Acta orthop. Scandinav. 38, 193–198, 1967

From the Propaedeutic Surgical Clinic of Athens' University
(Head: Prof. C. N. Alivisatos), Hippocrateion Hospital, Athens.

FRACTURES OF THE FIRST RIB

Report of Two Cases of Bilateral Fracture of First Rib

By

E. K. FRANGAKIS

Received 25.IX.66

Fractures of the first rib are rare. Only about 270 cases are known in the literature, and only 22 of these were bilateral. Still, the majority of these cases were found incidentally during routine chest radiography in young men without any history of relevant trauma. This fact gave rise to skepticism whether this was a developmental anomaly rather than a true fracture (*Bowie & Jacobson* 1945, *Sycamor* 1944, *Gershon-Cohen & Delbridge* 1945). However, few cases have been reported in which fracture followed lifting, straining or collison and gave rise to symptoms. Furthermore in a few cases an earlier radiograph was available, showing a previously intact rib, (*Alderson* 1947, *Jenkins* 1952) a fact which establishes beyond any doubt the traumatic character of these particular lesions.

There have been several explanations as to the etiology and the mechanism of the fracture of the first rib.

The anatomical features and relations of the first rib protect it, however, from direct external violence, make i susceptible to indirect violence, stress and sudden muscular contractions. The first rib is broad and flat with a groove for the subclavian artery on its upper surface which weakens the middle part of the bone. On either side of the groove, the scalene muscles are inserted exerting a constant upward tension on that part of the rib. The anterior part of the rib is immovably fixed to the manubrium through the first costal cartilage. The attachment of the first digitation of the serratus anterior, the subclavian muscle and the costoclavicular ligament, render the anterior half of the first rib even less mobile. Sudden and violent contraction of the scalene muscles cause a bending strain at the thinnest and more mobile seg-

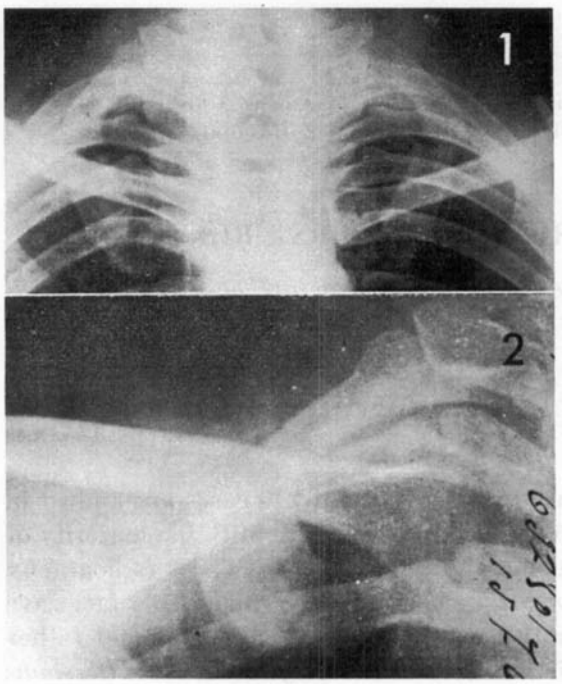

Figure 1. Transverse fracture of both first ribs caused by sudden muscular contraction. Fractures caused by this mechanism are constantly located in the region of the groove for the subclavian vessels (Case 1).

Figure 2. (Case 1) X-Ray of the right shoulder taken three months before the accident shows clearly that there was not any preexisting defect in the first rib.

ment of the rib and may fracture it (*Aitken & Lincoln* 1939). Isolated fractures of the first rib are seldom produced by direct external violence, although in the first record of such a fracture the mechanism of injury was direct violence by repeated kicks (*Jones* 1869). Fractures of the first rib due to direct external violence are most often associated with fractures of the protecting shoulder girdle or of oher ribs, and may be complicated by injury to the pleura causing haemothorax or pneumothorax. There may be too, an associated injury of the subclavian vessels.

A third mechanism by which the first rib may fracture, is indirect violence. *Powell* (1950), described three cases of fracture of the first rib caused by this mechanism. One of his patients suffered a shoulder to shoulder collision with another footballer, another fell on to his outstretched hand, and a third suffered a forcible hyperabduction at the shoulder.

Finally, there are cases in which a fracture of the first rib is unassociated either with muscular contraction, or with any form of violence, it does not produce symptoms, and it is discovered incindentally. It may be assumed, that in these cases it is a stress or fatigue fracture (*Proctor et al.* 1945).

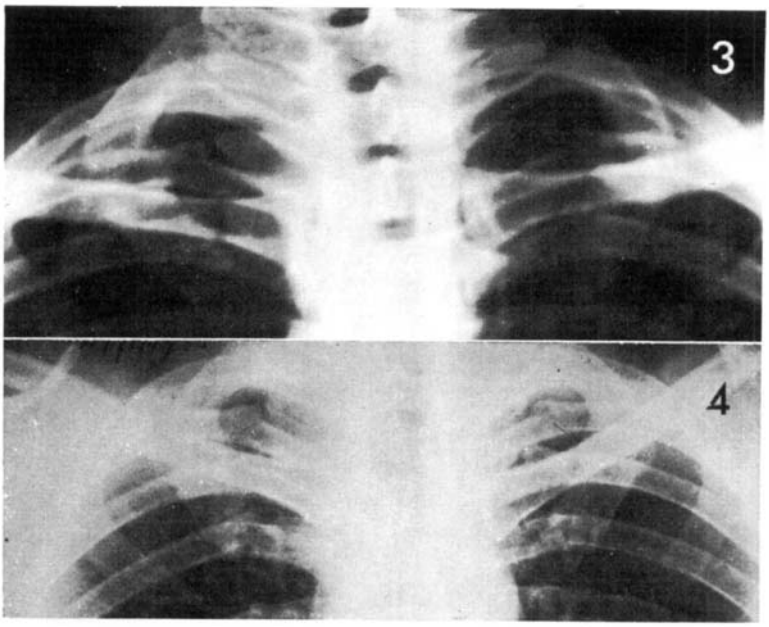

Figure 3. Same as Figure 1. Five months later there is a callus formation but not certain union.

Figure 4. Same as Figure 1 and 3. At fifteen months there is sound union of the fracture of both first ribs.

CASE REPORTS

Case I. A healthy young painter aged twenty eight, was working on a scaffolding facing a wall, when suddenly, the board on which he was standing cracked. Instantly, he grasped a bar above, pulling at the same time his head back forcibly, in order to avoid striking his face on the wall. At this moment, he experienced acute pain behind the clavicles which persisted afterwards, radiating in to the shoulders, scapulae and upper chest, and having a stabing character. The pain was aggravated on deep breathing or coughing. Abduction or flexion of the arms increased the pain.

On clinical examination the day after the accident, the pain was situated behind the clavicles. Any active movement of the shoulders produced acute pain. There was tenderness in the neck triangle, in both sides.

X-Rays showed transverse fractures of both first ribs in the region of the groove (Figure 1).

Because of the severity of the symptoms, a figure of eight bandage was applied to restrict the shoulder movements. This proved sufficient to relieve acute pain. Immobilisation of the shoulders in this way continued for two weeks. By then the patient complained only for discomfort. By the end of the third week he was able

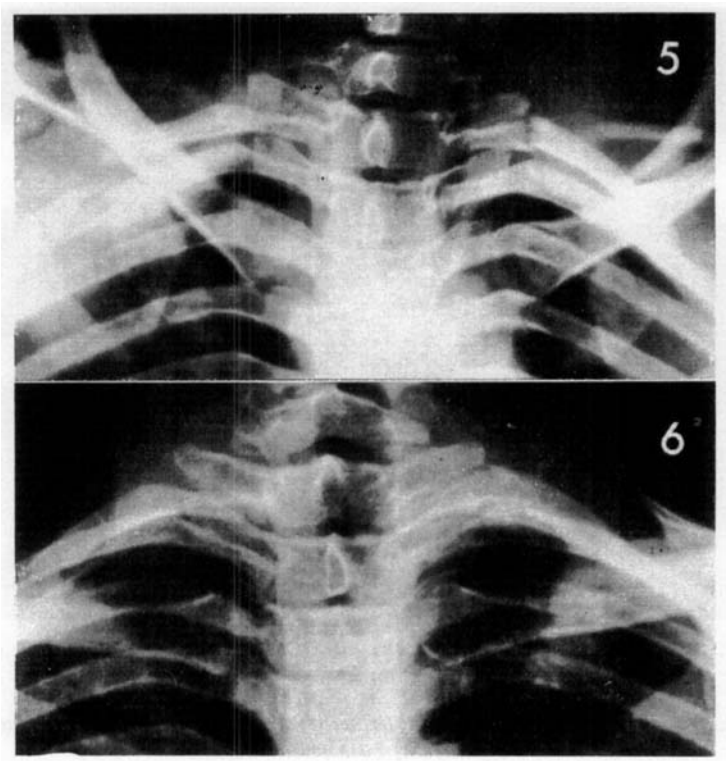

Figure 5. (Case 2). Fracture of both first ribs, double on the left, caused by direct violence. The location of these fractures varies.

Figure 6. Same as Figure 5. Three and a half months later, the double fracture of the left first rib is united, and the right one shows signs of union.

to resume work, although a slight discomfort remained for another week, after which the patient was completely symptom-free.

Because of a trivial injury of his right shoulder three months before the recent accident, the patient had an X-Ray taken in which the right first rib is seen intact (Figure 2). This is certainly an undisputable proof that the lesion of the rib seen in the radiograph of the day of the accident, is a recent fracture. Five months after the accident, X-Rays shows hypertrophic callus, but bony union is questionable (Figure 3). Final radiographs taken fifteen months after the accident show union of both first rib fractures (Figure 4).

Case 2. A young lorry driver aged 25, suffered a severe chest injury when he was squeezed under his overturned ear. On admission there was subcutaneous emphysema and a left pneumothorax, but no paradoxical movement. Radiographic examination showed fractures of both first ribs, associated with fracture of clavicle and 2nd rib on the left, and fracture of the 2nd, 3rd, 4th and 5th rib on the right. The frac-

ture of the left rib is double (Figure 5). After proper treatment the patient made an astonishing recovery, and was discharged 13 days after the accident.

Radiographs taken three and a half months after the accident, show that both fractures of the left first rib have united. The fracture of the right first rib which was displaced has not united, although an established pseudarthrosis (Figure 6) has not developed.

Although the patient has not yet returned to work, his only complaint is discomfort on lifting weights.

SUMMARY

1. Two cases of bilateral fracture of first rib produced by different mechanisms are described.

2. In the first case, the existence of a radiograph which shows a previously intact rib, proves that this was in fact a case of true spontaneous fracture due to sudden and forcible contraction of scalene muscles.

3. In cases of direct violence as in our 2nd case, fractures of the first rib are associated with fractures of other ribs and complicated by pleural injury.

4. In the first case it took more than five months for fractures to unite. In the second case, the undisplaced double fracture of the one rib united in less than three and a half months. The situation of the fracture may play a part in the rate of union.

RESUME

1. Deux cas de fracture bilatérale de la première côte produite par différents mécanismes sont décrits.

2. Dans le premier cas, l'existence d'une radiographie qui montre une côte antérieurement intacts, prouve qu'il s'agit en réalité d'un cas de fracture spontanée due à une contraction soudaine et forcée des muscles scalènes.

3. Dans le cas de violence directe, comme dans notre 2ème cas, les fractures de la première côte sont associées aus fractures des autres côtes et compliquées de lésion pleurale.

4. Dans le premier cas, il s'écoula plus de cinq mois avant la soudure de la fracture. Dans le second cas, la double fracture sans déplacement d'une seule côte se souda en moins de trois mois et demi. La localisation de la fracture peut jouer un rôle pour le temps qui s'écoule avant la soudure.

ZUSAMENFASSUNG

1. Zwei Fälle von doppeltseitigen Brüchen der ersten Rippe, die durch verschiedenartigen Mechanismus entstanden waren, werden beschrieben.

2. Im ersten Falle zeigte eine frühere Röntgenaufnahme eine völlig intakte Rippe, wonach sich dieser Fall als ein spontaner Knochenbruch erweist, der durch eine plötzliche und starke Kontraktion des Scalenusmuskels verursacht war.

3. Bei Rippenbrüchen nach direkter Gewalt, wie in unserem zweiten Fall, ist ein Bruch der ersten Rippen oftmals mit Brüchen weiterer Rippen sowie mit einer Beschädigung der Pleura verbunden.

4. Im ersten Falle dauerte die Frakturheilung mehr als fünf Monate. Im zweiten Falle wurde der doppelte, nicht verschobene, Bruch der einen, von den ersten Rippen in weniger als 3½ Monaten geheilt. Die Lokalisation eines Bruches dürfte die Schnelligkeit der Heilung eine gewisse Rolle spielen.

REFERENCES

1. Aitken, A. P. & Lincoln, R. E. (1939) Fracture of the first rib due to Muscle pull. New England Journal of Medicine, **220**, 1063.
2. Alderson, B. R. (1944) Stress fractures of the first rib. *Brit. J. Radiol.* **17**, 323.
3. Alderson, B. R. (1947) Further observations on fracture of the first rib. *Brit. J. Radiol.* **20**, 345.
4. Bowie, E. R. & Jacobson, H. G. (1945) Anomalous development of the first rib simulating isolated fracture. *Amer. J. Roentgenol.* **53**, 161.
5. Garber, R. L. (1944) Isolated fracture of the first rib produced by muscular traction. *Radiology*, **42**, 395.
6. Gershon-Cohen, J. & Delbridge, R. E. (1945) Pseudarthrosis, Synchondrosis and other anomalies of the first ribs. *Amer. J. Roentgenol.* **53**, 49.
7. Jenkins, S.A. (1952) Spontaneous fractures of both first ribs. *J. Bone Jt Surg.* **34** B, 9.
8. Jones, T. E. (1869) A remarkable injury.*Brit. med. J.* ii, 201.
9. Joshi, S. G., Panday, S. R., Parulkar, G. B. & Senp, K. (1965) Bilateral fracture of the first rib. *J. Bone Jt Surg.* **47** B, 283.
10. Powell, F. I. (1950) Fracture of the first rib. *Brit. med. J.* i, 282.
11. Proctor, S. E., Campbell, T A. & Abramson, A. S. (1945) March fracture of the first rib (Barrack Bags Fracture). Bulletin of the U.S. Army Medical Dep., No. **89**, 101.
12. Sycamor, L. K. (1944) Common congenital anomalies of the Bony Thorax. *American Journal of Roentgenology and Radium Therapy*, **51**, 593.