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Calcification and Ossification in the Arytenoid Cartilage: Incidence and Patterns

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ABSTRACT: Calcification or ossification occurs early and commonly in the arytenoid cartilage. It may be difficult to detect, but there are only eight patterns that specifically identify ossification and calcification. Each arytenoid independently ossifies or calcifies. The cervical spine examination can specifically identify the patterns found at autopsy.

KEYWORDS: pathology and biology, musculoskeletal system, X-ray analysis, arytenoid cartilage, larynx, radiography, larynx cartilages

The arytenoid cartilage has been recently identified as an occasionally ossified (10%) laryngeal structure [1]. Ardran and Kemp described the cartilage as calcified and showed specimen radiographs helping to depict the relationship of the calcification to the cartilage itself. The various patterns of calcification or ossification have been poorly characterized in spite of these descriptions.

This study was performed (1) to determine if the cartilage was calcified or ossified, (2) to determine the incidence of calcification and ossification in normal and cadaveric populations, and (3) to elucidate further the anatomic relationship of calcification and ossification in the arytenoid.

Materials and Methods

The larynges from 40 cadavers were harvested following anatomic dissection by medical students. Thirty-nine intact hemilarynges were obtained. These specimens were radiographed at 200 mA for 1/40 s at 52 kVp. Sixteen calcified arytenoids were identified, further dissected, and reradiographed.

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TABLE 1—Arytenoid patterns of calcification. Calcium is identified as black.

LATERAL	PA	CADAVERS # CASES	LATERAL SPINE # CASES
		1	14
		3	6
		3	5
		25	6
		1	0
		1	4
		1	3
		<u>1</u>	<u>0</u>
TOTAL		36	65

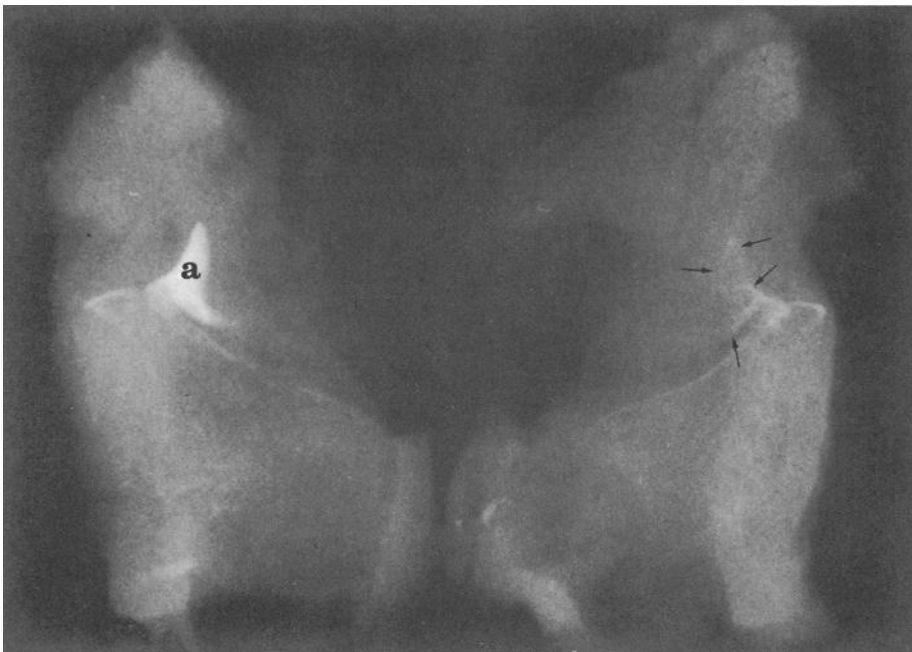


FIG. 1—Two hemisected cricoid cartilages are imaged in the lateral projection. One arytenoid is heavily calcified (a). The second is delicately ossified (arrows). The calcification pattern only is seen *in vivo*.

The radiographic calcification characteristics were tabulated. Reevaluation of the original radiographs was made upon discovery of a subtle ossification pattern. Results are presented in Table 1.

Two hemilarynges were found which showed patterns of calcification (Fig. 1). These specimens were decalcified and sectioned. Photomicrographs were obtained (Figs. 2 and 3).

One hundred and three unselected lateral cervical spine examinations were reviewed for calcification of the arytenoid. Results are presented in Table 1.

Results

Ranging from 53 to 93 years of age (75 years, average), 39 cadavers were examined. There were 14 females (36%) and 25 males (64%). Only four hemilarynges (10%) were found to have no calcification in their arytenoids. Of the 16 hemilarynges with calcification in the arytenoid, 10 showed dense calcification (25%) and 6 (15%) showed ossification. Upon reevaluation an

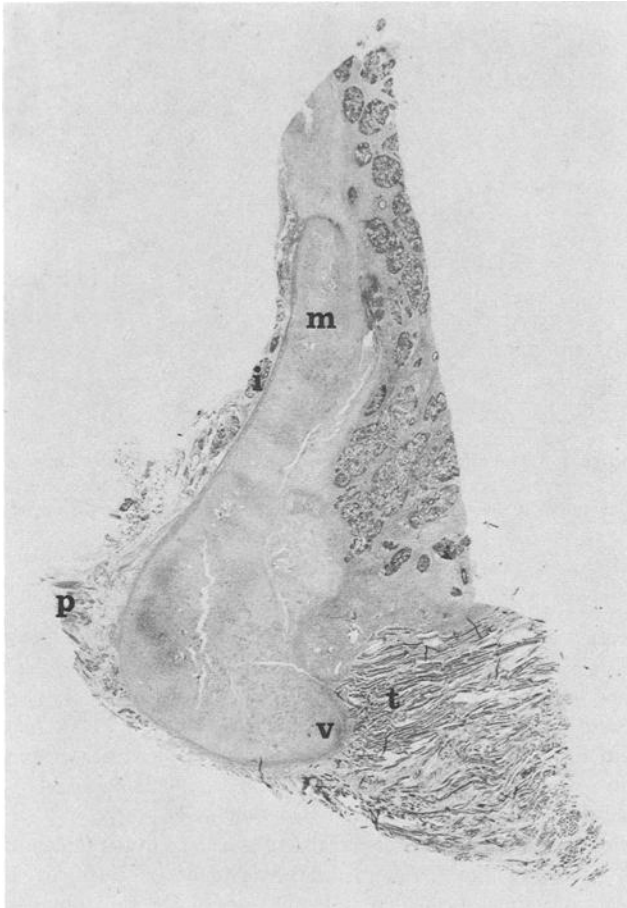


FIG. 2—Lateral view of sagittal section of decalcified arytenoid cartilage. The extent of calcification cannot be determined. The muscular process (m) and vocal process (v) are shown. Muscle fibers from the interarytenoid (i) posterior circumarytenoid (p) and thyroarytenoid (t) muscles are shown. The articular surface is not shown. No ossification is seen.



FIG. 3—Lateral view of sagittal section of decalcified arytenoid cartilage. There is a large focus of ossification with a few remaining delicate trabecula (arrows). The ossification incompletely fills the arytenoid cartilage identifying the extent of calcification seen in 1a. The articular surface is shown (a).

additional 19 ossified arytenoids were found for a total of 25 (63%) ossified arytenoids. Five corniculate cartilages (13%) were also found to be calcified.

Of the 103 randomly selected lateral cervical spine examinations, 38 cases (37%) showed calcification or ossification. Thirty-two were calcified (33%), six (7%) were ossified. Sixty males (58%) and forty-three (42%) females were examined with ages ranging from five months to seventy-six years. The youngest patient with calcification was a 17-year-old female. The youngest patient with ossification was a 24-year-old male.

The calcification/ossification involved the articular surface of the arytenoid in all but two cadaveric cases (one calcified, one ossified) and three patients (all calcified). The calcification involved the vocal process in 24 calcified arytenoids (4 cadaver and 20 patients). Of the patients (17/20) with this finding, 85% were females averaging 45.4 years. None of the cadavers or patients with ossification showed involvement of the vocal process. Eighty-three percent of the patients with ossification (5/6) were males.

Discussion

Calcification/ossification of arytenoid cartilage is a common finding [2]. Ninety percent of the cadavers and thirty-seven percent of the randomly selected lateral cervical spines showed identifiable calcification or ossification. This latter percentage is lower than pathologically present since ossification is difficult to detect with less than optimum radiographic techniques (an additional 60% were identified in the cadaveric hemilarynges once the pattern was identified). Additionally, *in vivo* ossification is difficult to attribute to the arytenoid because of (1) overlying thyroid cartilage ossification, (2) superimposed opposite arytenoid calcification (Fig. 4), (3) overlying soft tissue scattering effects, and (4) ossification is a relatively fine pattern as compared to the dense calcification.

Asymmetric calcification and ossification may occur in the same patient. There is an apparent sex distribution (females tend to calcify, males to ossify). Note that none of the specimens showed a precursor of detectable calcification before bony metaplasia as has been described in the normal progression of enchondral (cartilage model) ossification [3].

The sex predilection for calcification in females and ossification in males suggests that ary-

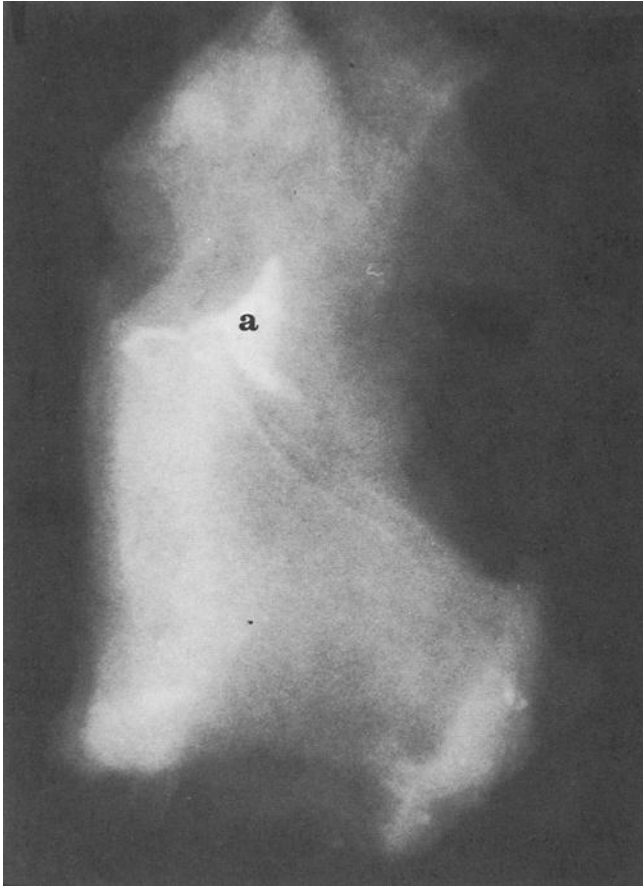


FIG. 4—Lateral view of the same cricoid cartilage as seen in Figs. 2 and 3 with the two halves joined. Note that only the calcified arytenoid (a) is seen.

tenoids might be useful for identification of sex as well as adjunctive in confirming identification of persons over 20 years of age.

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References

- [1] Smith, C. and Ramsey, R. G., "Xeroradiography of the Lateral Neck," *Radiographics*, Vol. 2, 1982, pp. 306-328.
- [2] Ardran, G. M. and Kemp, F. H., "The Mechanism of the Larynx Part I, Movements of the Arytenoid and Cricoid Cartilage," *British Journal of Radiology*, Vol. 39, 1960, pp. 641-654.
- [3] Johnson, L. C., "Mineralization of the Turkey Leg Tendon. I. Histology and Histochemistry of Mineralization," in *Calcification in Biological Systems*, R. F. Sognnaes, Ed., American Association of Advanced Sciences, Washington, DC, 1960, p. 177.

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