Acta Orthop. Belg., 2010, **76**, 120-123

TECHNICAL NOTE

A modified Weaver-Dunn procedure without need for internal fixation

Paul M. C. Dearden, Nicholas A. Ferran, Mohammad Maqsood

From Lincoln County Hospital, Lincoln, United Kingdom

The shoulder as the most mobile joint in the body has a complex anatomy providing it with an increased range of motion, at the expense of its stability. The complex of ligaments and tendons around the acromioclavicular joint (ACJ) is prone to injury especially during sporting activity or following falls onto the apex of the shoulder. The original classification of ACJ dislocations having been modified by Rockwood suggests that types III to VI injuries may benefit from surgical intervention. Many procedures have been described to correct the deformity in the ACJ and to reestablish its ligamentous support. We describe a modification to the Weaver-Dunn procedure, which aims to establish a stable reduction with bone-to-bone healing, provided by bone plug fixation with Ethibond suture.

Keywords : acromioclavicular joint ; disruption ; repair ; modified Weaver Dunn.

INTRODUCTION

Injuries to the acromioclavicular joint (ACJ) which result in disruption of the normal joint account for approximately 3-5% of trauma to the shoulder girdle (*6*). Rockwood type III injuries are primarily managed conservatively, but can be treated operatively dependent on the clinical severity of the affected individual (*2*). Type IV-VI are best treated operatively. The operative methods of stabilization are varied with over 60 surgical techniques currently described, the choices of which include ACJ stabilization with Kirschner wires (*12*), screws (*1*), hook plates (*5*), autograft or allograft materials to reduce the ACJ (*3,8*), as well as artificial materials such as Dacron (*15*), braided polyester (The Nottingham Surgilig) (*6*) or polydioxanone-sulphate (PDS) (*4*) ; either with or without the use of a coracoacromial ligament transfer to reconstruct the ruptured coracoclavicular ligaments.

Weaver and Dunn first described the use of the coracoacromial ligament to reconstruct the coracoclavicular ligaments in 1972 (*17*). Many publications exist which describe modifications to this method (*8,9,10,11,14*), but to our knowledge none of them describe the same method described in this paper, although there are some similarities. We describe a modified Weaver-Dunn procedure, which is reliant on a bony plug, fixed into the lateral end of the clavicle with the use of Ethibond (Ethicon, Somerville, NJ) sutures.

■ Paul M. C. Dearden, BMBS (Hons), Specialty Trainee Trauma & Orthopaedics.
■ Nicholas A. Ferran, MRCS, Specialist Registrar Trauma & Orthopaedics.
■ Mohammad Maqsood, FRCS (Tr & Orth), Consultant Orthopaedic Surgeon.
Department of Trauma and Orthopaedic Surgery, Lincoln County Hospital, Greetwell Road, Lincoln, UK.
Correspondence : Mr. Nicholas A. Ferran, Department of Trauma & Orthopaedics, Lincoln County Hospital, Greetwell Road, Lincoln LN2 5QY, U.K. E-mail : nferran@uku.co.uk

No benefits or funds were received in support of this study

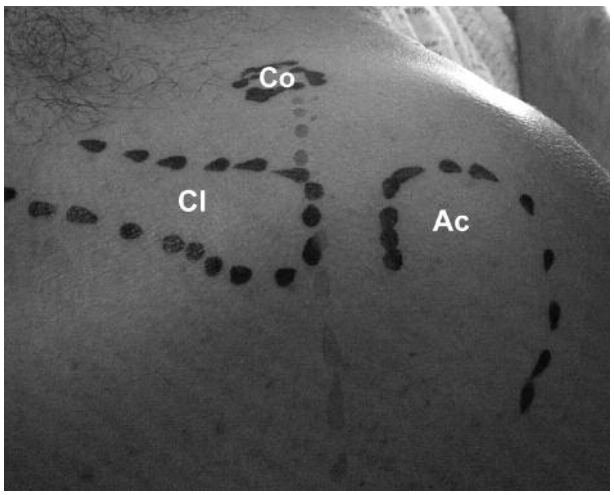

Fig. 1. — The clavicle (Cl), acromion (Ac), and coracoid (Co), are palpated and marked. The incision is then planned (dotted grey line).

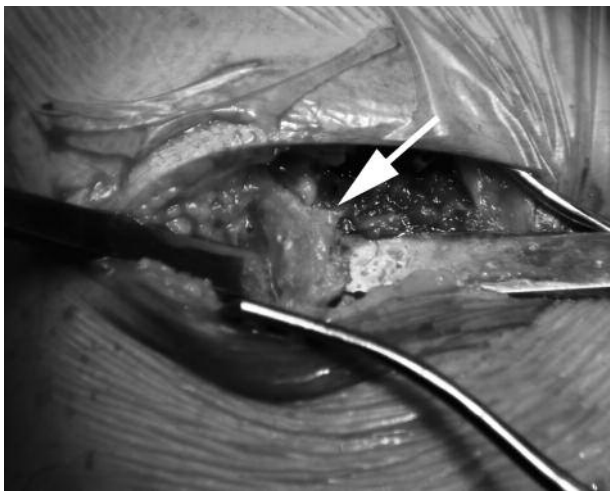

Fig. 2. — The acromial insertion of the coraco-acromial ligament is osteotomised (white arrow).

Operative technique

The patient is given a general anesthetic and placed in beach-chair position. A longitudinal ('bra strap' or saber) incision is employed to gain sufficient access to the ACJ and surrounding structures. The incision should be linear in nature, extending from the tip of the coracoid anteriorly, to the spine of the scapula posteriorly, and centered over the ACJ (fig 1). The deltoid fibres are identified and peeled off in a subperiosteal fashion to expose the ACJ, the lateral end of the clavicle and the acromion.

The tip of the coracoid, the coracoacromial ligament, and its insertion to the undersurface of the acromion are identified. The acromial end of the coracoacromial ligament is isolated and detached using a reciprocating saw. A 5-10 mm osteotomy cut is made from the under side of the acromion and a piece of bone with the coracoacromial ligament attached is preserved (fig 2). This pedicled bone plug anchored to the tip of the coracoid is prepared with two to three No 5 Ethibond sutures passed through both bone and tendon.

The lateral 2cm of the clavicle are excised with the saw. The medullary bone of the clavicle is identified and curetted to create a cavity for the bone plug to insert into (fig 3). Two or three unicortical drill holes are made in the upper cortex of the clavicle only.

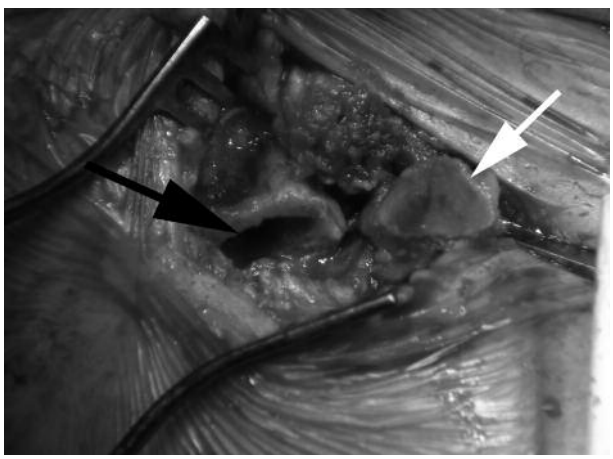

Fig. 3. — The medullary canal of the distal clavicle is prepared (black arrow) for the bone plug (white arrow).

The bone-plug-ligament complex is held by the Ethibond sutures and its length tested to ensure comfortable fit within the clavicle (fig 4). If additional length is required a partial release of the coracoid insertion will in most cases create enough length. The free ends of the Ethibond sutures are

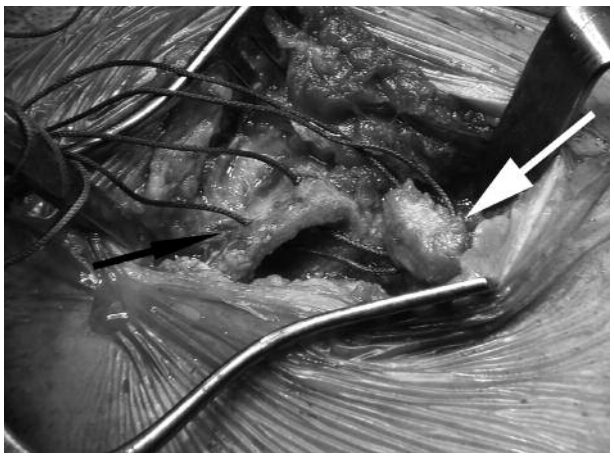

Fig. 4. — Ethibond sutures passed through the fashioned acromial bone-plug (white arrow) and clavicle (black arrow), graft length is tested.

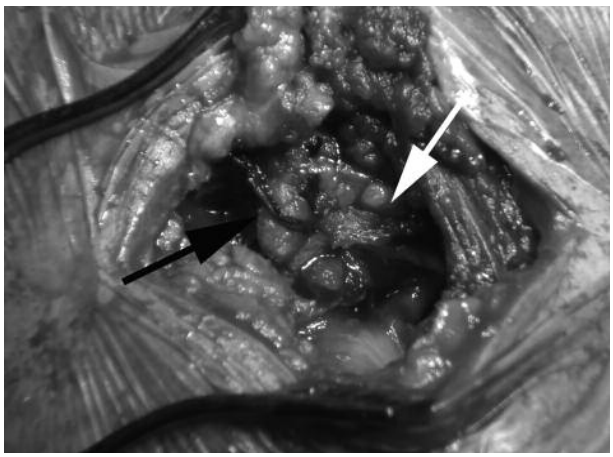

Fig. 5. — Bone-plug secured within medullary canal of clavicle (black arrow). The coraco-acromial ligament is now tensioned (white arrow).

passed through the drill holes in the superior cortex of the clavicle and the bone-plug guided to fit within the bed created for it. With the acromial bone plug within the intramedullary canal, sutures are tensioned and the clavicle manipulated to sit in the normal anatomical position. The repair is secured with several knot throws (fig 5). Soft tissue repair is made, ensuring closure of the ACJ capsule and fat overlying the repair. Skin is sutured using continuous subcutaneous absorbable suture.

A soft sling is applied to protect the operative repair and is worn for 6 weeks following surgery. Passive and pendular shoulder exercises are commenced on day one, and progressed to active at two weeks, with range of movement limited to 90 degrees of forward flexion and abduction. At 6 weeks post-operatively full range of motion is allowed.

DISCUSSION

Studies generally show good functional outcomes with the various described modification of the Weaver-Dunn procedure, however there is an association with persistent subluxation or dislocation of the ACJ after treatment (*8,11,14*). It has been noted that the previously described procedures attached the coracoacromial ligaments to the clavicle at either, a bone-ligament interface where the coracoacromial ligaments are stitched or screwed directly to the clavicle, or a bone-bone interface where a piece of acromion is detached with the coracoacromial ligaments and attached to the clavicle.

Even with a secure fixation at the time of operation, a bone-ligament interface will require a longer time to heal than that of bone-bone. This is due to the relative avascularity of the ligamentous aspect of the repair (*13*). In previous modifications of the Weaver-Dunn procedure with attempted bone-bone healing, the location of attachment was usually to the undersurface of the clavicle, i.e. medullary to cortical bone. The aim of the method described in this paper was to create a bone-bone fixation of medullary bone to medullary bone, by placing the acromial bone plug in an intramedullary cavity.

By attaching the bone-plug-ligament graft in the medullary canal after excision of the lateral end of the clavicle, there is good blood supply to the bone-bone interface of the repair, and an initial inherent mechanical stability. No further synthetic augmentation of repair is required and early rehabilitation can be commenced. Anteroposterior stability of the Weaver-Dunn technique is considered to be poor and as such, the literature suggests an acromioclavicular joint capsular repair is required to provide additional stability (*8*).

The Weaver-Dunn technique, its modifications, and the many surgical alternatives for treatment of

acromioclavicular dislocations rely upon augmentation of repair with metal or synthetic products to provide support whilst healing occurs. The additional strength provided by fixation of clavicle to acromion or coracoid is not without its limitations. Temporary fixation with Kirschner wires has been described as inadequate due to migration of wires or failure of fixation requiring removal or revision (*3*). Hook plates require an adequate surgical exposure for safe insertion and may require additional plate bending to allow for anatomical ACJ reduction. In addition, their very design places tremendous contact stress upon the undersurface of the acromion predisposing to acromial fractures or plate failure (*8*). Disadvantages of screw fixation or screw with tension band wiring include difficulty in screw insertion, local irritation over screw head, infection, screw pullout and screw or wire breakage (*7,8*). The use of synthetic ligaments is still in its infancy but reports of osteolysis of surrounding bone are beginning to arise (*16*). Instrumentation of the coracoid carries a risk of fracture or osteolysis that may make salvage/revision procedures challenging.

With the modification described in this technique a stable reduction in all planes is achieved allowing early mobilization of the shoulder joint. Without addition of metalwork or synthetic devices, the risk of fractures of the bony structures surrounding the ACJ is reduced. Local pressure necrosis on the cortex of the clavicle is minimized, by using only Ethibond sutures, thus reducing the risk of osteolysis. With the coracoid left intact, the possibility of its use for revision fixation by one of a number of described techniques is not precluded.

Our experience thus far with this technique is encouraging with good radiographic evidence of ACJ reduction post operatively and patient satisfaction and early return to normal activity.

Acknowledgement

We would like to acknowledge the contributions of Dr. Benjamin George to this article.

REFERENCES

1. **Bosworth BM.** Acromioclavicular dislocation ; end-results of screw suspension treatment. *Ann Surg* 1948 ; 127 : 98-111.
2. **Bradley JP, Elkousy H.** Decision making : operative versus nonoperative treatment of acromioclavicular joint injuries. *Clin Sports Med* 2003 ; 22 : 277-290.
3. **Brunelli G, Brunelli F.** The treatment of acromioclavicular dislocation by transfer of the short head of biceps. *Int Orthop* 1988 ; 12 : 105-108.
4. **Clayer M, Slavotinek J, Krishnan J.** The results of coraco-clavicular slings for acromio-clavicular dislocation. *Aust N Z J Surg* 1997 ; 67 : 343-346.
5. **Faraj AA, Ketzer B.** The use of a hook-plate in the management of acromioclavicular injuries. Report of ten cases. *Acta Orthop Belg* 2001 ; 67 : 448-451.
6. **Jeon IH, Dewnany G, Hartley R, Neumann L, Wallace WA.** Chronic acromioclavicular separation : the medium term results of coracoclavicular ligament reconstruction using braided polyester prosthetic ligament. *Injury* 2007 ; 38 : 1247-1253.
7. **Leow HK**, **Hyzan Y**, **Gan EC**, **Hassan S.** Surgical treatment of acromio-clavicular dislocation. *Med J Malaysia* 1998 ; 53 Suppl A : 71-76.
8. **Luis GE, Yong CK, Singh DA, Sengupta S, Choon DS.** Acromioclavicular joint dislocation : a comparative biomechanical study of the palmaris-longus tendon graft reconstruction with other augmentative methods in cadaveric models. *J Orthop Surg Res* 2007 ; 2 : 2.
9. **Park TS, Kim YH.** Modification of the Weaver-Dunn procedure. *Int Orthop* 1999 ; 23 : 113.
10. **Pavlik A, Csépai D, Hidas P.** Surgical treatment of chronic acromioclavicular joint dislocation by modified Weaver-Dunn procedure. *Knee Surg Sports Traumatol Arthrosc* 2001 ; 9 : 307-312.
11. **Payvandi S, Jeong J, Seitz WH Jr.** Treatment of complete acromioclavicular separations with a modified Weaver and Dunn technique. *Tech Hand Up Extrem Surg* 2008 ; 12 : 59-64.
12. **Phemister D. B.** The treatment of acromioclavicular joint by open reduction and threaded-wire fixation. *J. Bone Joint Surg* 1942 ; 24 : 166-168.
13. **Ramachandran M.** *Basic Orthopaedic Sciences. The Stanmore Guide,* 1st Edition. Hodder Arnold ; 2007, p 71-79.
14. **Rokito AS, Oh YH, Zuckerman JD.** Modified Weaver-Dunn procedure for acromioclavicular joint dislocations. *Orthopedics* 2004 J27 : 21-28.
15. **Stam L, Dawson I.** Complete acromioclavicular dislocations : treatment with a Dacron ligament. *Injury* 1991 ; 22 : 173-176.
16. **Stewart AM, Ahmad CS.** Failure of acromioclavicular reconstruction using Gore-Tex graft due to aseptic foreign-body reaction and clavicle osteolysis : A case report. *J Shoulder Elbow Surg* 2004 ; 13 : 558-561.
17. **Weaver JK, Dunn HK.** Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. *J Bone Joint Surg* 1972 ; 54-A : 1187-1194.