Cost Comparison of Rotator Cuff Repair between Double and Triple Loaded Anchors

Abstract

We performed a retrospective case series that examined efficiencies that accrue by virtue of triple loading rotator cuff anchors with suture. Patients were divided into two groups: 34 patients had rotator cuff tears arthroscopically repaired using double-loaded anchors and 34 patients had rotator cuff tears repaired using triple-loaded anchors using double row repair techniques. Based on number of anchors used per repair and the number of suture passes through the tendon, triple-loaded anchors were 30% more efficient than double loaded while using 15% fewer anchors per unit area. Stable technology implants were used and demonstrated to offer substantial cost savings relative to branded commercial anchors. Level of evidence IV.

Keywords: Rotator Cuff; Anchors; Sutures; Triple loaded; Stable technology; Generic; surgical cost

Case Report

Volume 4 Issue 6 - 2016

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Received: April 27, 2016 | **Published:** May 09, 2016

Abbreviations: RC: Rotator Cuff; RCR: Rotator Cuff Repair; A-P: Anterior-Posterior; M-L: Medial-Lateral; StDev: Standard Deviation; SR: Single Row; DR: Double Row; CPT: Current Procedural Terminology; ASC: Ambulatory Surgery Center; CMS: Center Medicare Services; CA: Commercial Anchor; RōG: Rhode Orthopedic Group; UHMWPE: Ultrahigh Molecular Weight Polyethelene

Introduction

Musculoskeletal disorders constitute a major healthcare expense that is increasing as the U.S. population ages. There were 272,148 rotator cuff (RC) repairs performed in 2006 based on the NSAS database [1]. There has been a movement towards repairing rotator cuff tears arthroscopically with a 600% increase in arthroscopic repair from 1996 until 2006 [1]. Arthroscopic rotator cuff repair utilize anchors to facilitate tendon to bone repair. Numerous studies have been conducted to determine the optimal method of restoring the tendon footprint using various single row (SR) and double row (DR) anchor-suture repairs. Controversy remains as to which repair technique provides the best clinical outcome as determined by measures of patient pain and shoulder function. Multiple reviews of SR: DR repairs have concluded that there is no significant difference between SR and DR repairs based on patient outcomes [2-8]. In contrast, recent studies conclude double row RC repairs result in improved footplate restoration with greater coverage, fewer RC retears thereby reducing revision surgeries, and an increased ultimate load to failure. DR repairs are especially recommended for massive tears [9-16]. There has recently been a movement towards maximizing the number of suture passes through the tendon and minimizing anchor usage to preserve the greater tuberosity footprint real estate.

The use of anchors in rotator cuff repair adds significant cost to a procedure typically performed in an outpatient surgical setting. A cost analysis of over 1,100 US hospitals and surgery centers (Intralign Health, Scottsdale AZ) found that premium pricing for shoulder anchors is as high as $1,900 per anchor. A four anchor double row rotator cuff repair can cost $7,600 for the implants alone. Medicare ASC reimbursement for a rotator cuff repair (CPT 29827) is $2,381 in 2015 (CMS-1613-CN (2-24-15) ASC Addendum AA, BB, DD1, DD2, and EE, effective January 1, 2015). This fee does not allow for independent billing of orthopedic implants. A recent article found that surgical disposable costs average $936.35 for an outpatient rotator cuff repair [17]. A fair market analysis demonstrated the average operating expense per surgical case in an orthopedics driven ambulatory surgery center was $614.13 (Employee salary and wages per case- $489.05, taxes and benefits per case- $55.96, insurance per case- $13.16, general and administrative per case- $55.96) [18]. Excluding real estate costs, the potential cost to perform a rotator cuff repair at an outpatient surgery center may be as high as $9,150.48 resulting in a loss of $6,769.48 per case on a Medicare patient.

Triple-loaded anchors have recently been developed to improve anchor efficiency, thereby gaining an increase in suture tendon passes and a decrease in the number of anchors inserted into the greater tuberosity footprint. An added benefit is the potential costs savings achieved by this efficiency. This study compares the use of double- and triple-loaded suture anchors for rotator cuff repair (RCR). A reduction in the number of anchors per repair results in saving humeral head real estate. An equally important consideration examines potential cost savings through the use of stable implant technology (generic) for RC anchors.

The null hypothesis is that there will be no difference in efficiencies between double-loaded and triple-loaded anchors used in RCRs.

Methods

This study is a retrospective case series of two groups of 34 consecutive patients who underwent arthroscopic RCR. Repair technique was dictated by tear size and pattern. Double-loaded anchors were used in the first 34 patients and triple-loaded anchors were used in the second group of 34 patients. In all cases the anchors were stable implant technology molded 5.5

mm polyetheretherketone (PEEK) anchors loaded with ultrahigh molecular weight polyethelene (UHMWPE) sutures (RōG®). A single surgeon performed all repairs on an outpatient basis.

Outcome metrics were tear size measure in the medial-lateral (M-L) and anterior-posterior (A-P) axis, the number of anchors used and the number of suture passes through the tendon. Tear sizes ranged from 1 to 5 cm with the latter classified as a massive tear.

Patients undergoing repairs with double loaded anchors averaged 53.5 years (StDev =9.16), 15 F and 19 M. Patients undergoing repairs with triple loaded anchors averaged 50.1years (StDev =9.13), 13 F and 21 M.

An argument has been made for increasing the number of suture passes through the tendon to improve footprint restoration and increase repair strength as measured by ultimate failure load. An increase in the number of suture passes through the tendon may provide an improvement in tendon stabilization [19]. At the same time, there is often limited humeral area for anchor placement. Therefore, there is a compromise between the number of sutures available for repair and the number of anchors used. Furthermore, any reduction in the number of anchors used in the repair results in costs savings.

Results

The results of using double-loaded anchors to repair 34 consecutive RC tears are summarized in Table 1A. Average tear size in the A-P and M-L axis was 1.75 cm and 1.28 cm respectively with a 1 to 4 cm range. The density of anchor placement was 1.07 /cm^2. The number of suture passes through the tendon per double-loaded anchor was 2.95. In comparison, using triple-loaded anchors, anchor density was reduced to 0.91 / cm^2 and the number of suture passes per anchor were increased to 3.83.

The use of triple suture loaded anchors results in a 30% increase in suture passes through the tendon thereby improving suture efficiency (Table 1B). Suture efficiency increase = 3.83 passes per triple-load anchor - 2.95 passes per double-loaded anchor = 0.88, % increase = 0.88/2.95* 100 = 30%. The use of triple-suture-loaded anchors resulted in a 15% decrease in the number of anchors per cm^2.

Table 1A: Statistics for 34 rotator cuff repairs with anchors double loaded with sutures.

Double Loaded	Total Anchors	Suture Passes	A-P Tear (Cm)	M-L Tear (Cm)	Area Tear (Cm^2)	Anchors Per Cm^2	Passes Per Anchor
Count	72	204					
Average	2.12	6	1.75	1.28	2.52	1.07	2.95
St Dev	0.84	2.34	0.65	0.57	2.64	0.42	0.77
Minimum	1	3	1	1	1	0.125	1.5
Maximum	3	8	4	4	16	2	4

A-P: Anterior to posterior tear length; M-L: Medial to lateral tear length; Area: M-L times A-P

Table 1B: Statistics for 34 rotator cuff repairs with anchors triple loaded with sutures.

Triple loaded	Total anchors	Suture passes	A-P tear (cm)	M-L tear (cm)	Area tear (cm^2)	Anchors per cm^2	Passes per anchor
Count	59	208					
Average	1.74	6.12	1.87	1.37	3.1	0.91	3.83
St Dev	0.62	1.51	0.77	0.86	3.92	0.43	1.26
Minimum	1	3	1	1	1	0.08	2.67
Maximum	3	10	5	4	20	1.5	6

Discussion

The goal of this study was to demonstrate that the use of triple-suture loaded RC anchors would result in the use of fewer anchors per RCR and an increase in the number of suture passes through the tendon per anchor used in a repair. Both goals were achieved. 18% fewer anchors were required on average when triple-loaded anchors were used instead of double-loaded anchors resulting in a 15% reduction in the number of anchors per unit area along with a 30% increase in the number of passes per anchor. Any decrease in the use of limited tuberosity real estate can be important in RCRs.

Stable implant RC anchors were used for all repairs to assess potential cost savings. Triple loaded RC anchors were $90 molded-PEEK triple-load anchors while double loaded anchors cost $70. Both stable technology anchors were extensively tested for eyelet reliability and acceptable ultimate failure load [20]. Using triple loaded anchors instead of double loaded anchors resulted in a cost savings of 5.2%. Evaluation of branded anchor costs to a stable technology option for a 4 anchor repair demonstrated a potential net savings of 96% (72% to 96%). While a small savings can be achieved by conversion to a triple loaded anchor, the majority of savings realized comes from conversion to a stable technology option.

Table 2 Anchor cost comparison for 100 rotator cuff repairs with 1.74 anchors per repair based on anchor use in the 68 RCRs in this study. Results are based on a survey of 90th percentile costs for 86 commercial rotator cuff anchors. Titanium anchors were not included in the analysis due to their lack of transparency in MRIs. Reference costs were obtained from an analysis performed by Intralign Health, Scottsdale, AZ with data from over 1,100 US hospitals. Only 4.5 to 5.5 mm PEEK RC anchors were included in this analysis. Stable implant triple-load anchor cost = $90.

Table 2: Anchor cost comparison for 100 rotator cuff repairs with 1.74 anchors based on anchor use in the 68 RCRs.

Anchor Type	Minimum CA Cost = $245	Average CA Cost = $571	Maximum CA Cost = $1900
Commercial Anchor (Ca)	$55,005	$116,024	$386,069
Stable Implants-Triple Loaded	$15,660	$15,660	$15,660
% Savings Using Stable Implants	72%	87%	96%

Limitations

Patients were serially selected which could involve a selection bias. All measurements were made by the surgeon. No blinding of outcome.

Conclusion

The null hypothesis that there is no difference in efficiencies between double-loaded and triple-loaded anchors used in RCRs is rejected. Triple loaded anchors achieved a 30% increase in the number of suture passes per anchor while achieving a 15% reduction in the number of anchors per unit area. While a 5.2% savings may be achieved by converting to triple loaded anchors, the vast majority of savings is achieved by using stable technology. By using stable technology anchors for the 272,148 rotator cuff repairs performed in 2006, a potential $1.99 billion savings could have been achieved.

Conflict of Interest

The authors report the following potential conflict of interest or source of funding: Dr. Rhode is owner of RōG, the supplier of the anchors.

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Citation: Rhode BA, Rhode WS (2016) Cost Comparison of Rotator Cuff Repair between Double and Triple Loaded Anchors. MOJ Orthop Rheumatol 4(6): 00161. DOI: 10.15406/mojor.2016.04.00161

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Citation: Rhode BA, Rhode WS (2016) Cost Comparison of Rotator Cuff Repair between Double and Triple Loaded Anchors. MOJ Orthop Rheumatol 4(6): 00161. DOI: 10.15406/mojor.2016.04.00161