Spiral CT of the larynx.

J N Suojanen, S K Mukherji and F J Wippold

AJNR Am J Neuroradiol 1994, 15 (8) 1579-1582
http://www.ajnr.org/content/15/8/1579

Spiral CT of the Larynx

J. N. Suojanen, S. K. Mukherji, and F. J. Wippold

PURPOSE: To compare conventional and spiral CT studies of the larynx. **METHODS:** Ten patients had both conventional and spiral CT studies of the neck using 5-mm section collimation and 5-mm increments. The spiral scans also were reconstructed at 2-mm increments. Five patients had two spiral CT larynx studies with 5-mm and 2-mm collimation. Two observers independently rated the visibility of laryngeal structures and absence of motion artifact in the studies and assigned values from 1 (poor) to 4 (excellent). **RESULTS:** The spiral scan images showed less motion artifact (1.9 versus 3.6) and better anatomic detail (2.3 versus ~2.6). Thinner reconstruction intervals and sections gave better anatomic detail (2.3 versus ~3.3). Interobserver κ was 0.65. **CONCLUSION:** Spiral is better than conventional CT scanning when studying the larynx.

Index terms: Larynx, computed tomography; Computed tomography, comparative studies; Computed tomography, technique

AJNR Am J Neuroradiol 15:1579–1582, Sep 1994

Computed tomography (CT) remains the primary imaging modality for evaluation of masses, trauma, and inflammatory lesions of the larynx (1). Despite careful attention to technical detail, studies of the larynx with both CT and magnetic resonance can be degraded by motion artifact during or between data acquisitions (2). Spiral (or helical) CT scanning is a new technique that permits rapid scanning of large tissue volumes while swallowing is suspended and quiet breathing maintained (3). We studied prospectively the ability of spiral CT scans to demonstrate normal laryngeal anatomy and compared spiral CT studies with conventionally acquired studies.

Received July 12, 1993; accepted after revision January 4, 1994.

Portions of this work were presented at the 31st Annual Meeting of the Americal Society of Neuroradiology, Vancouver, Canada, May 1993, and at the 79th Annual Meeting of the Radiological Society of North America, Chicago, 1993.

From the Department of Radiology, New England Deaconess Hospital and Harvard Medical School, Boston (J.N.S.); the Department of Radiology, Brigham and Women's Hospital, Boston (S.K.M.); and Mallinckrodt Institute of Radiology, St. Louis (F.J.W.).

Address reprint requests to James N. Suojanen, MD, Department of Radiology, New England Deaconess Hospital, 185 Pilgrim Rd, Boston, MA 02215.

AJNR 15:1579–1582, Sep 1994 0195-6108/94/1508–1579

Methods

Fifteen patients with suspected neck disease were studied in two protocols. Nine patients were men and six women. Ages ranged from 20 to 86 years (mean, 54.9). Ten consecutive patients had both conventional and spiral scans of the larynx on a Somatom Plus-S scanner (Siemens, Erlangen, Germany). Conventional images were acquired using section collimation of 5 mm at 5-mm increments at 120 kV and 250 mA. Spiral CT data were acquired using collimation of 5 mm but at 120 kV and 165 mA. Table feed was 5 mm/s (pitch, 1.0) with image reconstructions at 5-mm and 2-mm increments. Patients were instructed to breath quietly and not to swallow during both studies.

The images were then independently assessed by two readers with respect to visibility of laryngeal cartilages, true and false cords (including the paraglottic space), and image degradation caused by motion artifact. Depiction of laryngeal structures was rated on a scale of 1 (poor) to 4 (excellent); motion artifact was rated similarly, with 1 representing severe blurring of structures or spatial misregistration and 4 representing no motion artifact.

A second series of five consecutive patients with suspected laryngeal lesions was studied with 5-mm spiral images and pitch of 1.0, with 5 × 2-mm reconstructions through the larynx. A second spiral scan using 2-mm section collimation and 2-mm/s table feed (pitch, 1.0) for 24 seconds was performed. Images were reconstructed at 2-mm intervals. Again, patients were instructed not to swallow but to breath quietly during the study. We hypothesized that the 5 × 2-mm reconstructions might provide sufficient information to obviate the need for a more detailed study, thereby shortening the examination time of patients with laryngeal and glottic lesions. Two readers independently compared the two studies for depiction of laryngeal structures as noted above.

Interobserver variability was assessed using a κ test (4). Differences between the average scores of image sets were assessed using a two-tailed t test and were considered significant when $P < .05$.

Results

The κ value for interobserver variability (two neuroradiologists and senior members of the American Society of Neuroradiology) was 0.65, which represents very good agreement beyond chance (4). The results of comparisons between conventional and spiral CT studies are summarized in Table 1. These show that spiral images had significantly less motion artifact than conventionally acquired images. In fact, 4 of 10 of the conventional studies had significant spatial misrepresentation. That is, the patients moved their larynges during the intervals between two scans by breathing or swallowing so that anatomic gaps of 5 to 10 mm were readily apparent (Fig 1). Furthermore, the spiral images reconstructed at 2-mm increments were significantly better at depicting laryngeal structures (cartilages and false and true cords) than either the conventional or spiral images ob-

TABLE 1: Visibility scores: conventional versus spiral CT studies

	Cartilages	False and True Cords	Motion Artifact
Conventional 5 × 5 mm	2.3 ± 0.5	2.30 ± 0.5	1.9 ± 1.0
Spiral 5 × 5 mm	2.6 ± 0.5, NS	2.7 ± 0.5[a]	3.6 ± 0.5[a]
Spiral 5 × 2 mm	3.2 ± 0.9[a, b]	3.4 ± 0.7[a, b]	3.6 ± 0.5[a]

Note.—NS indicates difference not significant.
[a] $P < .05$ versus conventional 5 × 5 mm.
[b] $P < .05$ versus spiral 5 × 5 mm.

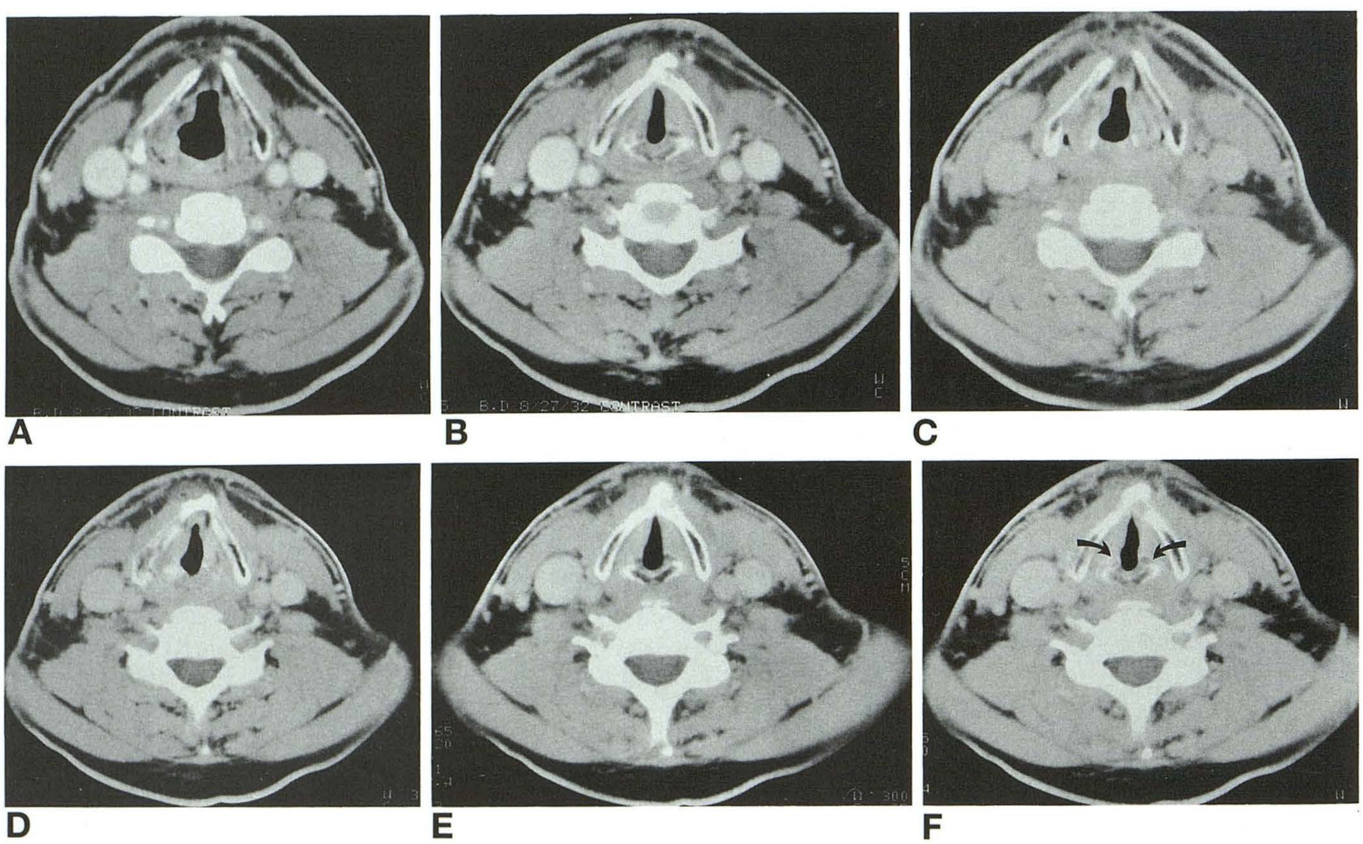
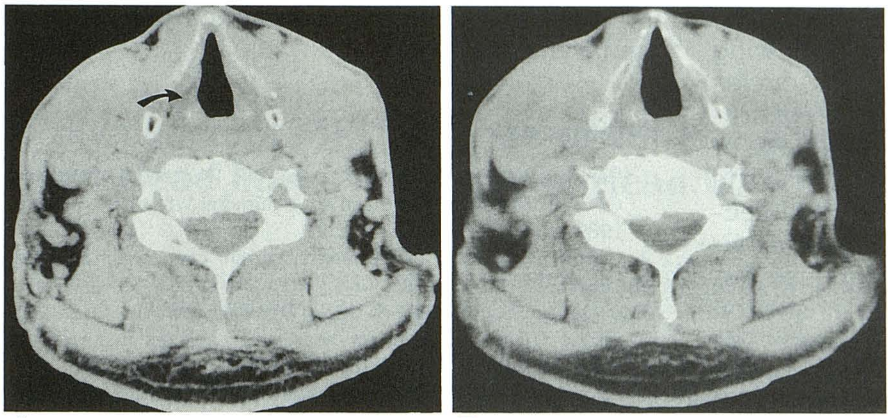


Fig 1. Conventional and spiral CT scans through the glottic region.

A and *B*, Sequential conventional 5-mm-thick sections show the upper portion of the false cords and then the true cords.

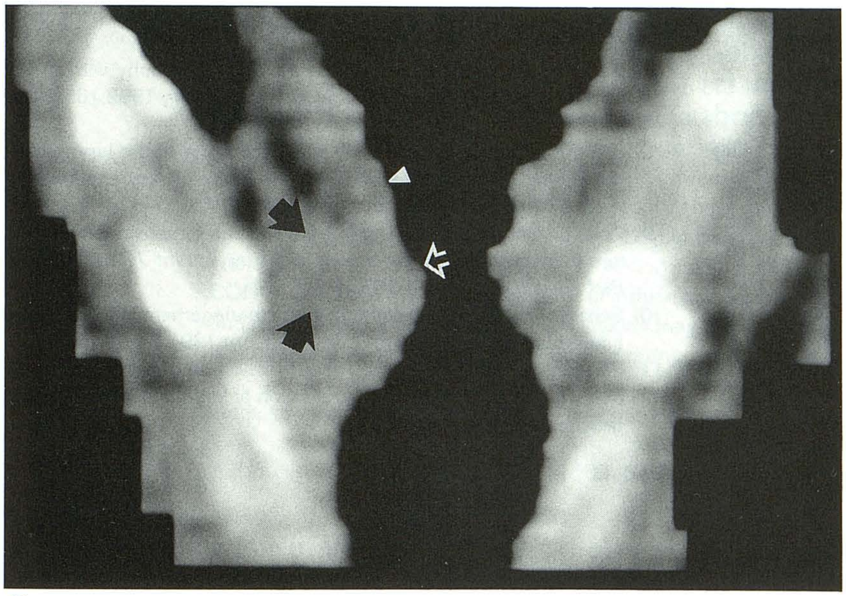
C, *D*, and *E*, Sequential spiral 5-mm-thick sections at the same levels as *A* and *B*, but showing an intervening section (*D*) between the two conventional sections that was missed. Thus, there is a 5-mm gap between *A* and *B*. Comparison between *B* and *E* shows the slightly greater quantum mottle produced by the lower milliamperes (165 versus 250 mA).

F, Five-millimeter-thick spirally acquired image from the same data set as *C* through *E* but reconstructed at 2-mm increments. This section is at a slightly higher level than *E* and demonstrates the arytenoid cartilages (*arrows*) better than the contiguous sections (*C*, *D*, and *E*) do because the section is more precisely through the middle portion of the cartilage and the joint.

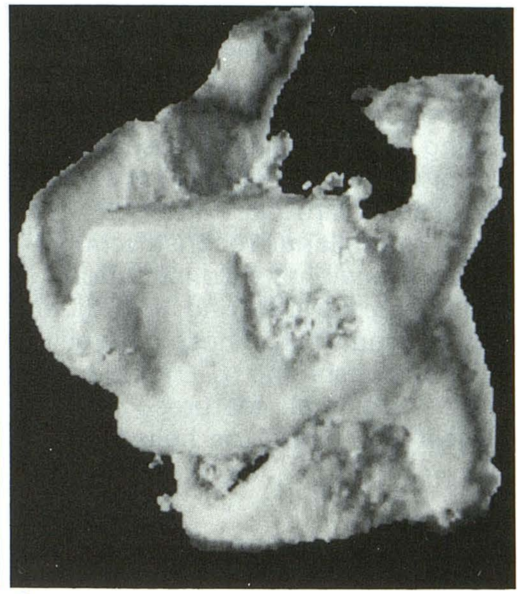


A B

Fig 2. Axially acquired spiral CT images at the false-cord level. The 2-mm-thick section (*A*) demonstrates paraglottic fat planes (*curved arrow*) better than the 5-mm-thick section (*B*).



3



4

Fig 3. Paracoronal reconstruction of a patient with a right-vocal cord tumor scanned axially using 2-mm collimation with reconstructions at 1-mm intervals. The tumor is well demonstrated (*arrows*), as is its relationship to the true (*open arrow*) and false (*arrowhead*) cords and to the cartilages.

Fig 4. Three-dimensional reconstruction of the laryngeal cartilages of the same patient as in Figure 3.

tained at 5-mm increments (Fig 1F and Table 1). The spiral 5 × 5-mm images were as good as or better than the conventional ones, although the quantum mottle was increased slightly because of lower milliamperes (Figs 1B and 1E).

TABLE 2: Visibility scores: comparison of spiral 5 × 2 mm versus 2 × 2 mm

	Cartilages	False Cords	True Cords
5 × 2 mm	3.0 ± 0.5	2.7 ± 0.4	2.6 ± 0.4
2 × 2 mm	3.5 ± 0.5[a]	3.2 ± 0.5[a]	3.0 ± 0.3[a]

Note.—Scores are mean ± SD; n = 10.

[a] $P < .05$ versus 5 × 2-mm images.

Table 2 summarizes the comparisons between 5 × 2-mm and 2 × 2-mm spiral studies of the larynx. These data show that the thinner-section spiral studies improve anatomic depiction of the laryngeal cartilages, false cords, and true cords (Fig 2) even with somewhat greater quantum mottle caused by the thinner collimation.

Discussion

Spiral CT has been successfully used for evaluation of the chest (5), abdomen (6), and vascular structures (7). Previous studies have shown its utility in studying the head and neck

(3). Our limited series reported here shows that the capability to scan quickly with swallowing suspended and during few respiratory cycles reduced motion artifact and spatial misregistration. Anatomic information is as good as or better than that in conventional CT studies. The ability to reconstruct the spirally acquired sections at smaller increments permitted better visualization of laryngeal anatomy, because the overlap was more likely to provide a section exactly at the level of a particular structure. We also found thin-section spiral scans to be better than thicker-section scans for depicting these same laryngeal structures, so routine neck studies with thin reconstruction intervals may not be able to replace studies directed at the larynx. However, larger series will be required to determine what level of anatomic resolution is required for adequate clinical evaluation and staging of laryngeal diseases. Spiral scanning also offers other methods for evaluating the larynx. The volumetric nature of the acquisition allows mutliplanar reconstructions (Fig 3) and three-dimensional reconstructions (Fig 4) with minimal step artifact and no additional scanning time or irradiation. These capabilities are helpful for tumor staging (8, 9) and trauma (10, 11). These technical features, and our results, suggest that spiral or helical scanning is the CT method of choice for evaluating lesions of the larynx.

References

1. Mancuso AA, Harnsberger HR, Dillon WP. *Workbook for MRI and CT of the Head and Neck.* 2nd ed. Baltimore: Williams & Wilkins, 1989
2. Curtin HD. Imaging of the larynx: current concepts. *Radiology* 1989;173:1–11
3. Suojanen JN, Mukherji SK, Dupuy DE, Takahashi JH, Costello P. Spriral CT in evaluation of head and neck lesions: work in progress. *Radiology* 1992;183:281–283
4. Fleiss JL. *Statistical Methods for Rates and Proportions.* 2nd ed. New York: John Wiley & Sons, 1981
5. Costello P, Anderson W, Blume D. Pulmonary nodule: evaluation with spiral volumetric CT. *Radiology* 1991;179:875–876
6. Dupuy DE, Costello P, Ecker CP. Spiral CT of the pancreas. *Radiology* 1992;183:815–818
7. Napel S, Marks MP, Rubin GD, et al. CT angiography with spiral CT and maximum intensity projection. *Radiology* 1992;185:607–610
8. Sulfara S, Barzan L, Querin F, et al. T staging of the laryngohypopharyngeal carcinoma: a 7-year multidisciplinary experience. *Arch Otolaryngol Head Neck Surg* 1989;115:613–620
9. Coia L, Galvin J, Sontag M, et al. Three-dimensional photon treatment planning in carcinoma of the larynx. *Int J Radiat Oncol Biol Phys* 1991;21:183–192
10. Schaefer S. Use of CT scanning in the management of the acutely injured larynx. *Otolaryngol Clin North Am* 1991;24:31–36
11. Meglin AJ, Biedlingmaier JF, Mirvis SE. Three-dimensional computerized tomography in the evaluation of laryngeal injury. *Laryngoscope* 1991;101:202–207