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ORIGINAL RESEARCH

A CRITERION BASED SLING WEANING PROGRESSION (SWEAP) AND OUTCOMES FOLLOWING SHOULDER ARTHROSCOPIC SURGERY IN AN ACTIVE DUTY MILITARY POPULATION

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ABSTRACT

Introduction: Little objective evidence is available to guide rehabilitation protocols in regard to the sling weaning process following arthroscopy surgery of the shoulder. The purpose of this study was to establish an objective, criterion based protocol for accelerated sling weaning following shoulder arthroscopy.

Methods: 82 active duty service members (ADSM) underwent elective shoulder arthroscopic surgery by three orthopaedic staff surgeons. One physical therapist progressed patients through the criterion based sling weaning progression (SWEAP) protocol for each surgery and documented pain levels, sleep habits, and decrease in sling use. Preoperative and six month postoperative Quick Disability of the Arm, Shoulder, and Hand (qDASH) and Shoulder Pain and Disability Index (SPADI) scores were obtained. The ability to perform an Army Physical Fitness Test (APFT) was recorded at six months postoperative.

Results: Patients completed sling weaning at an overall mean of 16.6 ± 5.0 days with continued use in unprotected military settings only beyond this timeframe. As patients steadily progressed out of the sling for 1 hour, 2-3 hours, and half-day periods, average pain scores decreased during these time periods at 5.0 ± 1.2, 3.7 ± 1.2, and 2.1 ± 1.3 (0-10 pain scale), respectively. Patients obtained 6-7 hours of sleep or normal sleep habits at an average of 10.9 ± 4.4 days postoperative. Overall, preoperative qDASH and SPADI scores improved from 39.8 ± 13.0 to 2.4 ± 2.0 and 46.4 ± 16.1 to 3.3 ± 3.2, respectively, at 6 months follow up. All 82 patients were able to return to deployable status. 30 (36.6%) patients required formal restrictions for the push-up portion of the APFT at six months postoperative. 7 of these 30 patients required running restrictions.

Conclusions: Early improvement in quality of life indicators can be obtained in the initial postoperative period with a progressive, criterion based SWEAP protocol. Patients demonstrated favorable outcomes with return to occupational and physical fitness activities. This study will guide orthopedic surgeons and physical therapists to enhance the sling weaning process during rehabilitation protocols and improve preoperative counseling sessions for accurate postoperative expectations.

Study Design: Retrospective Case Series; Level of evidence 4.

Key Words: Shoulder arthroscopy, shoulder rehabilitation, sling weaning

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INTRODUCTION

The use of sling immobilization after arthroscopic shoulder surgery is well accepted to protect surgical repairs in the immediate postoperative period. Postoperative stiffness is the most common complication ranging in incidence from 8.6-15% after these procedures and is often associated with prolonged immobilization.[1-3] This can be true both for the duration of time immobilized in a sling, as well as the aggressiveness of the physical therapy protocol. Traditional protocols generally follow longer periods of time for sling use for all patients within a given protocol and do not individualize patient progression regarding sling use based upon objective criteria.[1-5] Accelerated physical therapy protocols have been successful in decreasing pain scores and producing earlier functional activity and range of motion compared to conservative protocols.[6] Little clinical evidence is available regarding objective criteria to successfully wean patients out of the sling, which is why consensus rehabilitation guidelines prevail in most physical therapy literature and medical center protocols.[1,4]

Given successful reports of accelerated rehabilitation protocols in shoulder arthroscopy and high patient satisfaction, the purpose of this study was to establish an objective, criterion based protocol for accelerated sling weaning following shoulder arthroscopy.[6] The authors hypothesize that a criterion based early sling weaning protocol would yield improvements in quality of life with decreased pain and improved sleep habits with continued favorable outcomes at six month follow up.

MATERIALS AND METHODS

All active duty service members (ADSM) undergoing shoulder arthroscopy and open pectoralis major repair as performed by three orthopaedic staff surgeons at a single institution from October 1, 2011 to October 31, 2012 were included in this retrospective review. Patients excluded from the study were retired soldiers, active duty patients who retired during follow up, soldiers in the Warrior Transition Battalion, soldiers undergoing the medical board process to exit military service, or soldiers with any concurrent neurologic or psychological diagnosis including, but not limited to traumatic brain injury. The local Institutional Review Board approved this study protocol.

One physical therapist followed these patients during their rehabilitation and documented pain levels, sleep habits, and decrease in sling use at all postoperative visits. The most restrictive SWEAP (longest duration of protocol) was utilized for patients undergoing multiple procedures. All SWEAP protocols are available in Table 1. In general, surgeries involving repairs had six weeks of sling weaning with earlier progression as allowed, based on criteria assessing compliance, pain, use of narcotics, passive range of motion, sleep habits, and ability to tolerate progression. This specific progression criterion outlined in Table 2 was reviewed at each visit and needed to be favorable in order to advance to the next phase of the protocol. After the sling could be discontinued per protocol, soldiers were still allowed to wear the sling in unprotected military settings. This is important for enlisted soldiers with less control over their surroundings as compared to commissioned officers.

All patients completed preoperative and six month postoperative Quick Disability of the Arm, Shoulder, and Hand (qDASH) and Shoulder Pain and Disability Index (SPADI) scores. These objective outcome scores are well validated in the literature.[7-9] Active duty soldiers are required to take an Army Physical Fitness Test (APFT) twice a year which involves two minutes of pushups, two minutes of sit-ups, and a timed two mile run to gauge physical fitness. For medical reasons, soldiers can be granted formal restrictions or "profiles" by physicians on performing these activities. Soldiers' profiles to be exempt from or be allowed to perform modified physical fitness activities for the APFT were reviewed at six months postoperative.

Statistical analysis was performed in SPSS version 19. Descriptive data was generated for multiple variables including average time for sling use and pain. A series of independent t-tests were performed using age, gender, and profile status as the independent variables. Data is reported as mean $\pm$ standard deviation. The null hypothesis for each test was rejected at $p \leq 0.05$.

RESULTS

82 ADSM including 73 males and 9 females with an average age of 34.2 ± 8.7 years were included in the retrospective review. Individual procedures included 12 superior anterior to posterior labral (SLAP) repairs, 17 glenohumeral stabilization procedures

Table 1. *Criterion Based Sling Weaning Progression (SWEAP) Protocols.*

Procedure and Sling Type	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
• Shoulder Scope with no repairs (Distal Clavicle Resection, Subacromial Decompression, Coracoplasty)*	May come out of sling immediately. May need it for sleeping.	Continue to wear in public areas or to work for safety.	Discharge.			
• Biceps Tenotomy or Tenodesis*	May begin trials out of sling for 1-2 hour periods, 5-6 times per day. May need it for sleeping. Continue to wear in public places and work.	May begin trials out of sling throughout the entire day in controlled environments. Continue to wear in public places and work.	May continue to wean for comfort if pain or bicep cramping is still an issue.	Discharge.		
• Pectoralis Major Repair* • Superior Labrum Anterior to Posterior (SLAP) Repair (1 or 2 anchors)** • Small-Medium Glenohumeral Stabilization Procedure (1-4 anchors, ≤180˚circumference)** • Small-Medium Rotator Cuff Repair (1-2 anchors, ≤3cm tear)**	May come out of sling for hygiene purpose. May come out of sling to perform exercises. 1 hour trials out of sling if no increased pain with the above.	May begin trials out of sling for 1-2 hour periods, 5-6 times per day. May need it for sleeping. Continue to wear in public places and work.	May begin trials out of sling throughout the entire day in controlled environments. Continue to wear in public places and work.	Continue to wear sling while sleeping if 6-7 hours of uninterrupted sleep is not achieved.	Discharge.	
• Medium-Large Glenohumeral Stabilization Procedure (≥5 anchors, >180˚ circumference) ** • Large –Massive Rotator Cuff Repair (≥3anchors, >3cm) **	May come out of sling for hygiene purpose. May come out of sling to perform exercises. 1 hour trials out of sling if no increased pain with the above.	May begin trials out of sling for 1-2 hour periods, 5-6 times per day. May need it for sleeping. Continue to wear in public places and work.	May begin trials out of sling throughout the entire day in controlled environments. Continue to wear in public places and work.	May continue to wean if pain persists out of sling and requires sling with sleeping.	Continue to wear sling while sleeping if 6-7 hours of uninterrupted sleep is not achieved.	Discharge.

*Standard Sling: over the shoulder sling with arm resting on abdomen.

**Sport Postoperative Sling: abduction pillow adjusted to approximately 30-45 degrees abduction, slight horizontal adduction at 0-5 degrees in scapular plane, and in neutral rotation.

Table 2. *Criterion Based Sling Weaning Progression (SWEAP) Protocol: Progression Criteria.*

	Answering yes or no should be based over the past week.	Yes/No
1	Is the patient's subjective pain report on the 1-10 Visual Analog Scale decreasing?	
2	Is the patient's use of narcotics decreasing?	
3	Is the patient's PROM increasing gradually following the procedures based protocols?	
4	Is the patient's uninterrupted sleeping habits gradually reaching normal for them? - The patient may increase in 1 hour long increments. - The patient may also be progressing from sleep destination (e.g. recliner/couch, to elevated postures in bed to supine)	
5	Is the patient tolerating the progression out of the sling?	
6	*Is the patient compliant with procedure protocol precautions? - This is an absolute criterion. - If the patient is non-compliant and at risk of compromising the repair they are to stay in the sling.	

*Note: This criteria must be answered yes in order to progress. Of the first 5 criteria they must meet 4/5 to continue the progression.

with 4 or less anchors involving ≤180˚ circumference, 5 glenohumeral stabilization procedures with 5 or more anchors involving >180˚ circumference, 10 rotator cuff repairs utilizing a single row technique with 1-2 anchors (all followed small-medium rotator cuff repair protocol), 33 open sub-pectoral biceps tenodeses, 2 biceps tenotomies, 13 distal clavicle resections, 10 coracoplasties, and 38 sub-acromial decompressions. Two pectoralis major repairs performed in open fashion were included in the study due to requiring a sling during rehabilitation.

Data is summarized with a breakdown of individual protocols in Table 3. Patients were able to tolerate 1 hour without sling at average of 3.7 ± 1.2 days postoperative, 2-3 hours without sling at 5.7 ± 1.3 days postoperative, and half day at 8.1 ± 2.0 days postoperative. 100% of patients completed sling weaning

Table 3. *Summary of outcome data for all patients and individualized rehabilitation protocols.*

	Number of patients	Length of time without sling as patient progressed through SWEAP (Days)				Pain scores (0-10) as patient came out of sling for specified amounts of time during SWEAP protocol			Days to obtain 6-7 hours or normal sleep habits	Objective outcome scores pre-operative and 6 months post-operative			
Sling Weaning Protocol	N	1 Hour	2-3 Hours	Half Day	Discontinued	1 Hour	2-3 Hours	Half Day		Pre-qDASH	Post-qDASH	Pre-SPADI	Post-SPADI
Overall													
All	82	3.7±1.2	5.7±1.3	8.1±2.0	16.6±5.0	5.0±1.2	3.7±1.2	2.1±1.3	10.9±4.4	39.8±13.0	2.4±2.0	46.4±16.1	3.3±3.2
Permanent Profile	30	3.5±1.3	5.9±1.5	8.5±2.2	18.6±6.0	5.2±2.1	4.3±1.2	2.6±1.3	13.3±4.8	47.1±13.5	3.7±1.9	55.7±13.3	4.7±3.8
No Permanent Profile	52	3.7±1.2	5.6±1.3	7.9±1.8	15.4±4.0	4.9±2.1	3.3±1.1	1.8±1.2	9.5±3.6	35.6±10.9	1.7±1.8	41.1±15.2	2.4±2.5
		p=0.49	p=0.39	p=0.17	p=0.014	p=0.30	p=0.001*	p=0.008*	p=<0.001*	p=<0.001*	p=<0.001*	p=<0.001*	p=0.002*
SLAP Repairs													
All	12	4.3±0.8	6.4±0.9	9.1±2.3	19.6±5.7	4.8±1.0	3.0±1.2	1.2±1.1	9.0±2.8	40.8±12.4	2.1±1.5	47.4±15.6	2.1±1.9
Permanent Profile	4	4.3±1.0	6.8±0.5	9.8±1.7	25.3±4.9	5.4±0.9	3.5±1.1	1.5±1.1	9.3±4.6	53.5±9.4	2.9±1.1	61.4±10.9	2.9±2.2
No Permanent Profile	8	4.4±0.7	6.3±1.0	8.8±2.6	16.8±3.6	4.5±1.0	2.8±1.2	1.0±1.1	8.9±1.8	34.4±7.9	1.8±1.6	40.4±12.9	1.7±1.7
Glenohumeral Stabilization, ≤4 anchors													
All	17	3.2±1.3	5.2±1.3	7.0±1.6	16.1±4.1	5.1±1.4	3.7±1.1	2.1±1.2	11.1±4.4	40.0±11.5	2.5±1.9	46.8±15.0	4.1±3.3
Permanent Profile	8	2.3±0.9	4.3±0.9	6.1±1.4	14.8±3.9	5.0±1.4	4.2+1.2	2.6±1.3	12.3±4.7	44.0±11.4	3.5±1.1	52.5±10.3	6.0±3.4
No Permanent Profile	9	4.1±0.8	6.0±1.0	7.8±1.5	17.2±4.1	5.2±1.4	3.3+0.9	1.7±1.0	10.1±4.0	36.4±10.9	2.0±1.6	41.6±17.2	2.4±2.3
Glenohumeral Stabilization, >5 anchors													
All	5	4.4±0.5	6.8±1.3	9.8±1.3	19.8±3.3	4.9±1.3	2.9±1.2	1.0±1.2	15.0±3.9	47.1±12.2	4.6±4.2	62.0±11.0	5.8±6.0
Permanent Profile	3	4.3±0.6	7.0±1.0	9.7±1.5	19.3±4.5	4.3±1.5	3.5±1.3	1.7±1.2	14.3±4.9	52.0±14.0	5.3±5.7	66.9±12.1	7.6±7.5
No Permanent Profile	2	4.5±0.7	6.5±2.1	10±1.4	20.5±0.7	5.8±0.4	2.0±0.0	0.0±0.0	16.0±2.8	39.8±4.8	3.6±1.3	54.7±2.2	3.1±2.2
Rotator Cuff Repair													
All	10	4.1±0.9	6.6±1.2	9.7±1.8	23.1±4.5	5.5±1.4	4.3±1.3	3.0±0.9	10.7±3.1	42.9±12.9	1.6±1.9	47.5±14.8	1.7±1.6
Permanent Profile	5	4.2±0.8	7.0±1.0	10.6±1.5	25.6±5.4	6.5±0.5	5.3±0.8	3.3±1.0	12.6±2.7	43.7±13.2	3.3±1.1	52.7±15.5	2.6±1.6
No Permanent Profile	5	4.0±1.0	6.2±1.3	8.8±1.8	20.6±0.9	4.4±1.1	3.3±0.9	2.6±0.7	8.8±2.4	42.0±14.2	0.0±0.0	42.3±13.5	0.8±1.1
Biceps Tenodesis/Tenotomy													
All	24	2.9±1.4	4.8±1.1	7.2±1.5	13.5±2.3	5.0±1.2	4.2±1.2	2.9±1.0	12.3±5.6	42.0±15.2	2.8±1.7	48.4±18.4	4.6±3.3
Permanent Profile	6	3.5±1.8	5.3±1.4	7.5±1.4	15.2±2.9	5.3±1.0	4.8±1.3	3.7±1.2	19.5±1.8	56.1±14.6	4.1±0.9	61.5±12.2	6.4±3.8
No Permanent Profile	18	2.7±1.3	4.6±0.9	7.1±1.5	12.9±1.9	4.9±1.3	4.0±1.1	2.7±0.9	9.9±4.2	37.4±12.5	2.3±1.7	44.1±18.2	4.0±3.0
Pectoralis Major Repair													
All	2	4.0±1.4	7.0±1.4	8±1.4	20.0±1.4	4.5±0.7	2.8±0.4	0.0±0.0	9.5±2.1	37.5±8.1	3.4±1.6	43.5±13.6	3.5±1.6
Permanent Profile	0	NO QUALIFYING PATIENTS											
No Permanent Profile	2	4.0±1.4	7.0±1.4	8±1.4	20.0±1.4	4.5±0.7	2.8±0.4	0.0±0.0	9.5±2.1	37.5±8.1	3.4±1.6	43.5±13.6	3.5±1.6
Shoulder Arthroscopy (no anchors or formal repair)													
All	12	4.3±0.8	6.2±1.0	8.5±1.7	13.0±2.5	4.8±1.2	3.1±1.2	1.3±1.1	8.3±2.1	29.0±7.2	1.6±1.8	34.1±10.3	0.9±1.0
Permanent Profile	4	4.0±1.2	6.8±1.0	10.0±1.2	15.3±2.5	4.6±0.5	3.6±0.8	1.8±0.6	10.5±1.3	33.6±10.6	3.5±1.2	43.1±13.6	1.9±0.5
No Permanent Profile	8	4.5±0.5	5.9±1.0	7.8±1.4	11.9±1.7	4.8±1.4	2.8±1.3	1.1±1.2	7.1±1.5	26.7±3.8	0.6±1.1	29.6±4.2	0.4±0.7

All=All patients in subgroup, Permanent Profile= Patient required permanent profile at 6 months post-operative, No Permanent Profile= Patient did not require permanent profile at 6 months post-operative. *= Statistically significant after adjusting the p-value for multiple comparisons. p values provided are for comparison of soldiers with and without permanent profiles at 6 months post-operative.

before the individualized protocol goal at an overall average of 16.6 ± 5.0 days postoperative (SLAP repairs 19.6 ± 5.7, glenohumeral stabilization procedures with 4 or less anchors involving ≤180˚ circumference 16.1 ± 4.1, glenohumeral stabilization procedures with 5 or more anchors involving > 180˚ circumference 19.8 ± 3.3, rotator cuff repair 23.1 ± 4.5, biceps tenodesis/tenotomy procedures 13.5 ± 2.3, pectoralis major repairs 20.0 ± 1.4, and arthroscopy with no repairs performed 13.0 ± 2.5).

Pain scores as measured on a 0-10 scale (0 for no pain, 10 for maximal pain) decreased from 5.0 ± 1.2 when patients were trialing for 1 hour out of the sling, 3.7 ± 1.2 when trailing for 2-3 hours out of the sling, and 2.1 ± 1.3 when trailing for half day periods out of the sling. Those under age 35 reported significantly less pain after being out of a sling for half a day than those 35 years and older (1.71 ± 1.3 vs 2.55 ± 1.3, $p = 0.004$). Patients obtained 6-7 hours or a normal night's sleep at an average of 10.9 ± 4.4 days postoperative. Females had a statistically significant more rapid return to normal sleep patterns compared to males at 9.56 ± 3.0 days postoperative compared to 11.04 ± 4.6 days postoperative, respectively ($p = 0.04$). Age and gender differences were not statistically significant for any other outcome parameter ($p > 0.05$). No patient experienced clinical failure of any repair during the follow up period.

Overall, preoperative qDASH and SPADI scores improved from 39.8 ± 13.0 to 2.4 ± 2.0 and 46.4 ± 16.1 to 3.3 ± 3.2, respectively. All patients were deployable at six months postoperative. 30 (36.6%) patients required a profile for the push-up portion of the APFT at six months postoperatively. 7 of these 30 patients required running restrictions as well (1 for SLAP repair, 1 for glenohumeral stabilization procedure with 5 or more anchors involving > 180˚ circumference, 2 for rotator cuff repair, 2 for isolated biceps tenodesis/tenotomy, and 1 for shoulder arthroscopy without repair).

Patients requiring a profile to be exempted for certain portions of the physical fitness test at six months postoperative were found to have a statistically significant increase in sling weaning time compared

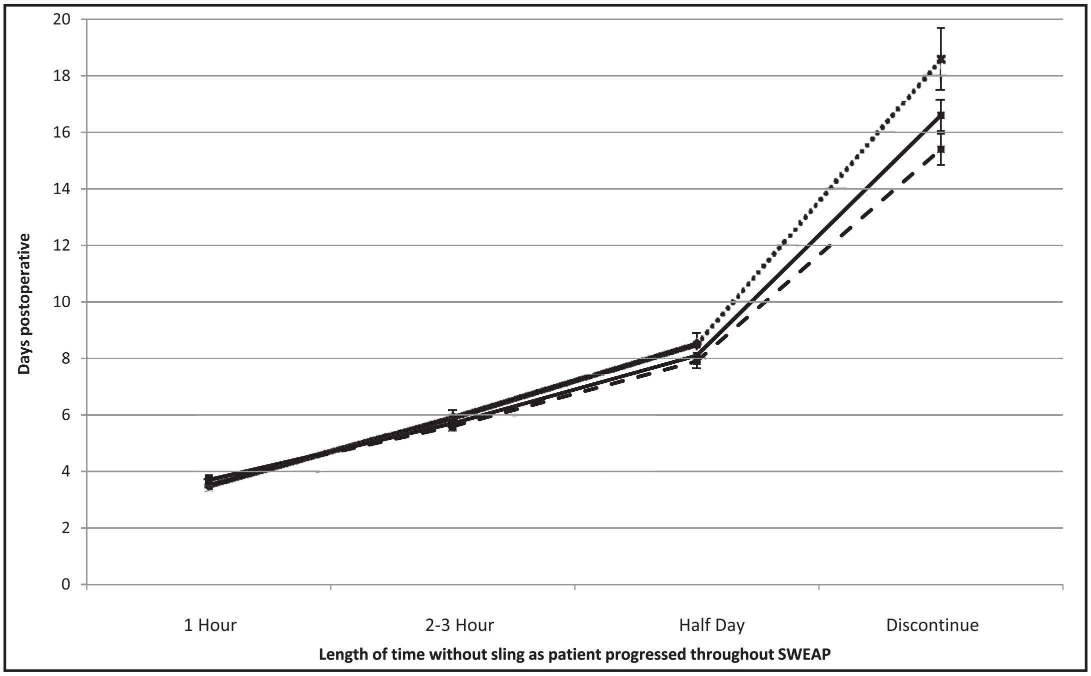

Figure 1. *Average decrease in sling use (days postoperative) throughout Criterion Based Sling Weaning Progression (SWEAP) as patient came out of sling for specified periods of time during protocol. Error bars reported as standard error of the mean. *Solid line = All Patients, Dotted Line = Patients with Profile, Dashed Line = Patients without Profile.*

to soldiers not requiring profiles (18.6 ± 6.0 days vs 15.4 ± 4.0 days, p = 0.014*) (Figure 1), increased time to obtain normal sleep habits (13.3 ± 4.8 days vs 9.5 ± 3.6 days, p = < 0.001*), and increased pain scores at the later portion of sling weaning (4.3 ± 1.2 vs 3.3 ± 1.1, P = 0.001 at 2-3 hours without sling, 2.6 ± 1.3 vs 1.8 ± 1.2, p = 0.008 at half day without sling) (Figure 2).

Preoperative qDASH and SPADI were significantly worse for patients with profiles at 47.1 ± 13.5 and 55.7 ± 13.3 compared to patients without profiles at 35.6 ± 10.9 and 41.1 ± 15.2, respectively (p = < 0.001, p = < 0.001*). Patients with profiles experienced a more significant quantitative change in outcome scores postoperative, but were still significantly worse than patients without profiles (postoperative qDASH 3.7 ± 1.9 vs 1.7 ± 1.8 p = < 0.001, postoperative SPADI 4.7 ± 3.8 vs 2.4 ± 2.5 p = 0.002).

DISCUSSION

Many studies have evaluated rehabilitation methods in order to improve outcomes after shoulder arthroscopy including accelerated rehabilitation protocols, customized physical therapy programs, and early use of passive motion.[6,10-12] Improvements in surgical repairs have enabled surgeons and physical therapists to explore these options with less fear of hardware or soft tissue repair failures.

Penna et al performed a cadaveric study to test the strength of transglenoid sutures for labral and capsular shift repair techniques.[13] The greatest stress was found in the abducted and externally rotated position at a mean force of 17.7N in the capsular shift with labral repair group. The maximum chondrolabral junction force in any trial was 26.1N which is still significantly below the biomechanical pullout strength of a knotless anchor at 650N as documented by Leedle and Miller.[14] An update on pullout strengths and modes of failure utilizing a biomechanical analysis found most current anchors fail by eyelet failure followed by suture breakage.[15] Pullout was not the predominant mode of failure for any anchor tested. Mean force for load to failure in cortical bone ranged from mean force of 161.1-521.6N and 116.8-611.8N for cancellous bone.

For rotator cuff repairs, cadaveric and animal models have demonstrated that the mode of failure has been

*Represents statistically significant differences between groups after accounting for unequal variances.

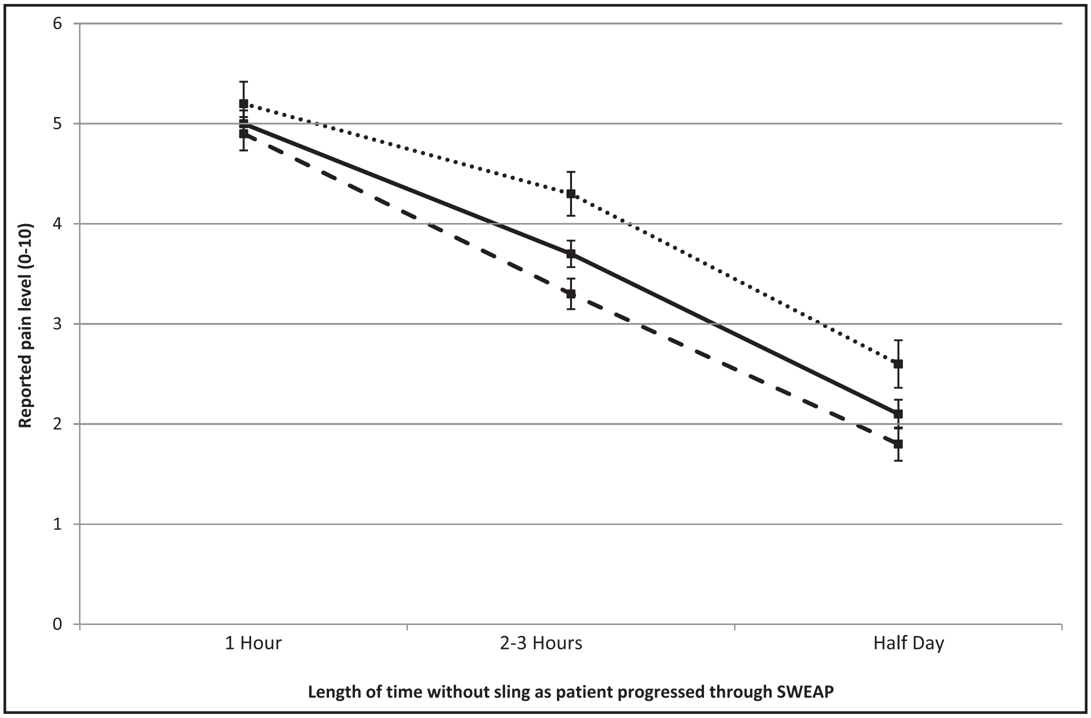

Figure 2. *Average pain level decreases throughout Criterion Based Sling Weaning Progression (SWEAP) as patient came out of sling for specified amounts of time during protocol. Error bars reported as standard error of the mean. *Solid line = All Patients, Dotted Line = Patients with Profile, Dashed Line = Patients without Profile.*

effectively transferred to the soft tissue instead of bone tunnel fracture or suture breakage with modern anchor fixation over bony tunnels.[16,17] These tests demonstrate improvement over historical repair methods and have allowed for further enhancement of rehabilitation protocols with biology now becoming the limiting factor in most cases.[18]

Consensus rehabilitation guidelines currently offer poor objective criteria for sling weaning. The American Society of Shoulder and Elbow Therapists provided the first multidisciplinary guideline in 2010 for therapy following arthroscopic anterior stabilization with or without Bankart repair which states a range of 0-4 weeks immobilization "dependent on patient's specific injury/pathology, co-morbidities, amount of natural laxity, past surgical history, specific surgical technique (including type of fixation and arm position at time of capsular plication), and physician philosophy".[1,4] This criterion gives a wide range of interpretation and offers little direct evidence for rehabilitation. These guidelines are similar to most large rehabilitation center protocols being formed mostly by expert opinion in Gestalt methodology. After reviewing all available literature, the AAOS Clinical Practice Guideline Summary for Optimizing the Management of Rotator Cuff Problems offers inconclusive recommendations for any purpose concerning immobilization duration or position.[19]

Stiffness continues to be a persistent postoperative complication following surgery on the glenohumeral joint which occasionally requires further operative intervention. Tokish et al prospectively followed 41 patients undergoing circumferential labral repairs and kept all patients in an abduction sling for six weeks except for bathing and range of motion of the elbow, wrist, and hand.[5] Pendulum exercises began at two weeks postoperative with a supervised physical therapy program not starting until six weeks postoperative. Two of 39 patients available at 31.8 month follow up developed postoperative stiffness and tightness requiring further arthroscopic release. Those authors concluded that a less aggressive rehabilitation protocol could have contributed to stiffness in these patients.

Patient dissatisfaction from prolonged immobilization may be considered a complication affecting the patient's perceived results of shoulder arthroscopy.

Kim et al performed a prospective randomized clinical study of an accelerated rehabilitation protocol following arthroscopic Bankart repair.[6] The control group remained immobilized for three weeks, but was allowed to wash the axilla daily and able to flex their wrist and elbow during this time. The accelerated group began gradual exercise on postoperative day one and wore the sling during sleep for two weeks. Minimal documentation was provided for directing sling use by the authors of this article. However, the authors found statistically significant favorable results in reducing pain at six weeks postoperative, improving patient satisfaction, earlier return of range of motion, and earlier return of functional activity level with the accelerated protocol ($p < 0.05$). Final follow up demonstrated no difference in recurrence of instability, objective outcome scores, pain, or return to prior activity. Satisfaction was measured one year postoperatively with 64% of patients in the control protocol recalling an "unsatisfactory" rehabilitation protocol compared with only 9% in the accelerated protocol.

Utilizing the criterion based sling weaning progression (SWEAP) protocol described in the current study, patients reported decreasing pain scores that progressively improved as less time was spent immobilized in the sling. Normal sleep patterns were obtained before the standard two week follow up appointment for most patients. The SWEAP protocol utilized in this study can supplement the current rehabilitation therapies at most major medical centers and rehabilitation facilities.

Soldiers who ultimately required formal physical activity restrictions or "profiles" had increased time for sling weaning, increased postoperative days to obtain normal sleep habits, and increased pain scores during the sling weaning timeframe. Increased disability on preoperative and postoperative qDASH and SPADI scores was found for patients who required these formal restrictions compared to patients who did not require a profile at six months follow up. The postoperative difference in qDASH and SPADI scores, although statistically significant after controlling for multiple comparisons, had an absolute value difference of only two points. This minimal difference would not be expected to correlate with a significant increase of functional disability requiring a profile for the APFT. The increased qDASH and SPADI scores in this group could potentially be attributed to differences in pain tolerance or willingness to report pain. Another explanation is the potential for secondary gain for some soldiers to attempt to decrease their physical fitness requirements even though they may have similar qDASH and SPADI scores compared to a more motivated soldier. This study gives general statistics that about one-third of soldiers undergoing shoulder arthroscopy will require a profile which will aid preoperative counseling, but this finding needs to be studied more in future research, and discussion needs to be individualized for every soldier's diagnosis and planned surgery as demonstrated in Table 3.

LIMITATIONS

Limitations of this study include its retrospective nature and relatively small sample size for each individual type of surgery. No control group was available at the authors' institution and no representative standard was found in literature to compare our results. All data collection was obtained by one physical therapist which could introduce an element of bias. Patients were allowed to continue to wear the sling in unprotected military settings which was unable to be quantitatively documented. The vast majority of patients were male which reflects the military patient population. Increasing the number of patients including an equal balance of males and females, comparing results to a control group, and increasing the duration of follow up would strengthen the findings. Musculoskeletal ultrasound would also be a useful adjunct to evaluate the integrity of the repair for patients undergoing rotator cuff repair in addition to their clinical outcome.[20,21]

CONCLUSION

This study documents the initial favorable quality of life outcomes in the first six postoperative weeks and positive objective outcomes at six months postoperative following an accelerated SWEAP protocol after shoulder arthroscopy for a wide variation of surgical procedures in a military population. The majority of patients (63.4%) were able to pass an unrestricted Army Physical Fitness Test (APFT) at six months postoperative. At this timeframe, excellent return to occupational activities was demonstrated with all patients being deployment-eligible and being able to return to their prior military specialty. This data will improve preoperative counseling for patient expectations and provide physical therapists with objective criteria for sling weaning during the rehabilitation process.

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