Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 11, pp.22748-22752, November, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

CASE ARTICLE

SURGICAL MANAGEMENT OF TRAUMATIC CERVICO THORACIC JUNCTION FRACTURE SUBLUXATION – A SINGLE CENTRE EXPERIENCE

***Venkidesh Krishnamoorthy and Geo Senil. K.**

Department of Neurosurgery, Government Medical College, Thrissur Kerala, India

ARTICLE INFO

Article History:
Received 24th August, 2015
Received in revised form
03rd September, 2015
Accepted 22ed October, 2015
Published online 30th November, 2015

Key words:

Cervicothoracic junction,
Spine, Trauma,
Instability,
Operative treatment.

ABSTRACT

Traumatic injuries at the cervicothoracic junction are relatively a rare event compared with injury to other areas of the cervical spine. The transition from the mobile cervical to the rigid thoracic spine makes the cervicothoracic junction unstable. Due to relative rarity of these injuries, the ideal surgical management has not been clearly defined. There is debate over whether the vast majority of these injuries can be treated with a posterior only approach or if anterior or combined approaches have clearly defined roles for these injuries. This paper reviews our experience in surgical cases of cervicothoracic junction instabilities, clinical findings, instrumentation applied and outcome.

Citation: Venkidesh Krishnamoorthy and Geo Senil, K., 2015. "Surgical management of traumatic cervico thoracic junction fracture subluxation – A single centre experience" *International Journal of Current Research*, 7, (11), 22748-22752.

INTRODUCTION

This is a retrospective study, reviewing three patients with traumatic fracture-subluxation involving cervicothoracic junction, admitted in our institute between January 2011 and December 2013. All three patients were males. Case 1 presented following road traffic accident, Case 2 presented with history of fall from height, and Case 3 presented following fall with load over head. Neurological impairments were categorized based on ASIA (American Spinal Injury Association) impairment scale (Frankel *et al*.,). Case 1 and 2 had neurological deficits fulfilling ASIA impairment scale of grade B and Case 3 was categorized as ASIA impairment scale of D. All three patients underwent standard lateral spine radiograph, CT reconstruction and MR imaging. None of the standard lateral radiographs provided satisfactory visualization of the C7 body and C7-T1 junction. CT imaging revealed fracture dislocation of C7-T1 with bilateral facet locking in Case 1 and Case 2 and unilateral facet locking in Case 3. MR imaging revealed herniated disc at C7-T1 with underlying severe cord compression, complete disruption of the discoligamentous complex, C7-T1 translation with bilateral facet locking in first two cases.

****Corresponding author: Venkidesh Krishnamoorthy,***
Department of Neurosurgery, Government Medical College, Thrissur Kerala, India.

The third case revealed unilateral facet dislocation, with intermediate disruption of discoligamentous complex. Using the SLIC (Sub Axial Cervical Spine Injury Classification) (Fig:- 1) system all three patients had scores more than 5 which warrant surgery (Vaccaro *et al*., 2007). All three patients underwent circumferential fusion undergoing a ventral-dorsal-ventral approach. For ventral decompression, we used a low cervical approach in all three patients. The patient was positioned supine with slight traction on the head using Gardner well tongs, while resting head on a horseshoe head rest.

Traumatic disc materials at C7/T1 were removed under magnification, wound approximated and patient positioned to prone position. C7/D1 level exposed using standard midline cervical approach. Because of poor fluoroscopic visualization at upper thoracic levels D1/D2 laminectomy was done for pedicle screw placement at these levels. The rods were contoured and placed. In Case 2 and Case 3 facet locking was reduced through manual distraction, and in Case 1 reduction was achieved by partially drilling of the superior facet of D1 bilaterally. Two patients underwent C6 lateral mass screw insertion and D1/D2 Pedicle screw insertion and one patient underwent C5/C6 lateral mass and D1/D2 pedicle screw insertion using polyaxial screws of 3.5MM diameter and 16MM length.

Patient then repositioned to supine position, and through the same ventral approach used initially, C7/D1 disc space exposed, tricorticate iliac bone graft placed and reinforced with cervical plates and screws.

Outcome

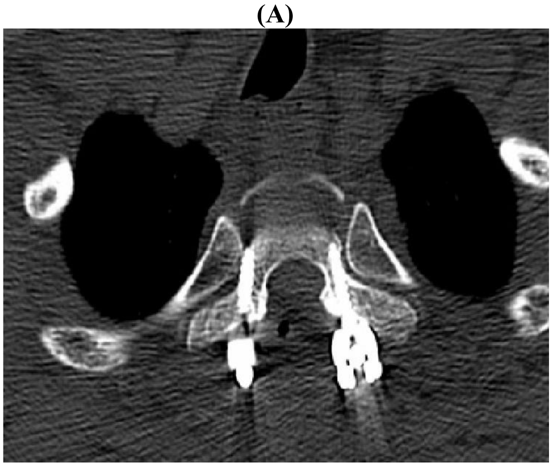
Follow-up after 12 months revealed, in Case 1 the ASIA impairment scale of grade B to grade D, in Case 2, the neurological status improved from ASIA impairment scale of grade B to grade C and in Case 3 the neurological status remaining same in Grade D.

Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

SLIC: Subaxial Injury Classification

Figure 1. SLIC (Sub Axial Cervical Spine Injury Classification).

(A)



(B)

Figure 3. (a) Post operative X-Ray showing anterior and posterior fixations. (b) Axial CT showing Pedicle screws at D1

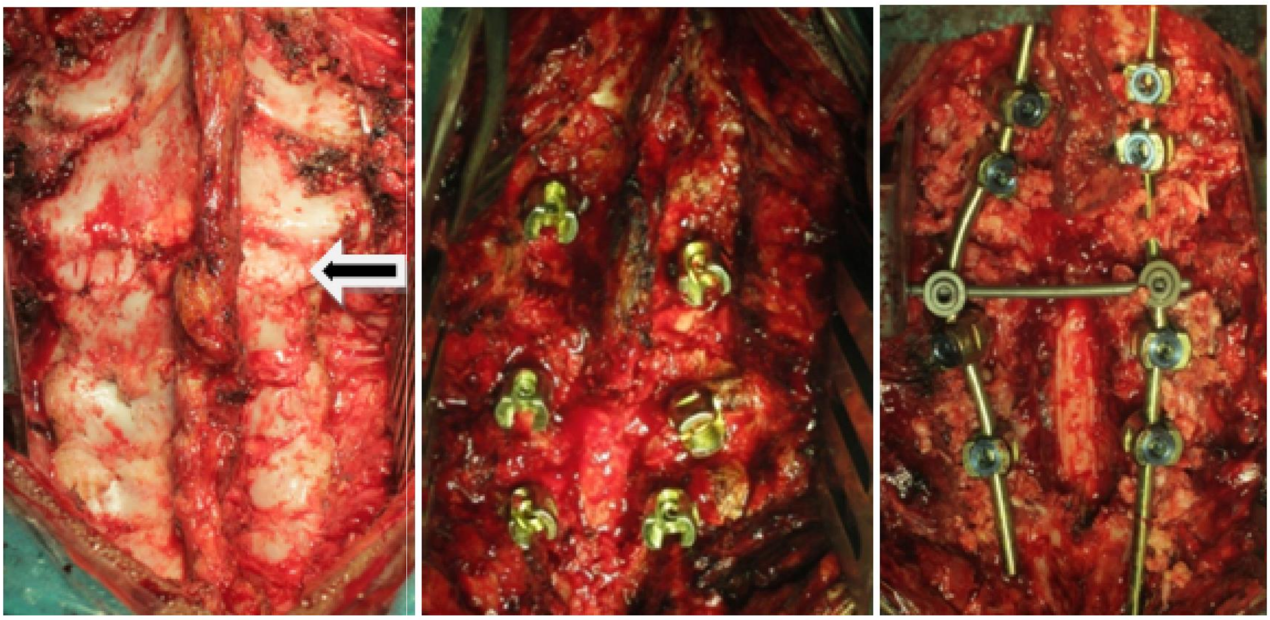


Figure 2. (a). Arrow showing Bilateral facet locking C7/ D1, (b) C6 Lateral mass, D1, D2 Pedicle screw in situ(c) Rod placement after contouring and interconnector in situ.

DISCUSSION

Traumatic injuries at the cervicothoracic junction are a relatively rare event and the incidence has been reported between 2% and 9% of all cervical fractures and dislocations.[1-4] Missed or delayed diagnosis is common on standard lateral cervical spine radiographs. (Vanden Hoek and Propp, 1990) Arm traction and swimming position may be beneficial in visualizing the cervicothoracic junction. However patients with an increased body mass index are unlikely to benefit from these methods. (Aydin Toksoy *et al.,* 2010) CT or MR imaging should be an alternate method in these patients as an initial choice. Injuries can range from vertebral body fractures, unilateral and bilateral facet dislocations, fracture dislocations, and isolated fractures of the posterior elements. (Amin and Saifuddin, 2005; Evans, 1983; Gisbert *et al.,* 1989; Nichols *et al.,* 1987; Chapman *et al.,* 1996) Despite technological advances in spine surgery, classification of sub-axial cervical spine injuries remains largely descriptive. Majority of recent reports use Subaxial Injury Classification (SLIC) and Severity Scale injury proposed by Vaccaro *et al.* (Vaccaro *et al*., 2007) (Table 1). This system assigns a numerical value to each of components, the sum of which is added to produce a total score. For scores higher than or equal to 5, recommendations are for surgical treatment options; scores less than or equal to 3 are treated nonoperatively.

A score of 4 is considered unclear and might be treated operatively or nonoperatively depending on the clinical circumstances involved. The aim of surgical management of cervicothoracic junction fracture includes decompression of the neural elements, reduction of fracture dislocation and achieving rigid fixation to permit rapid mobilization. The reconstruction of cervicothoracic junction is complicated by the need to bridge the normally lordotic, mobile cervical spine to the kyphotic, fixed thoracic spine. Early reduction of the locked facets is recommended, even in those patients without neurological deficit (An *et al.,* 1994; Wiseman *et al.,* 2003). Although the ideal timing of reduction is unknown, many investigators favor reduction as rapidly as possible after injury in order to maximize the potential for neurological recovery (Ordonez *et al*., 2000). Closed skull traction with weights upto 50 pounds often fails to reduce dislocations not associated with fractures and the chance of reducing cervicothoracic dislocation with closed reduction technique is often met with minimal success even under general anaesthesia, hence often requiring open reduction with its attendant risks (Evans, 1983). Posterior open reduction for irreducible dislocations is considered to be an effective method of reduction by allowing direct disengagement of the inferior facet from the superior facet, at least if there is no major disc herniation (Wiseman *et al*., 2003; Fazl *et al.,* 2001).

Although several articles have reported successful outcomes for anterior only decompression and instrumentation for pathological fractures of the cervicothoracic junction, the reported use for traumatic fractures and dislocations is extremely limited (Kaya *et al.,* 2006). Several biomechanical and clinical studies have raised concern regarding the adequacy of anterior plating for stabilizing posterior element injuries of the cervical spine (Do Koh *et al*., 2001; Johnson *et al*., 2004; McAfee *et al*., 1995; McLain *et al*., 1994). Indeed, *in vitro* anterior plating has been found to be inferior to posterior fixation, particularly in resisting flexion-distraction moments (Bueff *et al*., 1995). Boockvar *et al* reported that anterior reconstruction alone may not meet the biomechanical needs of this spinal region and that supplementary fixation may be considered to augment stabilization for fusion success (Boockvar *et al*., 2001). The presence of significant disc herniation is a relative indication for initial anterior decompression before closed or open reduction from posterior (Amin and Saifuddin, 2005; Kwon *et al*., 2006; Ordonez *et al*., 2000). Anterior approach often needs preoperative mid-Sagittal cervicothoracic MRI to evaluate whether the manubrium is an obstacle or not (Kim and Jeong, 2007). Fraser *et al*. demonstrated reliable, reproducible, and practical criteria that effectively evaluate the cervicothoracic region on MRI (Fraser *et al*., 2002). They recommend preoperative mid-Sagittal cervical MRI as decision making tool of anterior approach to the cervicothoracic junction and upper thoracic spine

Posterior only decompression and instrumentation using screw rod system has the advantage of immediate rigid internal fixation, flexibility in deformity correction and high rates of fusion. Although there are several reports describing use of screw rod instrumentation systems for management of instability caused by tumors of the cervicothoracic junction, the number of reports detailing use in cervicothoracic trauma is limited (Albert *et al*., 1998; Mazel *et al*., 2004). For unstable conditions of the cervicothoracic junction, the number of posterior segmental fixation points required to provide a stable construct and the thickness of the rods that cross the cervicothoracic junction are debatable (Nichols *et al*., 1987; Le *et al*., 2003). Posterior instrumentation from C-5 to T-2 is superior to anterior instrumentation after a 2-column injury at C7–T1, but insufficient for 3 column injury at cervicothoracic junction (Bueff *et al*., 1995; Kreshak *et al*., 2002). Among the different posterior implant configurations for posterior fixation across the cervicothoracic junction dual-diameter rod and fixed domino connector constructs stronger than 3.5mm rod and screw construct (Tatsumi *et al*., 2007). In assembling a cervicothoracic construct, one must take into account the offset between the laterally directed lateral mass screws and the medially directed pedicle screws (Kim and Jeong, 2007). The three dimensional bending of dual diameter rod is also a complex procedure and technically demanding. In some cases where the anatomy is not favorable, it may be necessary to skip a level in order to accommodate for the offset between lateral mass screws, or due to the flute of the tapered rod (Brian *et al*., 2007). The advent of polyaxial screws, lateral offset connector and dual diameter transition rod system has allowed greater versatility in the instrumentation of the cervicothoracic junction (Le *et al*., 2003; Dahdaleh *et al*., 2009; Vaccaro *et al*., 2000).

Cervical pedicle screws demonstrated a significantly higher resistance to pull-out forces than did lateral mass screws (Jones *et al*., 1997). If C7 pedicle fixation is not possible, then performing two-level lateral mass fixation at C6 and C7 will achieve similar stiffness except in axial compression (Rhee *et al*., 2005). Albert *et al*. reported that pedicle screws in C7 placed with a laminoforaminotomy and palpation technique seemed to be safe and effective while offering excellent fixation (Albert *et al*., 1998; Ludwig *et al*., 1999).

Circumferential reconstruction improved stability in models with great instability (Peybis *et al*., 2007; Ames *et al*., 2005). Studies performed on human cadaveric specimens had demonstrated the need for a combined posterior anterior fixation of three-column injuries, whereas posterior fixation alone is sufficient for two-column injuries (Kreshak *et al*., 2002). Biomechanical studies has revealed that, combined anterior-posterior fixation provided stabilization exceeding that of an intact segment in case of destruction of both anterior and posterior elements (Pitzen *et al*., 2003). However, it must be emphasized that clinical studies do not provide data suggesting that combined anterior-posterior instrumentation is mandatory for adequate treatment of instable cervicothoracic injuries. Therefore, transfer of bio-mechanical in vitro data to the in vivo situation must be done cautiously (Bernhard Schmidt-Rohlfing *et al*., 2009). In cases of substantial ventral compression caused by bone or disk material, the option of ventral decompression (with or without instrumentation) followed by posterior instrumentation is supported by a limited number of reported cases.

Conclusion

We opted for Ventral-Dorsal-Ventral approach in all three cases, as the MR imaging of Case 1 and Case 2 showed significant ventral compression because of traumatic disc herniation causing severe cord compression. In case 3 there is presence of traumatic disc herniation with continued cord compression in the setting of severe spinal cord injury. Decompression of neural elements was given first priority, as attempts for posterior reduction without ventral decompression can aggravate existing neurological deficits.

For ventral decompression Low cervical approach was employed in all three cases. In no case did the low anterior approach to the cervicothoracic junction limit visualization of the lesion, decompression of the neural elements, graft placement, or exposure of vertebral elements for adequate screw purchase. For posterior fixation three dimensional contouring of the rod is complex and technically demanding, but with the advent of polyaxial screws, dual diameter rods and lateral offset connector has allowed greater versatility. Eventhough it is not mandatory biomechanical studies have shown that combined anterior-posterior fixation provided stabilization exceeding that of an intact segment in case of destruction of both anterior and posterior elements. So we recommend circumferential fusion when both anterior and posterior elements are destroyed.

REFERENCES

Albert, T.J., Klein, G.R., Joffe, D., Vaccaro, A.R. 1998. Use of cervicothoracic junction pedicle screws for reconstruction of complex cervical spine pathology. *Spine*, 23:1596-1599

Ames, C.P. Bozukus, M.H., Chamberlain, R.H., *et al*. 2005. Biomechanics of stabilization after cervicothoracic compression-flexion injury. *Spine*, 30:1505-1512

Amin, A. and Saifuddin, A. 2005. Fractures and dislocations of the cervicothoracic junction, *J. Spinal Disord. Tech.,* 18:499-505

An, H.S., Vaccaro, A., Cotler, J.M., Lin, S. 1994. Spinal disorders at the cervicothoracic junction. Spine, 19: 2557-2564

Aydin Toksoy, Firat Bektas, Cenker Eken, Kaan Ceken, Yidiray Cete. 2010. Value of the swimming position and arm traction in visualizing the cervicothoracic junction over the standard lateral cervical x-ray *Int. J. Emerg. Med*, 3:85-90

Bernhard Schmidt-Rohlfing, Matthias Nossek, Matthias Knobe, Marco Das, 2001. "Combined approach for a locked unilateral facet fracture-dislocation of the cervicothoracic junction." *Acta Orthop Belg*, Vol. 74, no. 6, 2009

Boockvar, J.A., Philips, M.F., Telfeian, A.E., O'Rourke, D.M., Marcotte, P.J. 2001. Results and risk factors for anterior cervicothoracic junction surgery. *J Neurosurg* (Spine 1) 94: 12-17.

Brian, J.C. Freeman, Frank Kandziora, 2007. 7.2.5 Cervicothoracic Junction, AO Spine manual Principles and Techniques, 315-327

Bueff, H.U, Lotz, J.C., Colliou, O.K., Khapchik, V., Ashford, F., Hu, S.S., *et al.,* 1995. Instrumentation of the cervicothoracic junction after destabilization. Spine 15:1789–1792.

Chapman, J.R., Anderson, P.A., Pepin, C., Toomey, S., Newell, D.W. and Grady, M.S. 1996. Posterior instrumentation of the unstable cervicothoracic spine*. J. Neurosurg.,* 84:552-558

Dahdaleh, N.S., Nakamura, S., Torner, J.C., Lim, T.H. and Hitchon, P.W. 2009. Biomechanical rigidity of cadaveric cervical spine with posterior versus combined posterior and anterior instrumentation. Laboratory investigation *J Neurosurg Spine,* 10**:**133–138.

Do Koh, Y., Lim, T.H., Won You, J. *et al.* 2001. A biomechanical comparison of modern anterior and posterior plate fixation of the cervical spine, 26: 15-21

Evans, D.K. 1983. Dislocations at the cervicothoracic junction. *J. Bone Joint Surg., Br.,* 65:124-127

Fazl, M. and Pirouzmand, F. 2001. Intraoperative reduction of locked facets in the cervical spine by use of a modified interlaminar spreader: technical note. *Neurosurgery,* 48: 444-446.

Frankel, H.L., Hancock, D.O., Hyslop, G. *et al.,* The value of postural reduction in the initial management of closed injuries of spine with paraplegia and tetraplegia.

Fraser, J.F. and Diwan, A.D. Peterson, M., O'Brien, M.F., Mintz, D.N., Khan, S.N., *et al.* 2002. Preoperative magnetic resonance imaging screening for a surgical decision regarding the approach for anterior spine fusion at the cervicothoracic junction. Spine 27: 675-681.

Gisbert, V.L., Hollerman, J.J., Nevy, A.L., *et al*. 1989. Incidence and diagnosis of C7-T1 fractures and subluxations in multiple-trauma patients: evaluation of the advanced trauma life support guidelines. Surgery, 1989; 106:702-708, discussion 708-709

Johnson, M.G., Fisher, C.G., Boyd, M. *et al*. 2004. The radiographic failure of single segment anterior cervical plate fixation in traumatic cervical flexion distraction injuries Spine, 29: 2815-2820.

Jones, E.L., Heller, J.G., Silcox, D.H. and Hutton, W.C. 1997. Cervical pedicle screws versus lateral mass screws. Anatomic feasibility and biomechanical comparison Spine 22: 977-982, 1997

Kaya, R.A., Turkmenoglu, O.N., K.O.C O.N. *et al*. 2006. A perspective for the selection of surgical approaches in patients with upper thoracic and cervicothoracic junction instabilities *Surg. Neurol.,* 65:454-463, discussion 463

Kim, J.W., Jeong, J.H. 2007. Fractures and Dislocations of the Cervicothoracic Junction *J. Korean Neurosurg. Soc.,* Sep: 42(3):211-215

Kreshak, J.L., Kim, D.H., Lindsey, D.P., Kam, A.C., Panjabi, M.M., Yerby, S.A. 2002. Posterior stabilization at the cervicothoracic junction: a biomechanical study. *Spine* 27:2763–2770.

Kwon, B.K., Vaccaro, A.R., Grauer, J.N. *et al*. 2006. Subaxial cervical spine trauma. *J. Am. Acad. Orthop Surg.,* 14: 78-89

Le, H., Balabhandra, Park , J. *et al.* 2003. Surgical treatment of the tumors involving the cervicothoracic junction Neurosurgery Focus; 15(5): E3 Review.

Ludwig, S.C., Kramer, D.L., Vaccaro, A.R. and Albert, T.J. 1999. Transpedicle screw fixation of the cervical spine. *Clin Orthop Relat Res.,* 359: 77-88.

Mazel, C., Hoffmann, E., Antonietti, P., Grunewald, D., Henry, M. and Williams, J. 2004. Posterior Cervicothoracic instrumentation in spine tumors. Spine, 29:1246-1253

McAfee, P.C., Bohlman, H.H., Ducker, T.B. *et al.* 1995. One-stage anterior cervical decompression and posterior stabilization. A study of one hundred patients with a minimum of two years of follow-up *J. Bone Joint Surg.,* 77-A: 1791-1800.

McLain, R.F., Aretakis, A., Moseley, T.A. *et al*. 1994. Sub-axial cervical dissociation. Anatomic and biomechanical principles of stabilization *Spine*, 19: 653-659

Nichols, C.G., Young, D.H. and Schiller, W.R. 1987. Evaluation of Cervicothoracic junction injury *Ann. Emerg. Med,* 16:640-642

Ordonez, B.J., Benzel, E.C., Naderi, S. and Weller, S.J. 2000. Cervical facet dislocation: techniques for ventral reduction and stabilization. *J. Neurosurg.,* 92: 18-23

Peybis, B.G., Tortolani, P.J., Hu, N., Zorn, C.M., McAfee, P.C. and Cunningham, B.W. 2007. A comparative biomechanical analysis of spinal instability and instrumentation of the cervicothoracic junction: an in vitro human cadaveric model. *J. Spinal Disord. Tech.,* 20:233-238

Pitzen, T., Lane, C., Goertzen, D. *et al*. 2003. Anterior cervical plate fixation: biomechanical effectiveness as a function of posterior element injury. *J. Neurosurg.,* 99 (1 Suppl): 84-90.

Rhee, J.M., Kraiwattanapong, C. and Hutton, W.C. 2005. A comparison of pedicle and lateral mass screw construct stiffness's at the cervicothoracic junction : a biomechanical study. *Spine* 30: E636-640.

Tankson, C. and Chutkan, N.B. 2006. Posterior Cervical Instrumentation. Orthopedics 29:695-702, 2006.

Tatsumi, R.L., Yoo JU, Liu Q, Hart RA: Mechanical comparison of posterior instrumentation constructs for spinal fixation across the cervicothoracic junction. *Spine* 32:1072–1076, 2007

Vaccaro, A.R., Hulbert, R.J., Patel, A.A., *et al.* 2007. Spine Trauma Study Group. The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. *Spine,* 32: 2365-2374

Vaccaro, R., Conant, R.F., Hilibrand, A.S., Albert, T.J. 2000. A plate-rod device for treatment of cervicothoracic disorders: comparison of mechanical testing with established cervical spine in vitro load testing data. *J. Spinal Disord.,* 13**:**350–355,

Vanden Hoek, T. and Propp D. Cervicothoracic junction injury. *Am. J. Emerg. Med,* 1990; 8:30-33

Wiseman, D.B., Bellabarba, C., Mirza, S.K. and Chapman, J. 2003. Anterior versus posterior surgical treatment for traumatic cervical spine dislocation. *Cur. Opin. Orthop.,* 14: 174-181

****