Subaxial lateral mass fixation in management of cervical spine diseases.

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The Short Title

Subaxial lateral mass fixation.

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Keywords:

Cervical fixation - Lateral mass screw - Cervical fracture - Roy-Camille technique - Magerl technique.

Abstract:

Background: Posterior cervical fixation with lateral mass screws has been increasingly used since the concept was first described by Roy-Camille in 1979. Lateral mass screw fixation has advantages over standard wiring techniques, including the ability to instrument with laminectomy, the ability to do multiple levels easily, the ability to extend constructs cranially or caudally and biomechanical superiority.

Aim of work: This study aims at evaluating the outcome and complications of lateral mass fixation with screw-rod system in subaxial cervical spine in various pathologies with the help of preoperative CT spine.

Methods: A prospective study of total 94 lateral mass screws was placed in 13 patients (5 females and 8 males) in Sohag University hospital. All cases were performed with a polyaxial screw-rod construct. Pre-operative multislice CT cervical spine was used to

choose the technique and screw length for each lateral mass. We used either Magerl's or Roy-Camille techniques. Post-op CT spine was done for all patients and followed up for 1 year period.

Results: Most patients had 14-mm length and 3.5 mm diameter screw placed for subaxial lateral mass. Magerl's technique was used in 9 patients and Roy-Camille technique in 4 patients. No patients experienced neural or vascular injury as a result of screw position. One patient had Rt C5 rediculopathy that improved over the time. No patients developed screw loosening or significant adjacent segment disease within the period of follow up.

Conclusion: Posterior cervical fixation with screw-rod system using CT spine planning is a technique that can be used safely and efficiently for a variety of cervical spine pathologies.

Introduction:

Different cervical spine pathologies became more frequent now especially in the developing countries associated with heavy works. Moreover the recent dynamic imaging study for these cervical pathologies approved presence of instability in the majority of cases. Posterior fixation of the middle and lower cervical spine (subaxial cervical spine fixation) passed through different modalities from clamping, wiring, plate/screw system and they ended by lateral mass screw/rod system which had been widely used now in management of different cervical instabilities.[1,2,3]

Lateral mass screw fixation has advantages over standard posterior wiring techniques; it can be done easily for many levels on patients with laminectomy and it can preserve the biomechanical forces.[4,5]Also it is superior to the plating system; screws-rod systems are easily to contour; screw position is not constrained by the plate's entry holes; screw back-out difficult to occur; and screws-rod systems are easily adapted for extension to the occiput or thoracic spine.[6,7]

Ever since Roy-Camille first introduced posterior cervical lateral mass screw fixation in 1979, numerous authors developed and modified it. Louis, Magerl, Anderson and An were representative of these authors.[1,8,9,10,11]. The varieties that can be found in the dimension of the lateral mass indicate the value of preoperative cervical CT and lateral mass planning for choosing the suitable perfect trajectory without harming the vascular or neural element.

Patient and Methods:

With the approval of the Ethics Committee, 13 patients had been introduced to Neurosurgery Department of Sohag University Hospital diagnosed with cervical spine diseases from January 2012 to December 2015.

Data were collected and recorded including the following information: age, gender, neurological assessment on admission, pathology of the cervical spine, and surgical outcome.

All patients presented for complete neurological examination will full radiological and imaging study including MRI cervical spine (Fig 1).

Pre-operative CT cervical spine was done to measure the lateral mass dimensions and show the screw trajectory to be safe away from the vascular and neural injury (Fig 2).

After measuring the lateral mass we choose the more fitting technique for the subaxial fixation either Roy-Camille or Magerl technique (Fig 3).

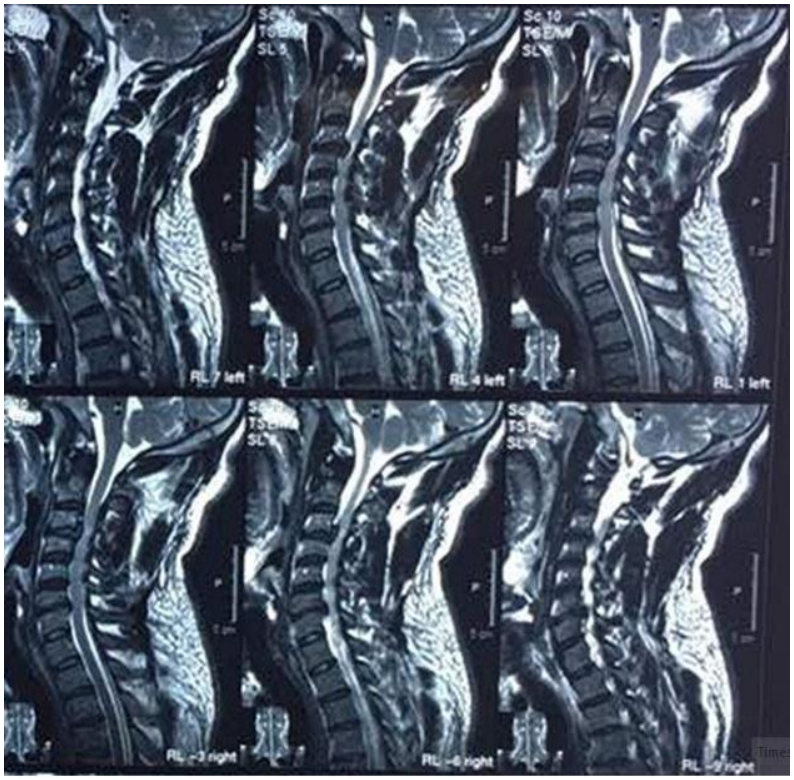

Fig (1) MRI cervical showing spondylosis with multiple disc prolapse.

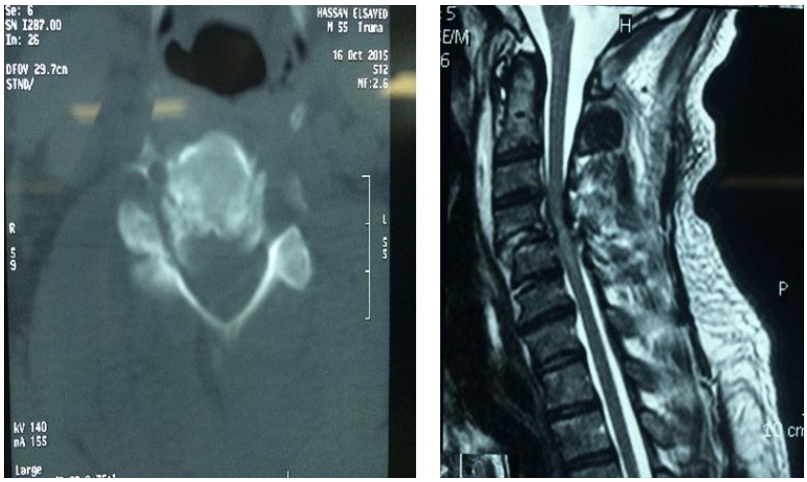

Fig (2) CT and MRI cervical spine showing post traumatic C4-5 dislocation

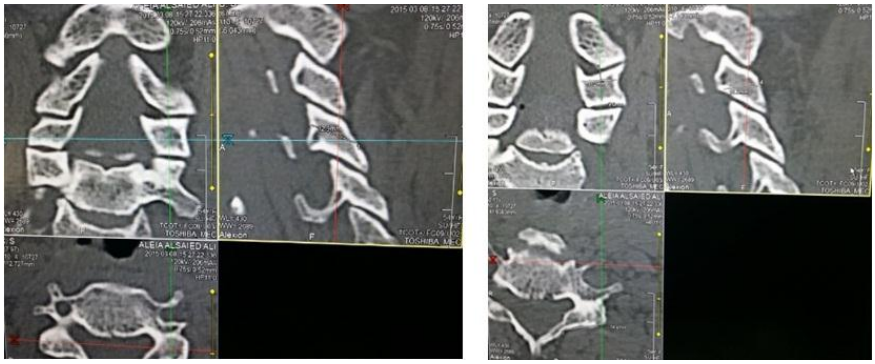

Fig (3) Pre-Op CT cervical spine showing the oblique trajectory of Magerl to be more suitable for the patient.

Surgical procedure:

Under general anesthesia with invasive blood pressure monitoring and CVP prone position using a May-field with head pins or using head rest, the alignment of the cervical spine was verified using a C-arm fluoroscope. A skin incision was made through the midline making C7, the most prominent spinal process, our landmark and extending the wound upward to the affected levels.

Using periosteal elevator, dissection of the muscle was done from the midline laterally till exposure of the outer edge of the lateral mass.

After exposure of the lateral mass the entry point should be estimated according to the using technique.

Using the technique described by Magerl [(14)], the entry point is 1-2 mm superior and medial to the midpoint of the posterior surface of the rectangular lateral mass with 20 degree to 25 degree lateral and cranial angulations parallel to the joint line of the adjacent facet to avoid injury to the vertebral artery and spinal nerve root.

Using this technique described by Roy-Camille [(20)], the entry point is the midpoint of the posterior surface of the rectangular lateral mass and the direction of the screw is to be perpendicular to the posterior aspect of the cervical spine and 10 degrees outward with screws 12 mm in length.

In the traumatic cases like facet dislocation reduction should be done before placing the rods.

Laminectomy was needed in the degenerative cervical spondylosis and the bone chips were placed over the decorticated lateral masses and into the appropriate facet joints (Fig 4). Postoperatively all patient were placed into a hard neck collar and plain x-ray and CT cervical spine was done on the first post-operative day (Fig 5).

CT cervical spine and/or X rays were used to verify the stability of cervical spine and role out any screw pull out in all patients in the period of follow up (Fig 6).

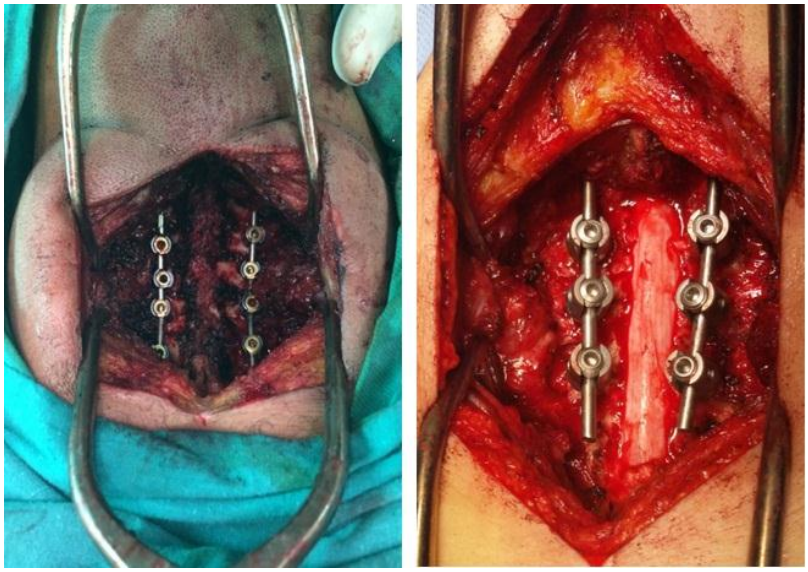

Fig (4) showing intraoperative placing of the subaxial lateral mass screws and the laminectomy was done.

Fig (5) Post-Op CT cervical spine showing good position of the lateral mass screws.

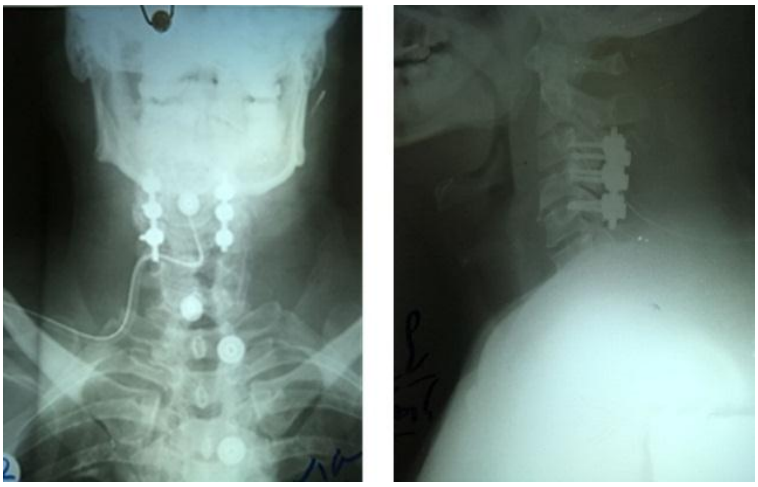

Fig (6) X ray cervical spine showing post-operative subaxial lateral mass screws for a traumatic C4-5 dislocation.

Results

In our series there is a male predominance in the incidence of cervical spine diseases (61.5%), the mean patient age was 42.3 years.

Table (1) Incidence of cervical spine disease according to sex.

Gender	No of cases
Males	8
Females	5

The cervical spine spondylosis as a degenerative disease is more common in our series than the traumatic cervical spine patients.

Table (2) incidence of cervical spine spondylosis versus traumatic instability in our series.

Pathology	Spondylosis	Traumatic facet dislocation
No of patients	10	3

Long segment subaxial lateral mass fixation was more frequent in our series starting from C3 to C6

Table (4) shows the levels included for posterior cervical screw-rod system fixation

Level	C3-C4-C5-C6	C3-C4-C5
No	**8**	**5**
Percent	**61.5%**	**38.5%**

In the assessment of the pre-operative cervical CT spine it showed well developed lateral mass with good dimensions that can harbor Magerl technique with screw length 14 mm and angulated trajectory in 9 cases while we used Roy-Camille technique in the remaining 4 cases.

C5 palsy is the most frequent complication that can be found in cases post operatively and in our series we found 1 case with Rt C5 palsy that improved by medical treatment within 3 months.

Only 2 cases showed superficial wound infection needed frequent dressing by local and systemic antibiotic and then the wound became clean and healed within 4 weeks.

We didn't experience any intraoperative vascular or neural injury in our series. Follow up period was 1 year post operatively with visit every 3 months.

Table (5) shows the complications for posterior subaxial cervical screw-rod system fixation

Complications	No.	Percent
Vertebral artery injury	**0**	**0%**
Dural tear	**0**	**0%**
CSF leak	**0**	**0%**
Root Injury secondary to screws	**0**	**0%**
Superficial infection	**2**	**20%**
Deep infection	**0**	**0%**
Screw pullout or breakage	**0**	**0%**
C5 palsy	**1**	**7.7%**
Adjacent segment disease	**0**	**0%**

Discussion:

Over the last 15 years authors considered lateral mass fixation as the procedure of choice in management of different cervical lesions with instability especially when the posterior elements are deficient. This technique involves the use of screws and rod system, which are attached to the lateral masses of the subaxial cervical spine and the pars interarticularis of C2, using polyaxial screws [15,16].

Targeting towards the lateral mass trajectory compared with other fixation techniques trajectories such as cervical pedicle screws makes it safer with higher success rate and lower co-morbidities.

In early studies with the beginning of this technique by using screw/plate system the failure rate was high in patients compared with the newer polyaxial screw/rod systems. The entry point of the screws is fixed in the screw/plate system making it semi constricted with no cross link that augment the stability of the system. In general, the newer polyaxial screw/rod systems are more constrained and avoid screw pullout [17,18,19].

Many screw entry points and directions have been described since this technique was first introduced; Roy-Camille advocated the entry point of the screw as the midpoint of the lateral mass and the direction of the screw to be perpendicular to the posterior aspect of the cervical spine and 10 degrees outward with screw 12 mm in length [20]. This what we did in our cases specially when the preoperative evaluation of the lateral mass by CT cervical spine showed small or rudimentary lateral mass.

While Magerl proposed that the starting point is 2-3 mm medial and superior to the midpoint of the lateral mass and angling 30 degrees superiorly and 25 degrees laterally with a screw length 14-16 mm due to the long trajectory with safe angulation away from the vascular and neural elements [14]. Thus we used this technique in our patient who showed well developed lateral mass in preoperative cervical spine assessment.

Other techniques for subaxial lateral mass fixation with different entry points were described. Anderson technique recommended the drilling point to be 1 mm medial to the midpoint of the lateral mass and the screw to be angled 30-40 degrees up and 10 degrees lateral[1]. An et al suggested angling 15-18 degrees superiorly and 30-33 degrees laterally, with a starting point 1 mm medial to the center of the lateral mass [8]. Pait et al divided the lateral mass into four quadrants with the upper outer quadrant is the intention for screw insertion in this way it's more likely to avoid neurovascular injury [3].

Magerl's technique with a relatively oblique sagittal angle decreases the incidence of violation of the facet joint and gives the screw more length and hence more stability making it the technique of choice in subaxial lateral mass fixation.

The number of techniques described points out the difficulty to avoid failure of the procedure and the possible complications of vascular or neural injuries. We used the pre-operative CT spine to evaluate the lateral masses for each patient and tailor the procedure for him. In this way we felt more confident to avoid complications and attain procedure success.

The risk of postoperative C5 palsy was not eliminated, and the incidence of this complication was 1.4% per screw placed. All patients in this series were thought to be stable, based on absence of motion on lateral flexion– extension radiographs and on absence of hardware breakage or migration, coupled with maintenance of alignment at 6 months follow-up.

Conclusion:

Pre-operative CT cervical spine in assessment of lateral mass dimensions is an important tool in the subaxial lateral mass fixation to be more meticulous in choosing between Magerl's trajectory and Roy Camille trajectory to be more safe and reliable for subaxial posterior cervical stabilization. It is a proper method for a wide range of cervical pathologies. With a long term follow up satisfactory results can be achieved.

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ملخص البحث

عنوان البحث:

التثبيت الخلفي بمسامير الكتلة الجانبية لعلاج أمراض الفقرات العنقية.

الباحث:

١- دكتور / عابدين خيرالله قاسم – مدرس جراحة المخ والأعصاب بكلية الطب – جامعة سوهاج

٢- دكتور / أحمد كمال عبدالحميد – مدرس جراحة المخ والأعصاب بكلية الطب – جامعة سوهاج

مقدمة:

لقد استخدم تثبيت الفقرات العنقية الخلفي بمسامير الكتلة الجانبية على نحو متزايد منذ وصف هذا الطريقة لأول مرة في عام ١٩٧٩ م. وتثبيت المسمار في الكتلة الجانبية له مزايا على تثبيت الفقرات التقليدي بالأسلاك ، بما في ذلك القدرة على التثبيت مع استئصال الحزام الخلفي للفقرات، وعلى مستويات متعددة ، والقدرة على مد التثبيت إلى أعلى أو أسفل بسهولة والتفوق الميكانيكي.

الهدف:

تهدف هذه الدراسة إلى تقييم نتائج ومضاعفات تثبيت الكتلة الجانبية للفقرات العنقية بنظام القضيب والمسامير في مختلف الأمراض بمساعدة الأشعة المقطعية.

المرضى والطرق:

تم وضع دراسة مستقبلية لمجموع ٨٤ مسامير للكتلة الجانبية في ١٢ مريضا (٧ إناث و ٥ ذكور) في مستشفى سوهاج الجامعي. وتم استخدام بالمسامير المتحركة في جميع الحالات. وتم استخدام الأشعة المقطعية للفقرات العنقية قبل العملية لاختيار الطريقة وطول المسمار لكل كتلة جانبية بطريقة ماجيرل أو روي-كاميل. وتم عمل أشعة مقطعية للفقرات العنقية بعد العملية لجميع المرضى ومتابعتهم لمدة ٦ أشهر.

النتائج:

كان طول المسمار في معظم المرضى ١٤ ملم و قطره ٣.٥ مم. ولم يعاني أي مريض من إصابة عصبية أو وعائية نتيجة لتثبيت المسامير. وعانى مريض واحد من عطب العصب الفقاري الخامس الأيمن والذي تحسن بمرور الوقت. ولم يصب أي مريض بخلع المسمار أو مرض الفقرات المجاورة خلال فترة المتابعة .

الاستنتاج:

يمكن استخدام التثبيت الخلفي بمسامير الكتلة الجانبية بمساعدة الأشعة المقطعية بأمان وكفاءة لمجموعة متنوعة من أمراض الفقرات العنقية.

الكلمات الإفتتاحية:

التثبيت الخلفي بمسامير الكتلة الجانبية - مسمار الكتلة الجانبية - كسر الفقرات العنقية - تقنية روي-كاميل - تقنية ماجيرل.