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Case Report

Operative Reduction and Fixation of a Sternomanubrial Dislocation: A Case Report and Literature Review
胸骨柄錯位的手術復位和固定：病例報告和文獻綜述

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ABSTRACT

A dislocation of the sternomanubrial joint is a rare injury with varied treatment methods including both nonoperative and operative described methods. There is a paucity of literature regarding the optimal method of treatment as well as a lack of consensus on the best surgical construct. This case demonstrates the successful use of dual locking plate fixation for an acute type II sternomanubrial dislocation in a 22-year-old man. In principle, locking plate fixation affords greater unicortical fixation than traditional nonlocking fixation, and allows for minimising the risk of damage to pulmonary tree structures. The patient achieved good pain relief and regained physical function.

中 文 摘 要

胸骨柄錯位是罕見的創傷，有很多不同的治療方法，包括非手術和手術的方法。　討論什麼是最佳的治療方法，以及公認最佳的外科手術的文獻很少。本病例說明如何在一個22歲患有急性II型胸骨柄錯位的男性病人身上，應用雙鎖定鋼板固定手術。原則上，鎖定鋼板固定法提供比傳統的非鎖定鋼板固定法更大的單側固定，並且允許減少對肺結構造成損害的風險。病人最終獲得了良好的疼痛緩解並恢復身體功能。

Introduction

A sternomanubrial joint dislocation is a rare occurrence that is most often associated with trauma but can also be associated with contorting exercises, particularly in young gymnasts and trampolinists, as well as with seizures.[1–3] In trauma patients, sternal fractures represent about 0.5% of all fractures and only 17.6% of sternal fractures involve disruption of the sternomanubrial joint.[4]

The sternomanubrial joint is an amphiarthrodial joint composed of hyaline cartilage connected by a fibrocartilage meniscus. The second rib attaches to the joint via an intraarticular ligament and provides strength, which is assumed to be the reason why dislocations are quite uncommon.[3] The sternum provides protection for thoracic structures and acts as an anterior stabilising strut for the thorax.[5] Two types of sternomanubrial dislocations have been established: type I is where the sternal body is dislocated posteriorly to the manubrium, while type II is where the sternal body is dislocated anteriorly to the manubrium.[5,6] Type I injuries are associated with direct impact, while type II injuries are associated with hyperflexion of the thoracic spine.[5,6] Type I dislocations can be particularly dangerous due to the risk of injury to the pulmonary tree, heart, and esophagus.[5]

Such injuries are confirmed using lateral chest x-rays or computed tomography (CT) scans. Several methods of treatment including nonoperative and operative methods have been described. For stable and uncomplicated dislocations, a closed reduction with strapping is often suggested; however, this has been associated with residual chest deformity causing impaired respiratory functions resulting in atelectasis and pneumonia.[4,6,7] Chronic instability can lead to dysphagia and dyspnoea due to sternal body displacement and impingement.[5]

Unstable injuries or those involving the mediastinum often require an open reduction and internal fixation for which many methods have been reported.[6] There is a wide range of procedures including wire fixation, plating, pin fixation with bioresorbable materials, and bone grafting.[8]

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Given such varied approaches and lack of standard of care for operative fixation of dislocated sternomanubrial joints, we present and discuss a successful case of dual locking reconstruction plate fixation as well as a review of the literature on this topic.

Case Report

A 22-year-old man was struck by a suburban utility vehicle while performing municipal landscaping work on a median. He was brought to a level one-trauma centre where advanced trauma life support protocol was performed. Minimally displaced fractures of the left medial malleolus and right sacral ala were identified. CT scan of the chest and thorax on admission was reported as negative and indeed after retrospective review failed to demonstrate any injury to the sternomanubrial joint. The day following injury and admission to hospital, the patient was pushing himself up in bed in a semirecumbent supine position and felt a painful clunk in his chest. He noticed a bump over his sternum in addition to pain with inspiration. On examination, his vitals were stable and he was not in any distress. There was a palpable prominence over the superior aspect of his sternum, which was tender to palpation. His Beighton score for hypermobility met six out of nine of the criteria. He denied previous injury and his past medical history was noncontributory. X-rays were done and showed an anterior dislocation of the sternal body relative to the manubrium (Figure 1). After reviewing the risks and benefits of both surgical and nonsurgical options with the patient, consent was obtained for open reduction internal fixation of the sternomanubrial joint. Cardiac surgery was consulted and was on standby during the procedure.

The patient was positioned supine and a general anaesthetic was administered. A longitudinal midline incision was centred over the sternomanubrial joint from the sternal notch towards, but not extending to the xyphoid process. Skin flaps were raised and the pectoralis fascia was incised longitudinally and reflected in a single layer from the sternum and manubrium. The anteriorly dislocated sternal body was identified (Figure 2A) and a large pointed bone clamp was placed on the manubrium to allow for anterior traction. The joint was very mobile in an anterior–posterior direction. Congruent reduction of the sternomanubrial joint was obtained after the meniscal analogue was flipped back into place; however, the joint remained highly unstable. Two Stryker 7-hole small fragment locking reconstruction plates (Stryker Orthopaedics, Mahwah, NJ 07430, USA) were placed longitudinally in a parallel fashion spanning the sternomanubrium (Figure 2B). The plates were contoured to decrease plate prominence and care was taken to drill to, but not through the inner table of the sternum and manubrium to avoid injury to the mediastinal structures. Three screws were placed proximally and three distally in each plate, achieving six screws in each of the manubrium and sternum in the final construct. Saline was pooled in the exposure and no air was seen bubbling from the thorax under positive pressure ventilation. Particular care was taken to close the pectoralis fascia using a #1 vicryl suture in a figure of eight interrupted fashion to avoid any dehiscence, soft tissue erosion, or fascial defect over the construct. Subcutaneous tissues were closed with 2-0 vicryl subcutaneously and a 3-0 monocryl was used in a running fashion subcuticularly. Open reduction and internal fixation was then performed on the left ankle. Postoperative X-rays confirmed reduction of the sternomanubrial joint and hardware placement (Figures 3A and 3B).

Figure 1. X-ray demonstrating anterior dislocation of the sternomanubrial joint.

The patient tolerated the procedure well. The patient was advised to avoid thoracic flexion-extension movements, repetitive above shoulder activity or force through the upper extremities exceeding 5 kg for 6-weeks postoperatively followed by a progressive and gradual return to function.

The patient did well postoperatively with a reduction in pain levels compared with his preoperative pain. At 1-year follow-up, his pain using the visual analogue scale was 2 out of 10. At 1-year follow-up he had forward flexion of 180°, external rotation to 70°, abduction external rotation of 95°, and internal rotation to the level of T5 (Figures 4A and 4B). X-rays at 1-year postoperatively demonstrated anatomic reduction of the sternomanubrium and no change in hardware position (Figure 4C). At the 1-year assessment, the patient's physical function score using Short Form Health Survey-36 was 65, General Health Score was 82, and Social Functioning was 62.5 demonstrating preservation of function.

Discussion

A dislocation of the sternomanubrial joint is rare and treatment of such injuries is controversial with no established standard of care. A few studies have shown successful treatment of sternomanubrial dislocations with nonoperative interventions including physical therapy.[19] Similarly, there are a few published cases of surgical fixation of dislocated sternomanubrial joints including plate fixation.

Studies have shown that disruption of the anterior sternomanubrial joint decreases stability of the thoracic spine both in flexion and extension.[5,10,11] The sternum acts as an anterior strut and when disrupted can lead to impingement of the pulmonary tree and oesophagus, a reason surgical fixation should be considered.[11] This case demonstrates the successful treatment of a 22-year-old man with a type II sternomanubrial dislocation with a dual locking plate construct. This was performed acutely during the initial hospitalisation to help reduce pain during respiration and mobilisation, which is generally supported by literature.[10] Gaines et al[5] reported fixation with dual anterior locking plates in a 20-year-old military recruit with delayed surgical fixation at 5 weeks. The patient was able to return back to duties in 4 months. Dual anterior locking plates with unicortical screws compared with bicortical screws with nonlocking plates have lower screw pull-out and less overall failure.[5] This fixed angle construct helps resist motions across this joint both in flexion and extension.[5] However, other studies have shown similar success with bridging techniques using nonlocking one-third tubular plates and H-type sternal plates.[8]

K-wire fixation has been thought to be risky because of the danger of pin migration as well as breakage of the K-wires with excursion of the thorax.[8] Furthermore, K-wire fixation is at a mechanical disadvantage as it does not resist flexion and extension of the thorax.[5] Lemaitre et al[4] reported stabilisation with two mattress sutures carried out with heavy polydioxanone ropes which may be