

## Research Article

### Occipito-Cervical Fixation Surgical Experience

Ramadan Shamseldien<sup>1\*</sup> and Hedaya Hendam<sup>2</sup>

<sup>1</sup>Department of Neurosurgery, Shebin Elkom Teaching Hospital, Al Minufiyah, Egypt

<sup>2</sup>Department of Neurosurgery, Alazhar Faculty of Medicine, Damitta Branch, Egypt

#### Abstract

**Background:** Occipito-cervical lesions not uncommon but usually fatal conditions. Pain, limitation of movements, and weakness, were the main complaints of patients with upper cervical lesions. Internal fixation and fusion almost is a successful way for treatment by different means. CT scan is the imaging modality of choice for evaluation.

**Aim:** To present our surgical experience in occipito-cervical fixation using both lateral mass screws and subaxial cervical pedicle screws in different cases.

**Patients and Methods:** We operated 14 patients, 11 with traumatic and 3 with pathologically diagnosed occipitocervical instability. From December 2016 to June 2019. Patients presented with neck pain, limitation of neck movement, and neurological deficits. The patients investigated by standard plain X ray cervical spine, CT scan and MRI cervical spine pre-operatively, and they operated through posterior occipito-cervical fixation rod system utilizing lateral mass screws in majority of cases and pedicle screws in some others.

**Results:** The mean age of the studied cases was 39.7 years; trauma was the cause of instability in 11 patients, one with rheumatoid arthritis and two with neoplastic lesions. The mean follow up period 15 months. We used screw rod system in posterior cranio-cervical fixation with iliac bone graft and or bone substitutes utilizing lateral mass screws in majority of cases and subaxial pedicle screws in some cases without operative or post-operative complications. All our patients were improved neurologically post-operatively and no hard were failure during the follow up period.

**Conclusion:** Craniocervical instability rare and, may be fatal condition. Posterior occipito-cervical fixation when indicated can be done

\*Corresponding author: Ramadan Shamseldien, Department of Neurosurgery, Shebin Elkom Teaching Hospital, Al Minufiyah, Egypt, Tel: +20 1001251003; E-mail: ramadangelal77@gmail.com

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by various techniques. The screw rod system was the most upgraded used technique with immediate rigid fixation. Subaxial cervical pedicle screw can be utilized in certain situations with caution after thorough understanding of patient CT. Surgery in this area was possible with confident results.

**Keywords:** Lateral mass; Occipito-cervical internal fixation; Spine; Sub axial cervical pedicle screws

#### Introduction

Occipito-cervical junction anatomy has an exceptionally solid ligamentous connection between occiput (C0), C1 and C2. So it requires an extremely solid force to result in to result in occipito-cervical bony or ligamentous disruptions [1]. Injuries at this zone can occur in case of high speed injuries as motor car accidents and in elderly with neck pain and stiffness following a fall [2]. Dislocation injuries at occipito-cervical region are relatively rare and represent roughly 1% of all injuries involving the cervical spine [3]. However, these injuries are frequently serious and accordingly will in general be fatal. In fact, they are thought to be under diagnosed [4]. Conventional cervical spine plain films miss between 50- 93% of occipital condyle fractures, which are also the most common cervical spine fracture missed by radiology residents. There is a need to have a high index of suspicion of such injuries in patients with dangerous mechanism of injury as elaborated by NICE (National Institute of Clinical Excellence) guidelines [2].

There are different means to mark the instability at the level of occipitoatlantal or atlantoaxial joints. Plain radiography is usually the first-line imaging modality. Findings related to occipitoatlantal translation, lateral atlas displacement, or atlantoaxial translation can raise suspicions of instability [5]. Computed Tomography (CT) improves definition of these articulations and can also detect rotational subluxation. Magnetic Resonance Imaging (MRI) can help determine ligamentous injury, especially of the transverse atlantal ligament [6].

The first preliminary report on successful use of a screw rod stabilizing system posteriorly applied to the occipito-cervical junction was in 1996 by Jeanneret et al., [7].

In many studies, the clinical utility, safety, and effectiveness of hook-and-screw-rod and screw-and-rod instrumentation for posterior craniocervical fixation were evaluated. There is no superior definite method for occipito-cervical fusion in case of an unstable Cranio Cervical Junction (CCJ) almost all are controversial since the immediate desired rigid stabilization increasing surgical complexity and risk [8]. Sub axial cervical pedicle screw fixation is an alternate technique to lateral mass screw fixation. Although it's biomechanically superior to lateral mass screw, but data about best entry point, trajectory and safety are limited, so it's not used routinely from C3-C6. The indication of pedicle screw fixation is limited to certain conditions where rigid internal fixation cannot be achieved with conventional techniques [9].

Pre-operative planning is essential and familiarity with different surgical techniques and implants allows the surgeon to choose the correct fixation method, giving the patients the best chance to heal [10].

### Patients and Methods

This retrospective analytical study was carried out on 14 patients who underwent occipito-cervical fixation in Shebin Elkom teaching hospital between December 2016 to June 2019. Their medical records and imaging studies were reviewed. All cases had preoperative craniocervical plain X-ray, CT and MRI examination. Preoperative traction was performed in two patients; one patient with trauma and the other with rheumatoid arthritis. All patients have rigid neck collar postoperatively until fusion was achieved. All patients underwent occipito-cervical fixation surgery with screw rod fixation systems and autologous bone grafts for fusion utilizing lateral mass screws in majority of cases and pedicle screws in some others.

### Operative steps

The patient was turned to the prone surgical position with the head rested on myfield head fixator maintaining neutral head position. The incisions were at midline, from external occipital protuberance to lower cervical area. After adequate exposure of sub occipital and posterior cervical areas. The methods used for occipito-cervical fixation was screw-rod system in all cases. Cervical laminectomy was done in three cases depending on the clinical and radiological findings. We used lateral mass screws in most of the cases and pedicle screws involving C2 and C3 and C4, to keep accepted lordotic craniocervical junction. Finally, the autologous bone grafts harvested from posterior iliac crest were put between C1 and C2 or posterolaterally with or without bone substitute posterolaterally.

### Follow up

The Frankel grade (Table 1) was used to assess neurological state preoperatively and postoperatively. Fusion was assessed by plain cervical X-ray films and CT scan. Fusion was defined as successful if 2 criteria were met: (1) there was no relative movement between the fused motion segments in dynamic views of cervical X-ray; (2) the bone grafts became a uniform bone mass in imaging studies. The mean follow-up period was 15 months.

Frankel grade	No. of cases	Preop.	Postop.
A=complete paralysis		-	-
B= sensory function only below the injury level		-	-
C=incomplete motor function below injury level		7	-
D=fair to good motor function below injury level		6	-
E= normal function		1	12

**Table 1:** Frankel classification of 10 patients with occipitocervical instability.

### Results

There were 11 males and 3 females, and their ages ranged from 16 to 67 years with mean age of 39.7 years. 11 patients with traumatic pathology (4 road traffic accident, 4 falls from height, 2 diving injury and one fire arm injury), two neoplastic lesions and one rheumatoid arthritis. These patients were followed mainly for 15 months. About

the clinical presentation, all patients had presented with neck pain before surgery, 7 patients with Frankel grade C, and 6 patients had presented with Frankel grade D and one grade E. All patients were improved post-operatively and reach to Frankel grade E from grade C and D pre-operatively, without neurological deficits. (Frankel classification of these 14 patients is shown in Tables 1-5).

	No of cases
14	
39.7	mean
67	maximum
16	minimum
15.12	St. deviation

**Table 2**

Male	Female
11	3
78.60%	21.40%

**Table 3**

**Tables 2,3:** Demographic data of the studied group.

Type of lesion	No
traumatic	11
Rheumatoid	1
neoplastic	2
infectious	non

**Table 4**

Mood of trauma	No
Road traffic accidents	4
Falling from height	4
Diving injury	2
Firearm injury	1

**Table 5**

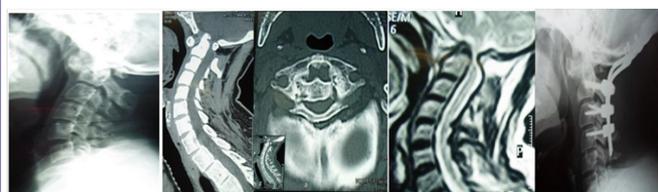
**Tables 4,5:** Type of lesions and mood of trauma among studied group.

In two cases with neoplastic lesion C2 bypassed and instead C3 and C4 pedicle screws inserted to get more firm stabilization with the occiput.

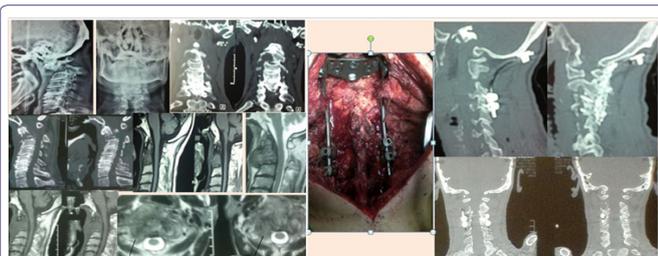
As regard to the radiological finding of these cases: Two patients had destructive neoplastic lesion in C2 body. One of them left pedicle involved with evident cord compression, proved post-operatively plasmacytoma, while the other the right pedicle involved and proved postoperative histopathological diagnosis lung metastasis. One patient diagnosed pre-operatively as rheumatoid arthritis presented by well-formed pannus and ventral cord compression. The remaining 11 traumatic patients radiologically diagnosed as 7 cases with Type II odontoid fracture and 3 cases burst fracture C1 and one case fire arm injury with complex fracture of C1 with C2. These patients operated through posterior occipito-cervical fixation using screws-rod systems. Post-operatively all cases were followed for stability of the hard ware fixation system and efficacy of bone fusion in regular visit. There was no hard ware failure of the used screws rod system with accepted bony fusion in 10 traumatic cases, poor fusion in rheumatoid arthritis

case and no observed fusion in the neoplastic case during the short period of follow up. There were no intra-operative or post-operative complications, no significant operative blood loss (Case 1 and 2).

### Case presentation



**Case 1:** Male patient 43ys falling injury. plain X-ray of cervical spine lateral view with anterior and upward displacement of the dens, sagittal reconstruction CT scan with evident upward migration and posterior displacement of the dens, axial CT scan cut opposite C1 with narrowed anteroposterior diameter, MRI sagittal view with marked upper cervical spinal cord compression and post operative plain X-ray of OC fixation BY screw rod system included the occiput and C2 C3 and C4 with laminectomy C1 and foramen magnum decompression.



**Case 2:** Male patient 64years old presented with neck pain, dysphagia and Right upper limb monoparesis. Plain radiography show C2 disturbed anatomy and instability, CT show detailed bony lesion destruction of C2 and MRI show anterior retropharyngeal and right posterior neural encroachment. Operated posterior craniocervical fixation and right transpedicular intralaminar decompression. The pathology was large cell lung carcinoma metastasis.

### Discussion

The atlantoaxial complex is more easily destabilized in certain pathological conditions. Significant atlantoaxial instability is a potentially serious progressive condition that, if untreated, may result in local pain, myelopathy or ultimately death [11]. The success of craniocervical junction surgery depends up on adequate reduction, decompression of craniovertebral junction followed by immediate fixation of atlantoaxial joint with bone grafting and compression for solid bony fusion [1]. Occipito-cervical fixation is indicated for occipito-cervical instability or atlantoaxial instability where the patient is not candidate for the atlantoaxial arthrodesis [10,12]. The screw-based construct provides immediate postoperative stability, so post-operative rigid external fixation is not needed in most cases, which makes patients more comfortable. This construct provides more rigidity biomechanically than the wire-rod construct, and can be applied to patients whose posterior elements are defective or need to be removed for decompression. The disadvantages include potential vertebral artery and cervical root injury due to cervical screw purchase. In contrast, the screw-rod system is more rigid biomechanically [13]. The rod is contoured only in the sagittal plane, and the cervical screw can be inserted from its ideal entry point, resulting in optimal screw purchase with less incidence of neurovascular tissue injury. The rod is

secured in an occipital plate fixed in the sub occipital midline ridge, which provides the strongest pullout strength for occipital fixation. In our experience, the screw-rod device offers some advantages, including strong occipital screw purchase, ideal cervical screw entry, easy contour of the rod to fit the occipito cervical curvature, and allowing cervical decompressive procedures [14].

Although pedicle screws biomechanically superior to lateral mass screw, data about best entry point, trajectory and safety are limited, so it's not used routinely from C3-C6, and its indication is limited to certain conditions where rigid internal fixation cannot be achieved with conventional techniques [9]. So in this series cervical pedicle screws were utilized at C3 and C4 levels in tow patients, suffering neoplastic lesion at C2, to get more firm stabilization with the occiput.

As regard to our patient's number (14) was small like other series [4,11,14,15] and males were dominant in all series. The main age (39.7 years) of our patients was younger than in other series. The clinical presentation of our patients was of no difference of other series due to rarity of the cases. We used Frankle grading scale in clinical evaluation in agree with others as Ihab et al., 2011, but another authors use Nurick scale [14] or Japanias orthopedic association score [4]. The indications for posterior occipito-cervical fixation were the same with all authors with different concepts about the used construct, with priority to the screw rod systems for fixation. In our series there were no intra-operative, post-operative complications nor surgery related deaths. This agreed of George et al 2011 series, and with both series of Yu et al., 2009, and Vinu et al., 2016, except for single case post-operative infection in each series. Hirsch et al., 2014, also recorded one case of failed fusion related to post-operative infection. Byung et al 2010, reported one case of vertebral artery injury during the operation, and Ihab et al., 2011, reported 3 cases with post-operative transient neurological deterioration, two cases had superficial wound infection and CSF leak occurred in one case. Byung et al., 2010 also reported one patient died 2 months after surgery because pneumonia and sepsis. Bony fusion along short time of follow up (about fourteen months) was achieved in 10 patients who were similar or nearly equal to other series.

### Conclusion

Craniocervical instability was rare condition, with miss diagnosis and may be fatal condition. Posterior occipito-cervical fixation when indicated can be done by various techniques. The screw rod system was the most upgraded used technique with immediate rigid fixation. The bone fusion was essential in these techniques to save grad against delayed hard ware failure. Pre-operative anatomical orientation by the craniocervical junction and screws occipital, lateral mass or pedicular entry points, with highly indicated patients for craniocervical fixation were the main points for successful surgery. Subaxial cervical pedicle screw can be utilized in certain situations with caution, as an alternate to lateral mass screw after thorough understanding of patient CT. Surgery in this area was possible with confident results.

### Conflict of Interest Statement

The authors whose names are listed immediately below certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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