

Fracture of the First Rib with Associated Fracture of the Clavicle

"If in another subject the outer end of the clavicle be forced backwards, so that it rests upon the first rib outside its tubercle, being separated from it by the scalenus medius, a heavy blow be struck horizontally backwards on its padded outer extremity, in some rare cases the inner end of the clavicle is dislocated forwards, but in the large majority of cases, the first rib is fractured at the point of impact. The facility with which this fracture of the first rib is produced is remarkable, and if one compares the relative thickness and strength of the first rib and clavicle and the mechanical advantages of the clavicle upon the first rib, one would not be surprised to find this fracture occur not uncommonly during lifetime."

(Lane W.A., Guy's Hospital report 43, 321, 1885).

SINCE THIS OBSERVATION was first made by Lane in 1885, little in the nature of publications appeared in the literature until about the end of World War II. A publication by Alderson in 1944 reporting a series of anomalies in the first rib, detected among routine skiagram of chest in naval personnel, stimulated considerable communications and debate (Alderson B.R., 1945; Hartley J.B. 1945). Close to 300 cases are known to be recorded in English language literature, the majority being retrieved in bulk from the radiological archives of the armed forces. It appears from reviewing the literature on the subject that papers hitherto have mainly

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limited itself to the hypothetical violent muscular action of the scalene (Jenkins S.A. 1952; Powell F.I., 1950) and serratus anterior muscles (Powell F.I. 1950) as the prime mechanism involved in the genesis of such fractures, and only a passing reference to a co-existing fractured clavicle with fracture of first rib have been made in Knoep's paper on fractures of ribs in 1945. This paper puts on record two cases of fracture of first rib with associated fracture of the clavicle and in the light of contemporary accident pattern, a hypothesis is offered regarding the mechanism of such fractures based on the sole pioneer experimental work of Lane (Lane W.A. 1884/1885).

Case 1

A 28-year-old labourer, while riding a motorcycle, collided with a lamp-post, hitting the left side of his

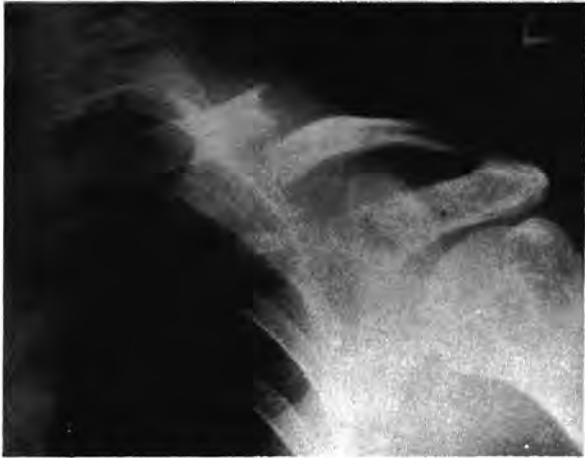


Fig. 1a, 2a, show the fracture of the first rib at their classical sites with associated fractures of the clavicle.



Fig. 1b, 2b: The dynamic nature of the lesion is demonstrated by the subsequent healing of the fractures.

neck against the post violently. As a result of this, he sustained a closed fracture of the middle third of the left clavicle and fracture of the first rib in the region of the scalene tubercle. A coincident fracture of the left forearm was treated by closed manipulation and immobilisation in a cast. The clavicle fracture was treated in a sling. Subsequently, within two weeks, the patient noticed progressive weakness and wasting of muscles of the shoulder girdle which since has progressed to a complete flail arm. B.P. is equal on both sides but radial pulse disappears on 90 degree

abduction of the arm.

Case II

A 25-year-old male, unable to negotiate a curve while driving a car, was hurled forward against the steering wheel and thrown out on to the road through the windshield. He sustained multiple lacerations with compound comminuted fracture of his face. Besides this, he had compound comminuted injury of the right shoulder with closed fracture of the clavicle on the same side together with fractures of the 2nd to

FRACTURE OF FIRST RIB, CLAVICLE

the 8th ribs and a flail right chest wall. On the opposite side, the clavicle and the first rib were found to be fractured. Dynamic stabilisation of the chest with intermittent positive pressure respiration and tracheostomy helped in the successful outcome of the patient.

Discussion

The normal anatomy affords considerable protection to the first rib from the effects of external violence. The immediate anatomical relations divide it into a fixed anterior segment to which is attached the costoclavicular ligament, a posterior mobile segment affording attachment to the scalene muscle, and a middle segment buttressed across by the subclavian artery. A sudden violent contraction of the scalene/serratus muscle is the commonly accepted cause of fracture. Nevertheless, solution of continuity through substance of the first rib have been variously attributed to

- (i) a persistent synchondrosis between the two ossific centres of the bone (Gershon-Gohen, & Delbridge, 1945)
- (ii) a fatigue fracture (Alderson 1944) and
- (iii) an actual developmental anomaly (Sycamore 1944).

All these papers are based on radiological appearances disregarding the role of trauma if any. Jones (Breslin F.J. 1937) in 1869 described a similar case following direct trauma on the neck. Later, Powell in 1950, in a series of 21 cases, described fractures following both direct and indirect trauma. Only in one paper (Knoep 1945) is there a passing remark on the association of fractures of the clavicle and of the first rib, with no explanation offered regarding the

mechanism involved.

After considerable deliberation, Lane, in his presentation at the Pathological Society of London in 1884/1885, submitted that fractures of the first rib was the result of either direct trauma or indirect trauma transmitted through the clavicle or sternum. When transmitted through the clavicle or sternum. When transmitted through the clavicle, the point of impact in relation to the clavicle is its centre and should the clavicle fracture, it may seem to do so, "so to speak, across the first rib, the clavicle yielding instead of the other parts affected by the strain." (Lane 1884/85). This was his casual remark.

In attempting to unravel the mechanism of fracture in the two cases, it is observed that in both cases, high speed vehicles have been brought to a rapid standstill after colliding with solid objects. This resulted in a rapid deceleration accompanied by deformation of the parts. When the force of deceleration generated is calculated from the formula $b = \frac{v^2}{2s}$ (where b = deceleration, v = speed of vehicle and s = linear deformation), it becomes apparent that the resultant force was of an intensity, which Lane is unlikely to have been able to produce in the dissection hall on the cadavers, a force more horizontal than vertical, transmitted on to the first rib through the clavicle, resulted in fractures of both the bones at their classical sites before dissipating itself. No doubt a combination of forces has been active, as is evident from the other co-incident injuries.

Summary

Two cases of fracture of the first rib associated with fractured clavicles are described and an explanation on the mechanism of the lesion submitted.

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