Post-mortem Computed Tomography of Hanging: Superior Horn Fracture of the Thyroid Cartilage

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Learning objectives

To illustrate the correlation between post-mortem forensic CT findings and the autopsy results of superior horn fractures of the thyroid cartilage in hanging cases. To outline various aspects of these fractures, and normal variants thereof.
Background

Post-mortem CT is increasingly being used in forensic medicine [1-3]. However, such CT findings are often difficult to interpret because post-mortem and clinical CT data differ in many ways. Therefore, radiologists require experience in interpreting post-mortem CT.

Superior horn fracture of the thyroid cartilage is a characteristic finding in hanging cases [4, 5]. When a person hangs himself/herself, the superior horns of the thyroid cartilage become pressed against the vertebral body and are frequently broken. Elderly people are more likely to experience such fractures because the thyroid cartilage is usually calcified.

However, evaluation of a superior horn of the thyroid cartilage is unusual in clinical practice. Additionally, any change associated with a superior horn fracture of the thyroid cartilage is usually minor. Although it is difficult to detect a fracture in many cases, it is necessary to establish whether or not a superior horn is broken in cases of hanging and cervical trauma. We illustrate various aspects of these fractures, and normal variants thereof.
Findings and procedure details

CT and autopsy

All cases were scanned using an eight-channel multi-detector row CT (MDCT) scanner (Aquilion 8; Toshiba Medical Systems, Tokyo, Japan). The scanning protocol was as follows:

- Tube Voltage: 120 kVp
- Tube Current: Arbitrary
- Rotation Time: 0.75 s
- Collimation: 2.0 mm
- Beam Pitch: 0.875
- Table Speed: 14 mm/rotation

All cases underwent conventional autopsy soon after CT examination. After the autopsy, reports were received from the forensic pathologist, the CT images were reviewed, and the correlations between CT findings and autopsy results were discussed.

Fracture of a superior horn of the thyroid cartilage

A superior horn fracture exhibiting major deviation or complete separation of cartilage fragments is easily detected on CT, but such cases are rare. Most fractures exhibit little deviation. Additionally, bleeding caused by the fracture is usually minor at the time of autopsy, and it is thus impossible to detect bleeding on CT. Occasionally, a gas bubble marks the fracture.

Fig. 1 on page 7 shows a left superior horn fracture of the thyroid cartilage at autopsy (arrowhead). The fracture exhibits a little bleeding. Fig. 2 on page 7 shows a CT image of the fracture. The left superior horn exhibits deviation and a fracture line (arrows). However, bleeding cannot be detected. In this case, it is easy to diagnose the superior horn fracture.

Fig. 3 on page 8 shows a left superior horn fracture of the thyroid cartilage at autopsy. A fracture line is observed at the left superior horn (arrow). Fig. 4 on page 8 shows
a CT image of the fracture. The left superior horn seems to be a little irregular, but any deviation or fracture line is unclear (arrows).

**Fig. 5** on page 9 shows a right superior horn fracture of the thyroid cartilage at autopsy. Separation of the cartilage fragment is observed (arrowhead), but bleeding is unclear. **Fig. 6** on page 10 shows a CT image of the fracture. The right superior horn seems to be a little irregular, but any fracture is unclear (arrows).

**Fig. 7** on page 11 shows a left superior horn fracture of the thyroid cartilage at autopsy (arrowhead). The fracture exhibits a little bleeding. **Fig. 8** on page 12 shows a CT image of the fracture. The left superior horn is inhomogeneously calcified, but any fracture is unclear (arrows). No bleeding can be detected.

**Fig. 9** on page 13 shows a right superior horn fracture of the thyroid cartilage at autopsy. The fracture surface is horizontal (arrow), and the fracture exhibits a little bleeding. **Fig. 10** on page 13 shows a CT image of the fracture. Although any deviation or fracture line is unclear, a small gas bubble is observed at the point of fracture (arrow).

**Degeneration of superior horns of the thyroid cartilage**

Superior horns of the thyroid cartilage are often degenerated. It is difficult to distinguish a fracture from degeneration. **Fig. 11** on page 14 shows degeneration of the right superior horn of the thyroid cartilage at autopsy (arrow). The superior horn is irregular, but is not fractured. **Fig. 12** on page 15 shows CT findings of degeneration (arrows). It is difficult to completely rule out a fracture from the CT image.

**Congenital abnormality of superior horns of the thyroid cartilage**

Superior horns of the thyroid cartilage occasionally exhibit a congenital abnormality. Care must be taken to not mistake an abnormality for a fracture. **Fig. 13** on page 16 shows a congenital defect in the left superior horn of the thyroid cartilage (arrow) and a right superior horn fracture of the thyroid cartilage (arrowhead) at autopsy. **Fig. 14** on page 16 shows CT findings for the defect (arrow) and the fracture (arrowhead).

**The triticeal cartilage**
The thyrohyoid ligament connects the greater horn edge of the hyoid bone with the superior horns of the thyroid cartilage. A small cartilage called the 'triticeal cartilage' is often observed in the ligament. It is necessary to distinguish between the triticeal cartilage and superior horn fracture of the thyroid cartilage. Fig. 15 on page 17 shows CT findings for the triticeal cartilage (arrows). The tip of the triticeal cartilage is round. The small structures should not be interpreted as fracture fragments of the superior horn of the thyroid cartilage.
Fig. 1: A left superior horn fracture of the thyroid cartilage at autopsy (arrowhead). The fracture exhibits a little bleeding.

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**Fig. 2:** A CT image of a left superior horn fracture of the thyroid cartilage. The left superior horn exhibits deviation and a fracture line (arrows). No bleeding can be detected.

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**Fig. 3:** A left superior horn fracture of the thyroid cartilage at autopsy. A fracture line is evident in the left superior horn (arrow).

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Fig. 4: A CT image of a left superior horn fracture of the thyroid cartilage. The left superior horn seems to be a little irregular, but any deviation or fracture line is unclear (arrows).

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Fig. 5: A right superior horn fracture of the thyroid cartilage at autopsy. Separation of the cartilage fragment is observed (arrowhead) but bleeding is unclear.

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**Fig. 6:** A CT image of a right superior horn fracture of the thyroid cartilage. The right superior horn seems to be a little irregular, but any fracture is unclear (arrows).

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Fig. 7: A left superior horn fracture of the thyroid cartilage at autopsy (arrowhead). The fracture exhibits a little bleeding.

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Fig. 8: A CT image of a left superior horn fracture of the thyroid cartilage. The left superior horn is inhomogeneously calcified, but any fracture is unclear (arrows). No bleeding can be detected.
**Fig. 9:** A right superior horn fracture of the thyroid cartilage at autopsy. The fracture surface is horizontal (arrow), and the fracture exhibits a little bleeding.

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Fig. 10: A CT image of a right superior horn fracture of the thyroid cartilage. Although any deviation or fracture line is unclear, a small gas bubble is observed at the point of fracture (arrow).

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Fig. 11: Degeneration of the right superior horns of the thyroid cartilage at autopsy (arrow). The superior horn is irregular, but is not fractured.

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**Fig. 12:** A CT image of degenerated right superior horns of the thyroid cartilage (arrows). The superior horn seems to be irregular in shape, but it is difficult to completely rule out a fracture from the CT image. Arrowheads mark the triticeal cartilage.

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**Fig. 13:** Congenital defect of the left superior horn of the thyroid cartilage (arrow) and a right superior horn fracture of the thyroid cartilage (arrowhead) at autopsy.

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**Fig. 14:** A CT image of a congenital defect of the left superior horn of the thyroid cartilage (arrow) and a right superior horn fracture of the thyroid cartilage (arrowhead).

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**Fig. 15:** A CT image of the triticeal cartilage (arrows).

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Conclusion

Any change associated with a superior horn fracture of the thyroid cartilage is usually minor on CT. Additionally, any fracture should be carefully distinguished from degeneration, a congenital abnormality, and the triticeal cartilage. Adequate experience and careful observation are required to evaluate a fracture.
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References


