EXTENSIVE SPINAL EPIDURAL HEMATOMA REMOVED BY A MULTILEVEL BILATERAL ALTERNATING HEMI-LAMINECTOMY

A.E.K. MOUMOUNI MD[1], P. COMPAORE MD[1], D. MEMIAZOLO MD[1], S. MOUCHARRAFI MD[1], A. HAMLAT, MD[1]

Department of Neurosurgery,CHU MARTINIQUE

ABSTRACT : *Objective and Importance* : Extensive spinal epidural hematoma (SEH) creates another treatment challenge because the aim of surgery is to remove the hematoma without devastating damage to the spine. We report herein, to the best of our knowledge, the first case of extensive SEH treated by a multilevel bilateral alternating hemi-laminectomy which may reduce the potential risk of associated spinal deformity often linked to multilevel laminectomy. *Clinical Presentation :* A 49 year-old woman was admitted to our Department for flaccid paraplegia. An emergent MRI showed an elongated spindle shaped lesion at the dorsal epidural space extending from T1 to T12, suggestive of SEH, with the most compressive bulk of the lesion extending from T3 to T9. *Technique :* The hematoma was successfully removed via a bilateral alternating hemilaminectomy, involving successively one lamina and the underneath opposite lamina, from T 4 to T 8. *Conclusion :* Extensive posterior SEH could be managed by bilateral alternating hemi-laminectomy, in place of devastating laminectomy which impairs the stability of the posterior vertebral column and predispose to spinal instability and deformity, notably in childhood.

Key words *: Spinal epidural hematoma ; Bilateral alternating hemi-laminectomy ; Surgical technique.*

INTRODUCTION

Spinal epidural hematoma (SEH) is a rare neurosurgical emergency. It has been reported in all age groups but most frequently after the fourth or fifth decade [1, 2]. The two prevalent sites of SEH are the cervico-thoracic and the thoraco-lumbar junctions; the first site is prevalent within all age groups while the thoraco-lumbar junction is the second prevalent site between the fifth and eighth decade [1, 2]. Usually SEH extends over two to five segments [2-6] but extensive forms affecting as many as eight segments to the entire spinal canal have been described both in childhood [7-10] and adults [11-22]. These extensive forms create another challenge, for spine surgeons, because the aims of surgery are to remove the hematoma and to improve or preserve neurological functions without excessive and devastating damage to the spine. Thus, neurosurgeons should consider the potential risk of associated spinal deformity and spinal motion disorders of an extensive emergent surgical decompressive multilevel laminectomy. We report herein, to the best of our knowledge, the first case of extensive SEH treated by a multilevel bilateral alternating hemi-laminectomy and discuss its interests.

CASE REPORT

A 49 year-old woman was awakened, from her sleep at 4:00 a.m, by an acute onset of severe thoracic spinal pain, irradiating to the chest and lumbar region, with simultaneous burn sensation in the abdomen and the chest. Within half an hour she noticed a numbness of her lower extremities, decreased motor sensation, and an inability to move her legs. Her medical history was significant for Hodgkin's disease 30 years ago. She was treated by a primary mantle field irradiation, two cycles of chemotherapy, and splenectomy. Following radiotherapy she developed a hypothyroidism, 10 years later, and she was treated for a coronary artery disease by a per-cutaneous trans-luminal coronary angioplasty in 2007 and permanent 200 mg/ day of Aspirin. In addition she did recall, 4 days before the onset, a fall from height on his buttocks but she had not experienced any pain.

First seen at local hospital, thoraco-abdominal CT scan was performed in consideration of a suspicious aortic dissection. The non enhanced CT scan showed a spontaneous hyper-dense epidural lesion at T5-T6 level with spinal cord compression.

She was then referred to our Department ; neurological examination revealed a complete flaccid paraplegia with a bilateral T5 pinprick sensory level; disturbance in micturiation and altered anal sphincter tone were noted. The paraplegia was graded Frankel A. Upper extremities and cranial nerves were normal. No external signs of trauma were noted during physical examination, which revealed thoracic para-spinal muscles atrophy with important sub-cutaneous exteriorization of thoracic spinous processes; this was identified as a coexisting pre-morbid condition for spine instability.

Laboratory examinations, including pro-thrombin time, partial thromboplastin time, platelet count, and liver function tests were unremarkable.

An emergent MRI showed an elongated spindle shaped lesion at the dorsal epidural space extending from T1 to T12 (Fig. 1). Axial MRI disclosed a clear separation between the posterior hematoma and the spinal cord, evocative of SEH (Fig. 2). There was no hematoma enhancement following gadolinium infusion.

Fig 1: (A): Sagittal T2 weighted MRI shows the cervical part of the hematoma visible from T1 while the most compressive part starts from T3. The hematoma discloses heterogeneous iso hypo signal intensity. (B): Sagittal T2 weighted MRI shows the thoracic part of the hematoma extending to T12; the most compressive part of the hematoma bulk is upper T9.

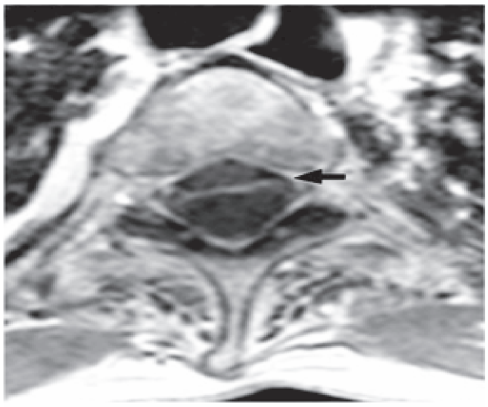

Fig 2: Axial T1 weighted MRI shows the posterior hematoma compressing anteriorly the spinal cord. A clear demarcation, representing the dura mater, is seen between the hematoma and the spinal cord

Surgery : She was operated on 6 hours after onset (AH). In view of the extensive length of the hematoma, midline skin incision, centered at the site of the most compressive hematoma as disclosed by MRI, was performed from T2 to T10. The fascia over the spinous process was incised bilaterally and the atrophic para-spinous muscles were stripped sub-periostally exposing the laminas of the vertebral arches, on both sides, from T3 to T9. A bilateral alternating hemi-laminectomy involving successively one lamina and the underneath opposite lamina was performed from T4 to T8; each hemi-space was opened wider by performing a sus and sub hemi-flavectomy with respect of the medial part of the ligamentum flavum and the spinous process–ligament complex (Fig 3).

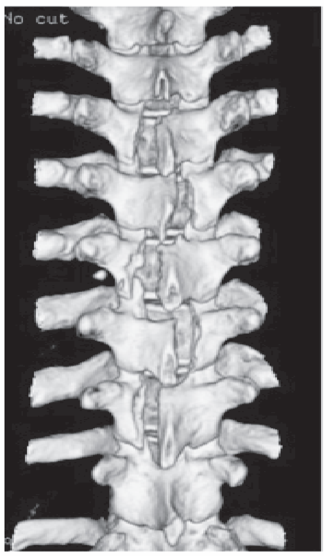

Fig 3: 3 D CT scan reconstruction shows the bilateral alternating hemi laminectomy extending from T4 to T8.

Blood clots beneath the preserved hemi laminas were removed by gentle aspiration with a compliant small sucker and a micro-curette. A free soft ventricular catheter was thereafter inserted, underneath the laminas, in the epidural space above and below the limits of the bilateral alternated hemi-laminectomy, to aspirate the remaining fluid filled hematoma. No active bleeding was found and brisk dural pulsations returned at the end of surgery. Partial resection of spinous process with respect of the supra and inter-spinous ligaments from T2 to T10 was finally performed to avoid post operative wound complications, owing to the para-spinous muscles atrophy. Before closure, 2 para spinal drains were placed on both sides, above the laminas and across the hemi-laminectomy, to prevent hematoma re-accumulation on the operative site. Surgery time-span from incision to closure was 2h30 while spinal cord decompression was achieved 1h 45mn after skin incision.

Histopathological study of the surgical samples was consistent with a hematoma. No vascular disease or tumor was disclosed.

Post operative MRI showed complete hematoma resolution (Fig 4, 5). No neurological improvement was noted after surgery and the patient was referred to rehabilitation center 1 week later. At 5 months and 1 year follow up the neurological examination remained unchanged (Frankel grade A) except for lower extremities spasticity. No spinal deformity was observed on clinical examination.

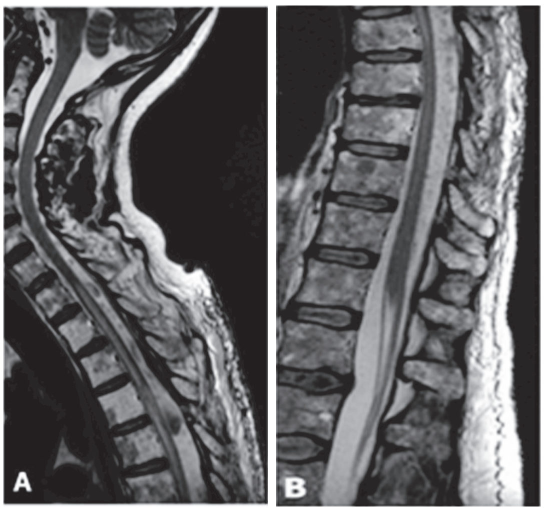

Fig 4: (A) Sagittal T2 weighted MRI shows the total removal of the hematoma at both cervical and (B) thoracic levels. There is a spinal cord hyper-signal extending from T1 to T8. The intense flow void demonstrates a complete spinal cord decompression with restoration of cerebro spinal fluid flow.

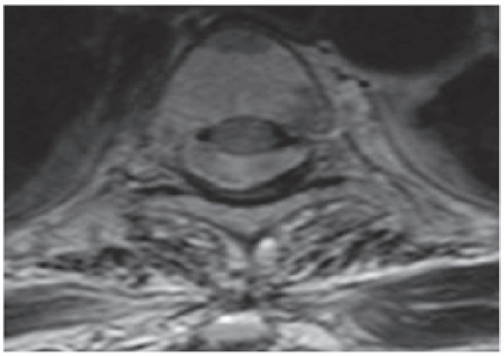

Fig 5: Axial T2weighted MRI shows the total spinal cord decompression and the restoration of the spinal sub-arachnoid space

DISCUSSION

In most cases, spontaneous SEH is an unknowable disease by its physio-pathology [1,2, 23] and controversial by its management because the traditional unconditional urgent neurosurgical decom-pression seems not always mandatory owing to some spontaneous recovery. The necessity of a surgical intervention versus conservative management has widely been discussed in the literature [2, 3, 5, 6, 14, 24, 25] and the length of hematoma can not solely be used as a crucial guide for treatment, because spontaneous recovery also correlates to larger hematomas; so neurological status stills the main indication for surgery [5,9,17,18,22].

Decompressive laminectomy is the first and the most used procedure for SEH removal, in all parts of the spine, independently of patient's age and hematoma extent. However, its widespread use, in spine surgery, has demonstrated that spinal deformity and disability of spinal motion, following multilevel laminectomy, can occur in both the adult and pediatric populations [26-31]. Since, several other surgical modalities have been used for localized SEH removal, including laminectomy with thoraco-lumbar pedicle screw fixation [32] hemi laminectomy, [18] laminoplasty [32] or sided laminoplasty, [33] inter-laminar fenestration or flavectomy [3] costo-transversectomy [34] with pediculectomy [35] anterior corporectomy [36] and anterior cervical dissectomy [6].

In opposition to the numerous surgical possibilities described for localized SEH, only multilevel laminotomy,[10, 37] broken multilevel laminectomy (i.e. C5-C7, T2-T4, T6-T8) [38], and multilevel unilateral alternating hemi-laminectomy [3] have been suggested as substitutes, to extensive multilevel laminectomy or hemi-laminectomy, in the treatment of extensive postero-lateral or posterior SEH. Consequently, extensive multilevel laminectomy [8,11-15,19,20,39]and multilevel hemi-laminectomy [7,18], over the most affected segments, have been preferentially performed for removal of such hematomas.

Herein we describe an extension of unilateral alternating hemi-laminectomy, first described by Borm [3]. Uni and bilateral multilevel alternated hemi-laminectomy approaches are likely to suffice to remove totally the majority of extensive hematoma because they are almost exclusively located in the dorsal or dorso-lateral spinal canal. The tendency of posterior SEH to be more extensive in the sagittal plan, in contrast to their anterior counterparts, could be explained by the fact that ventrally, the dural sac is attached anteriorly to the spinal canal by connective tissue strands (thus limiting the sagittal extension of hematomas) whereas dorsally the space is free and filled by fatty tissue [40, 41].

From neurosurgical point of view, fear of consecutive hemi-laminectomy is that they may result in inadequate spinal cord decompression [3]. However we agree with Börm's et al statement: postero-lateral SEH (developed on 4 segments or more) could be removed trough unilateral multilevel alternated hemi-laminectomy, involving successively one out of two or three laminas [3]. In contrast extensive dorsal SEH displacing anteriorly the spinal cord, could be rapidly removed through a bilateral multilevel alternating hemi-laminectomy involving successively one lamina and the underneath opposite lamina, and centered at the most compressive identified site, as reported in the present case (Fig 3). Successful removal of the hematoma and extirpation of the clots is usually not hindered by leaving alternatively half of lamina intact because cervical and thoracic laminas are not large. Clots can be removed beneath the lamina by gentle aspiration with a compliant small sucker and a free soft ventricular catheter, inserted in the epidural space (underneath the laminas) above and below the limits of the operative field, allows removing the remaining fluid filled hematoma, as reported in the present case. In posterior SEH, we believe that bilateral alternating multilevel hemi-laminectomy allows adequate spinal cord decompression on both sides inversely to unilateral approach which may result in inadequate opposite side decompression in view of the blindness of the contra-lateral preserved spinal side. Additionally these techniques may suffice to treat posterior and postero-lateral hematomas without risk, as most often no active bleeding is found at surgery.

In patients with spinal canal stenosis or in lumbar region use of the power drill with polishing diamond burrs may be an essential step in thinning enlarged arthritic laminae and facets, thus allowing the use of more delicate rongeurs to perform hemi-laminectomy. Dural or nerve lacerations are less probable to occur in such cases, because the spinal dura mater is protected by the hematoma.

There are no evidenced-based-guidelines of SEH and the results of treatment from the point of view of post operative spinal deformities have not been evaluated in previous reports.

However we believe that alternating hemi-laminectomy are able to remove extensive dorsally located SEH, with no risk of associated spinal deformities. It is well known that spine is a complex dynamic bio-mechanical system42 and its stability is an interaction of three passive and active sub-systems including: the vertebrae, discs, and ligaments which constitute the passive sub-system; muscles and tendons (surrounding the spinal column) constitute the active sub-system; the nerves and central nervous system constitute the neural sub-system [43]. The safety of uni or bilateral alternating hemi-laminectomy from the point of view of spine stability could be explained by the fact that the spinous process–ligament–muscle complex (SLMC) is restored at the end of surgery, thus reducing the risk of post operative spine deformity. Several authors have outlined the importance of SLMC in preventing spinal deformity,[44, 45], therefore the loss of the integrity of the posterior stabilizing SLMC realized by laminectomy, added eventually to neurological deficits, greatly favor spine deformities. Indeed, spine deformity related paraplegia is a significant fact and it can be assumed that the frequency of deformity relates directly to neurological deficit [46], although, the sequence of events and the reasons for such occurrence are not completely understood, but several factors may play part in this development [47]. So, permanent abrupt or chronic changes in spine biomechanical functions, as realized by multilevel laminectomy associated to neurological deficits predispose spine to instability and increase the risk of deformities.

PROGNOSIS

Due to the rarity of SEH, there is no Class I data to drawn meaningful conclusion, but several reviews have attempted to clarify the factors affecting postoperative out-come and the most important predictors of out-come, for neurological improvement, identified up to now, are the timing of the surgical treatment and the preoperative neurological status [2,4,48,49]. In the present case, no improvement has been observed 12 months later, although the patient was operated on within 6 hours after onset. Changes induced by radiotherapy cause the spinal cord to become more sensitive to compression and have lead to serious spinal cord impairment, as shown by post operative MRI. It has been state that patient who does not recover after surgery, have had axonal lesions [49] ; this has probably occurred in the present case, owing to the acute compression of an irradiated spinal cord. Therefore it could be deduced that previous spinal cord irradiation is a pejorative factor for neurological recovery.

CONCLUSION

Extensive postero-lateral or posterior SEH should be managed by uni or bilateral alternating hemi-laminectomy, because multilevel laminectomy impairs the stability of the posterior vertebral column and predispose to spinal instability and deformity. So, nowadays, extensive laminectomy for SEH removal, anywhere in the spine, should not be longer recommended notably in childhood.

ACKNOWLEDGEMENT

The authors thank A. El-Ghalem for his help and advices.

REFERENCES

1] GROEN RJ, PONSSEN H. The spontaneous spinal epidural hematoma. A study of the etiology. J Neurol Sci. 1990;98(2):121-138.

2] KREPPEL D, ANTONIADIS G, SEELING W. Spinal hematoma: a literature survey with meta analysis of 613 patients. Neurosurg Rev. 2003;26(1):1–49.

3] BÖRM W, MOHR K, HASSEPASS U, RICHTER HP, KAST E. Spinal hematoma unrelated to previous surgery. Analysis of 15 consecutive cases treated in a single institution within a 10-year period. Spine (Phila Pa 1976).2004;29(24):E555–561.

4] FOO D, ROSSIER AB. Preoperative neurological status in predicting surgical outcome of spinal epidural hematomas. Surgical Neurol. 1981 ; 15 (5) : 389-401.

5] GROEN RJ. Non-operative treatment of spontaneous spinal epidural hematomas: a review of the literature and a comparison with operative cases. Acta Neurochir 2004;146(2):103-110.

6] LIAO CC, LEE ST, HSU WC, CHEN LR, LUI TN, LEE SC. Experience in the surgical management of spontaneous spinal epidural hematoma. J Neurosurg.. 2004 ; 100 (Suppl Spine):38-45.

7] FOK WM, SUN LK, WONG NM, LAU PY, CHEUNG HM. Spontaneous spinal epidural haematoma in a 15-month-old boy presenting with a wry neck: a case report. J Orthop Surg. 2007 ; 15 (3) 373-375.

8] HEHMAN K, NORREL H. Massive chronic spinal epidural hematoma in a child. Amer J Dis Child. 1968;116(sept):308-310.

9] KALINA P, MORRIS J, RAFFEL C. Spinal epidural hematoma in an infant as the initial presentation of severe hemophilia. Emerg Radiol. 2008;15(4):281–284.

10] BALAJI PAI SB, MAIYA PP. Spontaneous spinal epidural hematoma in a toddler. A case report. Childs Nerv Syst. 2006 ; 22 (May) : 526-529.

11] BAEK BS, HUR JW, KWON KY, LEE HK. Spontaneous spinal epidural hematoma. J Korean Neurosurg Soc.2008;44(1):40-42.

12] FIRAT AK, FIRAT MM, AKMANGIT I, DINÇER C, GELEBEK V. Acute epidural hematoma involving entire thoracic and lumbar spine. Europ J Radiol Extra. 2006;59(1):7–10.

13] FRANZINI A, FERROLI P, MARRAS C, BROGGI G. Huge epidural hematoma after surgery for spinal cord stimulation. Acta Neurochir (Wien).2005;147(5):565–567.

14] FUKUI MB, SWARNKAR AS, WILLIAMS RL. Acute Spontaneous Spinal Epidural Hematomas. AJNR Am J Neuroradiol. 1999 ; 20 (7) : 1365–1372.

15] GELABERT M, IGLESIAS M, GONZALEZ J, FERNANDEZ J. [Spontaneous spinal epidural hematomas: review of 8 cases]. Neurologia.2003;18(7):357-363. [In Spanish]

16] HOLTAS S, HEILING M, LÖNNTOFT M. Spontaneous spinal epidural hematoma. Findings at MR imaging and clinical correlation. Radiology. 1996;199(2):409–413.

17] KUMAR R, GERBER C. Resolution of extensive spinal epidural haematoma with conservative treatment. J Neurol Neurosurg Psychiatry. 1998;65(6):949-50.

18] MATSUMURA A, NAMIKAWA T, HASHIMOTO R, ET AL. Clinical management for spontaneous spinal epidural hematoma: diagnosis and treatment. Spine J. 2008;8(3):534–537.

19] MORALES CIANCIO RA, DRAIN O, RILLARDON L, GUIGUI P. Acute spontaneous spinal epidural hematoma: an important differential diagnosis in patients under clopidogrel therapy. Spine J. 2008;8(3):544–547.

20] MORSE K, WEIGHT M, MOLINARI R. Extensive postoperative epidural hematoma after full anticoagulation: case report and review of the literature. J Spinal Cord Med. 2007 30 (3) : 282–287.

21] ZIYAL IM, AYDIN S, INCI S, SAHIN A, ÖZGEN T. Multilevel acute spinal epidural hematoma in a patient with chronic renal failure. Case report. Neurol Med Chir (Tokyo). 2003 ; 43 (8) ; 409-412.

22] ZIZKA J, ELIAS P, MICHL A, HARRER J, CESAK T, HERMAN A. Extensive spinal epidural hematoma: a rare complication of aortic coarctation. Eur Radiol. 2001;11(7):1254 1258.

23] BEATTY RM, WINSTON KR. Spontaneous cervical epidural hematoma. J Neurosurg. 1984 ; 61 (1) : 143-148.

24] HENTSCHEL SJ, WOOLFENDEN AR, FAIRHOLM DJ. Resolution of spontaneous spinal epidural hematoma without surgery. Spine (Phila Pa 1976). 2001;26(22):E525–527.

25] SILBER SH. Complete nonsurgical resolution of a spontaneous spinal epidural hematoma. Am J Emerg Med. 1996;14(4):391-393.

26] AIZAWA T, SATO T, SASAKI H, ET AL. Results of surgical treatment for thoracic myelopathy: minimum 2-year follow-up study in 132 patients. J Neurosurg spine. 2007;7(1):13-20.

27] ALBERT TJ, VACARRO A. Postlaminectomy kyphosis. Spine. 1998 ; 23(24):2738–2745.

28] BUTLER JC, WHITECLOUD TS 3rd. Postlaminectomy kyphosis. Causes and surgical management. Orthop Clin North Am. 1992 ; 23 (3) : 505–511.

29] LAM FC, IRWIN BJ, POSKITT KJ, STEINBOK P. Cervical spine instability following cervical laminectomies for Chiari II malformation: a retrospective cohort study. Childs Nerv Syst. 2009 ; 25 (1) : 71–76.

30] YASUOKA S, PETERSON HA, MacCarty CS. Incidence of spinal column deformity after multilevel laminectomy in children and adults. J Neurosurg. 1982;57(4):441–445.

31] YASUOKA S, PETERSON HA, LAWS ER JR, MACCARTY CS. Pathogenesis and prophylaxis of postlaminectomy deformity of the spine after multiple level laminectomy: difference between children and adults. Neurosurgery. 1981;9(2):145-152.

32] YU HP, FAN SW, YANG HL, TANG TS, ZHOU F, ZHAO X. Early diagnosis and treatment of acute or subacute spinal epidural hematoma. Chin Med J. 2007 ; 120 (15) : 1303-1308.

33] SANO H, SATOMI K, HIRANO J. Recurrent idiopathic epidural hematoma: a case report. J Orthop Sci. 2004;9(6):625-628.

34] CARROLL SG, MALHOTRA R, EUSTACHE D, SHARR M, MORCOS S. Spontaneous spinal epidural haematoma during pregnancy. J Matern-Fetal Med. 1997 ; 6 (4) : 218-219.

35] LABEODAN OA. Spinal epidural haematoma mimicking spontaneous subarachnoid haemorrhage. Emerg Med J. 2005;22(8):606–607.

36] MANGIONE P, MOUSSELLARD H, LESPRIT E, ROCHA J, SÉNÉGAS J. Anterior evacuation of a spontaneous cervical epidural hematoma. Eur Spine J. 1995 ; 4 (4) 257-259.

37] CALDARELLI M, DI ROCCO C, LA MARCA F. Spontaneous spinal epidural hematoma in toddlers: description of two cases and review of the literature. Surg Neurol. 1994 ; 41 (4) :325-329.

38] CUVELIER GDE, DAVIS JH, PURVES EC, WU JK. Torticolis as a sign of cervico-thoracic epidural haematoma in an enfant with severe haemophilia A. Haemophilia. 2006 ; 12(6):683-686.

39] CROMWELL LD, KERBER C, FERRY P. Spinal cord compression and hematoma: an unusual complication in a hemophiliac infant. Am J Roentgenol. 1977 ; 128 (5) : 847-849.

40] BROACKWAY M. Anatomy of the epidural space. Curr Anaest Critic Care. 1999 ; 10 (3) : 118-122.

41] PATEL H, GARG BP. Increasing irritability with sudden onset of flaccid weakness. Semin Pediatr Neurol. 1996;3(3):192-197.

42] REEVES NP, NARENDRA KS, CHOLEWICKI J. Spine stability: The six blind men and the elephant. Clinic Biomech (Bristol, Avon). 2007;22(3):266–274.

43] PANJABI MM. The stabilizing system of the spine. Part I. Function, dysfunction, adaptation, and enhancement. J Spinal Disord. 1992 5 (4):383-389.

44] LIU J, EBRAHEIM NA, SANFORD CG JR, ET AL. Preservation of the spinous process ligament-muscles complex to prevent kyphotic deformity following laminoplasty. Spine J. 2007; 7(2):159-164.

45] TANI S, ISOSHIMA A, NAGASHIMA Y, NUMOTO RT, ABE T. Laminoplasty with preservation of posterior cervical elements: surgical technique. Neurosurgery. 2002;50(1):97-102.

46] CAMPBELL JH, Outcome Study: The Progression of Spinal Deformity in Paraplegic Children Fitted with Reciprocating Gait Orthoses. JPO. 1999;11(4): 79-84.

47] BERSGTROM E. Spinal cord injury in children in: Bromley I, ed. Tetraplegia and paraplegia. A guide for physiotherapists. Churchill Livingston Elsevier Sixth edition, 2006;319-344.

48] GROEN RJ, VAN ALPHEN HA. Operative treatment of spontaneous spinal epidural hematomas: a study of the factors determining post operative outcome. Neurosurgery. 1996;39(3):494-509.

49] LAWTON MT, PORTER RW, HEISERMAN JE, JACOBOWITZ R, SONNTAG VKH, DICKMAN CA. Surgical management of spinal epidural hematoma: relationship between surgical timing and neurological outcome. J Neurosurg. 1995;83(1):1-7.