



Title	第1肋骨の透亮像
Author(s)	西谷, 弘
Citation	日本医学放射線学会雑誌. 1976, 36(5), p. 397-402
Version Type	VoR
URL	<a href="https://hdl.handle.net/11094/16024">https://hdl.handle.net/11094/16024</a>
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## FIRST-RIB "FENESTRATIONS"

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A Cooperative Research Agency of

U.S.A. NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL

and

JAPANESE NATIONAL INSTITUTE OF HEALTH OF THE MINISTRY

OF HEALTH AND WELFARE

with funds provided by

U.S.A. ATOMIC ENERGY COMMISSION JAPANESE NATIONAL INSTITUTE

OF HEALTH U.S.A. PUBLIC HEALTH SERVICE

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Research Code No.: 505

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Key Words: Rib, Anomaly, Fenestration

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## 第1肋骨の透亮像

原爆傷害調査委員会放射線部

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(昭和50年11月27日受付)

(昭和51年2月16日最終原稿受付)

今までほとんど報告されていない第1肋骨に認められる透亮像4例について報告する。特にこれは肋骨の中央部付近に認められ、両側性に生じやすいという点がもつとよく知られている肋軟骨部

の透亮像とは異なる。この臨床的意義は時に混同されやすい肺結核空洞、プラおよびプレブなどの肺実質病変との鑑別診断にある。この報告では鑑別診断及び文献的考察、並びに原因考案を述べた。

**Abstract**

Four cases of rarely reported "fenestrations" of the first ribs are described. These are peculiarly located in the mid-portions of the ribs and tend to be bilateral, unlike the well-known "fenestrations" at the costochondral junctions. Their clinical importance lies in differentiating them from parenchymal lung lesions, such as tuberculous cavities, bullae and blebs, with which they can sometimes be rather easily confused. This report describes means of differentiating them, and includes a review of the scientific

literature and a discussion of their etiology.

### Introduction

Foramen-like defects at the costochondral junctions, often termed "fenestrations," are known to be a part of bifid ribs and calcified cartilages.<sup>9)</sup> In 1942 Kellogg and Linsman<sup>8)</sup> reported a case of bilateral symmetrical "fenestrations" between the middle and anterior thirds of the first ribs, distinct from those occurring at the costochondral junctions. Review of the literature reveals that, except for Kellogg and Linsman's<sup>8)</sup> case this condition has been reported only in an Italian publication by Ravasini and Zacchi in 1969,<sup>12)</sup> and more recently by Keats.<sup>7)</sup> These "fenestrations" have a peculiar location. Since these defects may be incomplete, the term "fenestration" may not be appropriate, but, for want of a better one it will be used throughout this paper.

We found 4 cases with such "fenestration" of the first ribs. Because of their unusual locations, a discussion of their etiology is included. Their clinical importance lies in the differential diagnosis of parenchymal lung lesions, including cavities, bullae and blebs.<sup>9)</sup>

### Case Reports

**Case I (M.F. # 244690):** A 54-year-old Japanese female's posteroanterior (PA) chest radiograph of 2 April 1959 revealed bilateral symmetrical well-circumscribed round radiolucencies with questionable sclerotic margins in the middle third of each first rib (Fig. 1, A). She had had biennial chest radiography nine times through 4 April 1974 (Fig. 1, B) without interval change.

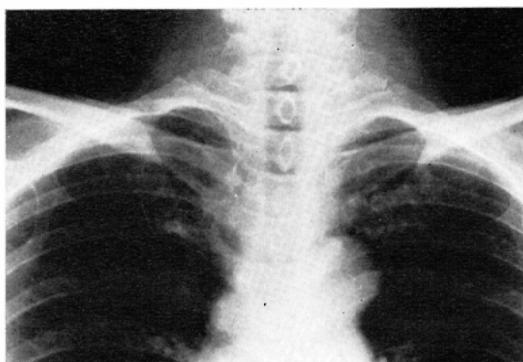


Fig. 1. Case I (M.F. # 244690). A Circumscribed "fenestrations" in the middle third of each first rib.



Fig. 1. B. Same patient, 15 years later.

**Case II (M.F. # 472895):** A 50-year-old Japanese male's first chest radiograph of 11 June 1957 revealed a typical "fenestration" in the middle third of the left first rib, and a questionable one in the right first rib (Fig. 2). Eight subsequent chest radiographs through 3 July 1973 showed no interval change.

**Case III (M.F. # 259944):** A 34-year-old Japanese male's first chest radiograph on 21 May 1951 showed a "fenestration" in the anterior portion of the left first rib, proximal to the costochondral junction. Calcification in the first costal cartilage was incomplete. The "fenestration" did not change during

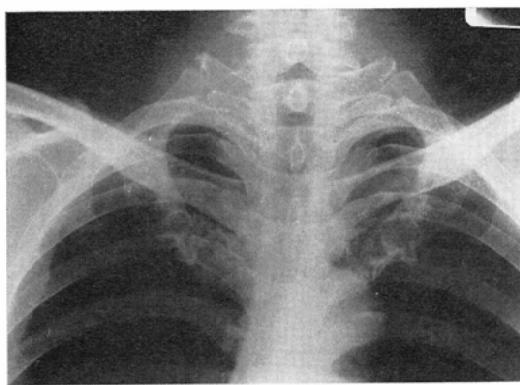


Fig. 2. Case II (M.F. # 472895). "Fenestrations" in the middle thirds of the left and possibly the right, first ribs.

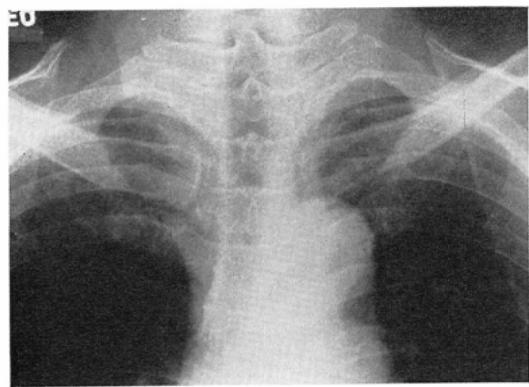


Fig. 3. Case III (M.F. # 259944). "Fenestration" in the anterior portion of the left first rib.

the course of seven follow-up examinations through 29 September 1971. It was clearly visualized on the latter PA chest film, at which time calcification of the first costal cartilage was complete (Fig. 3). Previously this had been diagnosed as a cystic lesion or chondroma. No such abnormality was visible in the other ribs.

**Case IV (W 4002):** An 18-year-old Japanese female had a "fenestration" in her right first rib in 1955, at which time calcification of the costal cartilage had not begun (Fig. 4, A). Calcification was complete in 1973 with no interval change in the "fenestration" (Fig. 4, B).

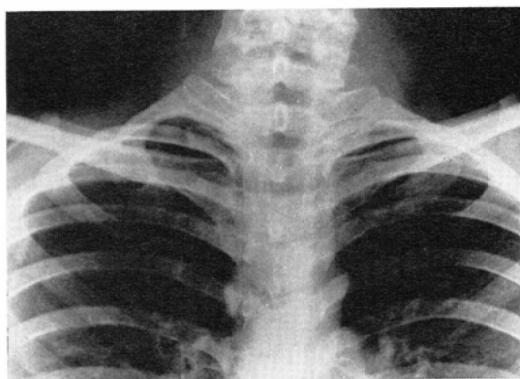


Fig. 4. Case IV (W 4002). A. "Fenestration" in the right first rib.

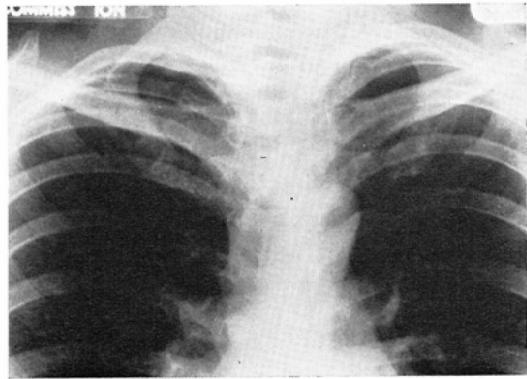


Fig. 4. B. Same patient, 18 years later, showing calcification at the costochondral junction.

### Discussion

Rib anomalies, frequent in normal individuals, are usually of little clinical significance.<sup>5</sup> "Fenestrations," however, can be confused with serious abnormalities. The incidence of rib anomalies has been variously reported between 0.15% and 8.4%.<sup>1,2,4,10,11,14,16</sup> According to Pionnier and Depraz<sup>11</sup> three-quarters of rib anomalies were at the seventh cervical and first thoracic levels. Cervical ribs are

one of the most common, but bifid ribs are also frequent. Quoted by Sweany,<sup>15)</sup> Ferrier in 1884 first described a bifid left third costal cartilage, forming a  $3.5 \times 2.5$  cm foramen. Sweany<sup>15)</sup> reported "fenestrations" and forking of the third and fourth ribs of tuberculous patients, emphasizing the importance of their radiographic identification. Many bifid ribs elsewhere were mainly in the third, fourth, and fifth ribs. Gershon-Cohen and Delbridge<sup>6)</sup> indicated that bifid first ribs were among the rarest of anomalies, and that incomplete "fenestrations," suggesting a pre-bifid stage, occurred near their costochondral junctions. Usually unilateral, these change in shape with aging. Typical of such "fenestrations" are those shown in Fig. 5.

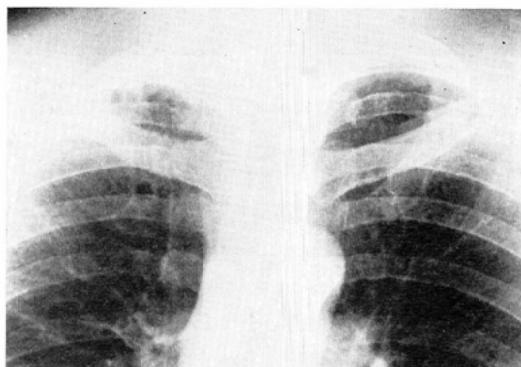


Fig. 5. Y 6611. An apparent cavity in the upper lobe of the right lung, later radiographically proven to be a defect in the costochondral junction of the first rib.

Our cases differed from this type by location, and with time, and tended to be bilateral, as did those of Kellogg and Linsman,<sup>8)</sup> and Ravasini and Zacchi.<sup>12)</sup> This suggests different etiological factors for the two types of "fenestrations."

First-rib "fenestrations," distinct from those at the costochondral junctions, are sometimes rather easily confused with pulmonary cavitary lesions but their differentiation is facilitated, providing observers are aware of their existence. Well-circumscribed and usually bilateral, these radiolucencies in the mid-portions of the first ribs, have smooth, very thin sclerotic margins. They have no surrounding or satellite densities, are unrelated to the pleura, and do not change with time. In doubtful cases, radiography—including apical-lordotic projections and/or tomography—can clarify their appearance and etiology.

Sometimes apical parenchymal cavities and first-rib "fenestrations" may at first be difficult to differentiate. For example, the PA chest radiograph of a 64-year-old Japanese male (M.F. # 229266) with pulmonary tuberculosis revealed a radiolucency very similar to a left first-rib "fenestration" in the projection of the first rib and clavicle (Fig. 6, A). Tomography failed to clearly distinguish it from a costal lesion (Fig. 6, B), but a lordotic projection and follow-up radiography revealed it to be a lung lesion (Fig. 6, C).

The superior surface of the first rib has several anatomical features, including oblique grooves, which accommodate the subclavian artery and vein.<sup>13)17)</sup> These grooves may play a role in the formation of "fenestrations." White et al.<sup>19)</sup> advanced etiological factors in the development of cervical ribs and

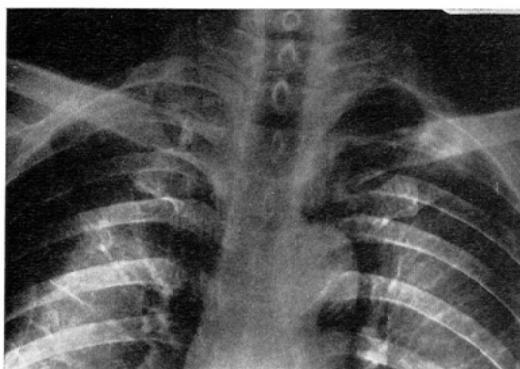


Fig. 6. M.F. # 229266. A. An apparent "fenestration" in the left first rib.

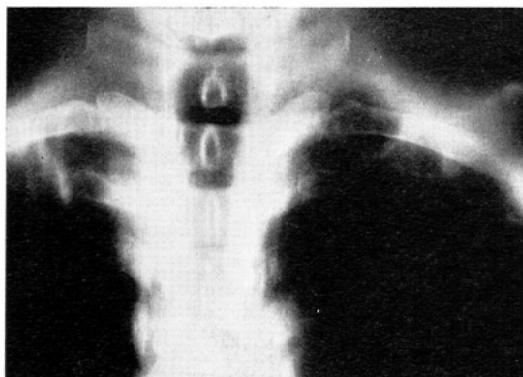


Fig. 6. B. Same patient. Tomography failed to establish this as a parenchymal lesion.

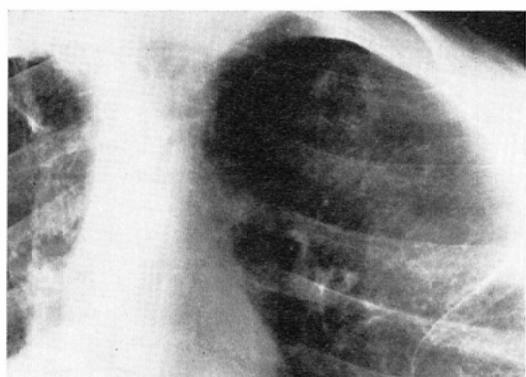


Fig. 6. C. Same patient. This lordotic view definitely shows a cavitary lesion in the upper lobe of the left lung due to active pulmonary tuberculosis.

in the maldevelopment of first ribs. They stressed the roles of the brachial plexus and variations in the arterial tree.

Warkany<sup>18)</sup> observed a variety of congenital rib deformities in rats born of mothers with nutritional deficiencies during early pregnancy. He obtained similar results by irradiating the maternal rat on the 13th and 14th days of pregnancy. Many interesting observations of the fracture-like synchondroses of the first ribs have been described.<sup>13)18)19)</sup> Synchondroses and "fenestrations" of the first rib may be etiologically similar.

First-rib "fenestrations" are clinically important since sometimes they must be differentiated from parenchymal lesions, such as tuberculous cavities, bullae and blebs. This is achieved by being aware of their existence, making careful observations, having a proper index of suspicion, and using appropriate radiographic projections.

#### Acknowledgement

The author is grateful to Miss Masako Shimooka for her assistance in the preparation of

this manuscript.

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