Main Abnormalities of the Videofluoroscopic Swallowing Study - a Valuable Technique in Swallowing Disorders

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Learning objectives

Recognize the importance of the videofluoroscopic swallowing study in patients with swallowing disorders.

Review the main abnormalities that can be found on the videofluoroscopic swallowing study.

Background

Swallowing and feeding problems are common, particularly in the elderly, and will be an increasing cause of disability in the aging population.

There is a wide spectrum of causes for swallowing impairment:

- Stroke, the most frequent cause in adults

- Other neuromuscular conditions

- Trauma

- Postoperative changes

- Malignancy

- Radiation injury

The most frequent symptoms of abnormal swallowing include:

- Difficulty initiating swallowing

- Cervical dysphagia

- Nasal regurgitation

- Coughing

- Choking

The videofluoroscopic swallowing study (VFSS) is the most commonly used tool for determining the nature and extent of the swallowing disorder. It can provide important

information on patterns of impairment of the swallowing mechanism, allowing important changes in patient treatment.

Despite these important aspects, the VFSS is now seldom taught and is practiced by relatively few radiologists.

Findings and procedure details

Swallowing is a complex and coordinated neuromuscular process consisting of both voluntary and involuntary activity. It is divided into oral, pharyngeal, and esophageal stages, which are in fact interrelated.

The VFSS focuses on oropharyngeal swallowing, evaluating oral, pharyngeal, laryngeal and cervical esophagic anatomy and physiology. These stages of swallowing last only 1-1.5 seconds, so the slow motion, reverse and stop-frame capabilities of videofluoroscopy are essential for the examination.

The patient is observed with the lateral projection. The frontal projection can also be used, to evaluate symmetry. Radiopaque material, usually barium of varying consistencies, is administered. Swallowing therapists can assist during the study.

The exam should be terminated if:

- the patient is uncooperative

- the patient has major difficulty in oral transport

- substantial aspiration occurs

Swallowing Abnormalities Relative to Level of Involvement

On the VFSS, the most commonly observed anomalies are:

- Laryngeal penetration

- Aspiration

- Pharyngeal stasis

- Cricopharyngeal bar

These anomalies should, however, be interpreted cautiously as they are generally non specific and may not correlate well with the presenting symptoms.

Oral Cavity

- Poor Oral Control

- Anterior loss of material through the lips [Fig. 1 on page 7]
- Inability to form and position the bolus in the oral cavity [Fig. 2 on page 8]
- Premature leakage [Fig. 3 on page 8] - prevented normally by a seal formed by the back of the tongue and the soft palate. Premature leakage can cause laryngeal penetration or aspiration before swallowing.

- Poor Oral Transport

- Hesitant or absent initiation of swallowing [Fig. 4 on page 9]
- Discoordinated tongue motions [Fig. 2 on page 8]
- Stasis of material in the oral cavity [Fig. 5 on page 10]

Pharyngeal Level

- Nasopharyngeal Regurgitation

This abnormality occurs when the palate does not elevate sufficiently and fails to produce the palatopharyngeal seal [Fig. 6 on page 11].

- Poor Laryngeal Motion

- Absent or decreased hyoid bone movement [Fig. 5 on page 10] - movement of the hyoid bone is directly correlated with bolus volume and flags laryngeal elevation.
- Reduced motion of the epiglottis [Fig. 7 on page 12] - reveals impairment of laryngeal closure and can lead to penetration of material in the supraglottic space and aspiration.

- Laryngeal Penetration or Aspiration

- Laryngeal penetration - entry of contrast material into the laryngeal vestibule [Fig. 7 on page 12]
- Aspiration - contrast passes below the vocal cords [Fig. 8 on page 13]

It is important to determine the timing:

- before swallowing - due to premature leakage from the oral cavity [Fig. 3 on page 8]
- during the pharyngeal stage of swallowing - due to impairment of laryngeal closure [Fig. 8 on page 13]
- after swallowing - due to pharyngeal stasis and overflow or regurgitation or reflux from the esophagus [Fig. 9 on page 14]

It is also important to assess if penetration or aspiration are symptomatic. Patients who display silent aspiration are 13 times more likely to develop pneumonia than those with normal swallowing.

- Stasis in the Pharyngeal Recesses

Stasis of material in the valleculae or piriform sinuses reflects an increased residual volume of swallowed material [Fig. 10 on page 15 , Fig. 11 on page 16]. It may lead to aspiration after swallowing.

Lateralization of pharyngeal stasis after a cerebrovascular accident may be observed in the frontal projection [Fig. 12 on page 17].

Small amounts of residual barium within normal-sized recesses can be deemed a normal variant.

Pharyngoesophageal Level

- Cricopharyngeal Bar

The cricopharyngeus is the main component of the upper esophageal sphincter (UES).

- Mild cricopharyngeal impression - usually regarded as normal, does not cause clinical symptoms [Fig. 13 on page 18].
- Prominent impression - narrowing of the lumen of more than 50% is considered a cause of dysphagia [Fig. 14 on page 19].

Conditions associated with cricopharyngeal prominence:

- Cricopharyngeal achalasia,

- Zenker's diverticulum,

- Advanced age,

- Gastroesophageal reflux and other esophageal motility disorders.

- Zenker's Diverticulum

Posterior hypopharyngeal diverticulum just proximal to the UES, through an area of anatomic weakness (Killian's dehiscence) [Fig. 15 on page 20 , Fig. 16 on page 21].

Associated to the same conditions as the cricopharyngeal bar.

Symptoms include dysphagia, halitosis, regurgitation of food and neck mass.

Barium in the diverticulum is regurgitated after swallowing and can cause overflow aspiration [Fig. 9 on page 14].

- Killian-Jamieson's Diverticulum

It is a transient or persistent protrusion of the anterolateral cervical esophagus into the Killian-Jamieson space [Fig. 17 on page 22 , Fig. 18 on page 23].

Relatively common, these diverticula can be bilateral or unilateral and most patients are asymptomatic.

- Cervical Osteophytes Impinging the Pharynx and Upper Esophagus

Osteophytes of the cervical spine rarely cause dysphagia despite their high prevalence on the elderly population [Fig. 19 on page 24].

Large osteophytes may mechanically compress the pharynx and esophagus producing obstruction, or hinder epiglottic tilt [Fig. 20 on page 25].

Compensatory Changes

When signs of compensation are observed, swallowing is already impaired. These include postural changes like neck flexing [Fig. 21 on page 26], neck extension [Fig.

22 on page 27] and head rotation. Other signs of compensation are increased motion of a particular structure to compensate for deficiencies of the opposite structure.

Other Abnormalities

Signs of a mass [Fig. 23 on page 28] or changes to the normal anatomy by surgical treatments or radiotherapy [Fig. 24 on page 29] can also be evaluated on the VFSS.

Images for this section:

Fig. 1: Patient with familial amyloid neuropathy. Loss of contrast through the lips (arrow).

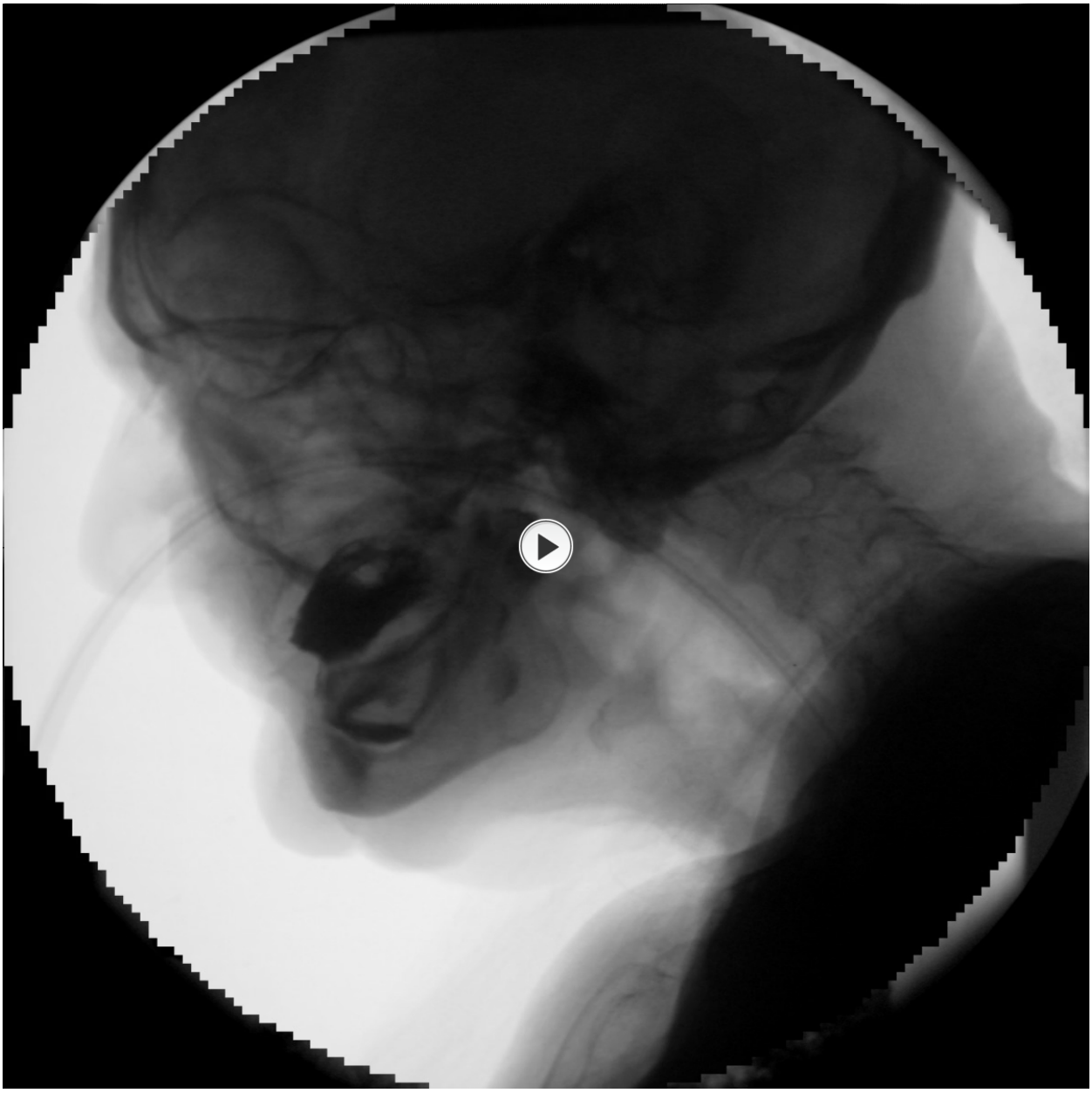

Fig. 2: Case of multiple brain infarcts. Marked changes of the oral phase of swallowing.

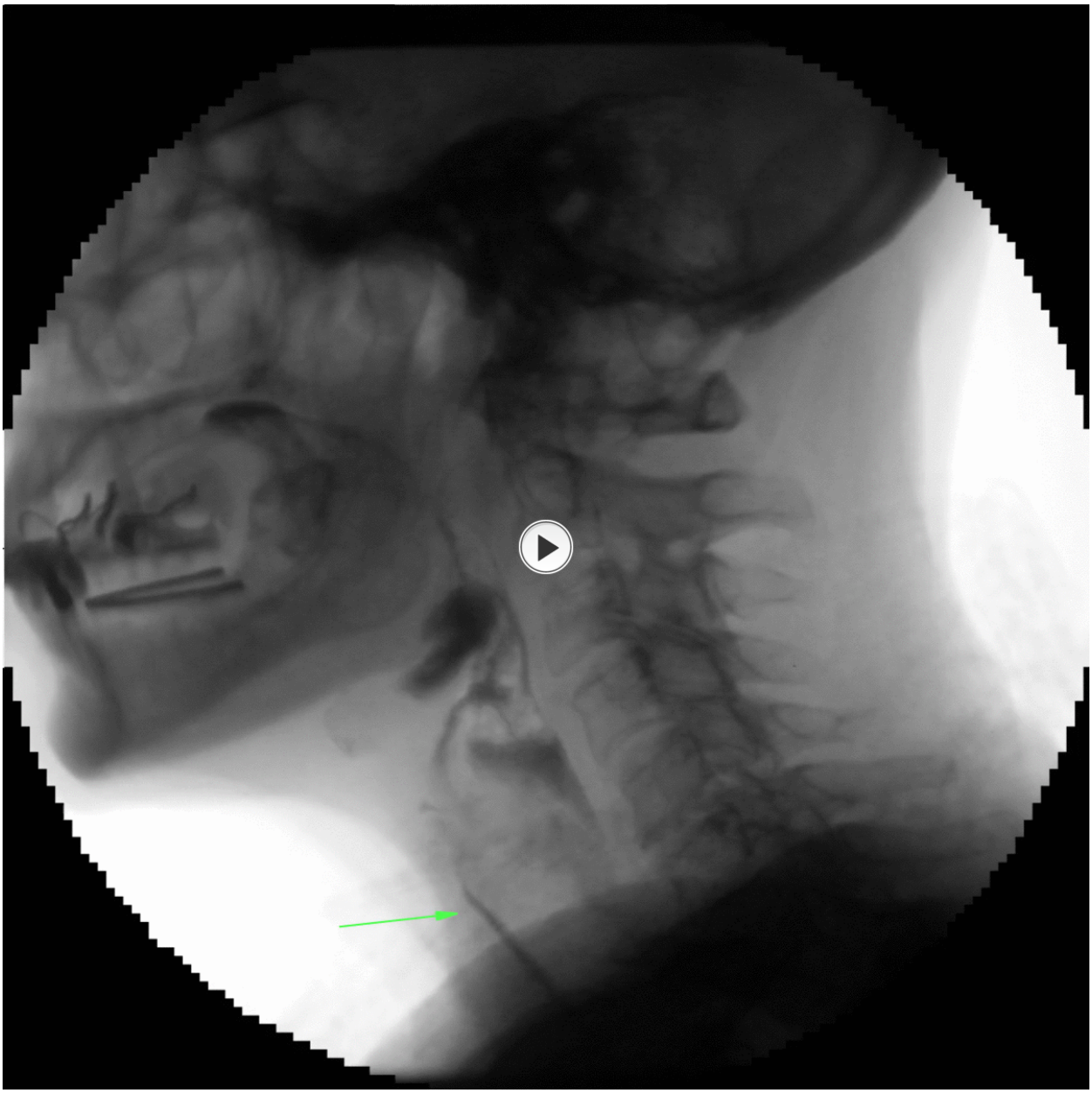

Fig. 3: Premature leakage of contrast material into the pharynx, with signs of aspiration (arrow) before triggering of the swallowing reflex.

Fig. 4: Hesitant initiation of swallowing in a patient who suffered a stroke.

Fig. 5: Patient with dysphagia. Stasis of contrast material in the oral cavity and decreased hyoid bone elevation. Normally the hyoid bone rises to appose the angle of the mandible.

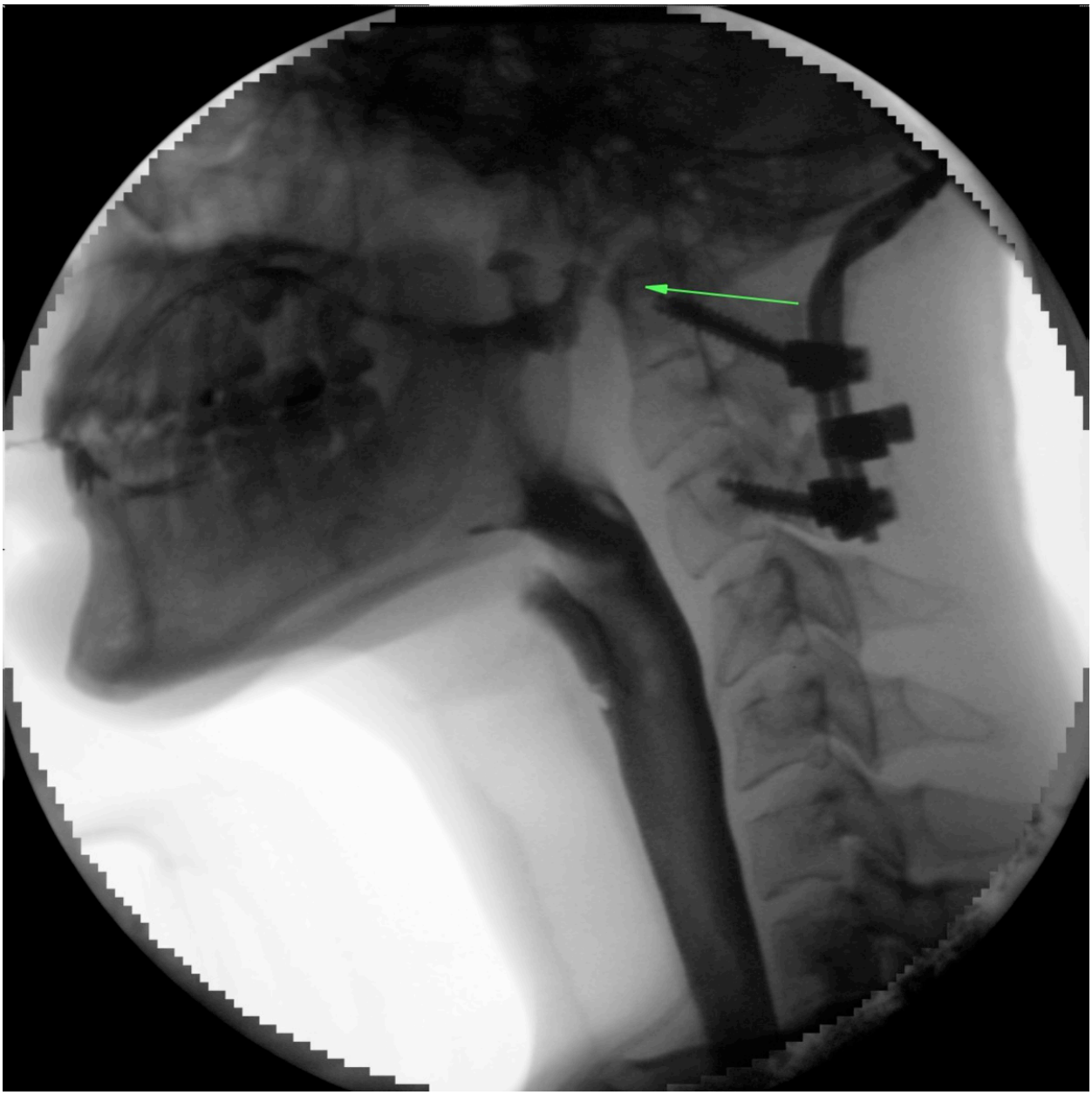

Fig. 6: Failure of the palatopharyngeal seal with passage of contrast to the nasopharynx (arrow).

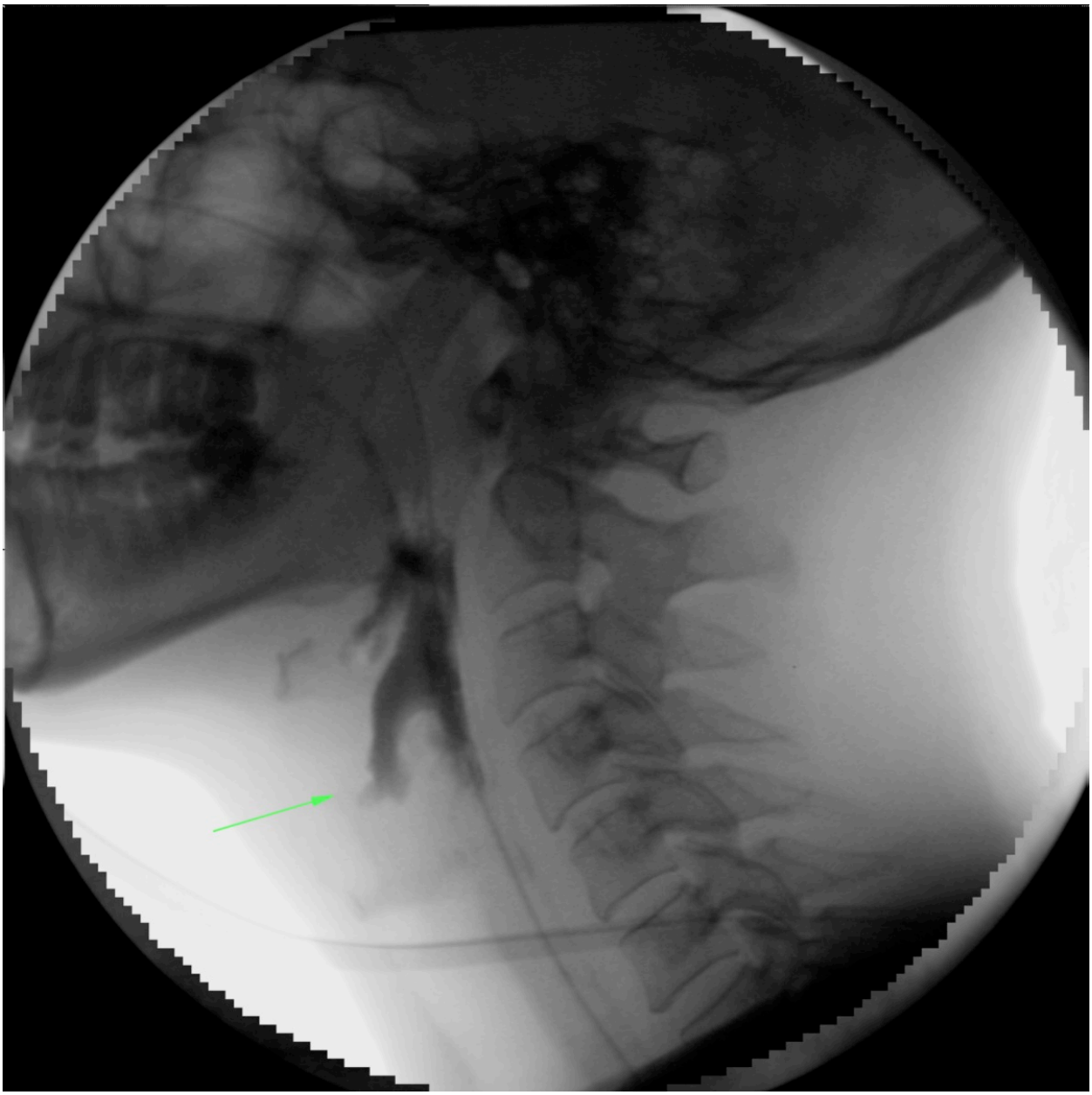

Fig. 7: Patient with dysphagia after a stroke. Reduced motion of the epiglottis with laryngeal penetration (arrow).

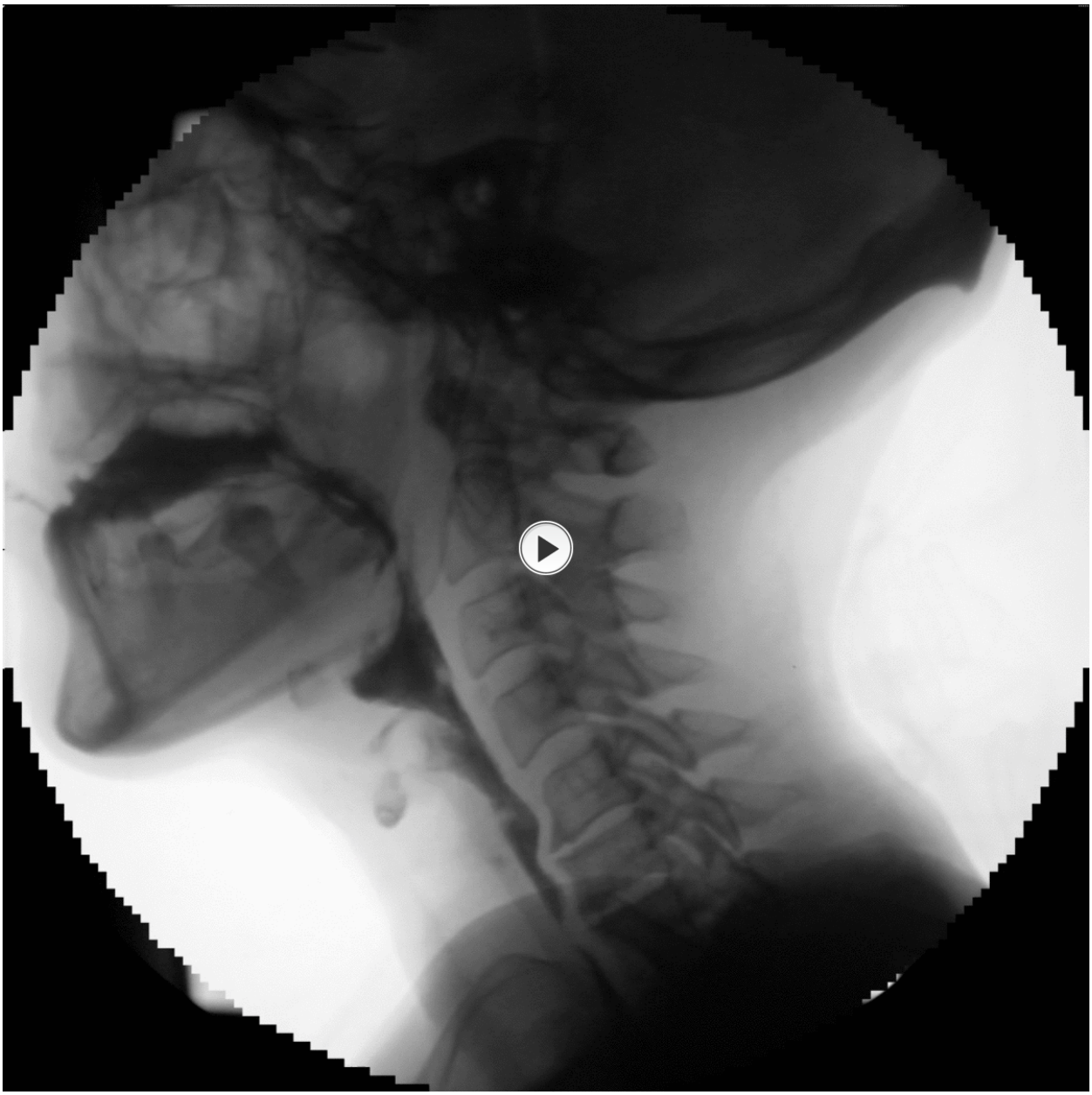

Fig. 8: Patient with pneumonia after a stroke. Aspiration of contrast material (arrow) during the pharyngeal stage of swallowing.

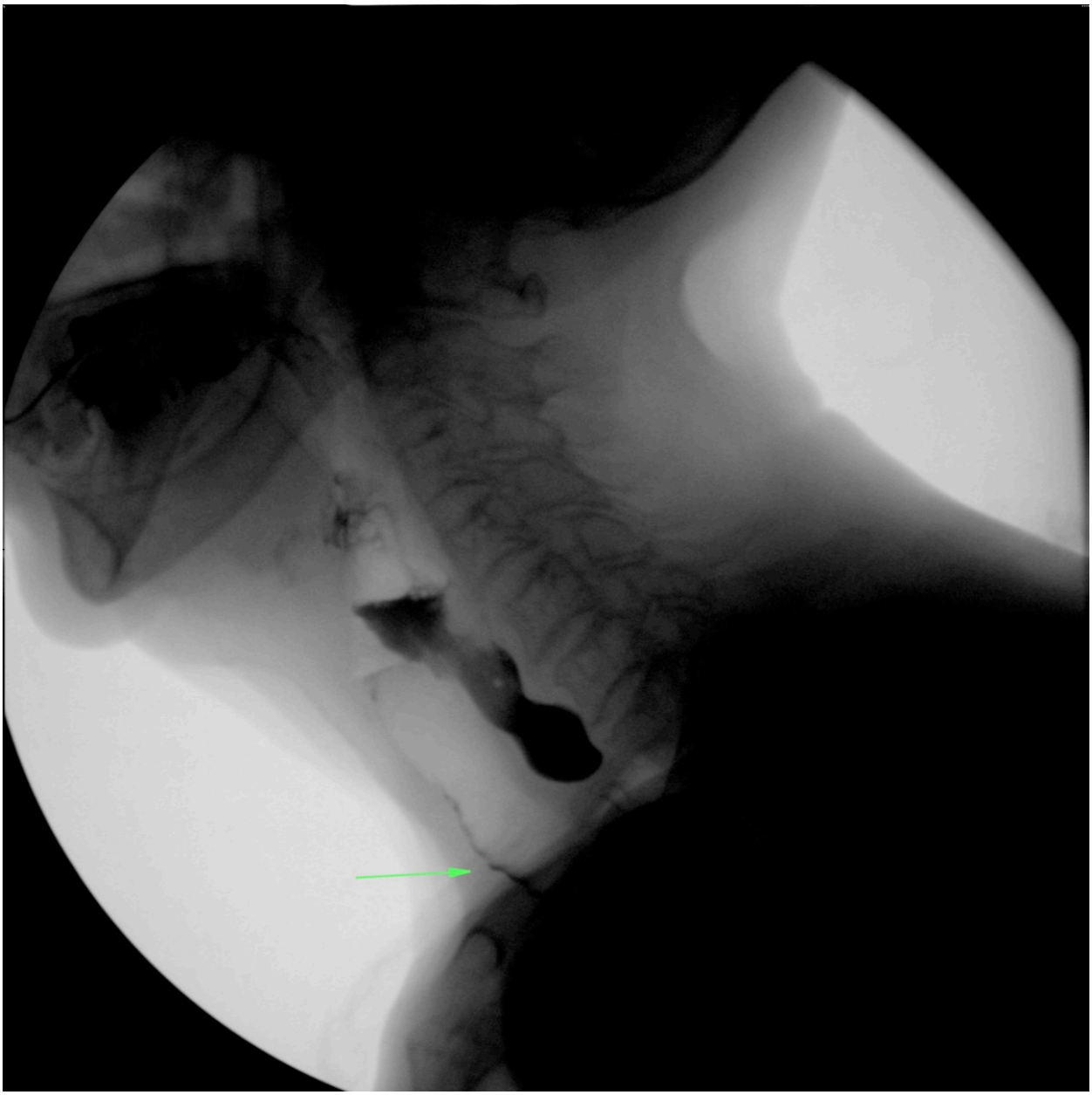

Fig. 9: Patient with a Zenker's diverticulum. After swallowing, regurgitation of contrast material in the diverticulum causes aspiration (arrow).

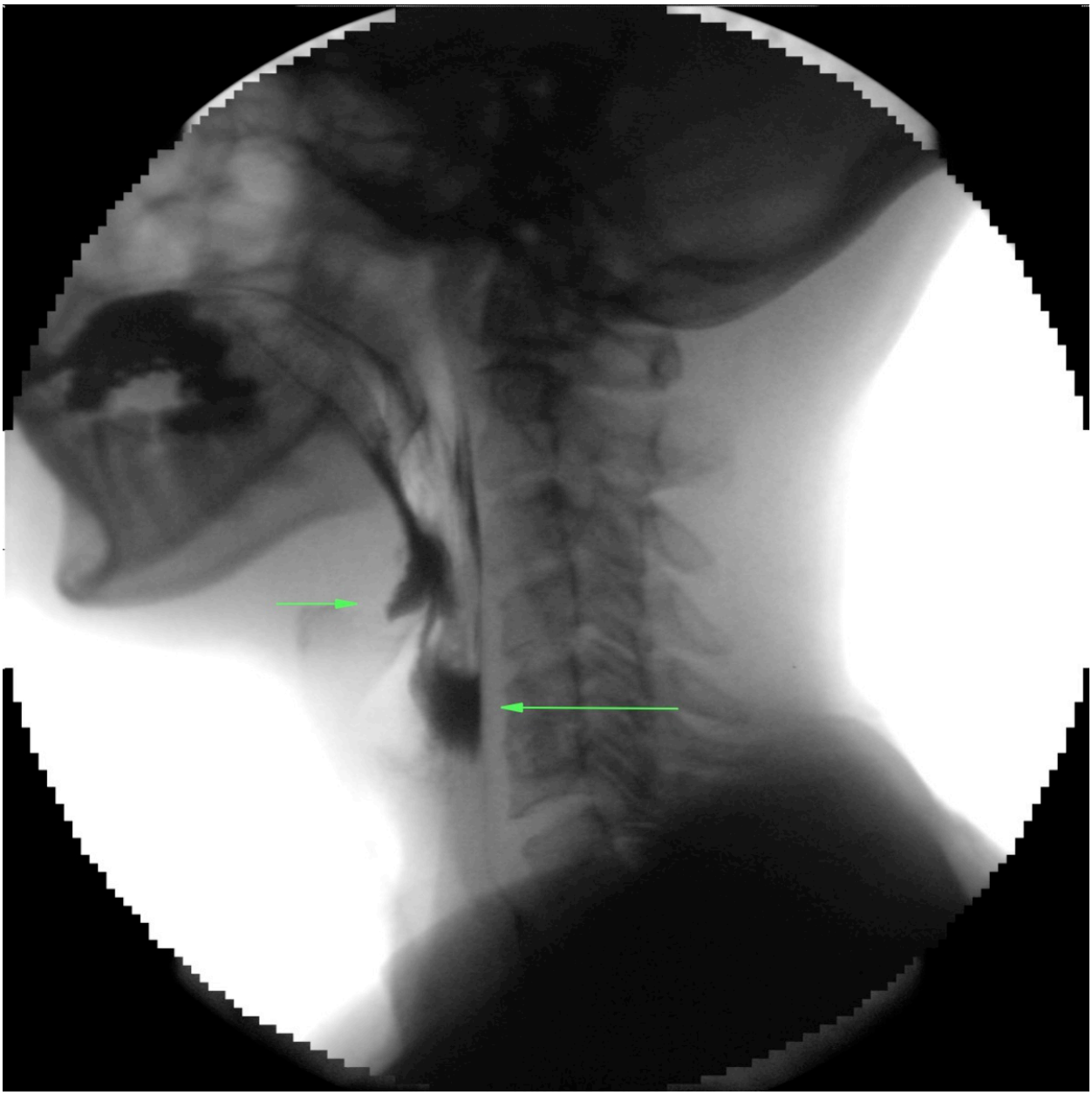

Fig. 10: Stasis of contrast material in the valleculae (short arrow) and piriform sinuses (long arrow).

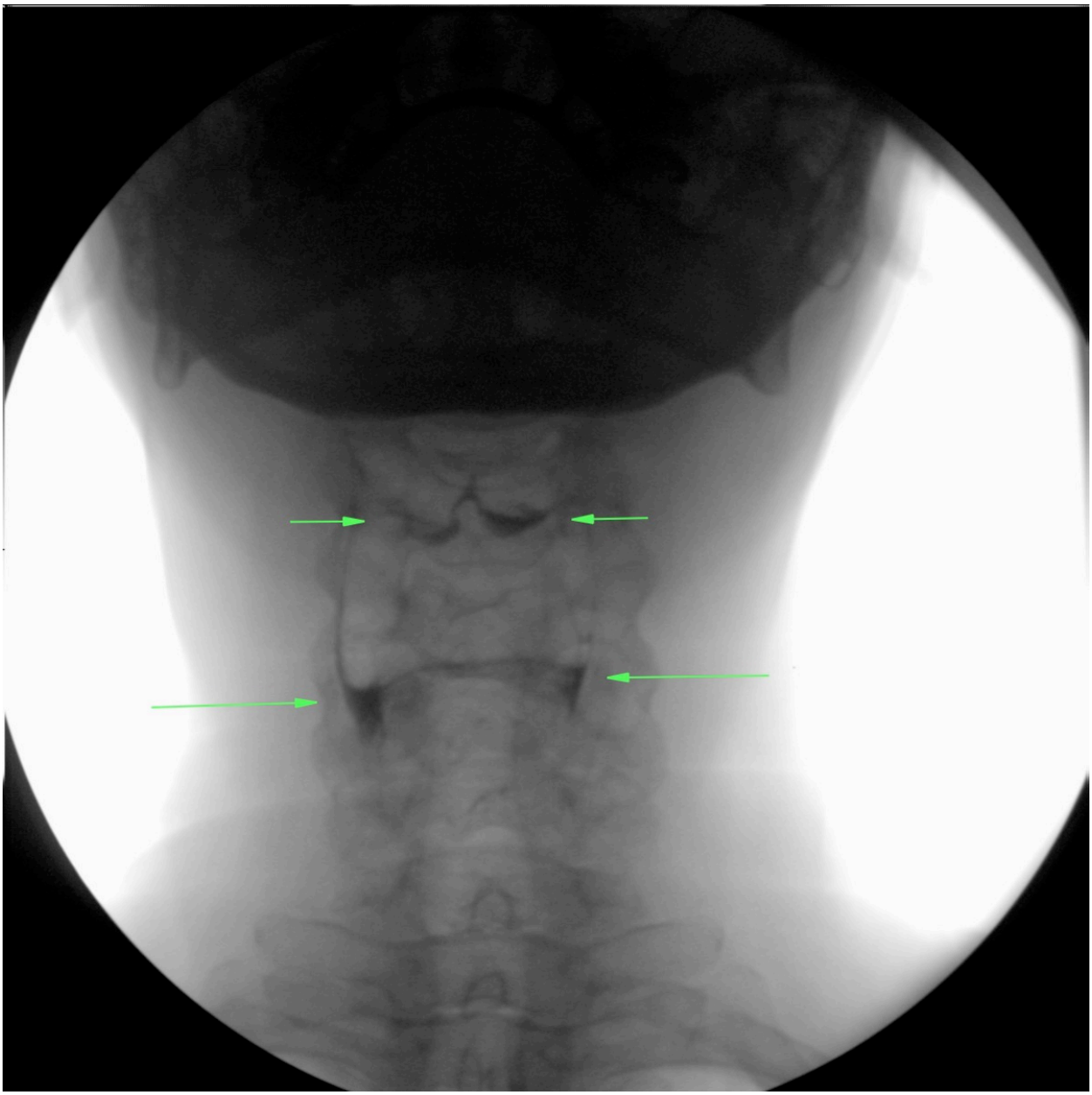

Fig. 11: Frontal projection. Symmetric stasis of contrast in the valleculae (short arrows) and piriform sinuses (long arrows).

Fig. 12: Patient with dysphagia after a stroke. Frontal projection shows asymmetric stasis of contrast in the right piriform sinus (arrow).

Fig. 13: Patient with cervical dysphagia. Mild cricopharyngeal impression (arrow), without any signs of stasis of contrast material during the exam.

Fig. 14: Patient with polimyositis. Prominent cricopharyngeal impression (arrow), with a narrowing of more than 50% of the lumen.

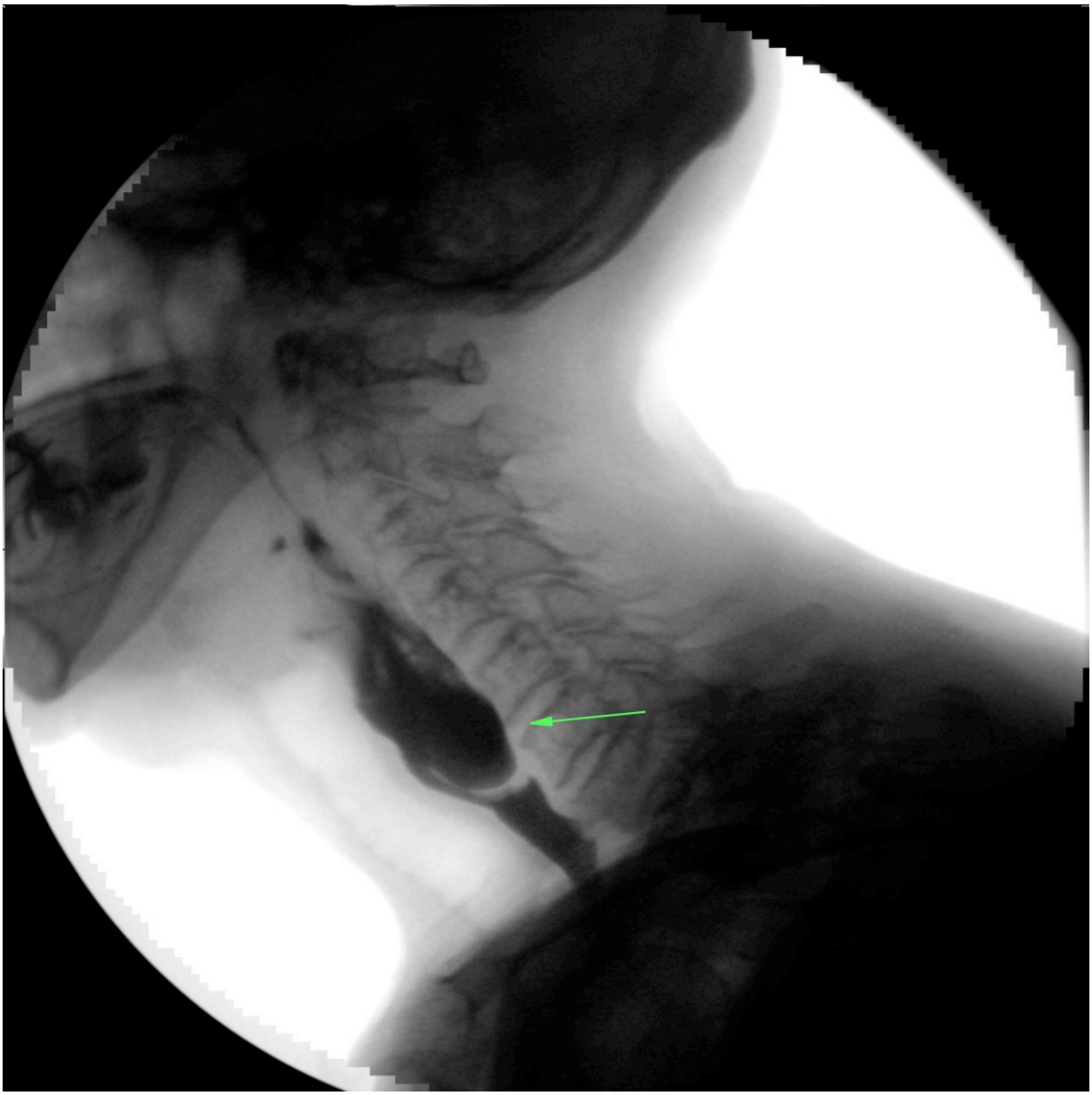

Fig. 15: Patient with cervical dysphagia. Posterior bulging of the distal pharyngeal wall, above the cricopharyngeal muscle but extending below this level, signs of a Zenker's diverticulum (arrow).

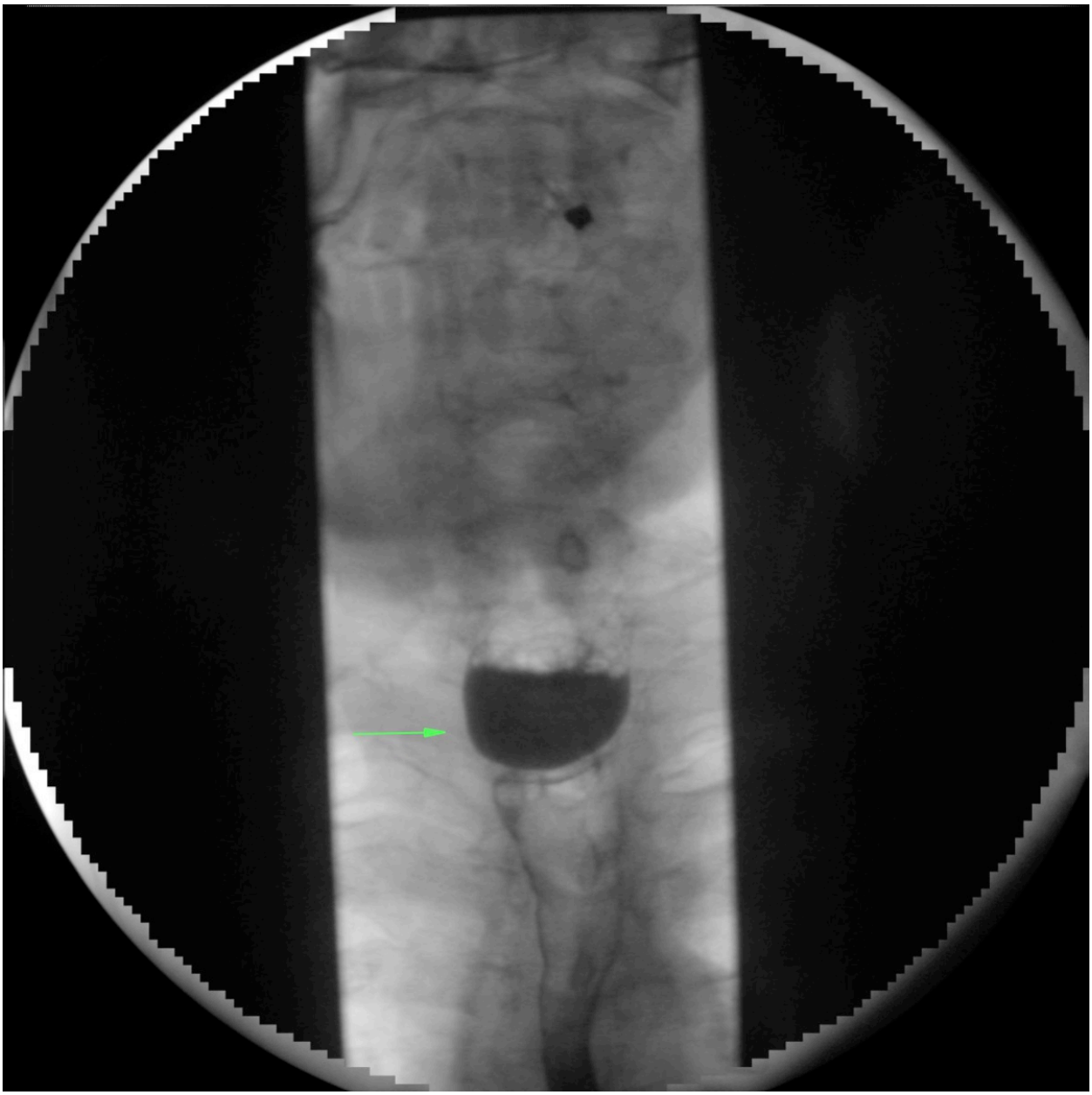

Fig. 16: Frontal projection showing a Zenker's diverticulum (arrow).

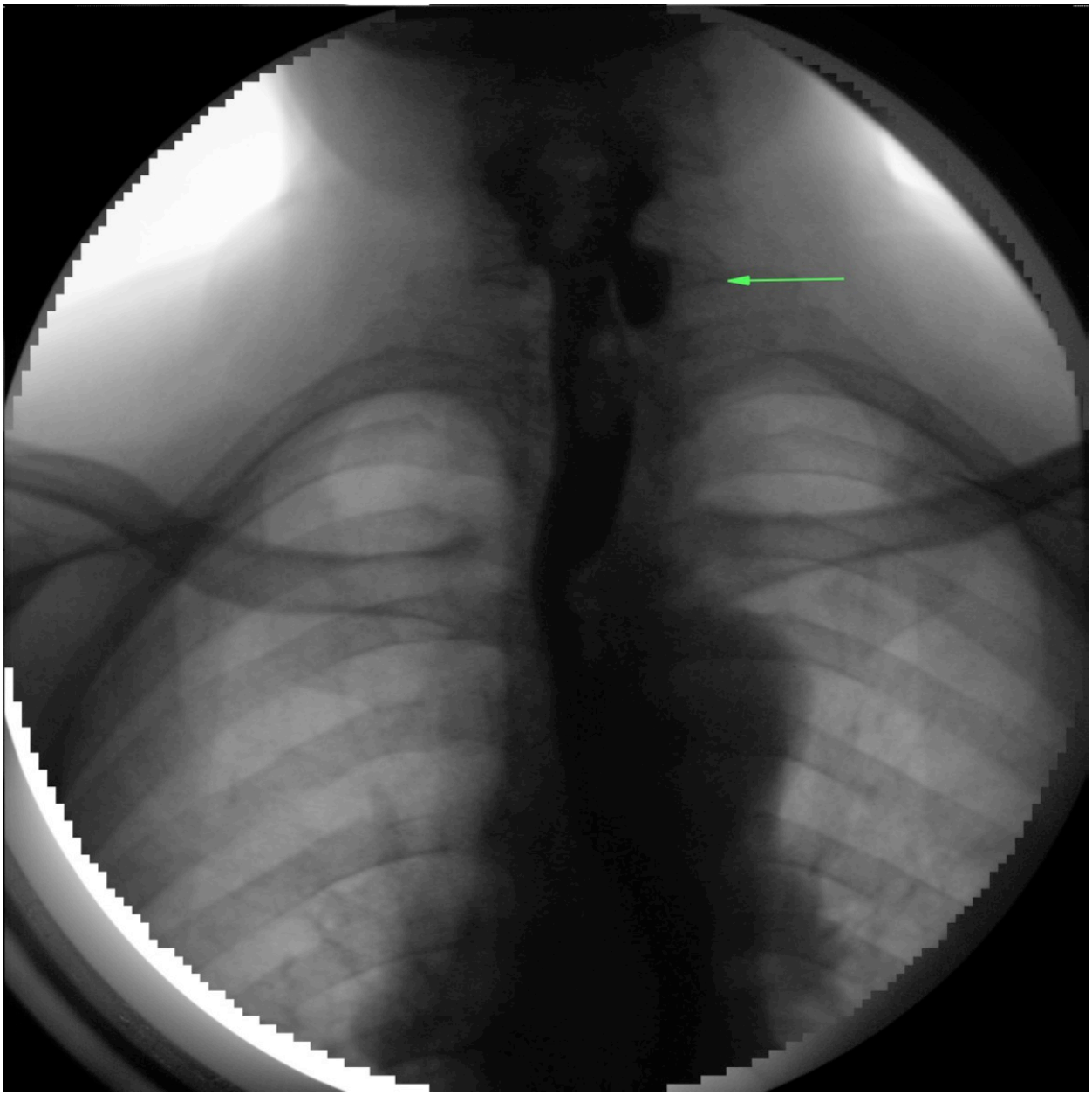

Fig. 17: Frontal projection displaying a lateral pouch filled with contrast (arrow) at the pharyngoesophageal level. Patient with a Killian-Jamieson diverticulum, which may be confused radiographically with Zenker's diverticulum.

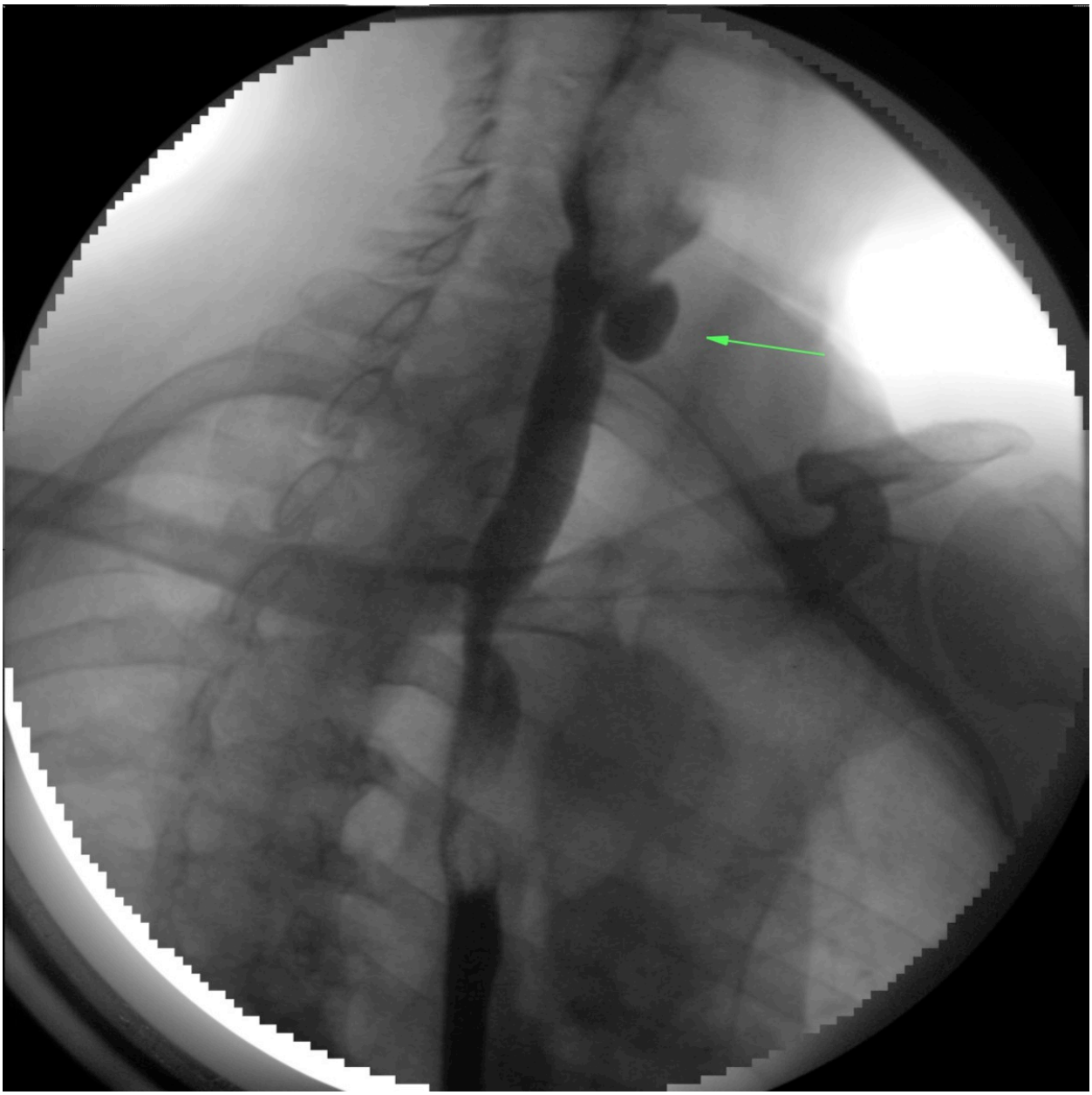

Fig. 18: Same patient as in Fig. 18. Oblique projection showing the anterior location of the pouch, consistent with a Killian-Jamieson diverticulum.

Fig. 19: Patient with intermittent dysphagia. Osteophytes of C5 and C6, molding the pharynx but not interfering with contrast progression.

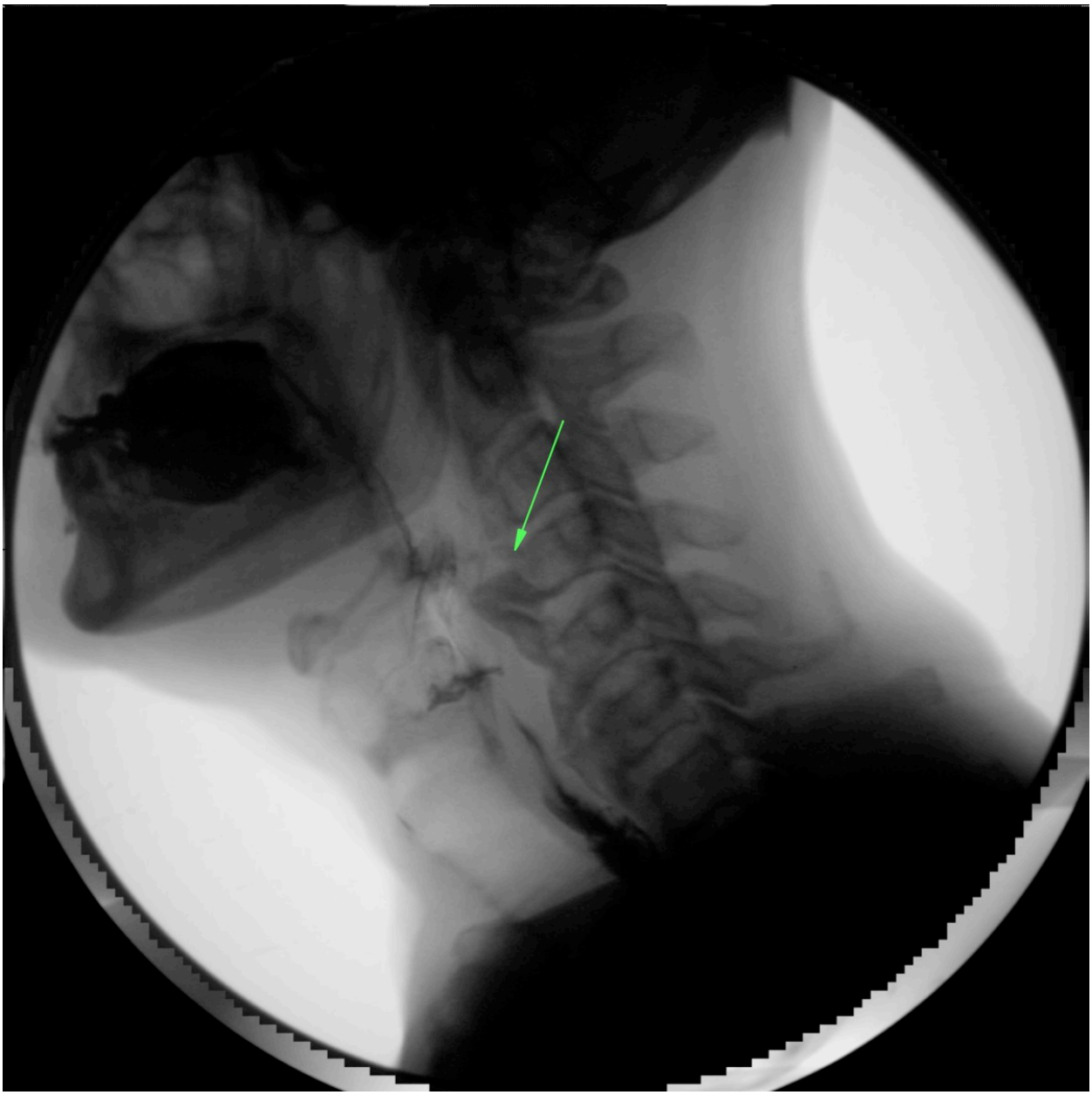

Fig. 20: Patient with cervical dysphagia. Prominent osteophytes in C4-C5 (arrow), causing stasis of contrast.

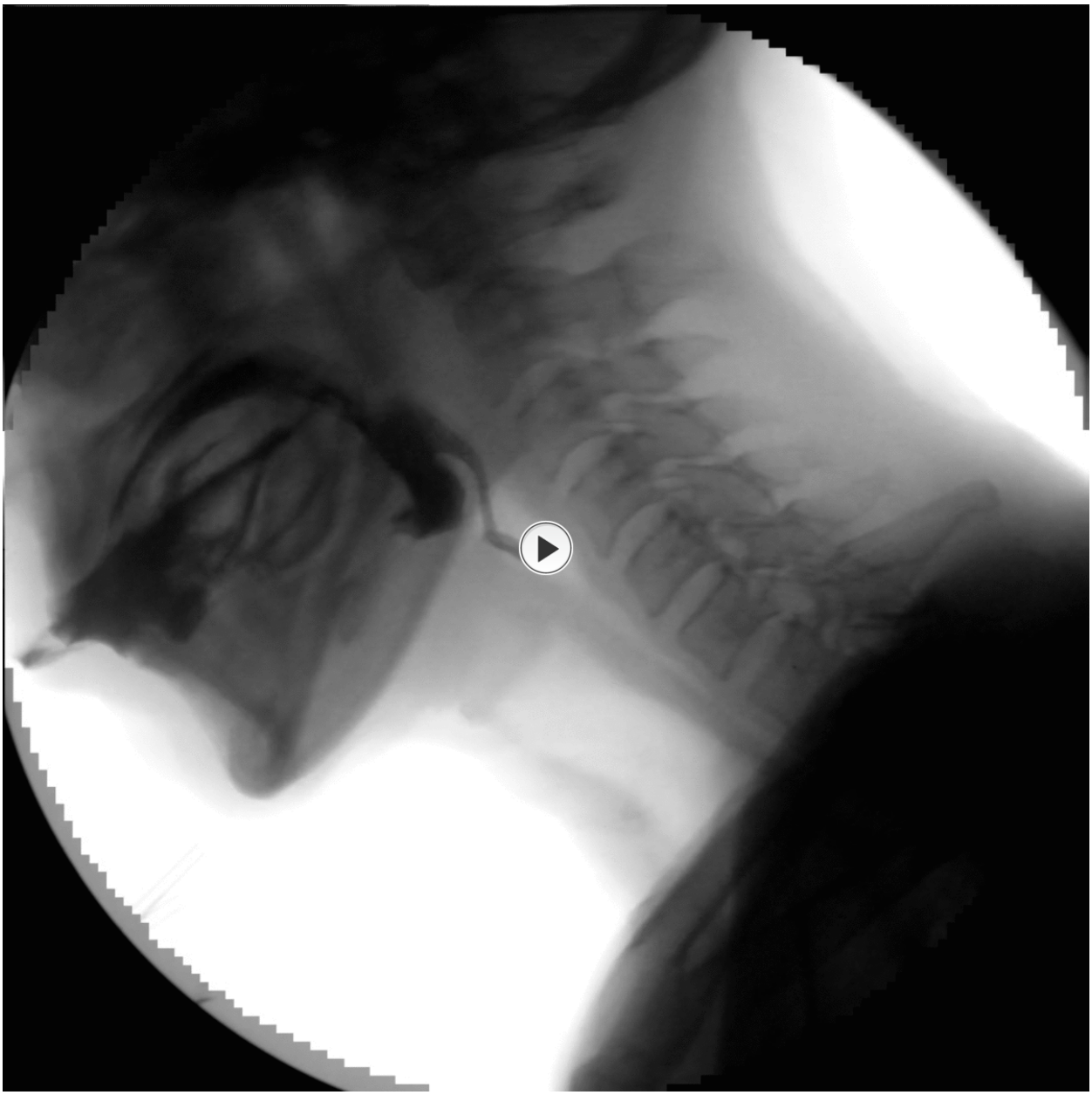

Fig. 21: Neck flexion (also known as chin-down or "chin tuck"). This positon may help a patient to swallow more effectively, reducing laryngeal penetration or aspiration and clearing any retained bolus.

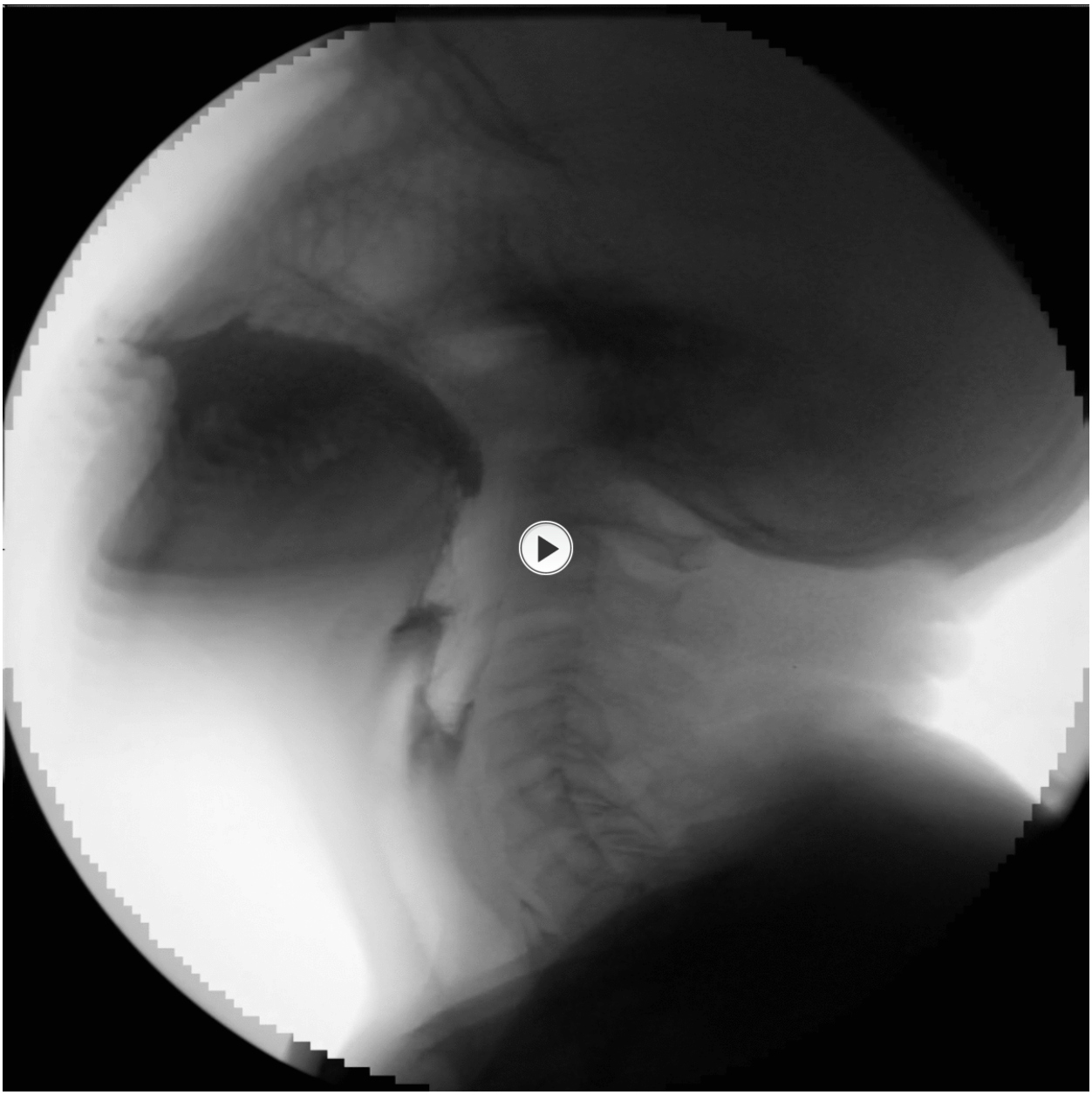

Fig. 22: Neck extension (also known as chin-up position) in a patient with poor oral transport, allowing gravity to help transfer the bolus to the oropharynx.

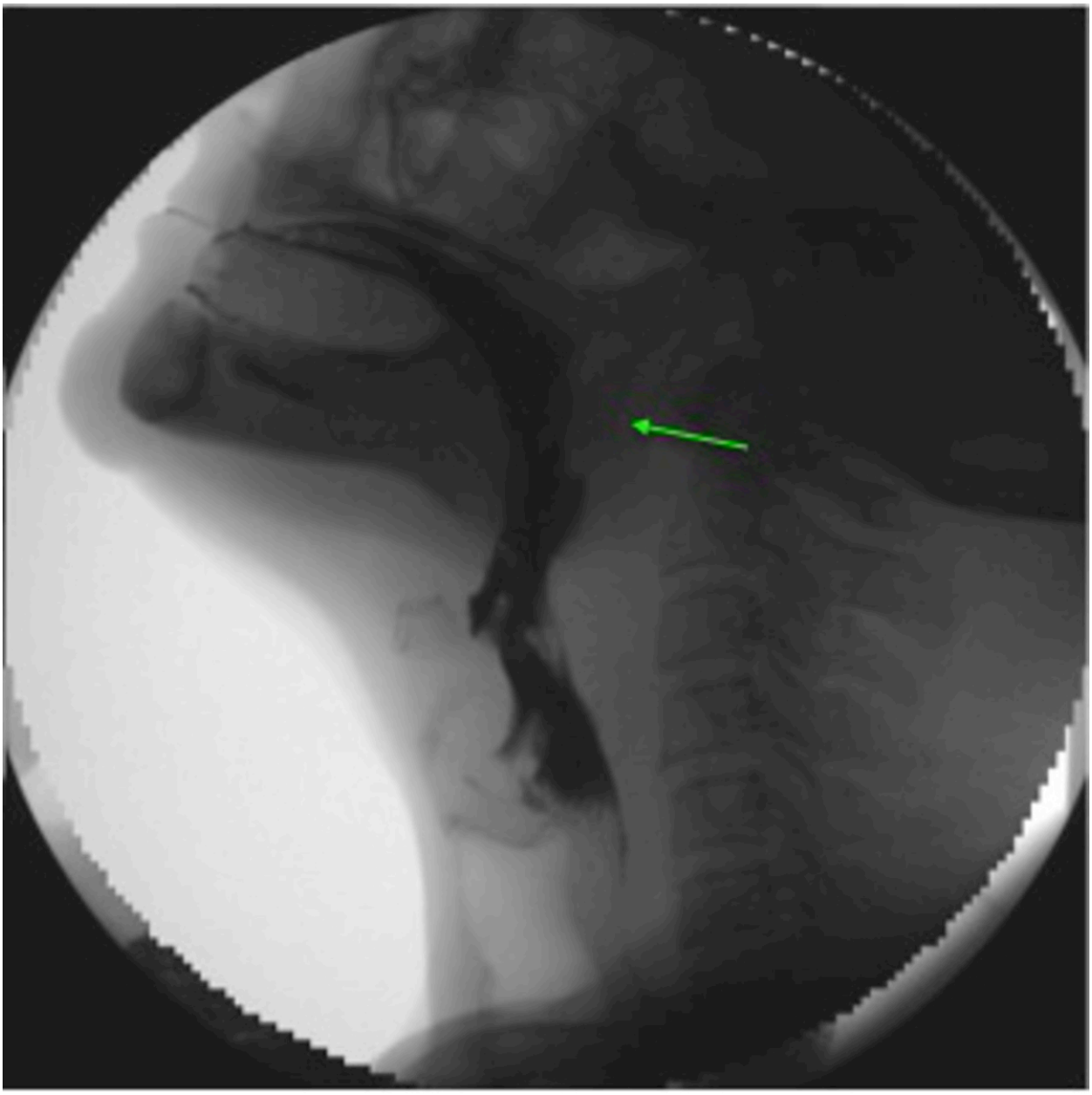

Fig. 23: Subtraction image (arrow) in a patient with an oropharyngeal tumor.

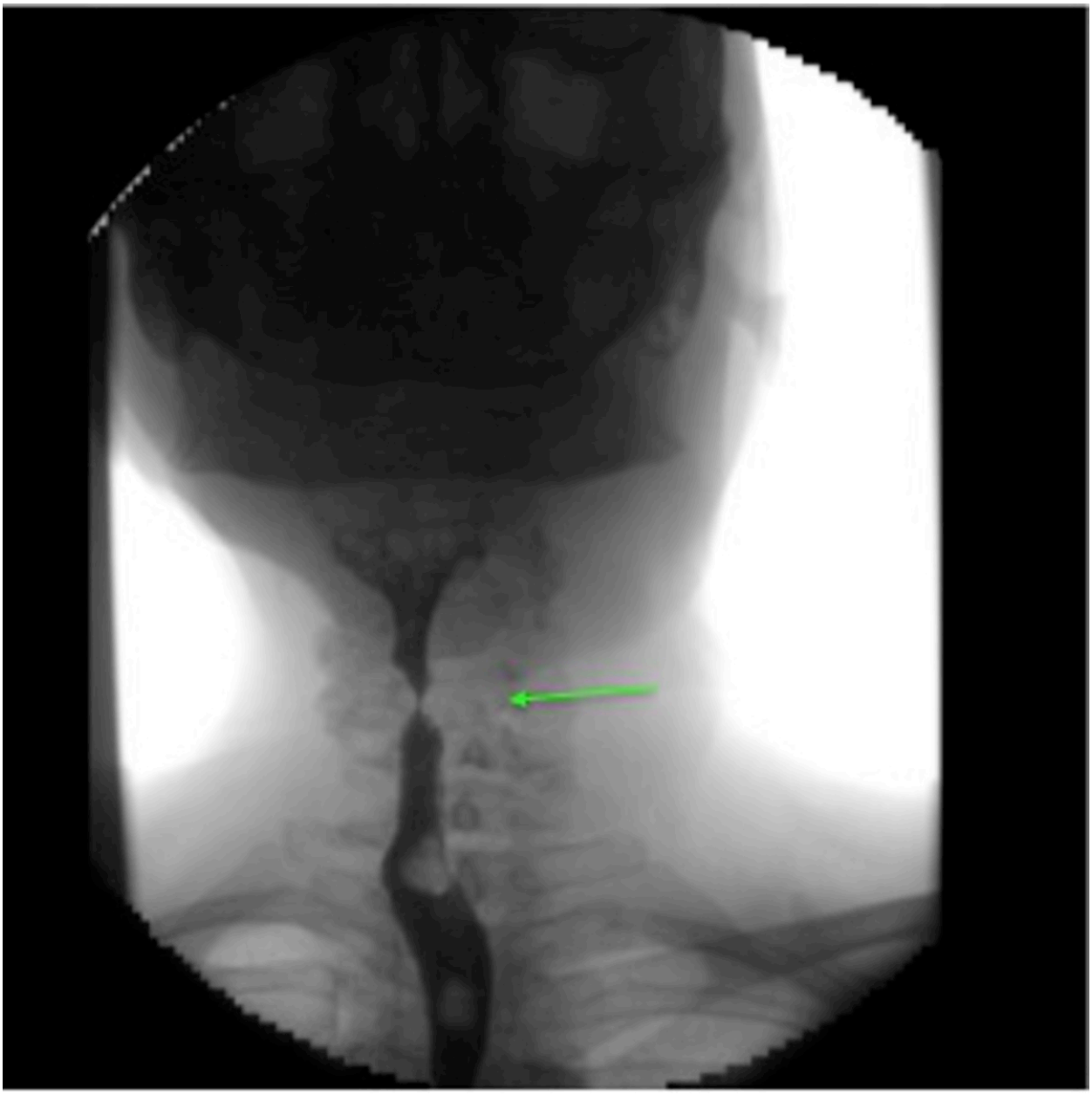

Fig. 24: Frontal projection of a stricture in a patient who underwent local radiotherapy.

Conclusion

The videofluoroscopic swallowing study is a valuable technique in swallowing disorders, which are an increasing problem. However this study is practiced by relatively few radiologists. It is important to recognize the main abnormalities that can be present in such patients.

Personal information

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