Overlooked Metastatic Lesions of the Occipital Condyle: A Missed Case Treasure Trove

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Radiologic images obtained in nine patients with known primary cancer and occipital or head and neck pain were retrospectively reviewed after having been initially interpreted as normal. Imaging studies included head computed tomography (CT) in five cases, brain magnetic resonance (MR) imaging in six cases, cervical spine CT and MR imaging in five cases, radiography in two cases, and scintigraphy in two cases. This reevaluation demonstrated lesions of the occipital condyles in all patients. Seven patients had unilateral occipital condyle masses, and two patients had bilateral condyle lesions. Lesions were found to either involve only the occipital condyle \((n = 4)\), extend to the adjacent occipital bone \((n = 3)\), or extend to the ipsilateral clivus \((n = 2)\). Misinterpretation of radiologic examinations resulted in an average delay in diagnosis of 10 weeks from the onset of symptoms to definitive therapy (irradiation). It is important to evaluate the occipital condyles in all patients with occipital pain, especially those with cancer. Neoplastic disease involving the occipital condyles is not common; however, it is frequently missed at imaging. Careful review of unenhanced sagittal and axial T1-weighted MR images and of the inferior sections from axial head CT studies will make it possible to avoid this potential pitfall.

■ INTRODUCTION
Disease of the occipital bones, specifically the occipital condyles, is relatively uncommon and often not suspected. The craniovertebral junction and the occipital condyles are usually included in all brain and cervical spine radiologic studies (Fig 1). However, because it is unusual for a physician to specifically request evaluation of the occipital condyles, and because these small structures are frequently seen only at the edge of radiologic images (the inferior sections of an axial brain MR or CT series of images and the lateral sections of a sagittal cervical spine MR study), they are often overlooked. For similar reasons, abnormalities involving the occipital condyles are frequently missed at radiologic examination, even by experienced radiologists.

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Figure 1. Normal anatomy of the occipital condyles at the craniovertebral junction. (a) Sagittal reformatteled computed tomographic (CT) scan of the cervical spine shows the occipital condyles (arrows) as inferior extensions of the occipital bones that articulate with the lateral masses of C-1. (b, c) Sagittal T1-weighted (repetition time msec/echo time msec = 600/11) (b) and axial T1-weighted (600/17) (c) magnetic resonance (MR) images demonstrate the normal appearance of the occipital condyles, with hyperintense fat throughout the marrow (*) and hypointense cortical margins.

Fractures of the occipital condyle caused by serious trauma are the most common intrinsic lesions of this structure reported in the literature (1-5). Little has been published on neoplastic disease involving the occipital condyles; only rarely have case studies of primary benign or malignant tumors involving the occipital bones been documented (4,6-9). Furthermore, metastatic disease to the occipital condyles has rarely been reported (10,11). One such case involved progressive unilateral occipital pain syndrome associated with ipsilateral tongue paralysis secondary to metastatic disease involving the occipital condyle (10), a situation similar to that of several patients in our study. Metastatic hepatocellular carcinoma was reported in another patient (11). Although osseous metastases to almost every bone in the body are widely discussed in the literature, the occurrence and significance of metastatic disease to the occipital condyles are not addressed.

In this article, we demonstrate that evaluation of the craniovertebral junction, including the occipital condyles, should be a routine part of all brain and cervical spine radiologic examinations, especially in patients with cancer or occipital pain.

**MATERIALS AND METHODS**

Our study group consisted of nine patients whose radiologic studies of the spine or brain were initially interpreted as normal but who all ultimately were believed to have metastases to the occipital condyles.
In all cases, radiologic images were retrospectively reviewed by a neuroradiologist. In four cases, these findings were reviewed after subsequent imaging showed a skull base lesion. Five cases came to the attention of the radiologist when clinicians (neurologists or oncologists) brought the images for rereview because of progressive symptoms referable to the occipital region without a clear cause.

The nine patients (seven men, two women) ranging in age from 47 years to 82 years (mean, 59.1 years) were seen at our institution over an 8-month period. All patients had a known primary cancer. Four patients had primary adenocarcinomas of the gastrointestinal tract (colonic in three, gastroesophageal in one), two patients had prostate carcinoma, and one patient each had head and neck carcinoma, renal carcinoma, and breast carcinoma. Four patients had previously known metastatic disease; in three cases, this disease involved the bones. In five patients, symptoms related to occipital condyle lesions represented the first manifestation of presumed metastatic disease (Table 1).

<table>
<thead>
<tr>
<th>Patient/Sex/Age (y)</th>
<th>Primary Cancer</th>
<th>Symptoms Leading to Imaging</th>
<th>Location of Lesion</th>
<th>Occurrence of Metastasis</th>
<th>Radiologic Examinations Misinterpreted as Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/F/58</td>
<td>Head and neck</td>
<td>2 mo failure to thrive, headache, low oral intake</td>
<td>Bilateral</td>
<td>First manifestation of metastatic disease</td>
<td>Brain MR imaging</td>
</tr>
<tr>
<td>2/M/50</td>
<td>Colon</td>
<td>3 mo headache, right occipital pain</td>
<td>Right</td>
<td>Prior liver, lung, bone metastases</td>
<td>Head CT</td>
</tr>
<tr>
<td>3/M/47</td>
<td>Renal</td>
<td>6 wk right neck pain and headache, slurred speech</td>
<td>Right</td>
<td>Prior lung metastases resected, isolated bone metastases</td>
<td>Brain MR imaging, cervical MR imaging, scintigraphy, plain radiography</td>
</tr>
<tr>
<td>4/F/48</td>
<td>Breast</td>
<td>Right occipital and neck pain</td>
<td>Right</td>
<td>Prior bone and brain metastases</td>
<td>Brain MR imaging, cervical MR imaging</td>
</tr>
<tr>
<td>5/M/82</td>
<td>Colon</td>
<td>Headache, right occipital and neck pain</td>
<td>Right</td>
<td>Prior inguinal nodal metastases</td>
<td>Brain MR imaging, cervical MR imaging, head CT, cervical CT</td>
</tr>
<tr>
<td>6/M/52</td>
<td>Gastroesophageal</td>
<td>Left neck and face pain, headache</td>
<td>Left</td>
<td>First manifestation of metastatic disease</td>
<td>Brain MR imaging, plain radiography, scintigraphy</td>
</tr>
<tr>
<td>7/M/54</td>
<td>Colon</td>
<td>Headache, left occipital pain</td>
<td>Left</td>
<td>First manifestation of metastatic disease</td>
<td>Head CT</td>
</tr>
<tr>
<td>8/M/73</td>
<td>Prostate</td>
<td>Right occipital pain</td>
<td>Right</td>
<td>First manifestation of metastatic disease, isolated bone metastases</td>
<td>Brain MR imaging, head CT</td>
</tr>
<tr>
<td>9/M/68</td>
<td>Prostate</td>
<td>Neck pain</td>
<td>Bilateral</td>
<td>First manifestation of metastatic disease</td>
<td>Cervical MR imaging, head CT</td>
</tr>
</tbody>
</table>
All patients in our study presented with similar but nonspecific complaints, including progressive occipital pain, headaches, neck pain, or tongue symptoms (weakness or fasciculations), that led to radiologic evaluation. Five patients complained specifically of occipital head pain associated with headache or neck pain on the side of involvement. The remaining four patients complained of more diffuse head and neck pain. One patient complained of slurred speech and tongue fasciculations related to hypoglossal nerve palsy (Table 1).

All patients were evaluated with multiple imaging studies including head CT studies in five patients and MR imaging examinations of the brain and cervical spine in six and four patients, respectively. One cervical spine CT study, two plain radiographic studies (one each of the cervical spine and skull base), and two scintigraphic studies were also performed.

All brain and cervical spine MR imaging was performed on a 1.5-T system. Three brain and two cervical spine examinations were performed at outside hospitals. All brain examinations included 5-mm-thick sagittal T1-weighted (500-600/10-25) images and 5-mm-thick contrast material–enhanced axial T1-weighted images with similar acquisition parameters obtained through the entire calvaria including the occipital condyles. Cervical spine MR studies consisted of 3-mm-thick sagittal T1-weighted (500/11-17) and T2-weighted (2,700-4,000/17-25, 80-90) images that included the occipital condyles. In all cervical spine MR studies, axial three-dimensional Fourier transform (50/11-13, 5° flip angle) gradient-echo volume images included the area from the C-2 level to the cervicothoracic junction, thereby excluding the condyles.

All head CT studies were performed at our institution with a helical or quick GE 9800 scanner (GE Medical Systems, Milwaukee, Wis) and consisted of 3-mm-thick axial images from the atlantodental articulation through the posterior fossa, followed by 10-mm-thick axial images through the remainder of the brain. Two sets of images were obtained at each CT examination, one optimizing bone detail and the other optimizing evaluation of the brain parenchyma. The cervical spine CT study, which was performed at an outside institution, included contiguous 3-mm-thick axial images through the craniocervical junction that were photographed for soft-tissue and bone detail.

All brain MR imaging studies included sections obtained after intravenous administration of 0.1 mmol/kg of gadopentetate dimeglumine, and all head CT examinations included scans obtained after intravenous administration of 100 mL of iodinated contrast material. CT and MR imaging examinations of the spine were not contrast-enhanced.

In the two patients whose work-up included plain radiography, anteroposterior, lateral, and oblique views of the cervical spine as well as multiple views of the skull were obtained.

In the two patients who underwent scintigraphy, delayed images were obtained 2 hours after intravenous injection of 20 mCi (0.074 \times 10^{10} Bq) of technetium-99m diphosphonate.

All brain MR and head CT images were assessed for lesions of the occipital condyles or other calvarial bones, associated extraosseous soft-tissue masses, and soft tissue in the hypoglossal canal and jugular foramen. We also looked for other findings including secondary manifestations of cranial neuropathies (fatty replacement of the tongue for the twelfth cranial nerve and deviation of the soft palate or pharynx for the ninth and tenth cranial nerves). The sagittal MR (n = 4) and CT (n = 1, reformatted from axial sections) images of the cervical spine were evaluated for condylar lesions. Radiographs and scintigrams obtained in two cases each were rereviewed for the presence of occipital condyle lesions.

The medical records of eight of the nine patients were reviewed; one patient's chart was not available for review. Each chart was evaluated in terms of patient age and sex; site of primary carcinoma; symptoms and findings at physical examination (eg, occipital pain, neck pain, neuropathies involving cranial nerves IX-XII); history of metastatic disease; and treatment and outcome.
Figures 2, 3. (2) Patient 5. Axial CT scan shows a focal lytic lesion with cortical irregularity of the right occipital condyle (arrowheads). The left condyle (N) is normal. (3) Patient 2. Axial head CT scan shows a mottled lytic lesion with cortical destruction of the right occipital condyle extending into the occipital bone (arrows).

Table 2
Clinical Sequelae of Delay in Diagnosis

<table>
<thead>
<tr>
<th>Patient</th>
<th>Time Delay in Diagnosis (wk)</th>
<th>Sequelae of Delay in Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>9th, 10th, 12th CN palsies</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>12th CN palsy</td>
<td>XRT</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>9th, 10th, 12th CN palsies</td>
<td>XRT</td>
</tr>
<tr>
<td>4</td>
<td>4½</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>Severe progressive pain</td>
<td>XRT</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
<td>9th, 10th, 12th CN palsies, dural sinus thrombosis due to extension into jugular foramen</td>
<td>XRT</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>Severe progressive pain</td>
<td>XRT</td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>12th CN palsy</td>
<td>XRT</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>None</td>
<td>XRT</td>
</tr>
</tbody>
</table>

Note.—CN = cranial nerve, XRT = radiation therapy.

RESULTS
Follow-up physical examination revealed that five patients had developed neuropathies of the twelfth cranial nerve. One patient presented with and three patients subsequently developed neuropathies of the ninth and tenth cranial nerves that manifested as dysphagia related to the extension of abnormal soft tissue into the jugular foramen (Table 2).

Seven patients had unilateral occipital condyle masses (five right, two left), and two patients had bilateral condyle lesions. Lesions were found to either involve only the occipital condyle (n = 4) (Fig 2), extend to the adjacent occipital bone (n = 3) (Fig 3), or extend to the ipsilateral clivus (n = 2) (Fig 4). In four patients, bone lesions were associated with an extraosseous soft-tissue mass extending into the perivertebral space or epidural compartment of the foramen magnum and posterior fossa (Fig 5c-5e). Evaluation of the remaining
**Figure 4. Patient 3.** (a, b) Sagittal unenhanced T1-weighted (600/11) MR images show replacement of the normal marrow in the right occipital condyle by hypointense tissue (arrowhead in a), compared with the normal left condyle (• in b). Arrows indicate vertebral arteries. (c, d) Axial T1-weighted (600/17) MR images (c obtained at a lower level than d) show the right condyle lesion (•) with abnormal soft tissue extending into the right hypoglossal canal (white arrows). The left hypoglossal canal (black arrows) is normal.

**Figure 5. Patient 8.** (a) Axial head CT scan shows a mottled, lytic lesion with cortical destruction of the right occipital condyle and occipital bone (arrows) (cf the normal left side). (b) Sagittal unenhanced T1-weighted (600/11) MR image shows soft tissue replacing the right condyle (•) and occipital bone. (c, d) Axial T1-weighted (600/17) (c) and T2-weighted (2,500/85) (d) MR images show the right condyle and occipital bone mass. Abnormal extraosseous soft tissue extends into the jugular foramen (JF), the epidural compartment of the foramen magnum (arrows), and the prevertebral space where there is anterior displacement of the longus muscle complex (L) from the vertebral column. (e) Axial T1-weighted (600/17) MR image demonstrates replacement of the normal marrow in the clivus and occipital bone, which constitute the medial and lateral borders of the hypoglossal canal, respectively. Soft tissue fills the right hypoglossal canal (arrows). Extraosseous soft tissue extends into the prevertebral space (M) with secondary mass effect on the retropharyngeal fat (arrowheads). (f) Axial T1-weighted (600/17) MR image obtained at the level of the oropharynx shows secondary findings of palsies of the ninth, tenth, and twelfth cranial nerves, including deviation of the soft palate (SP) and fatty replacement of the right side of the tongue (F).
calvaria revealed no additional focal lesions in eight of nine patients. In one patient, multiple skull lesions consistent with metastases were noted. In two patients, unilateral occipital condyle lesions were the sole foci of metastatic disease (Table 1).

Condyle lesions were best detected with CT scans processed with bone windows, which clearly demonstrated rarefaction of bone and cortical destruction (Figs 2, 3). At MR imaging, replacement of normal hypointense fat with abnormal hyperintense soft tissue on unenhanced sagittal and axial T1-weighted images was the most useful finding in the detection of condyle lesions (Fig 4a, 4b).

In the five patients with twelfth cranial nerve neuropathies and in the four patients with ninth and tenth cranial nerve palsies, MR and CT imaging revealed abnormal soft tissue extending into the ipsilateral hypoglossal canal and jugular foramen, respectively (Figs 4d, 5e). In two patients with twelfth cranial nerve symptoms, fatty replacement of the tongue was seen on the involved side, and in two patients with ninth and tenth cranial nerve neuropathies, associated deviation of the soft palate was seen at cross-sectional imaging (Fig 5f). In one patient, a follow-up MR image obtained 5 weeks after the initial study (the results of which had been misinterpreted as normal) showed development of soft tissue in the jugular foramen complicated by thrombosis of the ipsilateral jugular bulb, sigmoid sinus, and transverse sinus, as well as dural invasion and extension into the inferior left cerebellar hemisphere (Fig 6c–6h).

Retrospective review of plain radiographs obtained in two patients demonstrated focal lytic lesions of the occipital bone (Fig 6a), and retrospective analysis of scintigrams in two patients demonstrated subtle but definite increased radiotracer uptake in the involved occipital condyle (Fig 6b).

In no case was there pathologic proof of diagnosis (ie, no fine-needle aspirations or open surgical biopsies were performed). All patients were presumed to have metastatic disease to the occipital condyles on the basis of clinical and radiologic findings. Furthermore, all patients had a known primary cancer, four patients had previously known biopsy-proven metastatic disease (with skeletal involvement in two cases), and three patients developed multiple new bone lesions consistent with metastatic disease that were seen at follow-up scintigraphy (1 month after detection of the occipital condyle lesion in two cases and 3 months after detection in one case).

In all cases, there was a delay in diagnosis ranging from 4½ weeks to 13 weeks with an average delay of 10 weeks before a correct diagnosis was made (Table 2). Three patients were initially treated for benign occipital neuralgia with multiple medications such as carbamazepine and morphine as well as nerve blocks. In two other patients, symptoms were initially thought to be secondary to arthritis.

After lesions of the occipital condyles were identified, seven patients were treated with radiation therapy, which resulted in marked improvement of symptoms. Five of these seven patients are known to be alive (presently 4–12 months after completion of therapy). Three of the five patients have developed new osseous

Figure 6. Patient 6. (a) Plain radiograph obtained to evaluate left occipital pain demonstrates a lytic, mildly expansible lesion of the left occipital bone (arrows). (b) Posteroanterior delayed scintigram obtained 1 week later shows focal radiotracer uptake in the left occipital bone (arrows). L = left, R = right. (c) Sagittal T1-weighted (600/11) MR image demonstrates abnormal soft tissue replacing the left occipital condyle (●) and occipital bone (arrows). (d–g) Follow-up MR images obtained 5 weeks later to evaluate increasing occipital pain. Sagittal T1-weighted (600/11) (d) and axial T1-weighted (600/17) (e) MR images show progression of the left condyle mass (●) with expansion, cortical disruption, and extension through the inner cortical table of the occipital bone (arrows). Soft tissue now extends into the left jugular foramen (JP). (f) Axial contrast-enhanced, fat-suppressed T1-weighted (600/11) MR image demonstrates enhancing tissue in the occipital condyle and bone (●) as well as abnormal enhancing soft tissue (T) extending into the left posterior fossa. (g) Coronal fat-suppressed T1-weighted (600/11) MR image demonstrates tumor (T) in the left occipital bone, extension through the cortical tables, dural enhancement (straight arrows), and transludal spread (curved arrows). There has been interval development of thrombosis of the left transverse sinus (arrowhead).
metastases (ribs, spine), one has developed marked progression of a right occipital mass after 6 months of symptomatic relief, and one is stable without disease progression. Patient died of complications from extensive metastatic disease to multiple organ systems 2 days after diagnosis of skull base metastases. The seventh patient was lost to follow-up.

D I S C U S S I O N

- Normal Anatomy
  The occipital condyles are small, bilateral inferior extensions of the occipital bones and form a portion of the lateral aspect of the foramen magnum. The condyles articulate with the lateral masses of the C-1 vertebral body (Fig 1). They are intimately related to the other osseous structures at the foramen magnum and skull base by a number of ligamentous attachments. The tectorial membrane, the superior extension of the posterior longitudinal ligament, consists of longitudinally oriented fibers that arise from the dorsal surface of the C-2 vertebral body, extending cephalad to attach to the anterior aspect of the occipital bone. The right and left alar ligaments arise from the odontoid process of the C-2 vertebral body and attach to their respective occipital condyles. These as well as other ligaments are of particular importance in injuries to the craniovertebral junction or occipital condyles caused by trauma.

  The cervical vertebrae may be supplied with blood from the ascending cervical, deep cervical, and vertebral arteries. Additional sources of blood at the craniovertebral junction are the ascending pharyngeal and occipital arteries, which also supply most of C-1 and C-2. The occipital artery arises from the external carotid artery and courses between the occipital bone and C-1. Its terminal branches supply musculocutaneous structures of the upper neck and scalp and provide meningeal rami to the posterior fossa. Anastomoses between muscular branches of the occipital and vertebral arteries are common. Venous drainage of the occiput is through the condylar veins, the inferior petrosal sinus, and the clival venous plexus.

  Other anatomic regions important to the discussion of disease involving the occipital condyles include the hypoglossal canal and the jugular foramen. The hypoglossal canal is located at the anterior margin of the occipital condyles and transmits the twelfth cranial nerve. The jugular foramen transmits cranial nerves IX-XI, which are located anterolateral and superior to the occipital condyles. Abnormalities involving these foramina may result in lower cranial nerve neuropathies.

- Pathologic Processes
  A variety of disease processes may affect the craniovertebral junction. In the pediatric population, abnormalities may be either congenital (Arnold-Chiari malformations) or, less commonly, acquired (posttraumatic, inflammatory, neoplastic) (5,8-10,12). Patients may present with occipital pain or with symptoms related to compression of the cervicomedullary junction. In adults, acquired lesions involving the craniovertebral junction and foramen magnum may be the result of trauma (eg, occipital condyle fractures related to axial loading injuries in association with ipsilateral flexion, avulsion fractures from a combination of head rotation and contralateral head flexion) (1-3,13). Inflammatory disorders such as rheumatoid arthritis and metabolic disorders such as Paget disease and hyperparathyroidism are not uncommon and may result in basilar invagination (12).

  Although osseous metastases to the remainder of the skeleton are widely discussed in the literature, the occurrence and significance of metastatic disease to the occipital condyles are not addressed. In our experience, metastases to the occipital condyles are not rare. Spread is most likely hematogenous by way of arterial embolization or venous spread. Although we do not have pathologic proof, we believe each
case in our study represents metastatic disease because (a) all patients had a known primary cancer, (b) four patients had prior metastatic disease elsewhere and three developed other osseous metastases after identification of the condyle masses, and (c) all patients were symptomatic and responded to radiation therapy.

Multiplanar cranial and cervical MR imaging allows excellent visualization of the craniovertebral junction. Sagittal and axial unenhanced T1-weighted MR images are the most useful in identifying abnormalities of the occipital condyles because the hyperintense fat within the marrow is an excellent intrinsic “contrast agent” and replacement of this fat with abnormal hypointense soft tissue is readily seen. Axial T1-weighted images are also useful in identifying spread into the hypoglossal canal and jugular foramen (Figs 4-6). On axial T2-weighted images, lesions had intermediate signal intensity and thus they were less conspicuous (Figs 4f, 5d). Similarly, on non-fat-saturated contrast-enhanced images, the masses enhanced and were isointense relative to the fatty marrow in the surrounding normal bone, making lesion identification more difficult.

In patients with known carcinoma, progressive occipital head and neck pain should prompt careful evaluation of the skull base and of the occipital condyles in particular. Condyle lesions are usually unilateral but may be bilateral. Patients may have associated cranial neuropathies related to extension of tumor into the hypoglossal canal or jugular foramen as seen in five of the nine patients in our study. Symptoms related to occipital condyle lesions may be the first indication of metastatic disease. In addition, isolated metastatic disease to an occipital condyle may occur. Radiation therapy may result in dramatic improvement of symptoms.

Radiologists should be aware that lesions involving the occipital condyles may be missed. Careful review of unenhanced sagittal and axial T1-weighted MR images and of the inferior sections from axial head CT studies will make it possible to avoid this potential pitfall.

■ REFERENCES