Magnetic Resonance Imaging in the Evaluation of Infantile Torticollis

SHITAL N. PARIKH, MD; ALVIN H. CRAWFORD, MD; SAM CHOUDHURY, MD

abstract

This retrospective study assessed the use of magnetic resonance imaging (MRI) in 58 infants with infantile torticollis. Eighteen patients had nonmuscular causes of torticollis (group 1); MRI identified lesions in 16 patients. Of 40 patients with a diagnosis of congenital muscular torticollis (group 2), 28 had a normal MRI. Five patients had asymmetry of the sternocleidomastoid without noticeable signal changes. Seven patients showed evidence of fibromatosis colli. Asymmetry of the posterolateral skull consistent with plagiocephaly was common. Magnetic resonance imaging did not alter treatment of group 2. Findings of compartment syndrome of sternocleidomastoid were inconsistent. Magnetic resonance imaging is not recommended for asymptomatic patients with infantile torticollis.

Infantile torticollis is defined as torticollis in a patient aged <1 year.1 It can be congenital (present at or soon after birth) or acquired. It may originate from a number of primary etiologies including congenital muscular torticollis, congenital postural torticollis, ocular abnormalities, osseous abnormalities, and neurologic abnormalities.1-19 Congenital muscular torticollis is the most common cause of torticollis and is the third most common congenital deformity, with hip dysplasia and pes equinovarus being more common.20

Although many theories of etiology have been proposed, recent reports surmised that compartment syndrome of the sternocleidomastoid may be an etiologic factor in congenital muscular torticollis.21 The nonmuscular causes of torticollis in children are less common. In a report of 288 patients with torticollis, the estimated prevalence was 18.4%.2

The previous two decades have resulted in substantial technological advancements in radiographic imaging. New noninvasive imaging modalities have been developed and existing modalities have been refined. Magnetic resonance imaging (MRI) allows improved anatomical visualization of the spine and central nervous system without undue radiation exposure. The ubiquitous availability of MRI, however, may have led to its overuse and inappropriate application.

Ballock and Song2 suggested a useful algorithm for evaluation of torticollis in children. Initial evaluation of any patient with torticollis should involve a thorough history and physical examination including neurologic assessment, followed by plain radiographs and ophthalmologic consultation in a step-wise approach. Magnetic resonance imaging should be obtained only when the ophthalmologic evaluation is negative or the initial neurologic examination is abnormal.

Most patients with infantile torticollis who underwent MRI at our institution were referred from outside pediatric facilities. We hypothesized that MRI was increasingly used as a general screening study in otherwise asymptomatic patients with infantile torticollis or in the absence of a working clinical diagnosis. This study assessed the use of MRI in evaluating infantile torticollis and identified the signs of compartment syndrome of sternocleidomastoid as a factor in the development of congenital muscular torticollis.

MATERIALS AND METHODS

A computerized medical record-retrieval system was used to identify all patients referred to our institution from 1993-2000 for MRI evaluation of torticollis. The medical records of these patients were screened by the lead author...
(S.N.P.) to determine their age at initial presentation and initial diagnosis. All patients initially presenting after age 12 months and patients with insufficient documentation were excluded from the study. Eighty-six patients with congenital torticollis who underwent MRI evaluation were initially identified. Twenty-eight patients were excluded because of delayed initial presentation (age >12 months) or inadequate documentation. The remaining 58 patients (29 boys and 29 girls) comprised the study group.

Patients were divided into two groups. Group 1 consisted of 18 patients with infantile torticollis with associated specific clinical findings (eg, neurogenic torticollis, osseous anomalies of the cervical spine, or otolaryngology involvement). Group 2 consisted of 40 patients with congenital muscular torticollis.

The medical charts of these patients were reviewed for age at presentation, sex, side of involvement, symptoms, clinical findings, imaging studies, and primary diagnosis. The MRI reports were reviewed for the type of examination, procedure comments, MRI findings, and final impression. All MRIs were reviewed, with special attention to bilateral sternocleidomastoid muscles, to identify any comparable asymmetry or signal changes. A clinicopathological correlation was established for both patient groups.

All patients had evidence of torticollis from the neonatal period. The majority of MRI examinations were referred by primary care physicians from the communi-

### TABLE 1

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. patients</td>
<td>18</td>
<td>40</td>
<td>58</td>
</tr>
<tr>
<td>Mean age ± SD (mos)</td>
<td>5.8 ± 2.6</td>
<td>8 ± 3.1</td>
<td>7.3 ± 2.9</td>
</tr>
<tr>
<td>Male:Female</td>
<td>10:8</td>
<td>19:21</td>
<td>29:29</td>
</tr>
<tr>
<td>Left:Right</td>
<td>8:10</td>
<td>19:21</td>
<td>27:31</td>
</tr>
<tr>
<td>Positive MRI findings (%)</td>
<td>16 (89)</td>
<td>12 (30)</td>
<td>28 (48)</td>
</tr>
<tr>
<td>Positive orthopedic MRI findings (%)</td>
<td>2 (11)</td>
<td>12 (30)</td>
<td>14 (24)</td>
</tr>
</tbody>
</table>

Abbreviations: MRI=magnetic resonance imaging and SD=standard deviation.

### TABLE 2

#### Clinical and MRI Findings in Group 1 Patients With Infantile Torticollis (n=18)

<table>
<thead>
<tr>
<th>Clinical Presentation/Diagnosis*</th>
<th>No.</th>
<th>MRI Findings*</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seizures</td>
<td>6</td>
<td>Normal</td>
<td>2</td>
</tr>
<tr>
<td>Developmental delay</td>
<td>6</td>
<td>Plagiocephaly</td>
<td>7</td>
</tr>
<tr>
<td>Facial asymmetry</td>
<td>5</td>
<td>Macrocrania/mild communicating hydrocephalus</td>
<td>5 (2†)</td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>3</td>
<td>Inflammatory cells in mastoid</td>
<td>4 (2†)</td>
</tr>
<tr>
<td>Neck mass</td>
<td>2</td>
<td>Corpus callosum hypoplasia</td>
<td>5</td>
</tr>
<tr>
<td>Hoarse cry</td>
<td>2</td>
<td>Cervical lymphadenopathy</td>
<td>2†</td>
</tr>
<tr>
<td>Ptosis</td>
<td>1</td>
<td>Parenchymal volume loss</td>
<td>2</td>
</tr>
<tr>
<td>Otitis</td>
<td>1</td>
<td>Arnold-Chiari malformation</td>
<td>2</td>
</tr>
<tr>
<td>Hemiplegia</td>
<td>1</td>
<td>Parotid hemangioma</td>
<td>2</td>
</tr>
<tr>
<td>Right arm paresis</td>
<td>1</td>
<td>Malignant peripheral nerve sheath tumor</td>
<td>1</td>
</tr>
<tr>
<td>Hypotonia</td>
<td>1</td>
<td>Middle ear congestion</td>
<td>1</td>
</tr>
<tr>
<td>Erb’s palsy</td>
<td>1</td>
<td>Brachycephaly</td>
<td>1</td>
</tr>
<tr>
<td>Down’s syndrome</td>
<td>1</td>
<td>Hyperintense globus pallidus</td>
<td>1</td>
</tr>
<tr>
<td>Hairy patch</td>
<td>1</td>
<td>Rhombocephalosynapsis</td>
<td>1</td>
</tr>
<tr>
<td>Vomiting</td>
<td>1</td>
<td>Craniosynostosis</td>
<td>1</td>
</tr>
<tr>
<td>Post-traumatic</td>
<td>1</td>
<td>C1-C2 rotatory subluxation</td>
<td>1†</td>
</tr>
<tr>
<td>Spinal canal narrowing</td>
<td>1†</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: MRI=magnetic resonance imaging.
*Patient may have more than one clinical or MRI finding.
†Incidental finding.

### TABLE 3

#### Clinical and MRI Findings in Group 2 Patients With Infantile Torticollis (n=40)

<table>
<thead>
<tr>
<th>Clinical Presentation/Diagnosis*</th>
<th>No.</th>
<th>MRI Findings*</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital muscular torticollis</td>
<td>40</td>
<td>Normal</td>
<td>28</td>
</tr>
<tr>
<td>Facial asymmetry</td>
<td>4</td>
<td>Fibromatosis colli with signal changes</td>
<td>7</td>
</tr>
<tr>
<td>Mass within sternocleidomastoid</td>
<td>1</td>
<td>Sterno cleidomastoid asymmetry</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plagiocephaly</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Macrocrania/mild communicating hydrocephalus</td>
<td>2†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inflammatory cells in mastoid</td>
<td>2†</td>
</tr>
</tbody>
</table>

Abbreviation: MRI=magnetic resonance imaging.
*Patient may have more than one clinical or MRI finding.
†Incidental finding.

Congenital muscular torticollis is the most common cause of torticollis and is the third most common congenital deformity.
ty or outside pediatric facilities. The mean age at initial presentation for all 58 patients was 7 months (range: 1-12 months). The majority of MRIs were performed with the patient under sedation, with strict adherence to the hospital sedation policy. Standard technique for soft-tissue visualization was used, and imaging was performed in coronal, sagittal, and transverse planes.

**RESULTS**

Patient data and rate of positive MRI findings in each group and in the entire study group are summarized in Table 1. The torticollis was left-sided in 27 patients and right-sided in 31 patients.

The clinical and MRI findings in group 1 patients are summarized in Table 2.

Two of 18 patients had normal MRI studies. A 4-month-old female patient with torticollis and seizures and a 6-month-old female patient with torticollis and vomiting had no abnormal MRI findings. Two patients had evidence of a mass on clinical examination; both had parotid hemangioma diagnosed by MRI. A 3-month-old male patient presented with torticollis and right upper extremity hemiparesis, which was initially diagnosed as Erb's palsy. However, significant worsening of right arm function was noted and MRI revealed an anterior cervical extradural mass in C6-C7; this was diagnosed and histologically confirmed as malignant peripheral nerve sheath tumor.

Only 2 (11%) patients had positive orthopedic findings in this group. A 5-month-old female patient with Down's syndrome and torticollis underwent MRI to rule out cord compression. Magnetic resonance imaging showed anteroposterior narrowing of the cervical spinal canal. A 12-month-old male patient presented with post-traumatic torticollis. Magnetic resonance imaging showed C1-C2 rotatory subluxation; however, this was diagnosed previously on computed tomography (CT).

Of 6 patients with developmental delay, 3 had corpus callosum hypoplasia, 2 had parenchymal white matter loss, and 1 had increased signal intensity in globus pallidus. The most common incidental findings were macrocrania or mild comminuting hydrocephalus (2 patients) and inflammatory cells in mastoid (2 patients).

Sixteen of 18 patients presenting with infantile torticollis and associated symptoms had positive MRI findings; the clinicopathological correlation was 89%.

The clinical and MRI findings in group 2 patients are summarized in Table 3. The indications for the majority of MRIs were to rule out posterior fossa tumors. All patients in this group had congenital muscular torticollis, which was diagnosed by the treating physician. Of 40 patients in this group, 12 (30%) patients had sternocleidomastoid involvement on MRI; 7 patients had fibromatosis colli and 5 patients had sternocleidomastoid asymmetry (Figures 1 and 2). No patient had posterior fossa tumor or other significant pathologic findings. The mean age of these 12 patients was 7.5 months. The clinicopathological correlation was 30%.

The most common bony abnormality...
was asymmetry of the posterolateral skull consistent with plagiocephaly, which was present in 14 (24%) patients in this series. Except in 1 patient with craniosynostosis, MRI was unable to differentiate between postural plagiocephaly and plagiocephaly due to craniosynostosis. Facial asymmetry was present in 9 (16%) patients.

**DISCUSSION**

With the imaging capabilities of MRI, it is possible to examine the spine and central nervous system anatomy with excellent resolution. This has led to a better understanding of the frequency and spectrum of findings that can be present as part of the evaluation for nonmuscular causes of torticollis. Magnetic resonance imaging is a sensitive and specific diagnostic tool, especially for detection of neurogenic causes of torticollis, as evident in the present series. However, errors in clinical decision-making after MRI for infantile torticollis may arise in one of three general areas: 1) the timing of MRI during the patient’s clinical course, 2) matching the clinical indications to the optimum investigation, and 3) precise correlation of the abnormalities seen on MRI with the clinical symptoms.

The majority of patients with congenital muscular torticollis (group 2) were referred for MRI to rule out posterior fossa tumor. Torticollis has been described as the initial sign of a posterior fossa tumor in several reports.2,3,5,6,13,15,17,22 However, torticollis secondary to posterior fossa tumor is an acquired cause of torticollis, usually associated with symptoms and presenting in older age groups.

Gupta et al3 reported five patients with torticollis as the initial sign of posterior fossa tumor. Four of five patients had associated symptoms such as headache, nausea, vomiting, or positive neurologic signs. No patient had torticollis in the neonatal period. Ballock and Song2 reported six children with torticollis and central nervous system lesions. All patients had abnormal neurologic examinations on initial presentation, and the youngest patient in their series was 17 months old.

Kiwak et al13 reported three patients with syringomyelia and spinal cord tumor, with acquired torticollis as an early finding in each. All three patients had associated scoliosis or abnormal neurologic presentation. Boisen15 reported three patients with infratentorial tumors who presented with torticollis; all three patients were adults.

Marmor et al17 reported a triad of photophobia, epiphora, and torticollis as initial manifestation of posterior fossa tumors and recommended that children with this triad undergo MRI for evaluation of the posterior fossa. Taboas-Perez and Rivera-Reyes16 reported three children with torticollis and posterior fossa tumors; all had associated symptoms at presentation. No cases of posterior fossa tumor or other significant pathologic lesion were noted in group 2 patients in the present study.

Based on our study and review of the literature,2 when no sternocleidomastoid tumor of infancy and congenital muscular torticollis are referred to as different entities, no consensus exists in the literature for distinguishing these two conditions.

Although sternocleidomastoid tumor of infancy and congenital muscular torticollis often are referred to as different entities, no consensus exists in the literature for distinguishing these two conditions.

Despite the lack of a consensus in the literature,2,4,5,7,10,17,25 our results support the recommendation of MRI for evaluating the neck mass. Patients with acquired torticollis or posterior fossa tumor are referred for MRI to rule out posterior fossa tumor or other significant pathologic condition.

Magnetic resonance imaging findings of fibromatosis colli have been described in the literature.24,30,31 Ablin et al30 described the MRI findings in a biopsy-proven case of fibromatosis colli. The signal intensity of the mass on T2-weighted images was slightly less than on T1-weighted images, consistent with fibrous tissue within the muscle mass. They concluded that MRI was helpful in demonstrating signal characteristics of the mass, localizing the mass to within the sternocleidomastoid muscle, and demonstrating

**ORTHOPEDICS | www.orthobluejournal.com**
clear surrounding fascial planes with lack of associated lymphadenopathy, airway compression, vascular encasement, bone involvement, or intracranial extension associated with other neck masses.

Jaber and Goldsmith reported two cases with sternocleidomastoid tumor of infancy. Magnetic resonance imaging demonstrated diffuse isointense enlargement of the muscle in one patient and a focal hyperintense mass within the muscle in the other patient. The MRI appearance of these lesions often is variable and nonspecific. This is likely secondary to both the amount of collagen and degree of cellularity of the lesion. Only one patient in the present series had a palpable mass within the muscle. The MRI findings in this patient were suggestive of fibromatosis colli (Figure 3).

Although sternocleidomastoid tumor of infancy and congenital muscular torticollis are often referred to as different entities, no consensus exists in the literature for distinguishing these two conditions. It is unknown whether these two entities are distinct pathological conditions or whether they comprise a spectrum of the same muscular abnormality. Porter and Blount defined sternocleido-
muscle produced images different from that of compartment syndrome and failed to show any edema and muscle infarction.

In our series, of 40 patients in group 2 with a diagnosis of congenital muscular torticollis, sternocleidomastoid involvement on MRI was found in only 12 (30%) patients. Two reasons may be responsible for this inconsistent finding in our series: age and initial diagnosis. In contrast to all patients, two reasons may be responsible for this inconsistent finding in our series: age and initial diagnosis. In contrast to all patients, two reasons may be responsible for this inconsistent finding in our series: age and initial diagnosis. In contrast to all patients, two reasons may be responsible for this inconsistent finding in our series: age and initial diagnosis.

Whyte et al.35 reported the MRI findings suggestive of sternocleidomastoid fibrosis in a case of congenital muscular torticollis, represented by hypointense signals within the affected sternocleidomastoid on T1- and T2-weighted images. Clinically, an infant with congenital muscular torticollis may appear normal at birth. Between age 2 and 3 weeks, a palpable mass can often be appreciated in the midsubstance of the sternocleidomastoid muscle. When not treated, subsequent contracture of the muscle causes the infant to hold its head in a characteristic position of forward flexion, ipsilateral lateral bend, and lateral rotation. The muscle can be felt as a tight band with restricted neck range of movement.

It is a limitation of our retrospective study to apply strict criteria for diagnosis of congenital muscular torticollis. All patients in group 2 had an initial diagnosis of congenital muscular torticollis, but it may have included patients with other forms of congenital torticollis, such as congenital postural torticollis, ocular torticollis, or patients with sternocleidomastoid imbalance. The term “sternocleidomastoid imbalance” was introduced by Golden et al.35 to discern between a muscle mass or contracted sternocleidomasto-toid on one side, more identifiable with congenital muscular torticollis, versus an apparent sternocleidomastoid imbalance or weakness on the contralateral side. They characterized half of their patients with muscle imbalance as those with decreased ability to actively rotate or laterally flex their head to end range but near normal passive cervical range of motion.

As many as 80 different causes of torticollis have been documented in the literature.5 In one series of 53 patients with nonmuscular torticollis, the most frequent diagnosis was Klippel-Feil syndrome followed by oculor torticollis, obstetric palsies, and lesions involving the central nervous system.2 It was not meaningful to calculate such prevalence rates in our study because of the selective patients undergoing MRI study. Klippel-Feil syndrome can be diagnosed clinically or on plain radiographs, and these patients may not need MRI unless an orthopedic procedure is contemplated or for evaluation of symptoms related to cord compromise or instability.36 Similarly, patients with ophthalmic conditions may present with torticollis, nystagmus, defects in the visual field, or paralytic disorders of ocular movement. The most common ocular causes of torticollis in infancy are congenital paralytic squint due to superior oblique muscle palsy and congenital nystagmus.11,37 These children typically present at approximately age 1 year, with a head tilt without rotation.19 These conditions are diagnosed with formal ophthalmologic consultation and do not need MRI. This explains the absence of such patients in our study.

The most common bony abnormality in the present series was asymmetry of the posterolateral skull consistent with plagiocephaly. Torticollis has been associated with 64%-84% of infants born with a normal head who develop positional plagiocephaly.38,39 Also, torticollis may develop secondary to plagiocephaly, as the infant consistently lies on one side of the head, which may cause shortening or tightening of the sternocleidomastoid muscle.40 Huang et al.38 recommended diagnostic criteria to distinguish between positional flattening of the parieto-occipital area and synostotic lambdoidal plagiocephaly.

Despite the fact that the prognosis and consequently the treatment plan vary directly with the presence or absence of synostoses, clinical evaluation of plagiocephaly should include cephalometry, skull radiographs, or CT.40,41 In infants aged <1 year with positional plagiocephaly, physiotherapy usually cures the torticollis with regression of the neck symptoms and improvement of skull contours. Active counterpositioning, assisted positioning, head bands, and orthotic helmets have been used to manage positional plagiocephaly.38,42-44 However, craniosynostosis may require a corrective surgery.38 Magnetic resonance imaging failed to differentiate between postural and synostotic plagiocephaly in all but one patient in the present series.

**Conclusion**

Careful clinical assessment in infants with congenital muscular torticollis precludes the necessity of MRI. We emphasize the importance of neurologic evaluation in all patients with infantile torticollis. Although MRI is a safe and effective imaging study, it should be used to confirm the information gathered from history and physical examination and should not be used for general screening or to rule out central nervous system lesions without prior orthopedic, oculor, otolarynologic, and neurologic evaluation. Magnetic resonance imaging should not be used for evaluation of sternocleidomastoid tumor of infancy; ultrasound is the imaging procedure of choice, if required. Magnetic resonance imaging could not differentiate between postural plagiocephaly and craniosynostosis. Routine MRI examination is not recommended for otherwise asymptomatic patients with infantile torticollis.

The etiology of congenital muscular torticollis remains a mystery. Although it may represent a sequelae of intrauterine or peri-
nata compartment syndrome, other contributing factors may be associated with its development. Only in 30% of infants with congenital muscular torticollis did the MRI exhibit asymmetry or signal changes within sternocleidomastoid muscle; and further these MRI changes were not specific for the diagnosis of compartment syndrome of sternocleidomastoid. [3]

REFERENCES