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SURGICAL VENTRAL REDUCTION OF TRAUMATIC SUBAXIAL CERVICAL LOCKED FACET JOINT

By

Mohamed Hosam Eldien Abou Shahba, Hedaya Mohamed Hassan Hindam and Mohamed Farouk El-Faresy

Department of Neurosurgery, Faculty of Medicine (Damietta), Al-Azhar University

ABSTRACT

Background: Locked cervical spine facets accounting more than 50% of cervical spine injuries. It is a highly unstable condition in need of realignment, decompression, reduction and fixation.

Objective: Aprospective clinical case study to evaluate the effectiveness and safety of surgical anterior cervical decompression, reduction, and fixation approach for management of traumatic sub-axial cervical locked facets.

Patients and Methods: We studied 30 patients with traumatic cervical sub axial locked facets managed surgically through anterior cervical decompression, reduction and anterior plate fixation. All patients were subjected to full general and neurological clinical assessment, routine laboratory work and neuroimaging by plain X-ray, CT scan and MRI cervical spine. All patients were assessed post-operatively, clinically and radiologically with regular follow up for one year.

Results: This study included 30 patients (21 males and 9 females), with main age 39.3 years. The most common mode of trauma was road traffic accident in 23 patients. All patients presented by neck pain and cervical spine tenderness, and 23 patients presented by neurological deficits, mostly with bilateral facets cases 19 (82.6%). The most common affected level was C6-7, in 10 patients (33.3%). Traumatic disc herniation was presented in all cases with bilateral facets dislocation (23 cases -76.7%), and 4 cases with unilateral facet dislocation. All patients treated through anterior cervical approach, with main operative time 150 minutes, median operative blood loss 100 cc. One patient has intra-operative CSF leak, and no other intra-operative complications.

Conclusion: Open ventral reduction, decompression and fixation was considered the initial choice for treatment and stabilization of cervical locked facets, with less complication and several advantages to the patients.

Keywords: Cervical anterior approach, locked cervical facets, spinal cord injury, anterior plate.

INTRODUCTION

Locked facets of the cervical spine are a result of a flexion-rotation or flexion-distraction type of injury. This mechanism of injury makes the inferior facets of the rostral vertebra slip forward over the superior facets of the caudal vertebra, and this can occur unilaterally or bilaterally ***(*Krishnapundha *and Khaoropthan, 2011).*** Most locked facets occur at the cervical level accounting for more than 50% of all cervical injuries. Locked facets can also be found at the thoracic and

lumbar spine ***(Reddy et al., 2008).*** The dislocation of the bilateral facets compresses the spinal cord and the damage to the nerve roots is caused by narrowing of the spinal canal and the neural foramina. Treatment of these injuries includes attempted awake closed reduction with skull traction. After successful reduction, surgical fusion and fixation are commonly performed through anterior and/or posterior approach **(Younis et al., 2015).**

Cervical magnetic resonance imaging performed in patients with cervical fracture dislocation injuries demonstrates disrupted or herniated intervertebral disc in one-third to one-half of patients with facets dislocation injuries, causing neurological deterioration after closed traction reduction in awake patients by impugned ventral compression of the spinal cord by displaced disc material ***(Gelb et al., 2013).***All cases with facets dislocations should betreated surgically. Both anterior and posterior fixation with screw fixation is adequate and rarely combined anterior-posterior surgery is necessary. The choice of approach is often dictated by the presence of disc herniation or posterior comminution which would favor an anterior approach with removal of the associated disc herniation, indirect reduction, interbody grafting and stabilization and potential restoration of normal cervical lordosis with additional anterior plating instruments via a single approach. Alternatively, the presence of vertebral body fractures would favor a posterior approach. Combined anterior-posterior procedures are indicated when the comminution will prevent solid fixation or in cases of extreme ligamentous avulsion such as distraction injury ***(Anderson and Vaccaro, 2011).***

PATIENTS AND METHODS

This was a prospective study conducted on 30 patients with traumatic sub-axial cervical locked facets undergoing anterior cervical decompression reduction and fixation with anterior plate system as the surgical corridor in both Neurosurgery Department, Al-Azhar University Hospital (Damietta Branch), and Neurosurgery Department, Mansoura International Specialized Hospital during the period from November 2013 to November 2016. We excluded, medically unfit, Comatose or uncooperative patients and patients with associated vertebral fractures or CNS injury elsewhere. All patients involved in this study were subjected to history taking, general examination and neuro-logical examination. All patients had, routine laboratory investigations and neuroimaging including, plain X-ray cervical spine CT cervical spine and MRI cervical study.

Surgery: All patients underwent surgery within 48 hours of admission and ventral decompression, reduction, and stabilization of the cervical spine was accomplished in all cases.

Surgical procedure:

Anesthetic technique: Orotracheal access or fiber-optic intubation was used: Appropriate venous access was obtained, and one dose prophylactic antibiotic was administered before the skin incision was made.

Position: Patients were placed supine on a radiolucent table. Soft roll was placed in the interscapular space, then the neck was

built into normal lordosis using foam pillows and neck collar then removed.

Traction: Was applied when needed with head halter traction.

Skin incision: Right anterior transverse skin incision was made along langer lines or within the natural skin creases of the neck. It extended from the anterior border of sternocleidomastoid (SCM) muscle to just to pass the midline. An autograft was harvested and the right iliac crest was also prepared.

Superficial Dissection: The platysma muscle was identified and entered longitudinally at its medial border. Subplatysmal flap was made by dissection just deep to the platysma. Adequate mobilization helped prevention of excessive retraction and decreased the incidence of postoperative dysphagia and laryngeal edema.

Deep Dissection: The SCM muscle was mobilized and retracted laterally and laryngeal strap muscles were also identified and mobilized medially with Cloward retractors. The peritracheal fascia was then identified and dissected medial to the carotid sheath and just lateral to the thyroid. The superior and inferior thyroid arteries, which connected the carotid sheath with the thyroid gland, may limit exposure in high levels. So, it was ligated. Caudally, the omohyoid can also limit exposure in lower levels. So, it was retracted medially for levels above C7 or laterally for levels below, or more simply transected. Once the prevertebral fascia was visualized, sharp scissors dissection was used to carefully incise the fascia. Then, blunt dissection with the use of closed forceps and scissors was used to longitudinally split the fascia in the midline.

Localization of level of dislocation: Identification of the level was inspection of hematoma that may be found at site of dislocation, inspection and palpation of anterior corporeal stepladder that caused by dislocation, and by intraoperative lateral C-Arm X-Ray radiograph images with a marker (bayonetted spinal needle) within the disc space between suspected dislocated vertebrae. Anterior longitudinal ligament was opened if not torn. Dissection of the longus colli muscles bilaterally at its medial border was made, then Cloward retractors were repositioned under the longus colli medial border. A second set of retractors was placed in a rostro caudal direction to gain full exposure.

Decompression: Discectomy was carried outonce the posterior annulus was reached.Traction can be applied with head halter traction started by 2.5 Kg, and gradually increased till the disc space was opened enough to remove the posterior annulus, herniation fragment that may migrate cranially and posterior osteophyte. Also, bilateral foraminotomy was done if needed.

Reduction: Started with increase traction applied by head halter traction with head and neck manipulation temporary in flexion to facilitate reduction (In unilateral locked facet joint, some flexion and rotation can help to achieve reduction). If this maneuver failed, traction with the aid of reverse Cloward maneuver using interbody spreader placed into the disc space (at an angle), which were then distracted to disengage the facet joints and rostrally rotated to reduce the deformity.

If reverse Cloward maneuver failed, traction with the aid of vertebral body posts (Caspar) spreader were placed at approximately 10 to 20? divergent angle with respect to each other. Angling the vertebral body posts permitted the creation of a kyphosis, disengaged the facets and permit reduction when distraction was applied. Dorsally directed pressure to the rostral vertebral body was applied using manual pressure or alternatively. A force was applied by a curette to the mid-endplate region of the caudal vertebral body. The curette was used as a lever arm that forced the rostral vertebral body into normal alignment. In cases of unilateral facet dislocation, in which there was an accompanying rotational deformity, the patient additionally managed by placing the interbody spreader or Caspar pins at an angle with respect to each other in the coronal plane approximately a 15? angle. This permit a biomechanical advantage regarding the correction of the rotational component of the deformity. Once the facet joint was disengaged, an intraoperative radiograph was then obtained to confirm that the deformity has been adequately reduced, traction should be discontinued and keep the patient in extension.

Grafting: Once the decompression and reduction were completed, the vertebral endplates were cleared of any remaining cartilage and decorticated, then autogenous tricortical iliac crest bone graft was fashioned and used to facilitate rapid, reliable interbody healing. Care was taken when harvesting the graft to be an appropriate-sized graft did not over distract the disc space which may cause redislocation. Following placement of the graft, adequate lordosis in the cervical spine was ensured by lateral radiography, anterior plating was placed to decrease the possibility of graft extrusion, improve the fusion rates and increase stability of the construct. Real-time fluoroscopy helped in monitoring screw placement during procedure. Good hemostasis was insured and a non-suction drain was placed (for about 24-48 hours). Platysma, subcutaneous layer and skin in a subcuticular manner were closed in separate layers. A hard collar for approximately 6 weeks was used.

Postoperative assessment: All patients were assessed clinically and radiological, to detect the effectiveness of surgical procedure in decompression, reduction of cervical alignment and fixation.

Follow up: The follow-up period ranged from three months to one year.All patients underwent general and neurological evaluation monthly for three months to one year postoperative. They were followed by X-Ray and/or CT cervical spine, and MRI cervical spine if needed.

Statistical analysis: Statistical presentation and analysis of the present study was conducted using SPSS V.22. For numerical (continuous) data, the analysis was determined according to the distribution of data. In normally distributed data, the mean and standard deviation were calculated and independent t-test was used. In data that were not normally distributed, the median and interquartile range were calculated and non-parametric tests (Mann-Whitney, Kruskal-Wallis and Wilcoxon signed rank test). For qualitative data, number and percentage were calculated and chi-square goodness of fit test and Chi square test for

association/ Fisher's exact test were performed. Significance of statistical tests was adopted at $p < 0.05$ (**Dawson-Saunders and Trapp, 2001**).

RESULTS

This study included 30 patients (21 male and 9 female) with traumatic sub-axial cervical locked facets undergoing anterior cervical decompression, reduction and fixation with anterior plate system. Male patients significantly outnumbered females (70% and 30% respectively, P = 0.028) with female to male ratio 1: 2.3 The age of the patients ranged from 18 to 60 years with greatest incidence was in the 4thdecade of life (30%) with no statistically significant difference between the age groups (P= 0.363). The mean age was 39.3 ± 12.8 years (Table 1).

Table (1): Sex and Age incidence in the current study.

Parameters / Incidence		Sex		Total	Age				
		Male	Female		11-20	21-30	31-40	41-50	51-60
No		21	9	30	2	7	9	6	6
%		70	30	100	6.7	23.4	30	20	20
Chi-square goodness of fit test	X^2	4.800			4.33				
	P value	0.028*			0.363				
Mean ± SD		-			39.3 ± 12.8				

N: number, * significant at P <0.05, SD: standard deviation.

Road traffic accidents were the most common mode of trauma accounting for admission of23 patients (76.7%) with a statistically significant difference than other modes of trauma (p= <0.001). Four patients (13.3%) admitted with history of falling from height and 3 patients (10%) after falling of heavy object on head. All patients in the study presented with neck pain and spinous tenderness. The number of patients with neurological manifestations 23(76.7%) were much more than neurologically intact patients 7 (23.3%) which was statistically significant (P = 0.003).Neurological manifestations included: patients with sensory, motor and visceral manifestations.

15 (65.2 %) which were higher than patients with sensory and motor manifestations 6 (26.1%), and patients with sensory manifestations only 2 (8.7%) which was statistically significant (P = 0.003).

Motor affection in 21 patients (91.3%) (paraplegia upper diparesis11 patients (52.4%) was higher than other motor manifestations as upper monoparesis in 3 patients (14.3%), upper diparesis in 3 patients (14.3%), quadriplegic in 4 patients (19%) which was statistically significant (P = 0.036-Table 2).Most bilateral cases presented with neurological affection 19 (82.6%). In-between them, the commonest motor manifestations were paraplegia and upper diparesis 10

(52.6%), while in unilateral cases were either neurologically intact in 3 (42.9%) patients or with neurological affection in 4 (57.1%) patients, with most motor manifestations upper monoparesis 2 (50.0%). Although there was a higher percentage of cases presenting with neurological affection in bilateral cases 19(82.6%) than unilateral cases 4 (57.1%), there was no statistically significant relationship between laterality and the clinical presentation of the patient (P>0.05-Table 2).

Table (2): Association between laterality and clinical presentations of the studied patients.

Laterality / **Clinical presentations**	**Unilateral (N=7)**		**Bilateral (N=23)**		**Total (N=30)**	
	N	%	N	%	N	%
Neck pain	7	100.0%	23	100.0%	30	100.0%
Neurologically Intact	3	42.9%	4	17.4%	7	23.3%
Neurological manifestations	4	57.1%	19	82.6%	23	***76.7%***
Motor power	3	75.0%	18	94.7%	21	91.3%
Upper Monoparesis	2	50.0%	1	5.3%	3	14.3%
Upper Diparesis	0	0.0%	3	15.8%	3	14.3%
Paraplegia & Upper Diparesis	1	25.0%	10	52.6%	11	52.4%
Quadriplegia	0	0.0%	4	21.1%	4	19.0%
Sensory affection	4	100.0%	19	100.0%	23	100.0%
Visceral affection	1	25.0%	14	73.7%	15	65.2%
■ Chi square goodness of fit for type of motor affection: X2 = 8.524, P = 0.036*						

Twelve patients (40%) have nocord injury, 7 (58.3%) were intact, 5 (41.7%) with root injury, while 18 patients (60%) had cord injury, and 13 (72.2%), 2 (11.1%) and 3 (16.7%) patients were with ASIA scale A, B and D respectively. A significantly higher percentage of patients with ASIA scale A in cases had cord injury than other scales (P= 0.002-Table 3). Patients with unilateral facet dislocation mostly presented without cord contusion 6 (85.7%) either with root injury 3 (50%) or neurologically intact 3 (50%). Bilateral cases mostly presented with cord injury (17 -73.9%) and with ASIA impairment scale A 12 (70.6% - Table 3).

Table (3): Association between laterality and preoperative neurological assessment of the studied patients.

Laterality / Neurological Assessment	Unilateral (N=7)		Bilateral (N=23)		Total (N=30)	
	N	%	N	%	N	%
Patients Without Cord Injury	6	85.7%	6	26.1%	12	40.0%
Intact	3	50.0%	4	66.7%	7	58.3%
Root	3	50.0%	2	33.3%	5	41.7%
Patients with Cord Injury	1	14.3%	17	73.9%	18	60%
A	1	100.0%	12	70.6%	13	72.2%
B	0	0.0%	2	11.8%	2	11.1%
C	0	0.0%	0	0.0%	0	0.0%
D	0	0.0%	3	17.6%	3	16.7%
E	0	0.0%	0	0.0%	0	0.0%
▪ Chi square goodness of fit for patients with cord injury: X^2 =12.333, P = 0.002*						

N: number, * significant at P <0.05

The highest incidence of injured level was C6-C7in 10 patients (33.3%), while C3-4 was the least affected level in 3 patients (10%). There was no statistically significant difference between levels of dislocation (p= 0.276).Patients with bilateral facet dislocation were23 (76.7%) significantly outnumbered, patients with unilateral facet dislocation were 7 (23.3%-P= 0.003), with unilateral to bilateral facet dislocation ratio 1: 3.3.The minimum preoperative kyphotic angle was -2, while the maximum one was 50 and the median kyphotic angle in all cases was 13.5 (9-20). There was no statistically significant difference between the median kyphotic angle in unilateral cases 6.0 (3.3-16.0) and in bilateral cases 14.0 (10.0-23.8-P= 0.086).All patients were with ligamentous injury. Traumatic disc herniation incidence was significant in 27 patients (90.0%-P <0.001). Traumatic disc herniation was present in all cases with bilateral dislocation, while was present in 4 (57.1%) of cases with unilateral dislocation which was statistically significant (P=0.01).Cord contusion incidence was insignificant 18 patients (60%) P = 0.273, while it was present in 17 (73.9%) of cases with bilateral dislocation and 1 (14.3%) of cases with unilateral dislocation which was statistically significant (P=0.017- Table3).

In the study, all cases received in sub-axial injury classification (SLIC) score morphology sector 4 (rotation/translation) plus 2 (disruption) in DLC sector so scoring was determined by neurological

status. Patient was intact (0) received SLIC scoring 6, root injury (1) received SLIC scoring 7, complete cord injury (2) received SLIC scoring 8, incomplete cord injury (3) received SLIC scoring 9. The score of all cases ≥ 4 favored surgery.

The median duration of surgery was 150 minutes (ranged from 120 to 180). There was no significant difference in operative duration between unilateral and bilateral facet dislocations (P = 0.465).The median volume of intraoperative blood loss was 100 cc blood (ranged from 100 to 150)with no significant difference between unilateral and bilateral facet dislocations (P = 0.586). No patients were in need for intraoperative transfusion. One patient (3.3%) with bilateral dislocation hadiatrogenic intraoperative CSF leak. No other intraoperative complications were recorded.There were 12 patients without cord injury with no deterioration of preoperative intact patients (7), and improvement of 4 of 5 (80%) of patients with root manifestations became intact, and one of them still has root manifestations. Other 18 patients were with initial cord injury,13 patients received ASIA score A, 2 (15.4%) of them improved to had C, and D scoring other did not improve. Two patients received ASIA score B, one of them (50%) improved to had D score and the other one did not improve. Three patients received ASIA score D, 2 of them (66.7%) improved to had E scoring, and other one did not improve(Table 4).

Table (4): Preoperative and postoperative neurological changes of the studied patients.

Post-operative neurological status / Pre-operative neurological status		N	Without cord injury (12)		With cord injury (18)					Percent of improvement
			Intact	Root injury	A	B	C	D	E	
Without cord injury	Intact	7	7							0%
	Root injury	5	4	1						80%
With cord injury	A	13			11		1	1		15.4%
	B	2				1	2	1		50%
	C									
	D	3						1	2	66.7%
	E									
Total			11 (91.7%)	1 (8.3%)	11 (61.1%)	1 (5.6%)	1 (5.6%)	3 (16.7%)	2 (11,1%)	

N: number

The minimum postoperative kyphotic angle was -8, while the maximum one was 7and the median kyphotic angle in all cases was -4 to -3. There was no statistically significance between the postoperative median kyphotic angle in unilateral cases was -3.75 to -3 and in bilateral cases was -4 to -3- P= 0.820. The minimum corrective angle was 5, while the maximum one was 43 with mean corrective angle 18 ±9.4. There was statistically significance between mean corrective angle in unilateral 11.9 ± 6 and bilateral 19.9 ± 9.5 cases (P= 0.045- Table 5).

Table (5): Postoperative angle of kyphosis and corrective angle of the studied patients.

Parameters / Facets	Postoperative angle of kyphosis			Mann Whitney test		Corrective angle			Independent samples T test	
	Minimum angle	Maximum angle	Median (IQR)	U	P	Minimum	Maximum	Mean ± SD	T	P
Bilateral	-5	7	-3 (-4 to -3)	0.227	0.820	5	43	19.9 ± 9.5	-2.093	0.045*
Unilateral	-8	5	-3 (-3.75 to -3)			6	20	11.9 ± 6		
Both types	-8	7	-3 (-4 to -3)	5	43	5	43	18±9.4		

N: number - IQR: interquartile rangeSD: standard deviation, * significant at P <0.05.

Postoperative radiological follow up-showed no malalignment, instrumentation failure or graft problems of the studied patients.Complications includeddonor site pain in 17 patients (56.7%), disappeared within 2 to 3 weeks postoperatively, dysphagia which was temporary in 3 patients (10%) and disappeared in 2 to 5 days postoperatively, donor site iliac wound subcutaneous hematoma in one patient (3.3%) which disappeared within 10 days postoperatively. Chest complications were in 2 patients (6.7%) with mild and moderate degree which needed to ICU stay longer than one day and improved within 2 to 3 weeks.All patients (100%) lived until discharged from the hospital. Follow up showed late mortality in 5cases (16.7%): 4 cases (80%) and one case (20%) with postoperatively ASIA score A and B respectively. Late morbidity occurred in 12 (23.3%) cases: 11 (91.1%) and one (8.3%)with postoperative ASIA score A and B respectively. Late morbidity included urinary tract infection, bed sores, chest infection, deep vein thrombosis, nutritional problem and depression(83.3%, 66.7%, 41.7%, 8.3%, 8.3% and 8.3% respectively).

Cases presentation

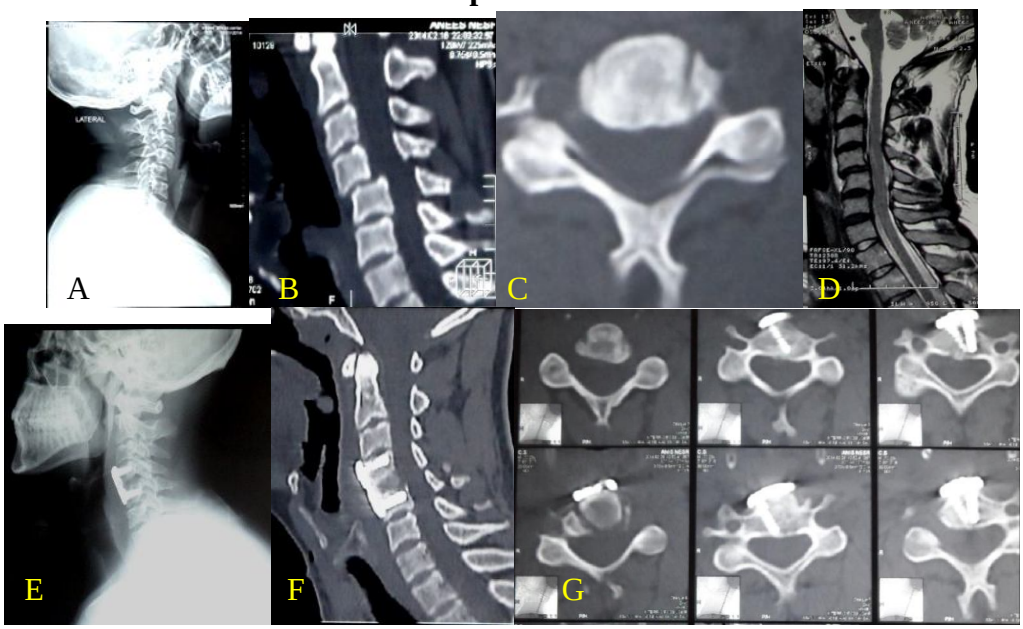

Figure (1): Male patient of 24 years old with history of road traffic accident, Left radiculomyelopathy, (C4-5 dislocation and left unilateral locked facet). (A)pre-operative cervical spine X-ray, (B)sagittal CT scan, (C) axial CT scan,(D)sagittal MRI, and post-operative, (E)X-ray and(F)sagittal CT scan and (G) axial CT scan.

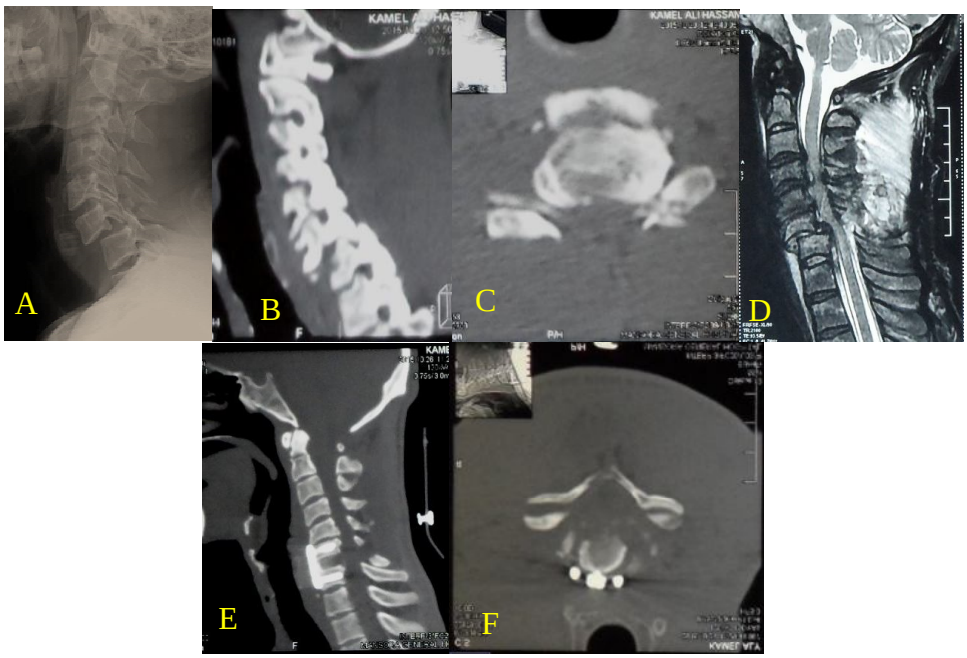

Figure (2): Male patient with 55 years old, with history of falling from a high, presented by quadriplegia, and sensory level at C5 (complete spinal cord injury, ASIA Grade A).(A) Pre-operative cervical X-ray,(B&C) CT scan and (D) MRI, with C6-7 anterolithesis and bilateral locked facet. (E)Post-operative sagittal CT scan and (F) axial CT scan views.

Figure (3): Male patient with 17 years old, with history of road traffic accident presented by upper limbs diparesis (Grade 3). (A) Pre-operative plain X-ray cervical spine,(B) axial CT scan and (C) sagittal CT scan and (D) sagittal MRI views, with C5-6 anterolithesis, with bilateral locked facets.

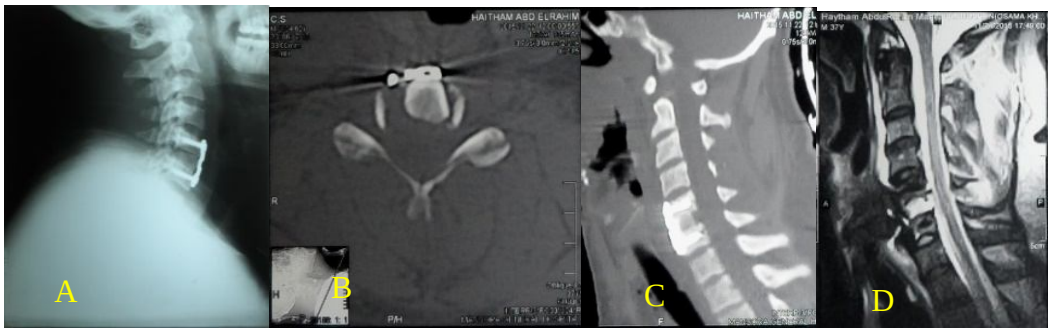

Figure (4): (A) Post-operative plainX-ray, (B) axial CT scan, (C) sagittal CT scan, and (C) sagittal MRI cervical spine views of the previous patient in Fig (3).

DISCUSSION

Cervical spine injuries are observed in 2–5% of patients presenting with blunt trauma. Cervical facet dislocations account for 6-15% of cervical spine injuries. Bilateral facet dislocation is associated with more neurological deficit **(Du Toit and Dunn, 2008)**. In this thesis, 30 patients with traumatic sub-axial cervical locked facets undergoing anterior cervical decompression reduction and fixation approach as the surgical corridor, with follow up from 3 months to 1 year. Among our patients, males were predominant (21 males and 9 females, with female to male ratio 1:2.3). This was like many studies on sub-axial cervical facet dislocations as the study of **Younis et al. (2015)**. **Du Toit and Dunn (2008), Sahoo et al. (2012)**, **Tofuku et al. (2013)** and **Park et al. (2015)** reviewed the clinical records and radiographs of 50 consecutive patients, where 41 patients were males, 9 were females.

The ages of our patients in this study ranged from 18 to 60 years, and the mean age was 39.3 ± 12.8. This mean age nearly equal to the average age in many studies as **Du Toit and Dunn (2008), Sahoo et al. (2012)** and **Younis et al. (2015)**. The average age was in the 5th decade in other studies as those of **Nakashima et al. (2011) and Park et al. (2015)**. It was in the 7th decade in the study of **Tofuku et**

al. (2013). This increase in mean age of no clinical expklanation except for the difference health care life expectancy, and average age of population in the different communities.

In this study, the road traffic accidents were the most common mode of trauma accounting for admission of 76.7%, with a statistically significant difference than other modes of trauma. Road traffic accidents also were the commonest mode of trauma in many studies **Du Toit and Dunn (2008), Song and Lee (2008), Tofuku et al. (2013) and Younis et al. (2015)**. The commonest mode of trauma was 56% offalling from heights and traffic accidents. Injuries in young aged persons are usually the result of high-energy trauma. Injuries in older persons usually result from low-energy trauma such as falls from the standing position **(Uhrenholt et al., 2009).**

Unilateral facet dislocations are often associated with either an intact neurological examination or nerve root injury. Bilateral facet dislocations are more commonly associated with a neurological deficit. These injuries are thought to represent a continuum of pathology with disruption of various osseous and ligamentous structures **(Joaquimet al., 2014)**. All patients in our study presented with neck pain and spinous tenderness. Patients with neurological manifestations were much more than neurologically intact patients which was statistically significant. Although there was a higher percentage of cases presenting with neurological affection in bilateral cases than unilateral cases, there was no statistically significant relationship between laterality and the clinical presentation of the patient.

In the present study, preoperative neurological assessment was according to presence of cord injury or not. Twelve patients (40%) didn't have cord injury (58.3% intact, 41.7% with root injury), while 18 patients (60%) had cord injury 72.2%, 11.1% and 16.7%, with ASIA scale A, B and D respectively. A significantly higher percentage of patients with ASIA scale A in cases had cord injury than other scales. It is also in thestudies of **Du Toit and Dunn (2008)**, **Nakashima et al. (2011), Sahoo et al. (2012**), **Tofuku et al. (2013)** and **Younis et al. (2015)** that most of bilateral facet dislocation cases presented with complete SCI, ASIA A, while unilateral facet dislocation cases presented with root syndromes.

The appropriate imaging analysis of suspected cervical facet dislocation is widely debated, and this was the core of multiple studies to outline clear diagnostic guidelines aiming to predict high risk patients to avoid misdiagnosis of devastating injuries and to reduce unnecessary examinations (**Lee et al., 2009**). Traditionally, plain radiography was used for initial evaluation of these injuries being a safe, good test in conscious, cooperative patients however; it is of limited diagnostic role as they are time consuming, less sensitive especially in poorly visualized craniocervical and cervicothoracic junctions and difficult positioning with painful restricted neck movements, intoxication, unconsciousness or concurrent severe injuries (**Bailitz et al., 2009**). The advent of helical and recently multidetector CT scanners with

multi-planar (axial, coronal, sagittal and 3D) reconstruction provides a faster, cost effective and comprehensive display of spinal anatomy, facet morphology and fracture detection with reduced number of missed injuries and better assessment of the inadequately shown craniocervical and cervicothoracic junctions (**Bailitz et al., 2009 and Delgado et al., 2010**). Magnetic Resonance Imaging plays a crucial role in evaluating cervical dislocations. It provides more adequate information about spinal cord parenchymal lesions, cord compression, ligamentous injury and bone marrow changes. MRI is not only helpful in diagnosis but also in planning management and may help in prognosis of the disease (**Grauer et al., 2011**).

In our study, all patients were evaluated by cervical plain X-Ray, when presented with just neck pain with no neurological deficit and if there is a radiological suspicion or X-ray inadequately shown craniocervical and cervicothoracic junctions, we do a CT cervical spine with 3D reconstruction. If there is a neurological deficit related to cervical spine, we do a CT cervical spine with 3D reconstruction from the start. And if dislocation is documented radiologically, we do MRI for all patients to rollout soft tissue disruption, cord condition and interbody disc. In our study, the highest incidence of injured level was C6-C7 in 10 patients (33.3%) while C3-4 was the least affected level in 3 patients (10%). There was no statistically significant difference between levels of dislocation. C6-7 level also was most affected level in literatures **Du Toit and Dunn (2008), Tofuku et al. (2013) and Park et al. (2015).**In our study patients with bilateral facet dislocation significantly outnumbered patients with unilateral facet dislocation (76.7% and 23.3% respectively). While in **Nakashima et al. (2011), Park et al. (2015)** and **Younis et al. (2015**) unilateral facet dislocations outnumbered bilateral facet dislocations. In our study, the minimum preoperative anterior translation percent at level of dislocation was 8% while the maximum one was 85% with the mean translation percent in all cases was 44.9 ±17.3. The mean translation percent in bilateral cases was much more than unilateral cases. Considering anterior displacement percentage, it was significantly higher in patients with cord contusion. The minimum preoperative kyphotic angle was -2 and the maximum one was 50 and the median kyphotic angle in all cases was 13.5 (9-20). There is no statistically significant difference between the median kyphotic angle in unilateral cases 6.0 (3.3-16.0) and in bilateral cases 14.0 (10.0-23.8).

Patients with DF dislocation injuries and uncontained herniated discs had an 89% incidence of neurological compromise on presentation (**Fleming et al., 2015**). The Sub Axial Injury Classification (SLIC) Scale is a decision support algorithm composed of 3 important variables with prognostic implications in lower cervical spine trauma. Distraction morphology qualifies as 4 points under the SLIC score, so any combination of posterior ligamentous injury or neurological injury will increase a patient's SLIC score 5 the threshold at which surgical intervention is recommended (**Vaccaro et al., 2007**). Many studies had been designed to evaluate the effectiveness of SLIC scale in decision making and to determining optimal

treatment (**Stone et al., 2010)**. In **Joaquim et al. (2014)** and **Da Cruz et al.(2015)** studies, suggested that the SLIC Scale can be helpful in differentiating mild from severe injuries, potentially improving the results of treatment. In this study, the SLIC Scale system was identified as being safe and effective at preventing neurological deterioration and, in most patients, lead to clinically relevant improvements in neurological function. **Dvorak et al. (2007)**, **Belirgenet al. (2013)**, and **Younis et al. (2015)** provide initial management algorithm starts with closed reduction with cervical traction. If dislocation was irreducible, open surgical reduction and stabilization should be performed either by anterior or posterior or both. They predict the success of stand-alone anterior discectomy and fusion for facet fracture-dislocations. The proposed algorithm does not distinguish between injuries with unilateral or bilateral facet joint fractures. We used this algorithm in management of our cases where, 30 patients with traumatic sub axial cervical locked facets was undergoing anterior cervical discectomy, reduction and fixation. Anterior surgery is associated with shorter operative times and less blood loss. Anterior instrumentation with interbody grafting can be the initial choice of treatment for stabilization for this subgroup of patients. Posterior surgery is indicated if radiographs after anterior instrumentation show failure (**Paxinos et al., 2009**).

Regarding operative time and intra-operative blood loss in our study the median duration of surgery was 150 minutes. There was no significant difference in operative duration between unilateral and bilateral facet dislocations. The median volume of intraoperative blood loss was 100 cc, with no significant difference between unilateral and bilateral facet dislocations. No patients were in needed of intraoperative transfusion. In comparison with other series **Woodworth et al. (2009)** and **Belirgen et al. (2013)**both were much. This can be explained by early experience of surgeons and anesthesia team. Regarding the surgical complications, studies demons-trate more favorable results with anterior approaches (**Kwon et al., 2007**). Potential surgical complications generally include vascular injury, neurological injury, dural tear, esophageal tear, infection, hematoma and hardware loosening. However most of these complications are uncommon. Transient dysphagia for the anterior group, and wound infection for the posterior approach predominate (**Kwon et al., 2007**).

In this study, one patient (3.3%) with bilateral dislocation had iatrogenic intraoperative CSF leak. No other intraoperative complications recorded. Regarding postoperative complications, donor site pain was present in 56.7%, dysphagia which was temporary in 10% and donor site iliac wound subcutaneous hematoma in 3.3%. Chest complications in 2 patients (6.7%). These recorded complications were like **Du Toit and Dunn (2008)** and **Younis et al. (2015)** in their studies. The most common surgery related complications were temporary recurrent laryngeal nerve palsy (n=2), CSF leak (n=1) and chronic post-op neck pain (n=1). There were no wound sepsis or donor site problems. In this study, there were 12 patients without cord injury with no deterioration of preoperative intact patients (7) and improvement of 4 of 5

(80%) of patients with root manifestations become intact and one of them still has root manifestations. Other 18 patients with initial cord injury 13 patients were ASIA score A, 2 (15.4%) of them improved to C and D scoring and others not improved. Two patients were ASIA score B, one of them (50%) improved to D score and the other one not improved. Three patients were ASIA score D, 2 of them (66.7%) improved to E scoring and other one not improved. In **Younis et al. (2015)** study, there was no deterioration of preoperative neurological function. Also, in **Sahoo et al. (2012**) series, no patient experienced neurological deterioration after undergoing this surgical approach. Sagittal alignment in the cervical spine is an important factor that should be considered in choosing the approach. Cervical injuries generally result the loss of the normal physiologic lordosis, and cervical spine is more prone to kyphosis(**Kwon et al., 2007** and **Belirgen et al., 2013**). Postoperative radiological follow up there was no malalignment, instrumentation failure or graft problems, of the studied patients. A potential explanation for this difference could be the interbody support provided by the graft in the anterior surgery. In our study, all patients (100%) lived until discharged from the hospital. Follow up showed late mortality in 16.7% of cases and late morbidity in23.3% of cases. Morbidity and mortality nearly equal to other studies, **Du Toit and Dunn. (2008), Thietjeet al. (2011), Sahoo et al. (2012) and Younis et al. (2015).**

CONCLUSION

Flexion-distraction injuries of the sub axial cervical spine comprise a broad spectrum of injury ranging from mild axial neck pain to complete spinal cord injury. Also, advanced imaging, including CT and MRI, is essential. Open ventral reduction is considered an initial choice for treatment and stabilization of cervical locked facets. Anterior surgery is providing, with less tissue damage, adequate decompression with no risk of cord injury during reduction and interbody fusion, with immediate stabilization. Also, short operative times and less blood loss and low risk of wound infection, less postoperative pain, good clinical outcome, a higher rate of radiographically demonstrable union and better radiographically proven alignment. Good health care and rehabilitation centers and good follow up of patients with cervical spine injury is strongly recommended.

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محمد حسام الدين أبو شهبة ـ هداية محمد حسن هندام ـ محمد فاروق الفارسى

قسم جراحة المخ والأعصاب ـكليه الطب بنين (دمياط) ـ جامعة الأزهر

خلفية البحث: القفل الوجيهى المفصلى يمثل 50% من إصابات الفقرات العنقية، وتعتبر حالة غير مستقرة للغاية للعمود الفقرى العنقى، وفى حاجة عاجلة لإعادة التنظيم والحد من الضغط على النخاع الشوكى، ورد و تثبيت الفقرات العنقية.

الهدف من البحث: دراسة الحالة السريرية المحتملة، و تقييم فعالية وسلامة الجراحة الأمامية لتخفيف الضغط على النخاع الشوكى والحد منه، ورد الوجيهات المفصلية المقفلة، وتثبيت الفقرات العنقية الأمامية مع مراجعة الأبحاث المتعلقة به .

المرضى وطرق البحث: تمت دراسة ثلاثين مريضاً مصابين بحالة غير مستقرة وتم التدخل الجراحى الأمامى لرد الوجهيات المفصلية المقفلة للفقرات العنقية تحت المحورية. وقد خضع جميع المرضى للفحص الإكلينيكى العام والعصبى، وتم عمل الفحوص المعملية اللازمة قبل الجراحة، والأشعات العادية والمقطعية وفحص الرنين المغناطيسى على الفقرات العنقية. وقد تم تقييم المرضى بعد الجراحة لمدة عام كامل.

النتائج: شملت هذه الدراسة ثلاثين مريضاً(21 رجلاً و9 من النساء) متوسط أعمارهم 39,3 سنة. وكانت حوادث الطرق أكثر أسباب الإصابة فى 23 حالة. واشتكى جميع المرضى من آلام بالرقبة والفقرات العنقية وقصور عصبى فى 23 مريضاً منهم 19 (82,6%) مصابون بالناحيتين، وكان أكثر المستويات تأثراً هو السادس والسابع فى 10 حالات (33,3%). وقد لوحظ إنزلاقاً غضروفياً عنقياً مصاحباً للإصابة فى 23 حالة (76,6%) متأثراً فى الناحيتين، و4 حالات متأثرة فى ناحية واحدة . وقد تم علاج كل المرضى عن طريق التدخل الجراحى الأمامى للفقرات العنقية، وكان متوسط وقت الجراحة 150 دقيقة، وكمية الدم المفقود أثناء الجراحة 100 مل ولم تسجل مضاعفات أثناء الجراحة إلا حالة واحدة حدث لها رشح للسائل النخاعى.

الإستنتاج: يعتبر التدخل الجراحى الأمامى للفقرات العنقية لرد الوجهيات المفصلية الصدمية تحت المحورية أول الإختيارات لعلاج هذه الحالات لأنه يصاحبه مضاعفات قليلة وفوائد ومنافع كثيرة للمريض.