approach,[3] posterior-anterior approach,[4-7] posterior-anterior-posterior[8,9] approach, and anterior-posterior-anterior-posterior[8] approach. No protocol


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| **DOI:** 10.4103/0974-8237.188414 | |




**How to cite this article:** Srivastava SK, Aggarwal RA, Bhosale SK, Nemade PS. Neglected dislocation in sub-axial cervical spine: Case series and a suggested treatment protocol. J Craniovert Jun Spine 2016;7:140-5.

suggested in literature to guide spine surgeons while treating neglected dislocations of SACS.

As neglected spinal injuries are infrequently discussed in literature, we would like to present six cases of neglected dislocation in the SACS. We present the treatment protocol, surgical technique, and the outcome of these patients. We also present a brief review of the cases of surgical management of neglected dislocation of SACS reported in English literature.

## Materials and Methods

Between January 2008 and December 2013, six consecutive patients of neglected dislocation (presenting to us more than 3 weeks following trauma) of the SACS were operated. The cause of neglected dislocation was inadequate evaluation due to polytrauma in two patients, inadequate sets of radiographs in two patients, and late presentation due to the absence of neurological deficit in two patients. A retrospective review of the occupational therapy reports, patient records, and radiographs was performed. Only patients with a minimum follow-up of 12 months were included in the study.

Our indications for surgery were presence of neurologic deficit ($n = 3$) and severe neck pain with decreased movements ($n = 3$). The protocol we followed for treatment of these patients has been shown in Figures 1 and 2. On admission, skeletal traction (after application of Gardener-Well's tongs) was given to all patients for 3 weeks starting with 3 kg and gradually increasing it to 8–10 kg (maximum 1/5$^{th}$ of body weight). Those that reduced satisfactorily underwent an anterior cervical discectomy and fusion (ACDF).

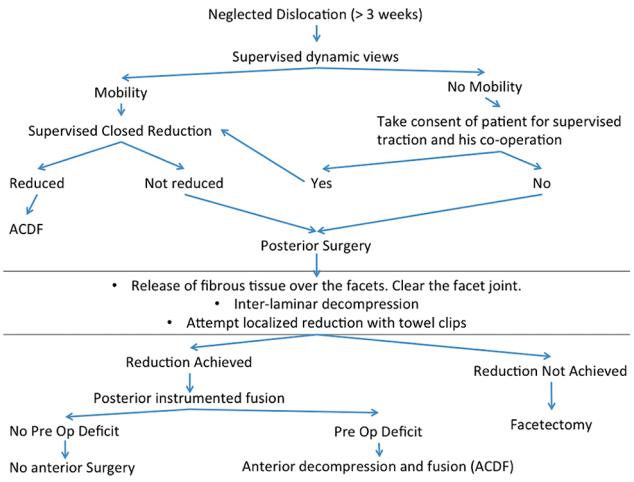


**Figure 1: Suggested protocol for management of neglected dislocation in the sub-axial cervical spine**

Those that did not reduce were taken under general anesthesia, and attempt at reduction was done using skeletal traction (maximum 1/5$^{th}$ body weight). Patients in whom reduction could be achieved underwent only ACDF with iliac crest autograft and anterior cervical plating. Patients in whom satisfactory reduction could not be achieved underwent posterior soft tissue release (release if adherent soft tissue around the dislocated facet) in the same setting. Partial facetectomy was done if the open reduction was not possible. Following reduction of dislocation, posterior instrumented fusion was done using interspinous wiring or lateral mass screws. Patients who had preoperative neurological deficit were turned supine, and ACDF was performed in the same setting.

### Data collected

Patient age, gender, level involved, type of dislocation, pre- and post-operative Benzel's modified JOA score, levels fused, surgical procedure/s, and postoperative complications.

### Radiological evaluation

Preoperative radiographs included an anterior-posterior (AP) view of cervical spine, lateral view, and dynamic flexion-extension view. Preoperative computed tomography scan and magnetic resonance imaging were done in all patients. An AP view and lateral radiograph of the cervical spine were done postoperative and dynamic radiographs were taken during follow-up at 3, 6, 12, and 24 months. Adequacy of reduction was judged on postoperative lateral radiographs.

### Brief surgical technique of posterior release and reduction

Posterior release and reduction is needed in patients in whom closed reduction (CR) fails. The patient is placed in the prone position on a cervical frame, and midline posterior incision is taken. Exposure is done until lateral border of the facet

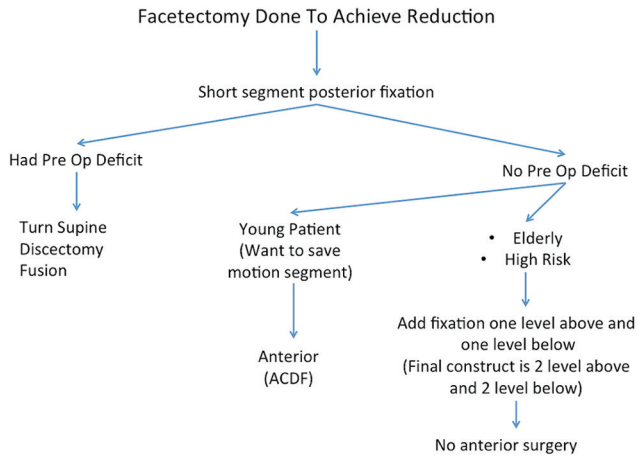


**Figure 2: Suggested protocol for management of neglected dislocation in the subaxial cervical spine when facetectomy is done to achieve reduction**

joints is visible. The dislocated facets are identified, and the facet capsule is cut. Fibrotic tissue seen around the dislocated facet joint is gently excised. Interlaminar decompression is performed with 1 or 2 mm Kerrison Rongeur. Towel clips are applied on the spinous processes of the vertebrae involved in dislocation. The direct reduction is attempted. If reduction is achieved, then a short-segment posterior fixation is done. Autogenous bone graft harvested from the posterior iliac crest is placed over facets involved in dislocation to achieve fusion. If reduction cannot be performed, partial excision of the superior articular process of the lower vertebra is performed. Patients who had preoperative neurological deficit were turned supine, and ACDF was performed.

### Postoperative management

Postoperatively, the patients' cervical spine was immobilized in a sternal occipital mandibular immobilizer brace. Antibiotics were continued for 5 days postoperative. Nasogastric tube was kept until oral diet was started. Ambulation was stared after drain removal. Brace was discontinued after the demonstration of fusion during follow-up.

### Review of literature

A brief review of previously reported cases of surgical management of neglected dislocation in the SACS in the English literature has been presented in Table 1. Only cases with time lapse of more than 3 weeks between the time of injury and initial management have been included in the review of literature.

## Results

The series included six patients (four males and two females) with a mean age of 51 years (range, 42–65 years). All patients had a minimum follow-up of 12 months (range, 14–60 months). The mean duration between trauma and presentation to us was 6 weeks (range, 4–12 weeks). All patients had minimum follow-up of 16 months. Average follow-up was 22.4 months (range, 16–48 months). Three patients had C4–C5 dislocation while three had C5–C6 dislocation. Two patients had bifacetal dislocation, and four patients had unifacetal dislocation. The preoperative characteristics, neurological status, and operative procedure have been briefly described in Table 2.

CR was successful in achieving reduction preoperatively in one patient and following general anesthesia in two more patients. These three patients underwent ACDF [Figure 3]. Dislocation in two patients reduced after posterior soft tissue release following which posterior instrumented

**Table 1: Review of reported cases of surgical management of neglected dislocation in sub-axial cervical spine**

| Author | Year | Number of patients | Type | Time | Presentation | Preoperative traction | Reduction | Approach | Outcome |
|---|---|---|---|---|---|---|---|---|---|
| Hassan[10] | 2002 | 12 | Uni - 2, Bi - 10 | Mean 3.5 months | Root injury - 2, Cord injury - 6, both - 4 | Yes (up to 12 kg) | 2 | ACDF - 2, PR + LM - 1, PR-traction - ACDF - 9 | Neurostatus improved in all |
| Bartels and Donk[8] | 2002 | 3 | Bi | 3 months | NP, Dec ROM | No | No | APAP - 2, PAP - 1 | Full recovery in all |
| Payer and Tessitore[9] | 2006 | 1 | Bi | 10 weeks | NP, Dec ROM | No | No | PAP | Full recovery |
| Liu *et al*.[11] | 2008 | 9 | Uni - 4, Bi - 5 | 2.8 months | Root injury - 4, Cord injury - 2, Both - 2 | 2 patients | No | PA (postinterspinous wiring f/b ACDF) | All improved neurologically, 8 fused, 1 partial loss but no revision |
| Jeon *et al*.[2] | 2011 | 5 | DF injury stage 1/2 | 37 days | NP, Dec ROM | Yes | Yes | ACDF | All fused |
| Rajasekaran *et al*.[3] | 2011 | 1 | Bi | 2 months | NP, Dec ROM, Biceps weakness | Yes | No | Posterior (release and instrumented fusion) | Fused, neuro recovery |
| Goni *et al*.[4] | 2013 | 6 | NM | 8.5 weeks | NP, Dec ROM | Yes | No | PA | One developed deficit, all fused |
| Shimada *et al*.[5] | 2013 | 1 | Bi | 8 weeks | NP, Dec ROM | No | No | PA (PR + LM f/b ACDF) | Fused |
| Jiang *et al*.[12] | 2013 | 14 | Uni - 4 Bi - 10 | 144 days | Cord injury - 10 | 9 patients | 3 patients | ACDF - 3 patients APA - 11 | All fused Neuro-improvement in 13 patients |
| Srivastava *et al*.[6] | 2014 | 1 | Bi | 14 months | NP, Dec ROM | No | No | PA (posterior instrumented fusion f/b ACDF) | Fused |
| Jain *et al*.[7] | 2010 | 4 | Bi | 4 months | Cord injury - 3 | 1 patient | No | PA (PR + facetectomy f/b ACDF) | Neurostatus improved in all, all fused |
| Bunmaprasert and Tirangkura[13] | 2015 | 6 | Bi - 5 Uni - 1 | 52 days | Neurological deficit | Yes | 1 | ACDF - 1, PA - 4, only foraminotomy - 1 | 1 root injury, 1 RL palsy, rest good |

Uni - Unifacetal; Bi - Bifacetal; ACDF - Anterior cervical discectomy and fusion; PR - Posterior release; LM - Lateral mass; NP - Neck pain; Dec ROM - Decreased range of motion; APAP - Anterior-posterior-anterior-posterior; PAP - Posterior-anterior-posterior; PA - Posterior-anterior; DF - Distraction-flexion; APA - Anterior-posterior-anterior; f/b - Followed by

**Table 2: The preperative characteristics, neurological status, operative procedure and postoperative neurostatus of patients in our series**

| Age | Sex | Duration (weeks) | Presentation | Preoperative JOA score | Level | Type | Reduction after traction?? | Approach | Facetectomy | Surgery | Postoperative JOA score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | Male | 4 | Myelopathy | 12 | C5-C6 | Bi | Yes | Anterior | NA | C5-C6 ACDF | 18 |
| 65 | Male | 6 | Radiculopathy | NA | C4-L5 | Bi | Yes | Anterior | NA | C4-C5 ACDF | NA |
| 35 | Male | 4 | NP, Dec ROM | NA | C4-C5 | Uni | No | Posterior | Not done | C3-C6 LM | NA |
| 52 | Female | 6 | NP, Dec ROM | 18 | C4-C5 | Uni | No | Posterior | Not done | C4-C5 Wiring | 18 |
| 49 | Male | 12 | Myelopathy | 9 | C5-C6 | Uni | No | Post-anterior | Done | C5-C6 LM + C5-C6 ACDF | 16 |
| 42 | Female | 4 | NP, Dec ROM | 18 | C5-C6 | Uni | Yes | Anterior | NA | C5-C6 ACDF | 18 |

JOA - Japanese Orthopaedic Association; Bi - Bifacetal; Uni - Unifacetal; ACDF - Anterior cervical discectomy and fusion; NP - Neck pain; Dec ROM - Decreased range of motion; Uni - Unifacetal; LM - Lateral mass fixation

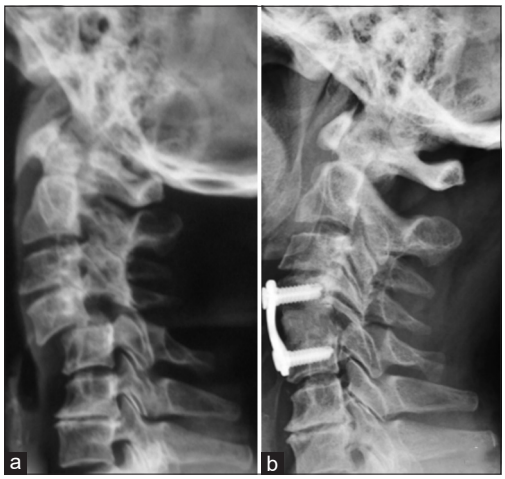


**Figure 3: Radiographs of the patient in whom closed reduction was achieved by traction. (a) Preoperative X-ray of patient with neglected dislocation, (b) postoperative X-ray**

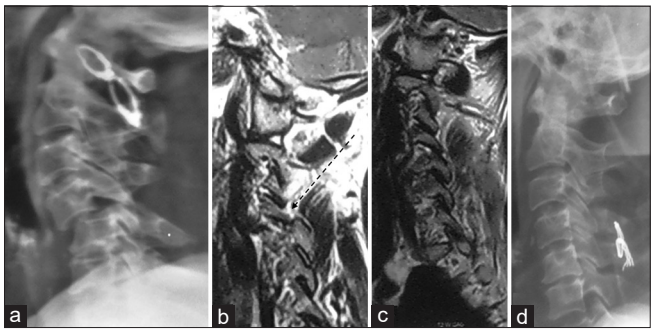


**Figure 4: Radiographs of patient number 4. (a) X-ray showing unifacetal dislocation at C4–C5, (b) para-sagittal magnetic resonance imaging showing the dislocated facet (arrow), (c) para-sagittal magnetic resonance imaging of the other side showing reduced facet, (d) postoperative X-ray showing reduction of dislocation and fixation with interspinous wiring**

fusion was done. Interspinous wiring was done in one patient [Figure 4], and lateral mass fixation was done in the other [Figure 5]. Partial facetectomy was needed to achieve reduction one patient. Short-segment lateral mass fixation was done followed by ACDF as the patient had preoperative neurological deficit [Figures 6 and 7].

None of the patients deteriorated neurologically following surgery. Of the two patients with myelopathy, one recovered fully while one had mild gait instability (mJOA = 17). One patient with radiculopathy had complete relief of symptoms. Fusion was achieved in all cases as confirmed by dynamic radiographs.

## Discussion

Cervical spine injuries getting missed are not uncommon. Bohlman reported that as much as one in three severe cervical spine injuries may not be recognized initially.[14] Misinterpretation of radiographs has been reported to be the most common cause of such missed diagnosis. Other causes are inappropriate or inadequate radiographs and inadequate physical/neurological examination due to associated injuries in polytrauma patients.[11] The absence of neurological deficit is also one of the reasons of patient presenting late. Sometimes, the patient may present as late as a year of dislocation. Radiographs in such patients may reveal bony fusion of the dislocated facets.[15] Such patients may be treated nonoperatively in the absence of neurological deficit.

Skeletal traction is successful in achieving CR in up to 94% of the patients with acute dislocations.[16-18] However, the role of preoperative traction in neglected dislocation has been controversial. Many surgeons have previously attempted CR by applying skeletal traction with varying success. Goni *et al*. attempted CR by skeletal traction in six patients but reduction could not be achieved in any of those. Based on this experience, they suggested that there was no role of skeletal traction in the management of neglected dislocation.[4]

However, we believe that skeletal traction does have a role in the management of such patients. Usually, patients with neglected dislocation have a localized kyphosis at the involved level. This leads to contracture of the anterior soft tissues such as longus colli, longus capitis, and anterior longitudinal ligament. Traction helps to gradually stretch these contracted soft tissues thus obviating the need for

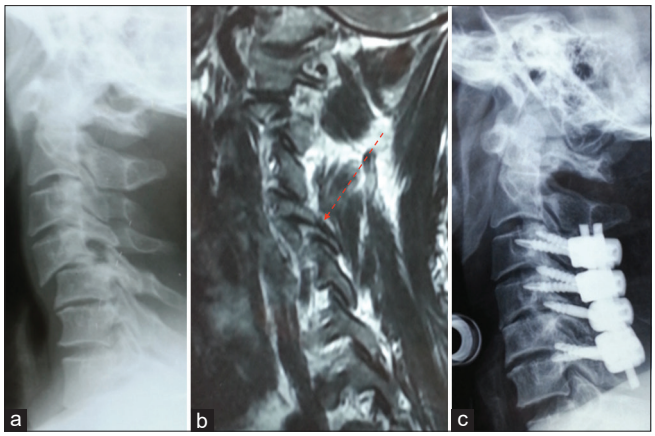

Figure 5: Radiographs of patient number 3. (a) X-ray showing unifacetal dislocation at C4–C5, (b) para-sagittal magnetic resonance imaging showing the dislocated facet (arrow), (c) postoperative X-ray showing reduction of dislocation and fixation with lateral mass screws

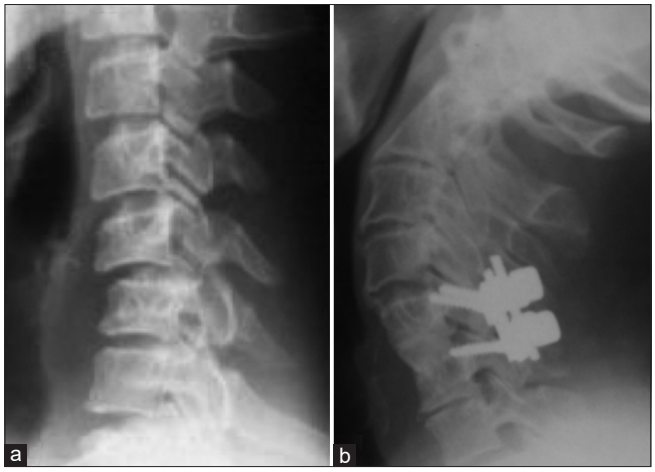

Figure 6: Radiographs of patient number 3. (a) X-ray showing unifacetal dislocation at C5–C6, (b) postoperative X-ray showing reduction of dislocation and fixation with lateral mass screws posteriorly and anterior cervical discectomy and fusion done anterurolt

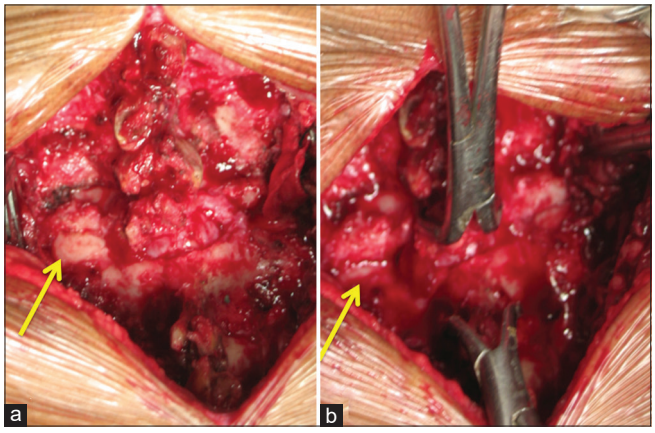

Figure 7: Intra-operative photographs of patient number 3. (a) Intra-operative photograph showing the dislocated facet on the right side, (b) intra-operative picture after doing facetectomy and achieving reduction of the dislocated facet

anterior release (cutting of contracted soft tissue and discectomy), which has been done by a few surgeons before posterior release. Moreover, skeletal traction itself can achieve CR as shown in 3 out of six patients in our series. These patients can be managed by ACDF alone obliterating the need for posterior release as well. One must keep in mind that informed consent must be taken from the patient before attempting CR by skeletal traction. The maximum weight that may be applied to achieve CR is not clearly defined in literature. Cotler *et al*. have used up to 140 pounds to achieve CR. We recommend that a weight of up to 1/5$^{th}$ of the patients' weight may be safely used.

Many surgeons have suggested that facetectomy is essential to achieve reduction while doing posterior release.[6,7,11] We believe that facetectomy should be the last resort and must be done if the reduction is not achieved after thorough soft tissue release. Facet joints are the most important stabilizing structures in the cervical spine; hence, preserving the facets provides inherent stability to the cervical spine following reduction.

Following excision of the facet joint capsule, all fibrotic tissue within the dislocated facets must be excised, and direct reduction with the help of two towel clips holding the spinous processes must be attempted. One must keep in mind that interlaminar decompression must be done before attempting reduction to prevent injury to the neural structures. If reduction is achieved, the cervical frame is slightly extended to lock the facets in extension. Using these steps, we could achieve stable reduction in two out of three patients requiring posterior release [Figures 4 and 5]. Only one patient needed a partial facetectomy of the superior articular process of the lower vertebra to achieve reduction [Figures 6 and 7].

Following posterior soft tissue release and achieving reduction, we recommend that ACDF is necessary only if the patient had preoperative neurological deficit or develops changes in somatosensory evoked potential/motor evoked potential following reduction. If facetectomy has been done to achieve reduction, ACDF should be considered in patients having preoperative neurological deficit or in young patients in whom it is desirable to save as many motion segments as possible. In elderly/high-risk patients, a long segment posterior instrumented fusion using lateral mass screws may be done to avoid the need for an additional anterior surgery.

## Conclusions

Preoperative and intraoperative traction have a role in the management of neglected dislocations in the cervical spine.

If CR is achieved, the patient may be managed by ACDF. If CR is not achieved, posterior soft tissue release may be done to achieve reduction, and partial facetectomy must be reserved for cases in which reduction is not achieved after soft tissue release. A treatment protocol for management of neglected dislocation in the SACS has been suggested in this paper.

### Financial support and sponsorship
Nil.

### Conflicts of interest
There are no conflicts of interest.

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