SPONTANEOUS FRACTURES OF BOTH FIRST RIBS

S. Aubrey Jenkins, Eastbourne, England

Formerly Lecturer in Orthopaedic Surgery, Postgraduate Medical School, London

This fracture has been variously reported as a developmental anomaly, a synchondrosis or a pseudarthrosis, but most authors now regard it as a true fracture. As far as can be ascertained, only 263 cases of isolated fracture of the first rib have been recorded in the literature and only seventeen of these were bilateral. The majority of the recorded cases have been found incidentally during routine radiography of young healthy adults, notably members of the Services (Alderson 1944 and 1947, Etter 1944, Sjögren 1942). Most of the patients have been unable to remember any injury or any symptoms attributable to a fracture, although a few recollect a sudden pain in the neck and shoulder when lifting or straining, followed by discomfort which persists for a few days afterwards. The fracture is usually symptomless at the time of radiography. Only fifteen cases have been reported with clinical symptoms sufficiently severe for an early radiograph to be taken and even in some of these patients the fracture appears to have been unsuspected before that examination.

When the fracture is first diagnosed, the radiographs may show either a simple linear crack in the rib or a pseudarthrosis with widened, irregular, sclerotic opposing surfaces, or the fracture may already be soundly healed with varying degrees of residual thickening of the rib about the fracture site. Alderson (1947) has shown by serial radiographs that non-union or a false joint often follows this fracture although bony union does occur in some. Symptomless established non-union is often found (Hartley 1945). The fracture is almost confined to males, usually under twenty years of age.

ANATOMY AND ETIOLOGY

The first rib is short, broad and flat. The scalenus anterior and scalenus medius muscles are inserted into its upper surface on either side of the groove for the subclavian artery. The subclavian vein lies on a second, shallower, groove in front of the scalenus anterior. Sudden contraction of the scalenus anterior or medius would tend to pull the rib upwards against the resistance of its anterior and posterior attachments. The intercostal muscles are attached to the convex outer margin of the first rib along the greater part of its length. Anterior to the scalene muscles, the rib also gives attachment to the first digitation of the serratus anterior, the subclavius muscle and the costo-clavicular ligament. It has been suggested that these attachments render the anterior half of the rib less mobile and that sudden powerful contraction of the scalene muscles may fracture the rib at its thinnest segment — where the subclavian artery crosses it.

Some deny that this lesion is a fracture at all and attribute it to a developmental anomaly, because of the absence of a history of injury and the rarity of non-union of fractures in other ribs (Bowie and Jacobson 1945, Sycamore 1944). The body of the first rib may arise from two centres of ossification, and the junction may persist as a synchondrosis (Gershon-Cohen and Delbridge 1945) but this lies farther back than the usual site of a fracture and the line of division between the two bony segments lies in a sagittal plane and not transversely as in a fracture.

The sex incidence is strongly in favour of an acquired lesion, and so is the history of recent unaccustomed physical effort in some of the patients. In a few cases an earlier radiograph has been available showing a previously normal rib (Alderson 1947). It is known that fractures of other ribs, especially the seventh and eighth, are sometimes caused by sudden muscular
effort (Kleiner 1924, British Medical Journal 1949) or by severe or constant coughing (Cohen 1949, Palfrey 1924, Paulley et al. 1949). In the lower ribs such fractures are usually situated at a point where two muscle masses pull in different directions. A simple muscle strain can also produce a fracture of the first rib (Aitken and Lincoln 1939), and the most frequent cause, when known, appears to be unaccustomed exertion and especially heavy lifting-strains (Garber 1944). Coughing alone does not appear to have precipitated a fracture of the first rib.

Direct external violence seldom fractures the first rib, which is deeply situated and protected by the shoulder girdle. However, the first recorded isolated fracture of the first rib was due to repeated kicks during a drunken brawl and led to rapid death from rupture of the subclavian vessels (Jones 1869). A fracture of the first rib may occasionally be associated with adjacent fractures of the clavicle, scapula, spine or lower ribs (Knoepp 1941) and such direct injuries are often complicated by injury to the subclavian vessels, the brachial plexus or the pleura (Breslin 1937).

Indirect violence causing a fracture of the first rib has been described by Powell (1950). One of his patients collided shoulder to shoulder with another player at football, another fell on to his outstretched hand and a third suffered forcible hyperabduction of the arm. In all three cases there was immediate pain, and the radiograph showed a recent fracture. Sudden forcible flexion of the neck to one side may also fracture the first rib, presumably from tension of the scalene muscles (Aitken and Lincoln 1939).

It seems likely that this fracture may sometimes be unrelated either to muscular pull or to injury and is then comparable with the stress or fatigue fractures occurring in the metatarsals, tibia, fibula and neck of femur (Hartley 1945). Proctor et al. (1945) have reported three cases in which the fracture was caused by the carrying of heavy weights slung from the shoulder.

**CLINICAL FEATURES**

In the few patients who present themselves with symptoms immediately after the fracture, the clinical findings are characteristic if the possibility of this fracture is kept in mind. The main feature is pain, which usually begins acutely and causes the patient to support the arm with his other hand as though he had sustained a fracture of the clavicle; but sometimes the pain develops only slowly. It persists as a vaguely localised pain at the base of the neck or in the upper chest, behind the clavicle or under the scapula. The pain is increased by abduction of the shoulder, and sudden unpremeditated movements of the arm in any direction may cause sudden stabs of pain. Occasionally, pain or paraesthesiae radiate down the arm (Aitken and Lincoln 1939) but always along its medial aspect, in the region supplied by the lower trunk of the brachial plexus. There may be weakness of the whole arm at first and the strength of the grip is diminished. This is directly related to the pain and rapidly recovers as the pain subsides.

There is no tenderness around the shoulder, which usually has a full range of movement. There may be a small area of acute accurately localised tenderness in the neck immediately over the fracture site; this lies behind the lateral border of the sternomastoid muscle at its insertion into the clavicle. The tenderness may not be present until several days after the fracture. There is no palpable swelling until callus has had time to form and this does not develop in less than a month. The mass of callus remains tender in the early stages and pressure over it may give referred pain down the medial side of the arm. Local compression of the chest does not provoke pain as it does in fractures of the other ribs, but simultaneous pressure over the clavicle and scapula may do so.

**TREATMENT**

No specific treatment is required. The pain or discomfort invariably subsides and the patient is usually free from symptoms within a few days irrespective of the treatment given,
and even though the fracture may not unite. A simple sling may be required and the patient should avoid heavy work or excessive movement of the arm until free from discomfort.

**CASE REPORT**

A healthy youth, aged sixteen years, was lifting a box weighing 70 lb. from the floor on to a high counter, when he suffered sudden pain behind the right clavicle, radiating into the shoulder and upper chest. The pain persisted as a dull ache with intermittent acute stabs when coughing, sneezing or deep breathing. The pain was increased by using the right arm and especially when lifting it to shave or to drink. On clinical examination two days later the pain was vaguely situated in the shoulder and behind the clavicle but could not be localised accurately and it did not radiate down the arm. Active movements of the arm and shoulder gave rise to acute twinges of pain, especially when any attempt was made to raise the arm above shoulder level. The range of passive shoulder movements was full and painless with the patient supine; but both active and passive movements increased the pain with the patient standing or sitting. No area of tenderness could be found despite a careful search in the neck and shoulder; and compression of the chest did not cause pain. Radiographs showed a transverse fracture of the first right rib in the region of the scalene tubercle. The fracture line was a mere crack and difficult to identify because it was obscured by the clavicle, but study of the rib contour showed a very slight lateral displacement of the posterior half of the rib in relation to the anterior half.

*Progress*—The symptoms were not sufficiently severe to require any form of immobilisation, but a course of short-wave diathermy was prescribed and the discomfort rapidly subsided. The patient was allowed to continue light work and instructed to avoid all heavy lifting.

A further radiograph was taken a week later, to include both first ribs. The fracture site in the right rib was more easily seen in this film and the left rib unexpectedly showed a large mass of callus with an irregular fracture line running transversely through it (Fig. 2). The fracture of the left rib was symptomless and the patient was unable to recall any incident, injury or symptoms relating to this region. A small, bony hard, painless swelling could be felt at the root of the neck on the left side, lying immediately behind the lateral margin of the sternomastoid muscle at its insertion into the clavicle. This was evidently the callus around the old fracture of the first left rib. No swelling could be felt on the right side.

In view of these clinical and radiographic findings a more detailed history was obtained. The patient had been working as a mattress maker for one and a half years—a dusty but not a heavy occupation. Two months before attending hospital he had developed a slight cough which persisted for three weeks and his family doctor sent him to a chest clinic for radiography. The films were subsequently obtained and show no abnormality of the first right rib, but the appearance of the left rib is identical with that in the more recent films (Fig. 1).

He changed his occupation and became a warehouse porter two months before the incident described, and it seems probable that the unaccustomed physical exertion was a factor contributing to the recent fracture of the right rib. On the other hand, the long-standing fracture of the left rib occurred some time before and without symptoms, which suggests that there was a predisposing weakness of the rib at this site.

When seen five weeks after the onset of symptoms the patient had only slight residual discomfort. Three weeks later still he was completely free from pain and was able to resume full heavy work as a porter. Now, for the first time, two months after the fracture, a small hard swelling could be felt at the fracture site in the first right rib in a position exactly corresponding with the mass on the left side. The swelling was slightly tender, and firm pressure on it produced a sharp pain radiating down the medial side of the arm and hand in the distribution of the lowest trunk of the brachial plexus. There were no objective signs of paresis, altered sensation or circulatory changes in the limb.

Further radiographs, with markers over the swellings, confirmed that the fracture on the
Radiograph of the chest taken two and a half months before the onset of symptoms on the right side. It shows an old fracture of the first left rib with the fracture line still viable, but no lesion on the right side.

Radiograph taken two weeks after the spontaneous fracture of the first right rib. The fracture is seen immediately above the upper margin of the clavicle. Note also the long-standing symptomless and previously unsuspected fracture of the first left rib, with considerable thickening of the bone at this point.

Radiograph taken two months after the onset of pain on the right side. Metal markers have been placed directly over the swellings which were felt in the neck and these are seen to coincide with the fractures. Note mass of callus and pseudarthrosis at each fracture site.
right side had now developed a mass of callus, comparable to the enlargement of the left rib but with incomplete bony union. The markers could be seen lying directly over the fracture site and as near to them as the intervening soft tissue would permit (Fig. 3).

Final roentgenograms, taken four months after the onset of symptoms, showed a fully developed pseudarthrosis of each fracture site. The patient had continued without symptoms at full heavy work.

**SUMMARY**

1. A case of spontaneous fracture of a first rib is described.
2. Its evolution from a previously intact rib through the stage of a "linear" crack to pseudarthrosis has been traced.
3. An older pseudarthrosis was present on the opposite side.
4. Alderson's observation is confirmed—that the breach in the rib is acquired. There is no need to suppose a developmental anomaly of ossification, even in a bilateral case.

**REFERENCES**


