
ARTICLE

Bilateral clavicle fractures

A case report and review of the literature

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Abstract

Bilateral clavicle fractures are rare and are seldom reported on. Based on the literature review the incidence of bilateral clavicle fractures is 0.43% of clavicle fractures with an overall incidence of between 0.011 and 0.017%. The common mechanism of injury is one of a compressive force across both shoulder girdles and is different from that causing unilateral clavicle fractures. Bilateral clavicle fractures are usually associated with high-energy impact injuries and are commonly associated with other severe injuries. These injuries are not always evident and should be actively sought for and excluded.

Bilateral clavicle fractures are not commonly mentioned as an indication for operative intervention. It is suggested that bilateral clavicle fractures should be surgically managed to limit the duration of functional disability. Furthermore the use of low profile locking plates provides the ideal fixation method allowing for an earlier functional outcome.

Case report

A 27-year-old male presented to our hospital on 22 October 2010. He was involved in a motor vehicle accident after he fell asleep behind the steering wheel and subsequently rolled his vehicle. The incident occurred six days prior to consultation. Immediately after the accident he had pain over both clavicles and his right shoulder. He was initially transported to a local hospital but due to a perceived delay in his definitive treatment he decided to seek treatment at our institution.

On examination the patient was haemodynamically stable. He had sustained a blunt injury to his left shoulder with a contusion and some superficial abrasions (*Figure 1*). He also presented with pain, tenderness, bruising and bony instability bilaterally over his clavicles. The clinical diagnosis was made of bilateral clavicle fractures.

Although the patient had marked bruising and abrasions over the left shoulder, he presented with increased pain over the lateral aspect of the right shoulder and was tender on palpation along the right scapular spine.

His shoulder movements on the right were more markedly decreased than on the left. He had no neurovascular injuries.

X-rays (*Figure 2*) revealed a left clavicle fracture, which was 300% displaced, a right clavicle fracture with mild comminution and 200% displacement and a right scapula neck fracture, which was minimally displaced. Both clavicle fractures were type 1C Allman fractures and type 2B1 Robinson fractures according to the relevant classification systems.¹ The right humeral head did not display any subluxation and the shoulder joint did not displace more than 5 mm.

For mobilisation purposes and due to the displacement of the individual fractures the patient subsequently underwent open reduction internal fixation (ORIF) of both clavicles. Both surgeries were performed through the classic superior incision and the fragments were fixed with interfragmentary screws and held with anatomical locking plates (*Figure 3*). The operation was uneventful and the patient was discharged on the second postoperative day.



Figure 1. Clinical appearance of young male with bilateral clavicle fractures. Some tenting of the skin can be seen over the right clavicle and superficial abrasions over the left shoulder



Figure 2. Pre-operative X-ray appearance of bilateral clavicle fractures. Both clavicle fractures have some comminution and are displaced. A scapula neck fracture is also visible on the right

The patient was given a Barford-Jones-type arm sling for the right upper limb and a broad arm sling for the left upper limb. He was instructed to keep his right shoulder immobilised for 6 weeks due to the associated scapula fracture, and to use his left hand for activities of daily living.

The patient was reviewed 2 weeks, 6 weeks and 12 weeks postoperatively.

On review of the patient at 6 weeks he was doing well. He had full, pain-free range of motion of both shoulders (*Figure 4*). The X-rays showed good alignment of the fractures with early signs of union.

At 12 weeks postoperatively the X-rays (*Figure 5*) revealed maintenance of initial reduction and advanced union. The patient was satisfied with the result and he was discharged.

For mobilisation purposes and due to the displacement of the individual fractures the patient subsequently underwent ORIF of both clavicles



Figure 3. Immediate postoperative X-ray showing good reduction and fixation with interfragmentary screws and low profile locking plates on both clavicles

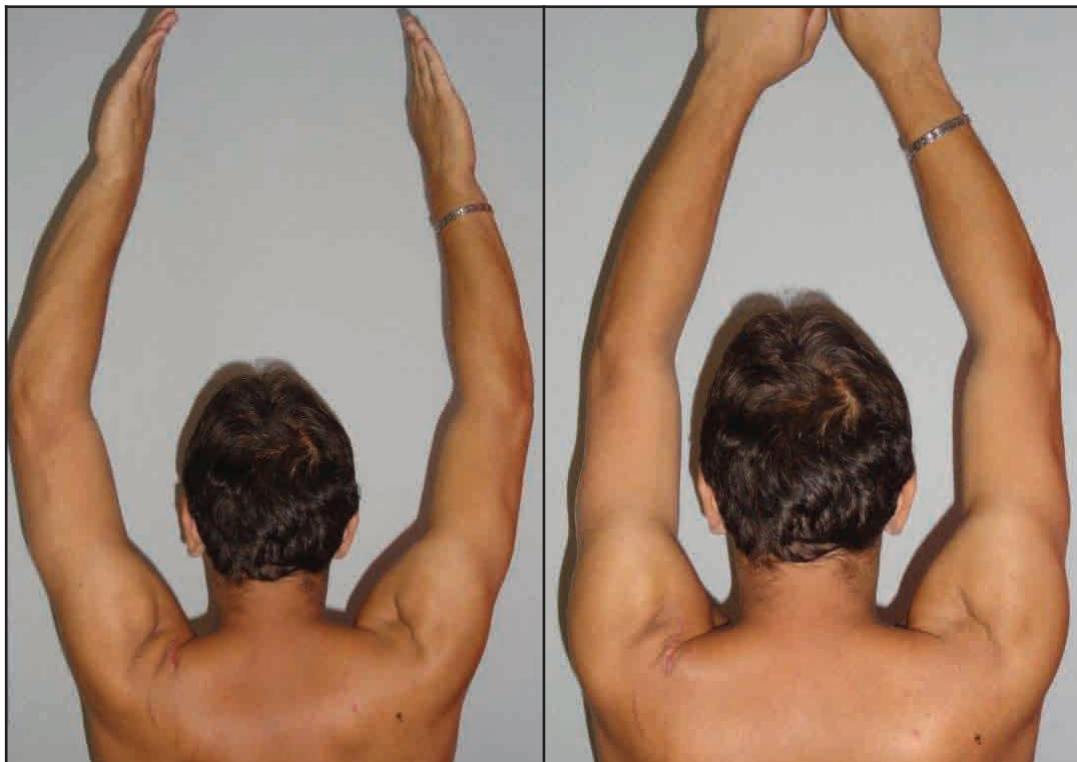


Figure 4a & b. Postoperative images showing full recovery of abduction and forward flexion of both arms

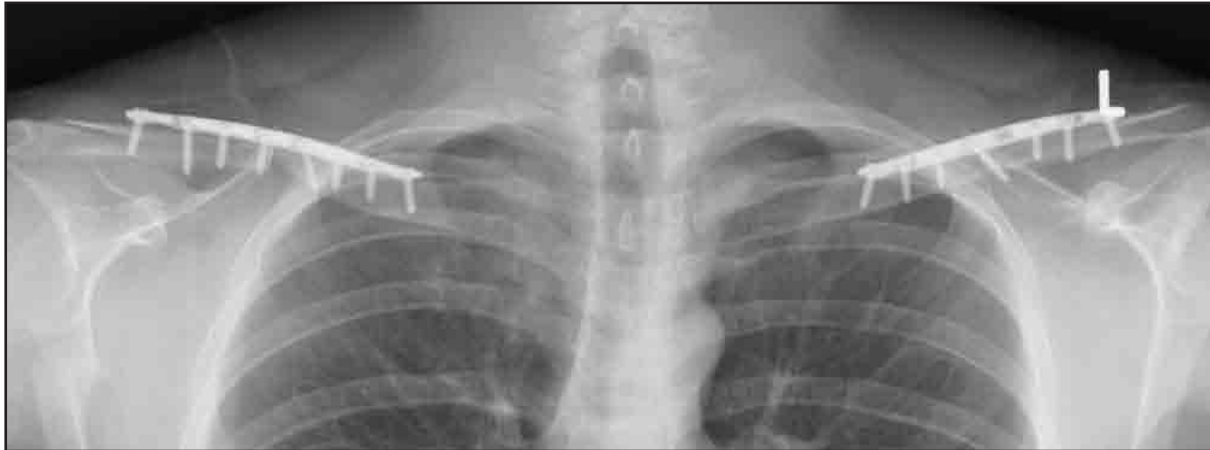


Figure 5. Postoperative X-ray at twelve weeks showing advanced union and maintenance of initial reduction

Literature review

Clavicle fractures are common injuries. Isolated clavicle fractures have a reported incidence of 2.6%² to 4%³ of all fractures. The overall reported annual incidence ranges from 29/100 000¹ to 64/100 000³ with the highest incidence (up to 150/100 000) found in young males.^{3,4}

Although clavicle fractures are often seen, bilateral clavicle fractures are rare and are seldom reported on.

An electronic search of the English literature from 1887-2010 was completed. Inclusion criteria were articles that report on patients with bilateral clavicle fractures as well as articles that investigated bilateral clavicle non-union and epidemiological studies on clavicles.

Several series of clavicle fractures have been published and the incidence of bilateral clavicle fractures is as follows:

- Nordqvist³ reported no bilateral cases in 2 035 clavicle fractures.
- Nowak⁴ had two bilateral cases in 185 patients.
- Throckmorton⁵ found 16 bilateral clavicle fractures in 593 patients.
- Daab⁶ found four cases out of 1 348 clavicular fractures.
- Rowe⁷ found a 1% incidence in 690 fractures.
- Malgaigne⁸ found only one case in over 2 000 cases.
- Robinson¹ had no bilateral cases in 1 000 cases but he excluded patients who had other shoulder girdle injuries.
- Postacchini² reported on two bilateral fractures in 533 patients but his study only looked at patients with isolated clavicle fractures, which means that polytrauma patients were excluded, and most patients with bilateral clavicle fractures have multiple injuries.

Based on above studies, excluding those by Robinson and Postacchini, the incidence appears to be around 0.43% of clavicle fractures.

There are however several case reports in the literature. These case reports vary from bilateral non-traumatic clavicle fractures,⁹ to bilateral traumatic clavicle fractures,^{8,25} and bilateral clavicle fracture non-unions.^{29,32,40}

Marya¹⁸ reports on five bilateral clavicle fractures seen in a time span of 3 months and they suspect that this injury might be more common than previously reported.

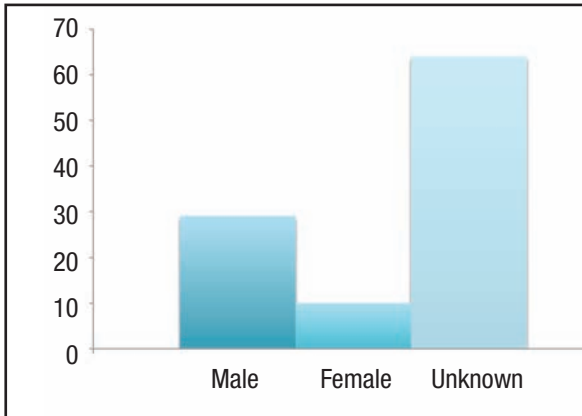
The first few cases of bilateral clavicle fractures found are documented and summarised in three articles in *The Lancet* of July 1890.^{8,23,24} In these three articles reference is made to 41 cases of bilateral clavicle fractures with Gurlt having seen 18 of them.

Including the two cases presented, there was a total of 29 males and 11 females with bilateral clavicle fractures, and 65 patients in which the gender was unknown (*Graph I*).

The different age groups of patients with bilateral clavicle fractures reviewed are illustrated in *Graph II*. In 74 cases the age is not stated.

Regarding the mechanism of injury in unilateral clavicle fractures, it has been shown that several mechanisms can cause a unilateral clavicle fracture²⁶ including a fall on an outstretched hand, a fall onto the shoulder, a direct blow on the point of the shoulder and a direct blow on the clavicle. It was previously thought that the most common cause of a unilateral clavicle fracture is a fall on an outstretched hand but subsequent studies have shown that a fall or a blow on the point of the shoulder is the more common mechanism,^{26,27} causing clavicle fractures in up to 94%.

Mechanisms for causing bilateral clavicle fractures include a compressive force across both shoulder girdles,^{14,17,19,23,28} direct trauma to both clavicles,^{8,12,14,22} direct trauma on one side and indirect violence in a subsequent fall on the other²² and two sequential episodes of direct trauma to the shoulder.^{20,21} Only one case is reported where indirect violence (fall on outstretched arms) caused bilateral clavicle fractures.⁸



Graph I: Gender distribution of patients with bilateral clavicle fractures reviewed in this article

Bilateral clavicle fractures are usually caused by a high energy impact incident such as a motor vehicle accidents,^{10,11,16-20,29,30} motorcycle accidents,^{12,28} pedestrian-vehicle accidents,^{21,25,31} pedestrian-cycle accident,²² crush type of injury,^{8,14,15,18,20,23-25,28} trampling by an animal,^{13,22} fall from a height^{8,32} and railway accident.⁸

All 18 cases seen by Gurlt⁸ were caused by great violence.

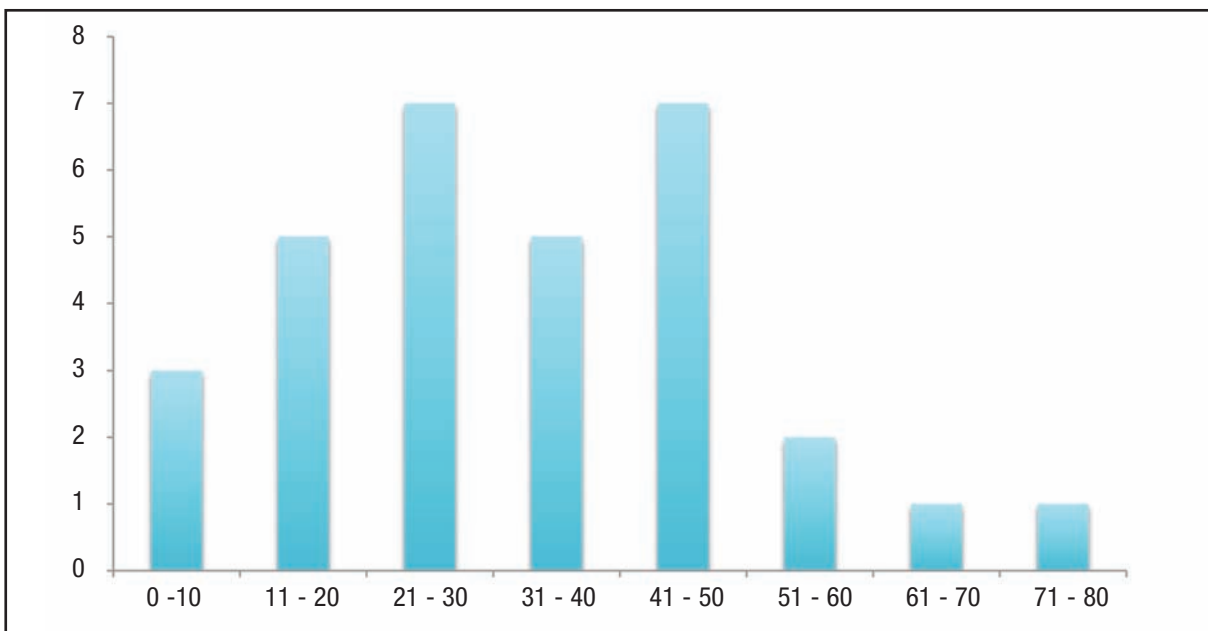
Associated injuries are seen much more frequently with bilateral clavicle fractures than with unilateral fractures and the associated injuries are often more severe. Robinson¹ reports associated injuries with unilateral clavicle fractures in 9.6% of patients. Nowak⁴ reported associated injuries in

36% of patients with unilateral clavicle fracture with 14.4% having a superficial wound on the upper extremity or head, 1.8% having another extremity fracture, 7.2% having one or more rib fractures, 5.4% cerebral concussion and 7.2% having two or more associated injuries.

In contrast, bilateral clavicle fractures are usually described in the setting of polytrauma.

Associated injuries reported^{8,10-14,16-21,29,31-33} includes severe head injuries, severe chest injuries (multiple rib fractures, flail chest, sternal fractures, haemopneumothoraces, pneumopericardium, lung contusion, aortic dissection), brachial plexus injury, associated scapula fractures (as in our presented case), humerus fracture, intra-abdominal injuries (ruptured spleen), spinal fractures, pelvic fractures and lower extremity fractures. Bilateral fractures of the medial third of the clavicle are most commonly associated with multisystem trauma and have a high associated mortality rate. In Throckmorton's study⁵ both patients with bilateral medial clavicle fractures passed away.

Similar to unilateral clavicle fractures the treatment of bilateral clavicle fractures has evolved over the years from conservative measures to operative measures. In the first few cases described, the patients were instructed to rest in bed, in an unsupported supine position.^{8,23} Other conservative treatment methods employed in the reviewed articles include bed rest with the arms bandaged across the chest,²⁴ handkerchiefs wrapped around each shoulder and tied at the back according to the method of Syme,⁸ figure-of-eight bandage,^{20,31} figure-of-eight plaster of Paris bandage,²² figure-of-eight bandage and slings,²¹ collar-and-cuff slings,²⁰ broad arm slings^{18,29} and others.



Graph II: Age group distribution of patients with bilateral clavicle fractures reviewed in this article. In 74 cases the age is not stated

Operative measures used for bilateral clavicle fractures include external fixators¹⁰ used in a case of suspected underlying infection, ORIF with reconstruction plates,^{13,17} ORIF with angle stable locking T-plates,¹² ORIF with dynamic compression plates^{34,35} and ORIF with intramedullary devices.^{15,28,33,36}

In our case described we used interfragmentary screws with low profile locking plates (see discussion).

Indications for ORIF specific to bilateral clavicle fractures are to improve ventilatory function³⁰ especially in associated, severe chest injuries¹³ and to reduce the duration of functional disability associated with conservative treatment.¹⁰

Non-union rates of clavicle fractures depend on several factors including age, gender, fracture comminution and displacement of the fracture.^{37,38}

Early studies reported low non-union rates for conservatively treated clavicle fractures. Neer³⁹ found a non-union rate of 0.13% of those treated conservatively, compared with 4.6% in patients treated operatively.

These early studies however did not look specifically at the non-union rate for displaced midshaft clavicle fractures in the adult. There are however recent studies showing that non-union rates for clavicle fractures treated conservatively are much higher than initially reported.

A systematic review by Zlowodzki of 2 144 clavicle fractures found a non-union rate of 15.1% for non-operatively treated displaced fractures of the middle third of the clavicle.³⁸ According to this review a relative risk reduction of 57% for non-union can be achieved when using a plate compared with non-operative treatment for acute midshaft clavicle fractures (86% for displaced fractures).

In the studies reviewed in this article there were no non-unions reported where ORIF was used to treat bilateral clavicle fractures. There are however several examples where non-operative treatment has led to non-union.^{8,29,31,32,40} Of the 18 cases seen by Gurlt, eight ended up with non-union. It is however not clear from the literature review how many of these fractures were displaced midshaft clavicle fractures.

Literature analysis

Study	Number of cases	Age	Gender	Type of injury	Mechanism	Type	Associated injury	Treatment	Outcome
Van den Bout	2	27	M	Motor vehicle accident (MVA)	?	Mid	Scapula fracture	ORIF locking plate	Union
		20	M	MVA	?	Mid	Severe head injuries Orbital fracture Right first rib fracture	Scheduled for ORIF locking plates	?
Bonneville ¹⁰	1	58	F	MVA Lateral collision and multiple rollovers	?	Mid	Pelvic fracture Bilateral lung contusions	External fixator	Union
Rodriguez-Martin ¹¹	1	27	M	MVA high velocity	?	Mid	Severe head injuries Aortic dissection Severe chest injuries Retroperitoneal haematoma Fracture dislocation right hip	?	?
Brunner ¹²	1	21	M	Motorcycle accident (MCA)	Direct trauma on shoulder girdles	Med	Haemopneumothorax Ruptured spleen Lower limb fractures	ORIF with angle stable lock T-plates	Union
Puranik ¹³	1	45	F	Trampling by cows	? Crush ? Bilateral direct trauma	Mid	Fractures of all 24 ribs Bilateral haemopneumothoraces	ORIF with AO 3.5 mm recon plates	Union
Agrawal ¹⁴	1	47	M	Crushed by stones	Bilateral direct trauma	?	Multiple rib fractures	?	?

Study	Number of cases	Age	Gender	Type of injury	Mechanism	Type	Associated injury	Treatment	Outcome
Dahners ¹⁵	1	18	M	Crushed between vehicle and ground	Compressive force across both shoulder girdles	Mid	?	ORIF intramedullary nail	?
Lee ¹⁶	1	24	M	MVA	?	Mid	Concussion Haemopneumothorax Multiple rib fractures Multiple T-spine fractures Brachial plexus injury	?	?
Hart ¹⁷	1	24	F	MVA	?	Mid	Bilateral floating shoulders Rib fracture	ORIF recon plates	Union
Marya ¹⁸	5	35	M	Crushed between tractor and wall	Compressive force across both shoulder girdles	Mid	Concussion	Broad arm slings	Union
		28	M	MVA high velocity	?	?	Multiple rib fractures Haemothorax	Broad arm sling	Union
		38	M	MVA high velocity	?	?	Severe head injury	Broad arm slings and a clavicular brace	Union
		7	F	MVA high velocity	?	Mid	Severe head injury	Bilateral clavicular brace with shoulder slings	Union
		40	M	MVA high velocity	?	?	Flail chest	Conservative	Union
Gould ¹⁹	1	31	M	MVA high velocity	?	?	Pneumopericardium Bilateral haemo-pneumothoraces Multiple rib fractures Sternal fracture	?	?
Sutherland ²⁰	2	18	M	Crushed between vehicle and ground	Compressive force across both shoulder girdles	Lat	Right first rib fracture	Collar-and-cuff slings	Union
		71	F	MVA	Sequential direct trauma to tip of shoulders	?	Rib fractures	Figure-of-eight bandage	Union
Tennent ²¹	1	49	M	Pedestrian vehicle accident (PVA)	Sequential direct trauma to tip of shoulders	Mid	? Lung contusion	Figure-of-eight bandage and slings	Union
Wilson ²²	2	?	?	Trampling by a horse	Direct trauma to clavicles	?	?	?	?
		7	M	Pedestrian cycle accident	Direct trauma to one clavicle and indirect trauma to other	Mid	?	Figure-of-eight POP bandage	Union

Study	Number of cases	Age	Gender	Type of injury	Mechanism	Type	Associated injury	Treatment	Outcome
Owen ⁸	1	50	F	Fell down stairs	Indirect violence (fall on outstretched arms)	Mid	?	Conservative - bedrest without a pillow, handkerchiefs wrapped around each shoulder and tied at the back according to the method of Syme	Union
Gurit ⁸	1	18	?	Great violence	?	?	?	Conservative	8 non-union
Hamilton ⁸	2	?	M	?	?	?	?	Conservative	?
Malgaigne ⁸	1	?	?	Fall from a height	?	?	?	?Conservative	?
Pick ⁸	1	?	M	Crushed by a heavy object	Bilateral direct trauma	?	?	?Conservative	?
Erichsen ⁸	1	20	M	Railway accident	?	?	Multiple rib fractures	?Conservative	?
Hulke ⁸	2	?	F	?	?	?	Rib fractures	?Conservative	?
		47	M	?	?	?	?	?Conservative	Non-union
Polailion ⁸	8	?	?	?	?	?	?	?Conservative	?
Ringwood ⁸	1	?	?	?	?	?	?	?Conservative	?
Burr ⁸	1	50	M	Thrown from a cart	?	?	?	?Conservative	Union of only one side
Page ²³	1	?	M	Crush injury between 2 wagons	Compressive force across both shoulder girdles	Mid	-	Conservative-bedrest without a pillow	Union
Boger ²⁴	1	45	M	Crushed by a horse	?	Mid	?	Bedrest with the arms bandaged across the chest	?
Bennett ²⁵	2	?	M	?	?	?	?	?Conservative	Union
		6	F	PVA	?	?	?	?Conservative	?
Flinn ²⁵	1	?	M	Crushed by a heavy object	?	Lat + med	?	?Conservative	Union
Malgaigne ²⁵	4	?	?	?	?	?	?	?Conservative	?
Kloen ³²	1	30	F	Fall from elephant	?	Mid	Right haemothorax Bilateral pneumothoraces Multiple rib fractures	Conservative	Non-union
Mullet ²⁹	1	51	F	MVA high velocity	?	Mid	Multiple rib fractures Haemothorax Right brachial plexus injury	Bilateral triangular splints	Non-union
Hargan ³¹	1	39	F	PVA	?	Mid	Head injury	Figure-of-eight bandage	Non-union
O'Conner ⁴⁰	1	?	?	?	?	?	?	Conservative	Non-union
Khan ³⁰	1	61	M	MVA	?	Mid	?	ORIF plating	Union

Study	Number of cases	Age	Gender	Type of injury	Mechanism	Type	Associated injury	Treatment	Outcome
Jubel ²⁸	3	?	?	MCA	?	Mid	?	ORIF nail	Union
		?	?	MCA	?	Mid	?	ORIF nail	Union
		?	?	Squeezed between ramp and trailer	? Crush/ Compressive force across both shoulder girdles	Mid	?	ORIF nail	Union
Shahid ³⁴	1	20	M	20	20	Lat	?	ORIF DCP	Union
Schwarz ³⁵	1	?	?	?	?	Mid	?	RIF DCP unilaterally	?
Ahmad ³⁶	1	?	?	?	?	?	?	ORIF Rockwood pin	Union
Lengua ³³	1	?	?	?	?	Mid	Humerus fracture	ORIF closed pinning	Union
Postacchini ²	2	?	M	?	?	?	?	?	?
Nowak ⁴	2	?	?	?	?	?	?	?	?
Throckmorton ⁵	16	?	?	?	?	10 mid 4 lat 2 med	?	?	?
Rowe ⁷	?	?	?	?	?	?	?	?	?

Discussion

Bilateral clavicle fractures are uncommon and seldom reported on. The mechanism of sustaining bilateral clavicle fractures is different from the mechanism for unilateral clavicle fracture. While a fall or a blow on the point of the shoulder usually causes unilateral clavicle fractures, bilateral clavicle fractures are often caused by a compressive force across both shoulder girdles. Bilateral clavicle fractures are usually associated with high-energy transfer and therefore are associated with other concomitant injuries.



Figure 6. X-ray demonstrating bilateral displaced midshaft clavicle fractures

This point was well demonstrated with a subsequent admission. A 20-year-old male was admitted to our institution on 13 January 2011 after he was involved in a motor vehicle accident. He sustained bilateral midshaft clavicle fractures (*Figure 6*). He had been involved in a high-energy transfer incident and had also sustained an orbital fracture, severe diffuse axonal brain injury, a right first rib fracture and significant lung contusion. His clavicle fractures were type 1B fractures according to the Allman classification and type 2B1 fractures according to the Robinson classification.

The treating surgeons should thus have a high index of suspicion for associated injuries and actively exclude any such injury. This requires careful examination of the involved areas (i. e. spine, thorax, scapula, plexus and others) as well as the necessary special investigations. This becomes especially important in the poly-traumatised patient,¹⁸ as bilateral clavicle fractures are associated with a higher mortality rate.⁵

While a single clavicle fracture is usually a simple injury, bilateral clavicle fractures are much more serious as they greatly incapacitate the patient, who can do little for himself.

Furthermore the inspiratory capacity of the thorax is greatly limited and the patients are prone to develop respiratory complications.²¹ This was evident in the above-mentioned patient, as the intensive care staff experienced great difficulty with the patient's ventilation.

The clavicle fracture can also form part of a more complex disruption of the shoulder girdle and stability of the shoulder complex can often be achieved by stabilisation of the clavicle.⁴¹

Open reduction and internal fixation should form the mainstay of treatment of bilateral clavicle fractures. In contrast to unilateral injuries, where each fracture is assessed individually for possible operative intervention, bilateral clavicle fractures are per se an indication for surgical stabilisation.

Anatomic angle stable fixation devices are becoming popular in the treatment of varying fractures, especially in osteoporotic bone where the pull-out strength of conventional systems is often overcome.^{42,43} Although clavicle fractures more commonly occur in normal bone in patients below the age of 50 years, the weight of the arm creates a cantilever force that increases screw pull-out, especially on the lateral aspect. Therefore screw pull-out strength can be improved with the use of locking plates.^{42,43}

Furthermore peri-articular fractures that require early mobilisation are also increasingly being stabilised with angle-specific locking plates.⁴⁴ A patient is severely incapacitated following bilateral clavicle fractures and will often need to use at least one of the injured limbs in activities of daily living. Therefore the use of stable angle locking plates that improve the fixation biomechanics allows for early non-weight bearing activities, as long as the general biomechanics of locking plates are followed. Current locking plates are anatomically contoured which reduces the need to bend the plates and thus concurrently weaken the fixation device.

Key notes on bilateral clavicle fractures

- Rare injuries but might be more common than previously reported
- Associated with high energy transfer
- Often caused by a compressive force across both shoulders
- More common in the polytrauma setting
- Actively exclude associated injuries of the head, thorax, spine, and shoulder girdle.
- Bilateral medial clavicle fractures have a high mortality
- Surgical stabilisation indicated:
 - to improve ventilatory function of severe associated chest injuries
 - to reduce the duration of functional disability associated with conservative treatment
- Fixed angle fixation devices indicated
- Anatomic locking plates recommended

The content of this article is the sole work of the authors. No benefits of any form have been or are to be received from a commercial party related directly or indirectly to the subject of the article.

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