Satisfaction and Pain Levels for Shoulder Injuries

A Interactive Qualifying Project Report

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In

Biochemistry

By

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APPROVED:

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Abstract

The objective of this study was to analyze self-reported satisfaction and pain levels of patients that received one of several treatments for shoulder injuries. The measurement of satisfaction and pain levels was accomplished by having patients fill out anonymous surveys. The surveys were evaluated statistically in order to determine if patients feel that they have been rehabilitated properly from their injury. Conclusions from the data found that a combined treatment of surgery and physical therapy provides patients with shoulder injuries a greater satisfaction level and lower pain level than patients that received only either of the treatments.

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Acknowledgements

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Thanks also like to thank my advisor, Prof. Phil Robakiewicz, for his patience, guidance, and wisdom.

Introduction

The objective of this study was to analyze self-reported satisfaction levels and pain levels of patients that received one of several treatments for shoulder injuries. Satisfaction can be defined as the difference in pain levels before and after treatment. It can also be defined as the difference in shoulder function before the injury's occurrence and after completion of treatments (Jarret et al.,1998).

The measurement of satisfaction levels and pain levels was accomplished by having patients fill out anonymous surveys. The surveys were evaluated statistically in order to determine if patients feel that they have been rehabilitated properly from their injury. The purpose of the survey was to determine the treatments that work best for these types of injuries

The shoulder is the most moveable joint in the body, however it is an unstable joint because of the range of motion allowed. It is easily subject to injury because the ball of the upper arm is larger than the shoulder socket that holds it. To remain stable, its muscles, tendons, and ligaments must anchor the shoulder. Some shoulder problems arise from the disruption of these soft tissues as a result of injury or from overuse or underuse of the shoulder. Other problem arises from a degeneration process in which tissues break down and no longer function well. Given the complexity of this joint and the wide variety of injuries that may affect it, I hypothesized that patients who received surgical intervention combined with physical therapy would report a more satisfactory outcome then those who treated the injury with surgery or physical therapy alone.

Background

The most commonly injured regions in athletes are the knee, shoulder and ankle. In a study of injuries in collegiate wrestling, shoulder injuries were the second highest among all injuries (Dick et al., 1998). The total number of athlete-exposures studied was 873,479 over 11 seasons. For every season, the shoulder was the second most commonly injured body part, averaging 14% of all injuries. It was also second to knees in injuries requiring extended time off or resulting in surgery.

According to the American Academy of Orthopedic Surgeons, about 4 million people in the United States seek medical care each year for shoulder sprain, strain, dislocation, or other problems (http://www.nih.gov/niams/healthinfo). Each year shoulder problems account for 1.5 million visits to orthopedic surgeons, doctors who treat disorders of the bone, muscles, and related structures.

Shoulder injuries were reported in high incidence in a study of claims incidence of work-related disorders of upper extremities (Kalat et al., 1998). Again, the shoulder is second highest of these injuries. Work-related rotator cuff syndrome (inflammation, degeneration, and tear of the tendons surrounding the shoulder) has been reported as the most common of the shoulder injuries occurring. Interestingly, each of the shoulder conditions has also been associated with an acute traumatic onset (e.g., falls).

Glenohumeral Stability

The shoulder is a tremendously complex joint which requires integrated accessory motions from four joints (glenohumeral, scapulothoracic, acromioclavicular, and

sternoclavicular) and the spine which enables an individual to perform functional activities. The glenohumeral joint is an inherently unstable joint and exhibits the greatest amount of motion of any other joint in the human body. It is also the most commonly dislocated joint in the human body is the glenohumeral (Gray, 1974).

The glenohumeral joint has the ability to precisely stabilize the humeral head in the center of the glenoid on one hand and to allow a vast range of motion on the other. This balance of stability and mobility is achieved by a combination of mechanisms particular to this articulation. In contrast to the hip joint, the glenohumeral joint does not offer a deep stabilizing socket. A suction-like joint would limit motion by contact of the anatomic head of the humerus with its rim (Gray, 1974). Instead, the small arc of the glenoid captures relatively little of the humeral articular surface so that the neck-rim contact is avoided for a wide range of positions.

Bankart Procedure

A treatment for traumatic anterior shoulder instability is the Bankart procedure. This procedure can achieve a good outcome for contact athletes with traumatic anterior shoulder instability. Of 83 patients, 73 attained complete return to contact sports (Hayashida et al., 1999).

The main cause of traumatic anterior shoulder instability is a functional insufficiency of the inferior glenohumeral ligament. This can be caused by the detachment of the anteroinferior glenohumeral ligament from the glenoid rim, also known as the Bankart lesion. The Bankart procedure, which repairs the detachment and

aims to correct malfunction of the inferior glenohumeral ligament, is recognized as the best operative treatment for traumatic anterior shoulder instability.

In this case study, a Bankart lesion was detected in all the subjects at surgery (Hayashida et al., 1999). The outcome for 58 shoulders (68%) was graded excellent, 21 (25%) were graded as good, 5 (6%) were graded as fair, and 1 (1%) was graded as poor. The overall success rate of this procedure was 93% (79 of 85).

Capsular Shrinkage

This is a new and up to date procedure that does not yet have much documented literature. Orthopedic surgeons have recently adapted the holium: yttrium-aluminum-garnet (YAG) laser for the shrinkage of capsular tissues for the treatment of glenohumeral instability (Anderson et al., 1997). This particular study examined the effects of heating bovine calf knee capsule and subsequent shrinkage of the capsule.

The glenohumeral joint capsule, like ligaments and tendons, is composed of type I collagen. When type I collagen is heated above 60°C, collagen fibers undergo a phase transition from a highly organized semi-crystalline state to a melted gel (Anderson et al., 1997). As a gel, the collagen is shortened and exists as a collection of randomly oriented polypeptide chains. The theory is that the shrinkage of capsular tissues correlates with collagen fiber denaturation and the corresponding decrease in molecular length.

This study concluded that the shrinkage of bovine knee joint capsule is a thermally induced phenomenon caused by collagen denaturation and depends on both the magnitude and duration of the heating. The maximal shrinkage of approximately 50% of the original length was achieved for capsular tissue at the temperature of 60°C to 62°C.

Rotator Cuff

The rotator cuff prevents bone striking against bone in the shoulder. Specifically, three of the rotator cuff muscles (the tres minor, infraspinatus, and subscapularis) pull down on the humerus just enough to prevent the collision and to allow the humeral head to move freely. During movement these three muscles counterbalance the upward pull of the deltoids, preventing the head of the humerus from striking the roof, or the acromion, of the shoulder (Horrigan and Robinson, 1991).

Many studies have shown that the rotator cuff tendons have areas where there is a very poor blood supply (Andrews and Wilk., 1997). In the human body, the better the blood supply a tissue has the better and the faster that tissue can repair and maintain itself from day to daywear and tear. These areas of poor blood supply in the rotator cuff tendons vulnerable to degeneration with age.

The weakened rotator cuff tendons can be injured and torn by an excessive force placed on it. The tears usually involve the supraspinatus and can occur from falls or lifting heavy objects (Horrigan and Robinson, 1991). Complete tears and ruptures need to be surgically repaired. A common rotator cuff problem in older people is degeneration, which causes loss of use and chronic pain. Injuries to the rotator cuff can usually arise in athletics. Any athlete or person who is involved in weight training and/or throwing can develop bursitis, tendinitis of the rotator cuff. Finally, muscle imbalance is a problem for the rotator cuff. This is the result of stronger internal rotators overpowering the relatively weaker external rotators (Horrigan and Robinson, 1991).

Separation

A shoulder separation is actually a dislocation of the acromioclavicular (AC) joint. The part of the scapula that makes up the roof of the shoulder is called the acromion. The site where the acromion and the clavicle join is known as the AC joint (Gray, 1974). There are ligaments that hold these two bones together. One set of ligaments surround the joint and make up the joint capsule. Two other ligaments hold the clavicle down, and attach the clavicle to a bony knob on the scapula known as the coracoid process (Gray, 1974).

The AC joint can be injured in a number of ways. The simplest type of injury is a sprain of the ligaments around the joint. A more severe injury can result from when the ligaments around he joint are actually torn. If the ligaments around the joint are torn as well as the ligaments that attach the clavicle to the coracoid process, then the injury results in an obvious bump on the shoulder (Barber et al., 1999). The most common cause of an AC joint separation is a fall on the shoulder. The fall causes the scapula to be pushed down. Since the collarbone can not adjust with from that force due to its attachment to the rib cage, something has to give. The ligaments around the AC joint begin to tear, separating or dislocating the joint.

Treatment for a simple sprain and tear usually consists of a sling and pain medication. The treatment for an injury worse than above is controversial. Many studies show no difference in the outcomes for surgically treated separations versus doing nothing (Barber et al., 1999). A significant number of patients who undergo surgery will need another operation later as the injury causes the joint to degenerate and become more painful.

The surgery involves relocating the joint and repairing the torn ligaments. A screw or some other type of fixation may be used to hold the joint together while the ligaments heal. This surgery is done through a 4-5 inch incision over the AC joint (Barber F.A. et al., 1999). The need for a second surgery depends upon the rate that the injured joint degenerates, which varies from person to person. The patient may also develop AC joint arthritis.

Labral Tear

A part of the scapula called the glenoid makes up the socket of the shoulder. This socket is very shallow and flat. To make the socket more like a cup, there is a rim of soft tissue called the labrum. The labrum acts almost like a gasket, turning the flat surface of the glenoid into a deeper socket that molds to the head of the humerus for a better fit (Gray, 1974).

This tissue can be caught between the socket and humerus and be torn. This flap of tissue can move in and out of the joint, getting caught between the humeral head and glenoid socket, and causes a catching sensation pain (Treacy et al., 1999). The labrum is also the area for attachment of several of the tendons and ligaments of the shoulder. The ligaments that attach to the labrum help with maintaining the stability of the shoulder.

The diagnosis of a labral tear can be extremely difficult. The tear is sometimes visible on the MRI scan or in CAT scan with a special dye injected in the shoulder. These two tests are not real accurate in detecting this problem. A diagnosis may finally rely on looking into the shoulder with the arthroscope. This allows the labrum to be viewed directly and the tear discovered.

The labral tear has not been recognized for long enough to adequately evaluate the results of different treatments. The arthroscope can be used to treat the torn labrum in many cases. If the tear is small and is primarily getting caught as the shoulder is moved, then simply removing the loose part of the labrum may help. In the case of a larger tear, the shoulder may have problems with instability, meaning that the shoulder is too loose. The labrum can be attached to the bone of the shoulder socket, the glenoid, with staples (Treacy et al., 1999).

Purpose of this IQP

The purpose of this IQP was to study the satisfaction levels of different treatments for shoulder injuries. It was hypothesized that patients of shoulder injuries who had surgical and physical therapy treatments would have a better satisfaction level than those who just received either surgical treatment or physical therapy treatment. It was thought that the combination of the manipulative repair directly to the shoulder and the physical strengthening of the muscles would serve the patient better not only in pain factors, but also in functionality. In the survey given out to the patients of UMass, I hoped to prove my hypothesis to be true by statistical analysis. Studies have been preformed on satisfaction levels of different types of surgeries (cite) and also different types of physical therapy (cite), but there are no studies, to my knowledge, that investigate different treatment types.

Methods

This project dealt with the sociological study of medical surveys of the shoulder. The survey included the measurement of comfort levels of an injury through four time periods. Those four periods included; pre-surgery, post-surgery, pre-physical therapy, and post-physical therapy. Types of surgical procedures and types of physical therapy procedures were asked of the patient, along with the type of injury. Overall satisfaction levels were reported for all treatments preformed. A small amount of basic background information was asked, including sex, age, occupation, and activity levels. The survey that was handed out and can be found in Appendix A.

Fifty-four patients who had current or past shoulder injuries were given an anonymous survey. All were patients in the physical therapy department in the University of Massachusetts Medical Center. Patients were divided into three treatment groups: first was patients who had received some form of physical therapy only; second was patients who had a surgical procedure only performed on their shoulder; and third was patients who had received both a surgical procedure and physical therapy. A spreadsheet of the patients' responses can be found in Appendix B.

Current patients were asked by the physical therapist to participate in our project. Sixty surveys were given to current patients and 50 surveys were returned. Also, surveys were sent to past patients. Addresses and phone numbers were acquired from the physical therapist. Patients were called to ask if they would participate in the survey. Surveys were sent to those patients willing to participate along with a prepaid return envelope. The return rate of surveys sent out was 4 out of 15.

The data was examined in four different ways. The outcomes of satisfaction levels were explored first by using the Kruskal-Wallis Test to check for a significant difference between the three groups. The difference between pain levels before and after each individual type of treatment was investigated by means of a non-parametric paired test called the Wilcoxon Signed Rank Test. The outcomes of pain levels were then looked at with the Kruskal-Wallis Test to check for a significant difference between the three groups. Lastly, the correlation of satisfaction and final pain level was examined by means of the Spearman's Rho Test.

Results

Outcome of Satisfaction Levels

The Kruskal-Wallis test is a nonparametric test that compares three or more unpaired groups. The SPSS 3.0 software was used to analyze the data. This program gave me a P value equal to 0.001, which indicates that the sums of the ranks are very different. Since the P value is small, the notion that the differences are all coincidence can be rejected. A critical value was then calculated by the following formula:

$$Z\sqrt{\frac{N(N+1)}{12}\left(\frac{1}{N_u}+\frac{1}{N_v}\right)} \qquad \textbf{Equation 1}$$

In this formula, Z is equal to the statistical rejection, N is equal to the total sample size, N_u and N_v are equal to the sample size of the groups being compared. The critical value was compared against the absolute value of the difference in mean ranks for the two groups. Pairs were considered significantly different if the critical value was greater than the mean rank difference.

Table 1

	Mean Rank Difference	Critical Value	Significant at P<0.05
Surgery vs. Surg & PT	15.13	16.32	YES
Surgery vs. PT	2.67	14.99	NO
Surg & PT vs. PT	17.80	11.66	YES

It is clear that the trend for combined treatment is more satisfactory to the patient than just surgery or physical therapy (table 1). There is no detectable difference between surgery and physical therapy treatment alone.

Difference in Pain Before and After Treatment

The Wilcoxon signed rank test is a nonparametric test that notes the sign of the deviation of each sample and also takes into account the magnitude of that deviation. This test assumes that the paired differences being analyzed are independent. Since the Wilcoxon signed rank test is based only on the ranks of the paired differences, the test can be preformed when the only data available are those relative ranks for the paired differences.

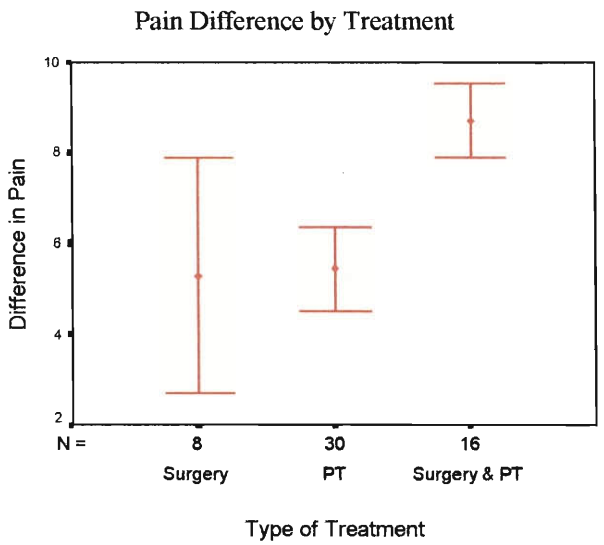

Figure 1. The difference in pain before treatment and after treatment. Data was analyzed using SPSS 9.0 software, where $P<0.001$. The mean confidence interval is indicated to be ± 95%. The sample size for each treatment type is labeled on the graph.

There is a significant reduction in pain in the combined surgical and physical therapy treatment (figure 1). By looking at the mean rank, it is unattainable to determine a difference in the correlation of pain and satisfaction for the independent groups' surgery and physical therapy.

Outcome of Pain Levels

The Kruskal-Wallis test was used to analyze the difference between the pain level before treatment and the pain level after treatment. The overall significance of the model was $P < 0.001$. The critical values for pair-wise comparison were found the same way as before, using formula 1.

Table 2

	Mean Rank	Critical Value	Significant at $P<0.05$
Surgery/Surg&PT	20.62	16.32	YES
Surgery/PT	1.26	14.99	NO
Surg&PT/PT	19.36	11.66	YES

The trend for combined treatment provides the patient with more relief from pain than surgery alone or physical therapy alone. There is no detectable difference between surgery and physical therapy treatment alone.

Correlation of Satisfaction and Final Pain Levels

Spearman's nonparametric rho test was used to analyze the rank correlation of satisfaction levels and final pain levels. The correlation factor indicated 90% of variation in data set is shared between satisfactory levels and final pain levels. This verifies that there is a direct correlation between lower final pain levels and higher satisfactory levels, and that there is a significant difference of $P < 0.001$ (figure 2).

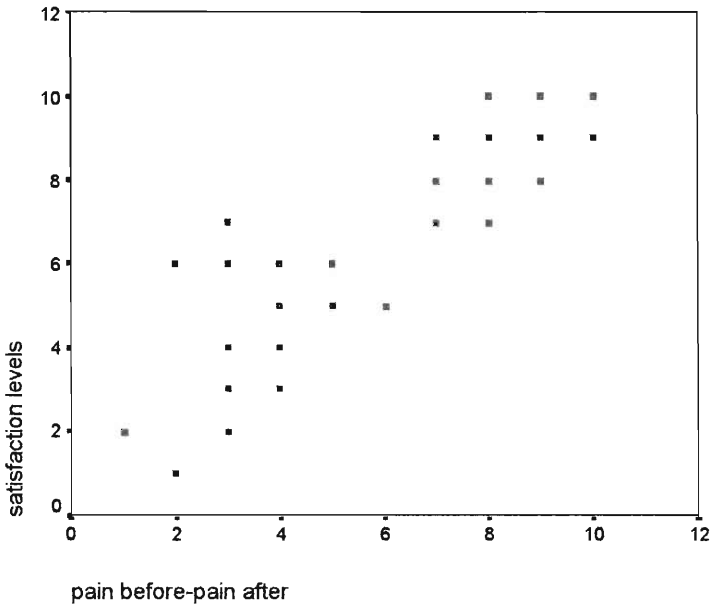

Figure 2. Direct correlation of satisfaction levels and final pain levels. SPSS 3.0 software was utilized to analyze and graph data.

Discussion

I can conclude from my data that a combined treatment of surgery and physical therapy provides patients with shoulder injuries a greater satisfaction level and lower pain level than patients that received only either of the treatments. It can also be concluded that there is no or little difference in satisfaction levels and pain levels between just surgical treatment and just physical therapy treatment. These results are useful for patients with shoulder injuries who are opting to have surgery or not. The project provides for patients' significant results indicating that surgery followed by a physical therapy regiment is the best treatment for them.

In future research it would be possible to look at specific shoulder injuries in conjunction with the different surgical treatments and different physical therapy programs used for treatment to distinguish exactly which procedures demonstrate the best overall outcome of satisfaction levels and pain levels. This would provide more specific information for patients in there own unique situation of injury.

Some pages are incorrectly numbered

IQP/MQP SCANNING PROJECT

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APPENDICES

Survey of Shoulder Injuries
Treatment and Satisfaction

Two students bring this survey to you from Worcester Polytechnic Institute. We are conducting a survey concerning shoulder injuries as well as the satisfaction level after surgery and rehabilitation. This survey is completely anonymous. We appreciate you taking the time to fill out the survey.

Please fill in where appropriate and please add comments when necessary:

1) Male ( ) Female ( )

2) Age____

3) Type of Shoulder injury:
Dislocation( ) Ligament Tear( ) Muscle Tear( ) Separation( ) Sprain( ) Strain( )
Other_____

4) Occupation-_____

5) Type of Sports/Physical Activity that you participate(d) in- _____

---

6) Activity Level Before Injury- *(1)least active-(5)moderately active-(10)most active*
1...2...3...4...5...6...7...8...9...10

7) Have you received surgery for your injury: yes( ) no( )
If no, please skip to number 16.

8) Pain Level Before Surgery- *(1) least painful- (5) moderately painful- (10) most painful*
1...2...3...4...5...6...7...8...9...10

9) Type of surgery _____

10) Date of surgery (month/year) _____

11) Length of Recovery (no activity allowed):
1-3 days( ) 3-7 days( ) 1-2 weeks( ) 2-3 weeks( )

12) Activity Level After Surgery- *(1) least active- (5) moderately active- (10) most active*
1...2...3...4...5...6...7...8...9...10

13) Pain Level After Surgery- *(1) least painful- (5) moderately painful- (10) most painful*
1...2...3...4...5...6...7...8...9...10

14) Satisfaction with surgery- *(1) least satisfied- (10) most satisfied*
1...2...3...4...5...6...7...8...9...10

15) Was rehabilitation recommended: yes( ) no( )
If no, please skip to number 24

16) Pain Level Before Rehab.- *(1)least painful-(5)moderately painful-(10)most painful*
1...2...3...4...5...6...7...8...9...10

17) How many days a week do you attended rehabilitation:
1...2...3...4...5...6...7

18) Treatments performed as a part of rehabilitation: (all that apply)
Electric Stimulation( ) Ultrasound( ) Stretching( ) Weight Lifting( )
Other-_____

19) Length of Rehabilitation:
1-3 weeks( ) 1-3 months( ) 4-6 months( ) 6 months-1 year( )

20) Activity Level After Rehab.- *(1)least active-(5)moderately active-(10)most active*
1...2...3...4...5...6...7...8...9...10

21) Pain Level After Rehab- *(1)least painful-(5)moderately painful-(10)most painful*
1...2...3...4...5...6...7...8...9...10

22) Satisfaction with Rehab.- *(1)least satisfied-(5)moderately satisfied-(10)most satisfied*
1...2...3...4...5...6...7...8...9...10

23) When was your last treatment:
1-3 weeks( ) 1-3 months( ) 4-6 months( ) 6 months-1 year( )

24) Current Activity Level- *(1)least active-(5)moderately active-(10)most active*
1...2...3...4...5...6...7...8...9...10

25) Current Pain Level- *(1)least painful-(5)moderately painful-(10)most painful*
1...2...3...4...5...6...7...8...9...10

26) Overall Satisfaction of Treatments Received - *(1)least satisfied-(10)most satisfied*
1...2...3...4...5...6...7...8...9...10

APPENDIX B:

Survey Responses for Physical Therapy

sex	M	M	M	F	M	F	F	M
age	20	19	21	17	45	56	69	17
occupation	student	student	student	student	lawyer	waitress	retired	student
injury	stain	mus tear	separation	dislocated	sprain	bursitis	frozen	separation
pain before	8	9	10	10	8	8	9	10
type of rehab	ultra, str	stim,str,w	stim,w,str	stim,w,s	ul,st,str,w	stim,w	str,w,ul,st	stim,str,w
satisfaction	7	10	8	5	6	2	6	7
pain after	1	0	1	5	5	7	5	2

sex	M	M	M	M	M	F	F	M
age	20	15	19	20	16	14	18	22
occupation	student	student	student	student	student	student	student	finance
injury	strain	dislocated	sprain	strain	separation	strain	tendon	separation
pain before	10	10	8	7	10	8	9	10
type of rehab	str,w	stim,w,str	stim,str,w	st,str,w,ul	stim,w	stim,str,w	mas,str,w	str,w,stim
satisfaction	3	10	10	6	5	3	2	4
pain after	6	0	0	5	5	4	6	7

sex	M	F	F	M	F	M	F	M
age	32	28	34	17	22	47	14	46
occupation	engineer	waitress	housewife	student	student	constructn	student	bus driver
injury	sprain	separation	dislocated	sprain	sublux	dislocated	sprain	strain
pain before	9	10	10	8	10	10	10	10
type of rehab	stim,str,w	stim,str,w	str,w	ul,st,str,w	str,w	stim,str,w	st,str,w,ul	stim,ul,w
satisfaction	6	7	3	2	4	8	6	5
pain after	5	2	7	7	6	1	5	5

sex	M	F	M	M	M	F
age	64	59	15	29	53	34
occupation	retired	child care	student	constructn	mail carrie	salesrep
injury	frozen	bursitis	strain	dislocated	frozen	tendonitous
pain before	9	10	8	10	10	10
type of rehab	str,w	str,w	stim,str,w	str,w	ul,st,str,w	ul,st,str,w
satisfaction	6	5	9	8	6	8
pain after	5	6	1	1	5	3

APPENDIX C:

Surgery

sex	F	M	M	F	M	M	F	M
age	20	16	22	34	18	32	34	18
occupatior	student	student	student	dietician	student	constructn	child care	student
injury	dislocated	dislocated	dislocated	dislocated	separation	dislocated	rotator	labral tear
pain befor	10	9	10	10	10	10	10	10
surgery ty	bankart	bankart	N/A	bankart	reconstr	bankart	arthro	arthro
satisfactio	5	9	7	2	1	8	9	8
pain after	6	1	7	9	8	3	1	2

APPENDIX D:

Survey Responses for Surgery and Physical Therapy

sex	M	M	F	M	M	M	M	F
age	20	19	21	20	19	28	23	36
occupation	student	student	student	student	student	sales	UPS	nurse
injury	dislocated	rotator	labral tear	dislocated	lig tear	sublux	separation	labral tear
pain before	10	10	9	10	9	10	10	10
surgery type	N/A	reconstr	arthro	arthro	N/A	cuff repair	arthro	arthro
type of rehab	str,w	stim,str,w,	stim,w,str	stim,w,str	stim,str	stim,str,w	stim,str,w	stim,str,w
satisfaction	10	10	8	10	10	9	6	8
pain after	0	1	1	0	0	1	5	1

sex	M	M	M	F	M	F	F	M
age	38	52	29	24	33	25	16	40
occupation	delivery	bartender	manager	student	policeman	dancer	student	finance
injury	rotator	rotator	separation	lig tear	dislocated	separation	labral tear	dislocated
pain before	10	10	10	10	10	10	9	10
surgery type	arthro	arthro	reconstr	arthro	recontr	N/A	arthro	bankart
type of rehab	stim,str,w	stim,str,w	stim,str,w	ul,st,str,w	stim,str,w	str,w	stim,w	stim,str,w
satisfaction	9	5	7	10	9	10	8	10
pain after	1	4	3	0	0	0	1	0