Congenital torticollis presents with lateral neck flexion and neck rotation to the opposite side, as shown in Fig. 1. The incidence of torticollis has been reported to be as high as 8.2%–16%, but it is more commonly reported as between 0.3% and 3.92%. The cause of congenital torticollis may be due to an abnormal position of the intrauterine fetus or fetal head descent causing trauma to the sternocleidomastoid muscle or its innervation. Birth trauma may result in compartment syndrome, which is characterized by ischemia and edema of the sternocleidomastoid muscle; biopsy studies have shown that fibrous tissue replaces healthy muscle. Torticollis is a risk factor for positional plagiocephaly, an acquired deformation of the skull. More than 90% of infants with positional plagiocephaly have torticollis that is likely attributed to the positional preference of the neck, resulting in repeated pressure to the skull while supine.

If left untreated, torticollis may lead to skull base and
facial asymmetry, requiring surgical correction.\textsuperscript{5,8,9,14,16}

Torticollis is also associated with scoliosis, hip dysplasia, brachial plexus injury, distal extremity deformity, early and persistent developmental delays, and temporomandibular joint dysfunction.\textsuperscript{8,9,13} Deformations begin in infancy; therefore, early identification and treatment is critical.\textsuperscript{17}

In the absence of an unrelated significant clinical finding, congenital torticollis is successfully treated with repositioning techniques and early physical therapy (PT).\textsuperscript{8,16} It has been suggested in previous reports that radiography, CT, and MRI are often unnecessary, as bony abnormalities are rarely found in conjunction with torticollis. Snyder and Coley\textsuperscript{4} published a retrospective study in which they analyzed radiographic images obtained in 502 infants with nontraumatic torticollis. Their results revealed that 4 of 502 patients had abnormal findings, and they found only 1 patient with an abnormality contraindicating management with PT. The authors concluded that radiographic imaging should only be recommended for patients with abnormal clinical findings or persistent torticollis after PT treatment.\textsuperscript{14} Yet physicians who first evaluate a patient with suspected congenital torticollis may order imaging prior to referral to a specialist.

The Goryeb Children’s Hospital Craniofacial Team clinical protocol includes examination of infants by the craniofacial team. This team comprises a pediatric neurological surgeon, a developmental pediatrician, and a pediatric physical therapist. The head and neck are examined for postural abnormalities, and a neurodevelopmental examination is performed. Infants with uncomplicated torticollis are eligible for management with repositioning techniques and PT without imaging. Imaging is recommended for infants with a clinical finding suggestive of a secondary condition or nonmuscular etiology for torticollis.

The PT treatment protocol consists of one 60-minute session per week. Stretching and flexibility exercises are recommended to improve range of motion, balance, coordination, and posture. Caregivers are encouraged to reposition infants, while awake, into the supine position throughout the day to promote strength development.

Reassessment of torticollis and response to therapy is performed every 2 to 3 months. PT is continued until torticollis resolves. Resolution is defined as full range of motion in the cervical spine and the ability to maintain the head in the midline position. If torticollis persists after 12 months despite therapy, diagnostic imaging is performed.

\section*{Methods}

As part of a quality improvement initiative, a General Electric Centricity database was searched for all patients with a diagnosis of torticollis who were evaluated between the period of August 5, 2005, and July 23, 2015. Data were reviewed by the research team. A search was performed to identify all medical records of patients with a diagnosis of torticollis. Patients older than 12 months of age at the initial visit and those lost to follow-up of their condition were removed from the sample population. Clinical data reviewed in each of the electronic charts included coexisting diagnoses, modalities of imaging used (radiography, CT, or MRI), and indication for imaging and correspond-
Six of the 44 patients were identified with ridging of skull sutures noted on physical examination, and imaging was subsequently performed. CT scanning was performed in 3 patients, radiography in 2 patients, and radiography and then CT scanning the following week in 1 patient. Of the patients who underwent CT scanning, one patient underwent CT scanning of the head and brain without contrast and was subsequently diagnosed with craniosynostosis. Another patient underwent CT scanning of the head, which revealed a 1.5-cm thyroglossal duct cyst and no craniosynostosis. The remaining patient underwent CT scanning of the head and brain without contrast, which revealed right parietal plagiocephaly, right frontal bossing, and no brain abnormalities or craniosynostosis. Complete skull radiographs were obtained in both patients who underwent radiography, which revealed craniosynostosis. The sixth patient underwent radiography of the skull, and interpretation of the findings was inconclusive. Craniosynostosis was ruled out with reconstructive CT of the skull obtained 7 days later. Overall, 3 of the 6 patients were diagnosed with craniosynostosis following imaging.

The remaining 4 of the 48 patients (0.6% of the torticollis population) underwent initial imaging and did not have an additional diagnosis or significant clinical finding as an indication for imaging. Two of the patients underwent CT scanning of the head and brain without contrast, one underwent radiography of the neck, and the remaining patient underwent complete skull radiography. Abnormal radiological findings were not identified in these patients.

One patient (0.2%) did not undergo initial imaging or achieve resolution of torticollis after 1 year of repositioning techniques and PT. Imaging was performed at this time, and an occipital condyle–C1 vertebral fusion abnormality was discovered.

Overall, 92.8% of our infantile torticollis patient population achieved resolution of torticollis with recommended repositioning techniques and completion of PT without undergoing radiography, CT scanning, or MRI. Excluding the 44 patients with a secondary diagnosis requiring initial imaging from the study’s total population (n = 683) revealed that 99.2% (634 of 639) of our patients with uncomplicated torticollis were successfully treated without imaging.

**Discussion**

The vast majority (99.2%) of infants with torticollis were successfully treated without undergoing imaging. The remaining previously mentioned 5 patients included 4 who underwent imaging without an additional indication and 1 who underwent imaging after management with PT had failed. On evaluation of the patients’ medical records, radiographic imaging was unnecessary in 4 of the patients and should not have been performed. Only 1 patient did not undergo initial imaging or achieve resolution of torticollis after 1 year of repositioning techniques and PT, which represents a small portion of the sample population. This patient’s outcome is unlikely to have been improved with earlier imaging. Therefore, our findings, along with those of others, favorably demonstrate the treatment and management of uncomplicated congenital torticollis in infants without the utilization of initial radiographic imaging.

This retrospective study has limitations in need of mention. A prospective study of infants treated with and without imaging would provide more valuable data, but it requires a group of infants to receive radiation exposure. We believe that this should be avoided. Also, our screening criteria for radiographic imaging state that we do not recommend imaging unless an additional significant finding is identified. Our protocol uses a multidisciplinary approach to minimize the risk of a missed clinical diagnosis. In addition, our results rely on the accuracy of the electronic medical record (EMR) system. Diagnosis-based searches have been performed successfully using the General Electric Centricity EMR system in other publications on con-
are unnecessary in cases of uncomplicated torticollis in infants. Haque et al. as well as Lin and Chou have suggested ultrasonography for evaluation of torticollis.6,12

For infants with simple torticollis, PT and treatment without imaging is recommended. Nonmuscular causes of congenital torticollis may include Klippel-Feil syndrome, syringomyelia, occipitoatlantal fusion, spondyloepiphyseal dysplasia, hemivertebra, and subluxation.9,14 These rare etiologies may require CT scanning and/or MRI for final diagnosis.

Conclusions

Our retrospective analysis provides Class III evidence for a Level III recommendation regarding the diagnosis, clinical assessment, and management of torticollis in infants. Our recommendations for imaging are as follows.

1) Clinical examination is sufficient in the diagnosis of congenital torticollis in infants. Imaging with radiographs, CT, and MRI is not necessary.

2) In cases in which additional clinical or neurological findings are present, imaging may be recommended.

3) PT and repositioning techniques are the recommended treatment modalities for congenital torticollis.

4) Additional evaluations should be performed throughout the duration of PT to assess progress and response to therapy.

5) Imaging should be performed to rule out nonmuscular pathologies if torticollis persists after 1 year of treatment. It is our hope that these recommendations will further improve the management of infants with congenital torticollis.

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Supplemental Information
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