Case Report

Bipolar clavicular instability – open reduction and tape augmentation of both joints: A case report

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ABSTRACT

A 62-year-old male suffered from a bipolar clavicle dislocation (BCD) due to a high velocity biking accident. Surgical reduction and repair was performed in both joints using non-resorbable tape-cerclages, which resulted in a good clinical outcome without any remaining instability. This technique for the fixation and stabilization is effective and not yet described in literature. Since BCD is a rare injury, there is no standardized treatment algorithm. In order to prevent chronic instability and enable adequate rehabilitation, we recommend early surgical repair and deem open reduction and tape augmentation an effective treatment option.

Introduction

Bipolar clavicle dislocation (BCD), also known as bifocal clavicle dislocation or floating clavicle, describes ipsilateral dislocation of both the acromioclavicular and the sternoclavicular joints (ACJ and SCJ, respectively) [1]. BCD is considered a rare entity. The first case report on this injury was published by Porral in 1831 [3], an incidence has not yet been determined [4]. The exact trauma mechanism is still unknown, it has been connected to high velocity accidents and falls from heights >3 m [2]. The integrity of both joints is essential, as loss of clavicular strut function can cause weakness, discomfort, or dyskinesia in the shoulder girdle [5].

A guideline on how to treat BCD has yet to be created. Management remains controversial ranging from conservative [6] to varying surgical treatment options [2,7], trending more towards open surgery in recent years – especially in young, physically active patients [7].

We report the case of a 62-year-old male with BCD on the right side using the novel repair technique of open reduction and tape augmentation of both joints, which to our knowledge has not been reported on before and achieved good results. We therefore present this method as an effective surgical treatment option for physically active patients with BCD.

Verbal informed consent was obtained from the patient for their anonymized information to be published in this article.

Case report

A 62-year-old male was referred to our center from a local hospital. He presented himself ten days after a high velocity biking accident, where he had been thrown over his handlebars onto the right shoulder. Since then, the patient had a more prominent right clavicle and he complained of pain in the SCJ and the right shoulder when lifting the arm or lying on his side. He had no preexisting conditions or regular intake of medication.

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During the clinical examination there was hematoma around the right ACJ. The medial clavicle protruded considerably in the SCJ and was elevated when compared to the other side. Palpation of both the ACJ and SCJ were painful. Clinically, reduction of the right SCJ could be achieved but not maintained. Shoulder passive range of motion (ROM) on the right side was limited due to pain with ante-/retroversion of 110-0-10°, internal/external rotation 10-0-30°, abduction/adduction 90-0-10°. Forced abduction and anteversion were extremely painful and he could actively elevate the right arm only by 30°. The rotator cuff presented itself intact during clinical examination. Peripheral blood circulation, motor function and sensitivity were intact in both arms.

The CT-scan of the right shoulder girdle showed an anteriosuperior dislocation of the SCJ and dorsal subluxation of the lateral clavicle in the ACJ [Fig. 1]. To examine vertical instability of the lateral clavicle and compare it with the contralateral side we took a loadbearing X-ray of both ACJs, which showed an 11 mm dehiscence between the lateral clavicle and the acromion on the right compared to 2 mm on the left side, without vertical dislocation [Fig. 2]. An additional Alexander view of the right shoulder confirmed the dorsal dislocation of the lateral clavicle [Fig. 3], which is an indication for surgical treatment of the ACJ [8]. We diagnosed a cranioventral dislocation of the SCJ (Type III according to Allman) and lesion of the ACJ capsule resulting in horizontal instability (Type IV according to Rockwood), which is the most frequent injury combination in BCD [9]. Due to the high physical demand, the limited range of motion, and to reconstruct the strut function we recommended surgical reduction and stabilization of both joints.

Surgery was performed 20 days after the initial trauma. The patient was placed in beach chair position. Both joints were exposed and reduction of the SCJ with a clamp leads to reduction in the ACJ [Fig. 4]. Surgical augmentation of the SCJ with reinforced, braided, polyethylene-blended sutures (FiberTape®, Arthrex, Naples, FL, USA) in a figure of eight configuration was performed by passing the sutures through 2,4 mm drilled holes in the medial clavicle and the manubrium sterni, as described by Adamcik et al. [10], without adding a cerclage around the first rib [Fig. 5]. In addition, a Vicryl cerclage (no. 1 CTX) was added as horizontal loop also passing through the previously drilled holes, as Thomas et al. described as ‘safe’ repair [11]. Next, the SCJ was temporarily held in place with a K-wire so that loss of reduction could be prevented whilst augmenting the ACJ with a horizontal cerclage passing through the acromion and the lateral clavicle also using a FiberTape® [Fig. 6]. After removing the K-wire, satisfactory reduction and retention of both joints was checked clinically and radiographically. Remnants of the ligaments and joint capsules were sutured for further stability.

Postoperatively, the shoulder was immobilized in a 15° shoulder abduction sling for two weeks. Then, active and passive motion up to 90° elevation was allowed. At eight weeks’ follow-up 90° passive and 80° active anteversion, 80° passive and 60° active abduction of the right arm were possible. There was no sign of instability and X-rays showed regular positioning of both joints [Fig. 7]. Thus, full ROM exercises were started and the patient could gradually begin to bear weight. At six months’ follow-up the patient was pain free and ROM had increased to 160° passive and 140° active anteversion and 170° passive and 130° active anteversion. Clinically, there continued to be no signs of instability in either joint.
Fig. 2. Anteroposterior X-rays of the right (R) and left (L) ACJ; both arms bearing a weight of 5 kg showing an 11 mm dehiscence between the lateral clavicle and the acromion on the right compared to 2 mm on the left side, but no vertical dislocation is evident at this point.

Fig. 3. Alexanderview of the right Shoulder verifying the dorsal dislocation of the lateral clavicle in the ACJ.
Discussion

The most important finding of this case report is, that by reduction of the SCJ and ACJ with horizontal cerclages, a satisfactory outcome can be obtained when treating patients with BCD.

The exact trauma mechanism has not yet been fully comprehended [4], but high velocity trauma or a fall from heights >3 m are mostly associated with this rare injury [2,7]. According to Bakir et al., combined clavicle injuries, i.e. clavicle fracture and ACJ or SCJ dislocation and BCD, make up only 0.7% of all clavicle injuries [4]. Considering that these injuries are rather rare, it is assumed, that many BCDs might be missed [1]. This is supported by several case reports in which initially only ACJ dislocation had been diagnosed.
After failed conservative treatment of the ACJ instability, an additional (chronic) SCJ instability was detected during follow-up [12]. In two reports one joint was surgically stabilized and the second joint dislocation was diagnosed only subsequently, so the patient had to undergo a second surgery to complete stabilization of the clavicle [13].

Radiographical diagnosis of BCD is difficult, as assessment of the SCJ on X-rays is difficult due to overlapping of thoracic structures [10]. CT-scans remain the gold standard. However, either joint can be temporarily reduced in a patient in a supine position, even though it is clinically unstable [13]. Thus, a thorough clinical examination should not be forgone [10].

Various methods to treat BCD have been described in literature, but so far, no standardized approach has been determined. Some report a good clinical outcome after conservative treatment with only cosmetic issues remaining [6]. However, cases with persisting instability and functional impairment in the shoulder have been recorded [14]. Sanders et al. presented six patients with BCD, who were treated conservatively. Four had persisting symptoms such as pain and limited ROM, so that their ACJs had to be surgically reconstructed over time [14].

In recent years, the trend seems to shift more towards surgical treatment. Various methods have been described, most stabilizing both joints. Methods for the ACJ include hook plates [9,13], K-wires [7], K-wires + wire cerclage [8], double- or triple-button fixation (e.g. MINAR® or Y-button) [1,2] or tendon augmentations [12]. Techniques used for the SCJ include plates [7,13], FiberWire® cerclages [10], PDS cerclage [9], or tendon augmentations [1,12].

Despite good clinical outcomes and the highest primary stability, surgeons should consider that K-Wires and most plate

Fig. 6. The FiberTape® has been shuttled through the lateral right clavicle and the acromion for the horizontal cerclage (a). Intraoperative fluoroscopy before (b) and after (c) tightening of the horizontal cerclage, demonstrating the achieved ACJ reduction.
osteosyntheses must be surgically removed at some point. Zou et al. described a BCD case where both joints had been stabilized with plates. A minor trauma a few weeks after surgery fractured the clavicle shaft in between the plates, presumably because the construction was too rigid putting too much strain on the shaft [13]. Although only one case like this has been published, we stipulate that early operative treatment of BCD should aim at stabilizing the joints as anatomically as possible by reconstructing soft tissue and holding the joints in place via suture cerclages, creating a more dynamic restoration of the shoulder girdle. Small diameter drilling holes for sutures suffice, which should not weaken the bone too much in contrast to a lateral clavicle fracture that occurred through a drilling hole for an allograft tendon after a minor trauma in a case report by Schmitt et al. [12].

For our patient we used FiberTape® cerclages in a similar fashion as Adamcik et al. described the treatment of isolated SCJ dislocations with FiberWire® for five patients with excellent results [10]. We then added horizontal suture cerclages due to the higher instability in BCD than monopolar SCJ dislocation. Clinically and radiographically the ACJ was unstable horizontally, which is why a horizontal FiberTape® cerclage was deemed sufficient to sustain retention. We achieved good results without any persisting instability in either joint, good ROM, and patient satisfaction at six months follow-up. To our knowledge, this BCD stabilization method has not been described before and is a good treatment option as it was successful, is minimally invasive and does not entail a second surgery to remove implants.

In conclusion, operative treatment of BCD can be recommended to young, physically active patients to avoid chronic instability, recreate the biomechanical integrity of the shoulder girdle, and enable early rehabilitation. According to our experience, this technique using FibreTape® cerclages is an effective surgical method in active patients. More, possibly multicentric, studies are needed to establish a standardized treatment algorithm for BCD.

Declaration of competing interest

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References

[1] M. Salmas, S. Angelis, D. Chytas, A. Apostolopoulos, D. Filippou, Traumatic floating clavicle: is this a rare injury? Cureus 12 (4) (2020), e7525.
[2] I.B. Moreno-Fenoll, H. Valencia, H. Fahandezh-Saddi, E. Arruti, Floating clavicle after a high velocity biking accident: a case report of an acromioclavicular dislocation with simultaneous proximal clavicle fracture managed surgically, Int. J. Surg. Case Rep. 85 (2021), 106115.
[3] MA Porral. Observation d’une double luxation de la clavicule droite. J. Univ. Hebd Med. Chir. Prat. 1831;2:78–82. French.
[4] M.S. Bakir, R. Carbon, A. Ekkernkamp, S. Schulz-Drost, Monopolar and bipolar combination injuries of the clavicle: retrospective incidence analysis and proposal of a new classification system, J. Clin. Med. 10 (24) (2021) 5764.
[5] S Oki N Matsumura W Iwamoto H Ikeyama Y Kiyama T Nakamura Y Toyama T. Nagura Acromioclavicular joint ligamentous system contributing to clavicular strut function: a cadaveric study. J. Shoulder Elb. Surg. 201;22(10):1433-9.
[6] K.P. Pang, S.W. Yung, T.S. Lee, C.E. Pang, Bipolar clavicular injury, Med. J. Malays. 58 (4) (2003) 621–624.
[7] W. Jiang, S.G. Gao, Y.S. Li, G.H. Lei, Bipolar dislocation of the clavicle, Indian J. Orthop. 46 (6) (2012) 721–724.
[8] M. Tauber, H. Koller, W. Hitzl, H. Resch, Dynamic radiologic evaluation of horizontal instability in acute acromioclavicular joint dislocations, Am. J. Sports Med. 38 (6) (2010) 1188–1195.
[9] M. Dudda, C. Kruppa, T.A. Schildhauer, Post-traumatic bipolar dislocation of the clavicle: is operative treatment reasonable? Unfallchirurg 116 (2) (2013) 176–179. German.
[10] S. Adamcik, M. Ahler, K. Gioutsos, et al., Repair of sternoclavicular joint dislocations with FiberWire®, Arch. Orthop. Trauma Surg. 137 (2017) 341–345.
[11] D.P. Thomas, P.R. Williams, H.C. Hodginott, A 'safe' surgical technique for stabilisation of the sternoclavicular joint: a cadaveric and clinical study, Ann. R. Coll. Surg. Engl. 82 (6) (2000) 432–435.
[12] S. Schmitt, P. Magosch, P. Habermeyer, S. Lichtenberg, Chronic acromioclavicular joint injury of Rockwood V type with concomitant chronic anterior sternoclavicular instability, Unfallchirurg 120 (9) (2017) 795–803. German.
[13] R. Zou, M. Wu, J. Guan, Clavicle shaft fracture after surgery for bipolar dislocation of the clavicle, Am. J. Case Rep. 12 (21) (2020 Oct), e924889.
[14] J.O. Sanders, F.A. Lyons, C.A. Rockwood Jr., Management of dislocations of both ends of the clavicle, J. Bone Joint Surg. 72 (3) (1990) 399–402.