Modified Weaver-Dunn procedure versus the use of a synthetic ligament for acromioclavicular joint reconstruction

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ABSTRACT

Purpose. To compare the subjective outcome of acromioclavicular joint (ACJ) reconstruction using the modified Weaver-Dunn procedure versus the Surgilig synthetic ligament.

Methods. 55 patients aged 19 to 72 (mean, 42) years underwent ACJ reconstruction of Rockwood grade 3 (n=38), grade 4 (n=8), and grade 5 (n=9) using the modified Weaver-Dunn procedure (n=31) or the Surgilig synthetic ligament (n=24), based on the surgeon’s preference. The mean period from injury to surgical treatment was 39 months. Subjective outcomes were assessed before and after surgery using the Oxford Shoulder score and Nottingham Clavicle score. The time required to return to work and sports was also recorded.

Results. After a mean follow-up period of 40 months, the mean Oxford Shoulder scores improved from 28 to 42 in the Weaver-Dunn group (p=0.009), and from 26 to 45 in the Surgilig group (p=0.007), whereas the respective mean Nottingham Clavicle scores improved from 53 to 81 (p=0.047) and from 51 to 93 (p=0.023). The Surgilig group achieved significantly better postoperative Oxford Shoulder score (p=0.008) and Nottingham Clavicle score (p=0.007), and could also return to work (14 vs. 6 weeks, p<0.001) and sports (25 vs. 12 weeks, p<0.001) sooner than the Weaver-Dunn group. Three patients in the Weaver-Dunn group and one patient in the Surgilig group had persistent pain and/or functional deficit with evidence of ACJ dislocation.

Conclusion. Chronic ACJ reconstruction using the Surgilig synthetic ligament achieved better Oxford Shoulder score and Nottingham Clavicle score and earlier return to work and sports, compared with the modified Weaver-Dunn procedure.

Key words: acromioclavicular joint; dislocations; reconstructive surgical procedures

INTRODUCTION

Acromioclavicular joint (ACJ) disruptions account for around 12% of injuries to the shoulder girdle...
in the general population and 40% of all shoulder injuries in athletes. The Rockwood system\(^1\) classifies these injuries into 6 grades, based on the extent of distal clavicular displacement and AC ligament and coracoclavicular (CC) ligament injuries, and the integrity of the deltoide and trapezius muscles. Most ACJ injuries can be successfully managed by non-operative methods,\(^2,3\) such as use of anti-inflammatory drugs, ice packs, and protecting the arm in a sling for 2 to 4 weeks until the pain subsides. However, those who need to adopt an overhead position of the arm or in high-demanding work activities may prefer operative treatments.\(^2\) These can be classified into 4 types: (1) primary direct fixation of the ACJ (with screws, sutures, pins, hook-plates, and even plates across the joint), with or without ligament reconstruction or repair,\(^4\) (2) primary CC fixation (with wire, screw, conjoint tendon or synthetic suture), with or without augmentation of AC ligament reconstruction,\(^5,6\) (3) excision of the distal end of the clavicle (as in the Mumford procedure), with or without CC ligament reconstruction; or repair with suture or coraco-acromial ligament transfer (as in the Weaver-Dunn method),\(^4,7\) and (4) dynamic muscle transfer of the conjoint tendon, with or without excision of the distal end of the clavicle.\(^8\)

The optimal operative method for ACJ reconstruction remains controversial. The modified Weaver-Dunn method is one of the most popular methods.\(^9,10\) It involves excision of the distal end of the clavicle and transferring of the coraco-acromial ligament to the distal end of the clavicle, using the ligament as a substitute for the ruptured CC ligament. The CC fixation is then usually augmented with an absorbable braided Vicryl suture.

The use of a synthetic ligament—Surgilig (Surgicraft, Redditch, UK)—to bring the acromion toward the clavicle enables a near anatomic reconstruction of the ACJ and hence healing of the AC ligament. It is made of braided polyester, which has a minimal foreign body reaction and acts as a scaffold for tissue ingrowth.\(^11\) It consists of 2 loops at either end (Fig. 2). The hard loop is for screw fixation, whereas the soft loop facilitates looping the Surgilig through itself after passing it around the coracoid process. The Surgilig provides a strong but non-rigid support for the ACJ and enables clavicular rotation during elevation of the arm.\(^11\)

This study aimed to compare the subjective outcome of ACJ reconstruction using the modified Weaver-Dunn procedure versus the Surgilig synthetic ligament.

**MATERIALS AND METHODS**

Between May 1999 and May 2009, 55 patients aged 19 to 72 (mean, 42) years underwent ACJ reconstruction of Rockwood grade 3 (n=38), grade 4 (n=8), and grade 5 (n=9) using the modified Weaver-Dunn procedure (n=31) or the Surgilig synthetic ligament (n=24), based on the surgeon’s preference. Patients with multiple injuries or mental illness were excluded.

All patients had chronic shoulder pain and weakness interfering with activities of daily living. Most had involvement of the dominant arm. They

![Figure 1](a) Detachment of the coraco-acromial ligament with a sliver of bone, and (b) the Weaver-Dunn procedure.
had undergone conservative management using a sling for 2 weeks followed by range-of-movement exercises and physiotherapy at week 2, and shoulder girdle strengthening exercises at weeks 6 to 8. The mean period from injury to surgical treatment was 39 months. The diagnosis was based on clinical (injury history, symptoms) and radiographic (the 10º cephalic tilted view, the Zanca view,12 and the axillary lateral view) assessment.

The modified Weaver-Dunn procedure was carried out in the beach-chair position. About 10 mm of the lateral end of the clavicle was excised. The coraco-acromial ligament was then carefully removed from the acromion with its bony attachment to facilitate bone-to-bone healing with the lateral end of the clavicle. The repair was reinforced by a CC Vicryl braided suture sling passed around the coracoid process and tied over the clavicle (Fig. 1).

The length of the Surgilig was determined before insertion. The most commonly used lengths were 10, 11, and 12 cm. The Surgilig was passed around the coracoid process, and then the hard loop was passed through the soft loop, and then the Surgilig was passed around the back of the clavicle and fixed with a 3.5 mm bicortical screw, with the Surgilig being fully tensioned (Fig. 2).

Rehabilitation protocol of the 2 groups was identical. The arm was placed in a sling for 2 weeks, followed by exercise regimen to mobilise the arm aiming to attain full range of movement and function by week 6. Patients were advised to refrain from heavy lifting (>5 kg) for the initial 6 weeks.

Subjective scores can better reflect a patient’s quality of life than some clinical objective assessment.13,14 Subjective outcomes were assessed before surgery and after a mean of 40 months using the Oxford Shoulder score2 and Nottingham Clavicle score. The former consists of 12 questions related to function, disability, and pain; scores range from 0 to 48 where 0 to 19 indicates severe dysfunction, 20 to 29 moderate dysfunction, 30 to 39 mild dysfunction, and 40 to 48 satisfactory function. The latter comprises 10 questions related to pain and activities of daily living; scores range from 20 (severe dysfunction) to 100 (satisfactory function). The Pearson correlation coefficient between the 2 score systems was 0.918 (p=0.01).

The Wilcoxon signed rank test was used to compare pre- and post-treatment scores and improvement in each group. The Mann-Whitney U test was used to compare outcome scores between the 2 groups. A p value of <0.05 was considered statistically significant.

RESULTS

Generally, less severe ACJ injuries were treated with the Weaver-Dunn procedure and more severe ACJ injuries with the Surgilig synthetic ligament: grade 3 (25 vs. 13), grade 4 (4 vs. 4), and grade 5 (2 vs. 7).

After mean follow-up periods of 47 (range, 9–108) months in the Weaver-Dunn group and 30 (range, 7–108) months in the Surgilig group, the respective Oxford Shoulder scores improved from 28±11 to 42±10 (p=0.009) and from 26±9 to 45±7 (p=0.007), whereas the respective mean Nottingham Clavicle scores improved from 53±12 to 81±23 (p=0.047) and from 51±11 to 93±13 (p=0.023). The Surgilig group achieved significantly better postoperative Oxford Shoulder score (p=0.008) and Nottingham Clavicle score (p=0.007), and could also return to work (14 vs. 6 weeks, p<0.001) and sports (25 vs. 12 weeks, p<0.001) sooner than the Weaver-Dunn group.

Failure was defined as persistent pain of visual analogue score of ≥5 and functional deficit with evidence of ACJ dislocation. Three patients in the Weaver-Dunn group and one patient in the Surgilig group had failure. The latter had a mid-substance rupture of the synthetic ligament following a fall onto the affected side at week 8. All failures were revised with the Surgilig synthetic ligament. Superficial
infection occurred in 3 patients in the Weaver-Dunn group and 4 patients in the Surgilig group; all were successfully treated with antibiotics. None had deep infection.

**DISCUSSION**

For chronic grade-3 ACJ injuries, non-operative treatments have achieved good results, with 80% to 90% satisfaction rates. However, up to 50% of patients treated non-operatively have residual pain and weakness. Surgery for acute injuries is associated with the risk of early failure and complications. Surgery for acute grade-3 ACJ injuries results in overtreatment and unnecessary financial costs in patients who might have otherwise done well. There is not enough evidence to support primary operative treatment for acute ACJ injuries in general. Even manual labourers and throwing athletes can achieve good outcome after non-operative treatment. In our hospital, surgery was indicated in patients who failed non-operative treatment and had symptoms affecting activities of daily living.

Modifications of the Weaver-Dunn procedure have achieved good outcome for acute and chronic ACJ dislocations. Transfer of the coraco-acromial ligament may be associated with the risk of ongoing pain, instability, and recurrent subluxation because of stretching or failure of fixation of the re-attached CC ligament. The Weaver-Dunn procedure has only 30% of the strength and 10% of the stiffness of the intact ligaments, and failures occur mainly at the suture that attaches the transferred coraco-acromial ligament. The mean laxity after reconstruction was 42 mm in an anteroposterior plane and 14 mm vertically, compared with 8 mm and 3 mm, respectively, in intact ligaments. This can be improved by augmentation of the CC suture. Newer suture materials such as Fiberwire (Arthrex, Naples [FL], USA) and more anatomic techniques may achieve better load to failure.

The tensile strengths of the CC ligament and the CC sling from Fiberwire are 500 N and 483 N, respectively, whereas the pullout strength of the Surgilig is in excess of 1700 N. Therefore, the Surgilig enables more aggressive rehabilitation and earlier mobilisation of the shoulder, compared with other surgical methods. The Surgilig is more cost-effective in terms of reduction in off-work time. The Surgilig enables non-rigid fixation of the ACJ while maintaining reduction and normal motion at the ACJ; the movement of the clavicle is not restricted and it can freely rotate during elevation of the upper extremity without causing erosion of the bone. In addition, preserving the coraco-acromial ligament enables its role for shoulder stability as a buffer between the acromion and the rotator cuff muscles. This is in contrast with the modified Weaver-Dunn procedure where the coraco-acromial ligament is sacrificed.

ACJ reconstruction using the Surgilig synthetic ligament has become popular for treating acute and chronic complete ACJ separation. The Surgilig is recommended as the primary treatment for ACJ dislocation, as it provides permanent protection to the damaged CC ligament. In a study of 11 patients with chronic complete ACJ dislocation treated with the Surgilig and followed up for a mean of 55 months, 10 achieved good-to-excellent results with a mean Constant-Murley score of 92 out of 100, and the remaining one had a score of 64 who had sustained a fracture at the coracoid process secondary to lifting heavy weight early. In another study of 11 patients with chronic complete ACJ dislocation followed up for 24 months, the mean Constant-Murley score was 83.1 out of 100, and 82% of patients were satisfied with their outcome.

Although some patients have a reaction to the synthetic material used in CC ligament reconstruction, none of our patients had tolerance problems or synovial reaction to the Surgilig, similar to that in other studies. Postoperative morbidity was low in our patients, owing to the limited use of hardware. Superficial wound infection is not uncommon owing to the extensive soft-tissue damage and foreign body reaction to non-absorbable materials. Other complications associated with the Surgilig include coracoid fracture, screw loosening in the clavicle, and distal clavicular osteolysis.

Limitations of our study included non-randomisation, a small sample size, no objective assessment (although radiographic appearance does not correlate with the clinical outcome), and possible observational bias owing to lack of blinding.

**CONCLUSION**

Chronic ACJ reconstruction using the Surgilig synthetic ligament achieved better Oxford Shoulder score and Nottingham Clavicle score and earlier return to work and sports, compared with the modified Weaver-Dunn procedure.

**DISCLOSURE**

No conflicts of interest were declared by the authors.
REFERENCES