

Original Article

Stabilization of metastatic lesions affecting the second cervical vertebra

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Abstract

Purpose: Metastatic spine disease is an ever-increasing burden on health care systems. Certain levels in the spine confer unique biomechanical characteristics and hence are of interest. Isolated C2 lesions are rare. We aimed to review our results in surgical management of C2 lesions. **Materials and Methods:** We reviewed all surgical stabilizations of metastatic spine lesions over the preceding 4 years. Six patients with C2 lesions were identified. Of these five underwent surgical stabilization primarily for disease affecting the second cervical vertebra. Case notes and radiology were reviewed to determine presentation, outcomes and complications. **Results:** Cases were treated primarily by posterior instrumentation from either occiput or C1 to the subaxial cervical spine. The median survivorship after surgery was 283 days. There were no cases of infection, VTE or implant failure. There were no cases of neurologic deterioration with all maintaining Frankel E grading. **Conclusion:** Metastatic lesions affecting the second cervical vertebra are rare. A variety of stabilization options tailored to the individual lesions, including occipitocervical fixation, in this small series was successful in maintaining stability and resolution of symptoms.

Key words: Axis, metastasis, instability, neoplasia

INTRODUCTION

Metastatic disease to the spine is an ever-increasing problem as the treatment modalities available in oncology continue to improve and as a result the life expectancy of the patient.^[1] A higher proportion of metastatic disease spreads to the thoracic and lumbar spine where the blood supply and the total volume of bone are greater. Metastatic disease affecting the cervical spine is less common and that affecting the axis even less common again.^[2,3]

It is estimated that approximately 0.5-1% of spinal metastatic lesions affect the craniocervical junction of which the C2 vertebra

is a single component.^[3] Lesions at this level have the potential to cause significant morbidity. In addition to mechanical pain as a result of the diseased vertebra and the possible radicular pain, catastrophic collapse at this level due to instability clearly poses a danger.^[2-4] As a junctional level, metastatic disease at the C2 level carries greater weighting when considering the potential for instability as a result of the bony disease.^[5,6]

Due to the rare presentation of C2 metastases there is a paucity of data available to determine what the optimum treatment is although it is accepted that surgical intervention has a clear role to play.^[7-12] A small number of papers focus on the treatment of C2 metastatic disease and a subsection have reported predominantly on vertebroplasty as an isolated treatment modality.^[13-15] The aim of this paper is to report on our unit's experience in surgical management of metastatic lesions occurring in the C2 vertebra.

MATERIALS AND METHODS

The operative logs of three spine surgeons were reviewed over the period January 2010 through to January 2014 inclusive.

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Over this period 125 metastatic spinal lesions were operated on. Six of these (4.8%) were metastatic lesions located in the C2 vertebral body.

We reviewed all clinical and radiographic records on the five patients. Clinical records were reviewed to determine presentation, primary tumor pathology, disease burden, surgical intervention and clinical outcome. All patients were worked up radiographically with plain radiographs, computed tomography (CT) and magnetic resonance imaging (MRI). Radiographic records were reviewed to determine evidence of instability and maintenance of fixation. Together, records were used to calculate the Oswestry Spinal Risk Index scores, revised Tokuhashi scores and the Spinal Instability in Neoplasia Score (SINS).^[5,16,17] Survivorship was recorded in days as time from stabilization of the C2 metastasis to the time of death.

Six patients underwent treatment for C2 lesions (three male). Of these one underwent vertebroplasty alone for the C2 lesion at the same setting as C4 vertebrectomy and stabilization — as the C2 procedure was a consideration in conjunction with a more unstable lesion we excluded this case from further reporting here thus five cases are considered in total.

The mean age at presentations and subsequent intervention was 72 years (range 54-89). Table 1 shows the basic details of each patient, presenting complaints, histology and includes the calculated survival scores where possible. Most cases were a result of metastatic breast cancer whilst Patient 1, while having a history of melanoma, had no record of bony metastases and surgical specimens returned as carcinoma of unknown origin. Complete details of disease burden were not always available at the time of presentation to allow all prognostic scores to be calculated — a factor that has been considered a weakness before.^[18]

Details regarding the operative intervention and SINS scoring are shown in Table 2. Occiput specific plates were used in

cases of fixation to the skull while lateral mass screws were used in all cases for caudad fixation. Lateral mass screws were inserted at C1 only in case 3. C2 was not instrumented in any case due to perceived poor fix in what was generally lytic bone. Figures 1 and 2 demonstrate two cases.

RESULTS

The median survival for patient undergoing surgical intervention was 283 days. When the patient with multiple myeloma, who is still alive, was excluded this dropped to 264 days.

All patients were Frankel grade E prior to surgery and there were no deteriorations in this post-operatively. Patient 1 initially underwent vertebroplasty of the C2 lesion via an open anterior approach. His pain failed to fully resolve after this and as there was persistent radiologic evidence of instability and pain the decision was made to additionally stabilise posteriorly. Patient 5 had a significant kyphotic deformity at the level of the C1-2 articulation and was placed in traction using J-tongs for a 9-day period prior to stabilization.

Patient 3 had persistent occipital neuralgia following surgical stabilization and required trigger point injections early in the post-operative course. There was no loss of fixation or subsequent deformity although the follow-up period was short for some of the cases.

Two patients (3 and 4) both underwent posterior decompression and stabilization of their thoracic spine for metastatic disease — one prior to the C2 stabilization and another presenting with metastatic cord compression 6 months after. Patient 4 has previously undergone an anterior C6 corpectomy with reconstruction using a cage, autologous graft and anterior plating.

One patient had a survival of only 15 days and did not survive to discharge. They suffered a massive gastrointestinal bleed related

Table 1: Demographics, presenting complaints, risk scores and survival for the cohort

Patient	Age	Gender	Histology	Presenting complaint	OSRI	Tokuhashi	Survival (days)
1	89	M	Unknown carcinoma	Axial pain	5	5*	244
2	54	M	Multiple myeloma	Occipital neuralgia	1		1348*
3	61	F	Breast	Occipital neuralgia	1	10*	283
4	72	F	Breast	Axial pain	2	8*	69
5	63	F	Breast	Axial pain	2	8*	15

OSRI = Oswestry spinal risk index; *indicates that scoring is incomplete due to a lack of completed investigations at the time of surgery

Table 2: Surgical details of the five cases

Patient	SINS	Approach	Instrumentation	Hb change (g/dL)	Transfusion
1	12	Anterior	Vertebroplasty	—	0
1	12	Posterior	Occiput-C5	—	4 RCC
2	12	Posterior	Occiput-C6	-3.1	0
3	12	Posterior	Occiput-C4	-0.4	0
4	9	Anterior	Vertebroplasty	-1.1	0
5	14	Posterior	C1-C4	-3.6	2 RCC

The change in Hb for Case 1 was not clearly documented; RCC = Red cell concentrate

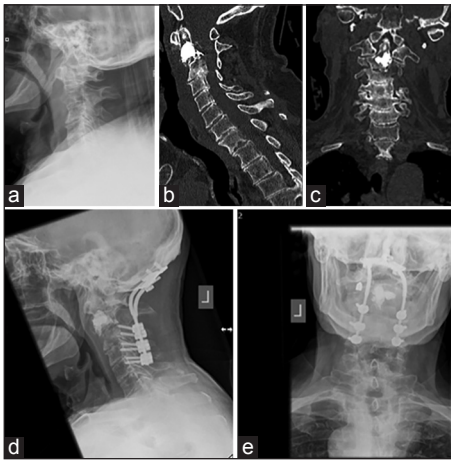


Figure 1: Images from Patient 1. Pre-operative lateral radiograph of the cervical spine (a). Persistent instability was felt to be present despite vertebroplasty on reviewing the CT (b and c) so surgical stabilization was elected (d and e)

to the oncologic disease. The remaining patients all received radiotherapy under the guidance of the radiation oncology team once the surgical wound was healed. There were neither surgical site infections nor cases of venous thromboembolism. Radiographically there were no failures of fixation during the follow-up period.

DISCUSSION

Little is published focussing on surgical intervention on metastatic disease to the C2 vertebra.^[8-12] We report here the details of five separate operative cases including one undergoing vertebroplasty alone via an open anterior approach. All patients had pain relief from the procedure although one had persistent intractable occipital neuralgia that required specialist input from the hospital pain service and palliative care teams. Significantly no patient suffered neurologically and all maintained their preoperative ambulatory status at least in the initial post-operative period.

The reported incidence of metastatic disease to the C2 vertebra is low.^[3] Almost 5% of cases that underwent surgical stabilization in our series were for lesions of C2, which is perhaps somewhat higher than expected. However, metastatic deposits at the craniocervical junction do represent a higher risk of catastrophic injury should the spine fail under load.^[3] The potential complications of instability at this level compared to caudal levels likely influences the decision to operate.

Sixty percent of cases in our series were a result of metastatic breast disease — this is not indifferent to the reported rate in the literature near 35% for the craniocervical junction.^[9,19] We acknowledge though that it is difficult to draw any real conclusion, as our series is small. We found a median survivorship of 283, dropping to 264 days when the single case with myeloma was excluded. This is similar to the 6 month survivorship reported by Fournery *et al.*^[17]



Figure 2: images from Patient 2. Pre-operative lateral radiograph (a). MRI (b and c) and CT (d and e) are part of the standard work-up prior to surgical stabilization with post-operative images (f)

Bilsky *et al.*, have reported on a small number of C2 lesions and recommend that posterior stabilization be performed for those that fail non-operative treatment including external beam radiotherapy (EBRT).^[8] Likewise Fournery *et al.*, also recommend a posterior only approach and have found that posterior stabilization, without anterior decompression, lasted the lifetime of the patient.^[9] In our series, with the exception of one patient, the remaining three who underwent posterior stabilization were all discharged ambulatory and in comfort without any fixation failures.

Anterior or transoral routes clearly confer certain risks including wound difficulties and surgical site infections with oral organisms. More recently a combined approach using occipitocervical fixation supplemented by vertebroplasty has been reported with success.^[20] The need for occipital fixation can be debated but in patients with systemic disease, poor bone stock and likely poor tolerance of repeated surgical interventions when quality of life is paramount confidence in the fixation used is essential.

More aggressive techniques have also been reported including transpedicular corpectomy. Eleraky *et al.*, reported a series of five cases including metastases from renal cancer without fixation failure and without neurologic deterioration.^[21] A lateral approach between the sternocleidomastoid and internal jugular vein is also feasible as reported by George *et al.*^[4] In their series of 41, four cases were of plasmacytoma infiltrating the axis. Proponents of this approach cite better control of the vertebral artery and feeding vessels to the tumor.

Previous reports on intervention for C2 metastatic disease have also focussed on the use of vertebroplasty with a variety of different techniques reports.^[13-15,20,22-24] We used this technique in two patients but in one found that sufficient stability was not achieved. In both cases an anterior approach was utilised with passage of the needle to C2, as one would do when passing an odontoid screw for fracture fixation. The attractiveness of this vertebroplasty we agree is the potential for a less-invasive

procedure and more rapid recovery. This is also a technique, when done in a minimally invasive fashion may be more suitable to the very-unwell patient. More aggressive techniques such as reconstruction of both the anterior and posterior columns naturally carry greater morbidity but also have the potential to result in a biomechanically sounder construct.^[9,21,25,26]

Although the inclusion of one with multiple myeloma is contentious, we chose to include it as the disease process resulted in clinical and radiographic instability. We agree though that the underlying disease is not as aggressive as in the other truly metastatic processes and in general the survivorship can be expected to be much greater.^[17] Indeed assessing survivorship prior to intervention, is not only fraught with difficulty, is sometimes not possible using existing classification systems. As noted elsewhere, using the Tokuhashi score in an acute setting is not always feasible as the required investigations are often not complete — this was evident even in this small series where none of the cases had a complete set of investigations at the time of surgical stabilization that would allow calculation.^[18]

In summary, we report a small series of surgical intervention for stabilization of C2 vertebral metastases. These lesions represent a small proportion of metastatic disease to the spine but when instability is encountered can be successfully treated with a variety of stabilization options including posterior stabilization from the occiput down.

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