

# Anchor utilization trends with the implementation of a triple-loaded rotator cuff anchor

## Abstract

As rotator cuff procedures have moved from open to arthroscopic, more attention has been paid to the use of anchors due to cost concerns and utilization of the real estate of the greater tuberosity footprint. A retrospective case series was performed to analyze anchor utilization during arthroscopic rotator cuff repair after triple-loaded anchors were available in comparison to the use of double-loaded anchors. One consecutive group of 69 patients had RCR with double-loaded anchors and a second consecutive group of 77 patients had RCR after triple-loaded anchors were available. For RC tear size greater than 2.5 cm<sup>2</sup> the use of triple-loaded anchors resulted in a decreased use of nearly 1 anchor per repair. Level of evidence IV.

**Keywords:** rotator cuff, arthroscopy, triple-loaded

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**Abbreviations:** RC, rotator cuff; RCR, rotator cuff repair; ARCR, arthroscopic rotator cuff repairs; A-P, anterior-posterior; M-L, medial-lateral; StDev, standard deviation; DL, double-load; TL, triple-load; UHMWPE, ultrahigh molecular weight polyethylene; RōG, Rhode orthopedic group; PEEK, polyetheretherketone

## Introduction

Arthroscopic rotator cuff repair (ARCR) surgery has grown in popularity as the subjective and functional outcome has improved over time. National trends in rotator cuff repair have demonstrated a 600% increase in arthroscopic procedures from 1996-2006.<sup>1</sup> There are multiple repair techniques, each with their own purported benefits. The most commonly evaluated repair techniques are the single row and double row repair. Whether single-row (SR) or double-row (DR) result in a clinically significant difference has not been fully resolved.<sup>2-4</sup> Advancements in anchor technology have focused on material usage or fixation methods. The development of a triple loaded anchor (3 suture limbs) has the potential advantage of decreasing anchor usage. This has the advantage of saving greater tuberosity real estate and decreasing repair costs. The average selling price (ASP) for a shoulder anchor was \$389 in 2017 Q3 (Orthopedic Network News, Vol 29(1) 2018).

A number of studies conducted using triple-loaded anchors concluded that SR repair was as good or even superior to DR repair.<sup>5-7</sup> When double-row suture-bridge repair was compared to single-row repair using triple loaded anchors for 1-3cm rotator cuff tears (RCTs), there was similar improvement in pain, function, and healing.<sup>8-10</sup> A recent report in 2016 of anchor usage for RCRs at the Cleveland Clinic performed by 13 surgeons in 925 cases<sup>11</sup> provides a comparison their results to those of the present study.

It is our belief that the use of triple-loaded anchors improves footprint restoration by an increase of the number of suture passes through the ruptured tendon which has been shown to increase ultimate failure load. The number of anchors that can be safely implanted is constrained by the limited humeral head area. Triple-loaded anchors allow more passes through the tendon with a reduction in the number of anchors used in a repair.

The purpose of this study of the utilization rate of triple-load versus double-load anchors was to evaluate rotator cuff anchor utilization before and after the triple loaded anchor became part of the surgeon's implant choice.

## Methods

This is a retrospective Level 3 Case series of two groups of patients that underwent arthroscopic rotator cuff repairs (ARCRs). 69 patients (48 male/21 female) average age was 51 years (StDev=8.2, range 31-78years) underwent ARCR with double-loaded anchors in the 2014-15 period. The surgeon also had the availability of a knotless anchor if the repair construct dictated its use. The age of the second group of 77 patients (50 males/27 females) averaged 52 years (StDev=8.96, range=22-73years) underwent ARCR when generic triple-loaded anchors become available in the 2016-17 period. After the triple loaded anchor was made available, it was left to the surgeon's discretion whether to utilize a double or triple loaded anchor. The availability of a knotless anchor continued to be a choice. In all cases the anchors were molded 5.5mm polyetheretherketone (PEEK) anchors loaded with ultrahigh molecular weight polyethylene (UHMWPE) sutures (RōG), a stable implant technology. A single surgeon performed all repairs on an outpatient basis.

Measures of patient's physical progress included: UCLA score, ultrasound assessment and strength recorded at 1, 3, and 6 months intervals. The RC tear pattern was recorded as the lengths in the anterior-posterior (AP) and medial-lateral (ML) dimensions in centimeters (cm). RC tear severity was encompassed in a single metric, area=AP\*ML in cm<sup>2</sup>. The inclusion of ML in the metric provides a measure of the number of tendons involved in the tear, hence, tear severity.

## Results

Two patient populations with similar age distributions that had arthroscopic rotator cuff repair by a single surgeon provide the basis for DL versus TL comparison. Average anchor usage as a function of RC tear size when DL and TL anchors are used is listed in Table 1. There were 48(<3cm<sup>2</sup>) and 21(≥3cm<sup>2</sup>) RCRs using DL anchors and

57 (<3cm<sup>2</sup>) and 20 (≥3cm<sup>2</sup>) using primarily TL anchors. RCTs ≥3cm<sup>2</sup> are considered large/massive tears. Average anchor use per repair when tear size is <3cm<sup>2</sup> is 2.02(DL) and 1.26(TL). Average anchor

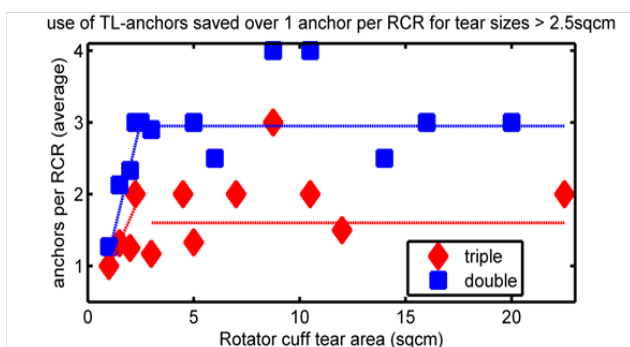
use per repair when tear size is ≥3cm<sup>2</sup> is 2.95(DL) and 1.6(TL). Use of triple-loaded anchors resulted in saving at least one anchor per RCR regardless of RCT size.

**Table 1** Double-loaded anchor and triple-loaded anchor usage as a function of rotator cuff tear area. After triple-loaded anchors were available there were 22 repairs that also included a double loaded anchor. Knotless anchors were used in 41 RCRs before triple-loaded anchors were available and in 14 RCRs afterwards. Double and triple load anchor usage as a function of rotator cuff tear (RCT) area in cm<sup>2</sup>

RCT(cm <sup>2</sup> )	Double-load anchor average (count)	Triple-load anchor average (count)
1	1.18(11)	1.00(9)
1.5	2.13(24)	1.32(31)
2	2.33(9)	1.25(16)
2.25	3.00(3)	2.00(1)
2.5	3.00(1)	
3	2.89(10)	1.17(6)
4.5		2.00(1)
5	3.00(3)	1.50(4)
6	2.5(2)	
7		2.00(1)
8.75	4(1)	3.00(1)
10.75	4(1)	2.00(2)
12		1.50(4)
14	2.50(2)	
16	3.00(1)	
20	3.00(1)	
22.5		2.00(1)

The data in Table 1 are illustrated in Figure 1 as a function of tear size for double-loaded and triple-loaded anchor RCRs. Anchor usage increases from 1 to 3 anchors as tear size increases from 1 to 3cm<sup>2</sup> when DL-anchors are used. Anchor usage per RCR is nearly constant for tear sizes ≥3cm<sup>2</sup>: RCR DL/TL anchor average use was 2.95(blue line)/1.6(red line). 70% of double-load anchor repairs were for RCTs < 3cm<sup>2</sup> and 74% of triple-load anchor repairs were for RCTs <3cm<sup>2</sup>.

anchors while RCTs ≥3cm<sup>2</sup> repaired with double-loaded anchors required more than one additional anchor (2.95) than when triple-loaded anchors are used (1.6 anchors). Second, when all RCTs are considered (column 4), the use of triple-loaded anchors achieved greater efficiency, approximately one anchor less than when double-loaded anchors are used (1.35 triple-loaded anchors versus 2.3 double-loaded anchors). The reduction in the number of anchors use results in a cost savings and less compromise to the greater tuberosity footprint.



**Figure 1** Average anchor usage as a function of rotator cuff tear area for ARCRs before and after triple-loaded anchors were used. Tear size is given in AP<sup>2</sup>ML=area (cm<sup>2</sup>). RCT size in area captures tear severity better than AP length alone. Horizontal lines are averages for tear areas ≥3.0 cm<sup>2</sup>.

Two important points of RCR using either double or triple loaded anchors are illustrated in Table 2. First, smaller RCTs require fewer

**Table 2** DL:TL RCR anchor utilization

	RCTs <3 sq cm	RCTs ≥3sq cm	RCTs all
patients	57	20	77
Triple-loaded anchor average	1.26	1.6	1.35
SD	0.45	0.6	0.53
patients	48	21	69
Double-loaded anchor average	2.02	2.95	2.3
SD	0.82	0.63	0.85

Comparing UCLA scores and Strength at 6 months post repair time demonstrated no difference in outcomes as a function of the use of either double-load or triple-loaded anchors (Table 3). T-test of the

gender differences in the Summary Table resulted in insignificant two-tailed P value.

**Table 3** Average UCLA scores for four repair types. Repeat repairs for each type are given in Column 4. UCLA scores are nearly identical for DL and TL repairs. TL\_Lateral combined one TL anchor and one anchor for a lateral repair. DL\_TL employed one of each anchor

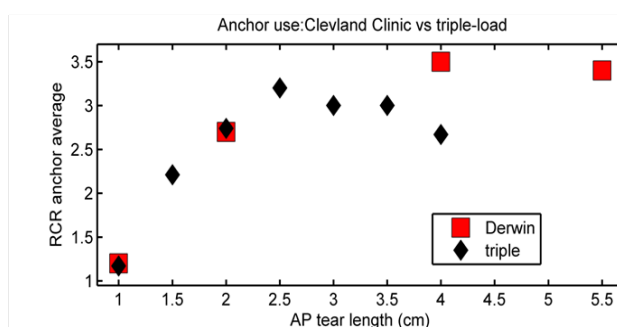
Repair	Ave_UCLA	Count	RCR repair
DL	23.9	22	0
TL	24	35	2
TL_Lateral	22.1	14	2
DL_TL	17.7	6	1

## Discussion

One of the few studies of the direct clinical costs of outpatient ARCR surgery an outpatient academic surgical center concluded that cost reduction should focus on reducing the number of anchors used along with anchor cost.<sup>12</sup> It was pointed out that direct clinical costs are difficult to measure and substituting billing or charges for the cost are fraught with inherent inaccuracies. Direct costs appeared not to be related to RCT size, severity, or operative technique (e.g., single vs double row). Several factors influence total cost including BMI, ASA classification, and muscle quality along with facility utilization, pharmacy and supply costs. However, whereas many factors that affect parts of the total cost are confounders and are insignificant in the total cost. Only total number of anchors and a subscapularis repair affect total cost.

Triple-loaded anchors have been employed in an attempt to reduce the number of anchors used in RCR.<sup>2,13</sup> In a bovine shoulder repair using TL anchors, a single-row construct was more resistant to stretching than a double-row repair.<sup>6</sup> Another study performed on 47 patients found that DR and SR-TL repairs resulted in similar improvements in pain and function with equivalent healing rates for ARCR of 1-3cm full-thickness tears.<sup>8</sup> SR repair can result in reduced operative time, complexity, and cost relative to DR repairs. There is an ongoing discussion as to whether DR has an improved proven clinical difference over the use of SR. However, DR repairs have been shown to result in better outcomes for larger RCTs as determined by structural healing.<sup>2,9,13-18</sup> Despite multiple studies supporting the use of DR for large tears it has been suggested that cost-effectiveness research is needed to determine whether the increased implant cost and operative time for DR repairs are worth based on the outcome differences.

The present anchor usage rate is compared to anchor usage for 925 RCRs performed at the Cleveland Clinic<sup>11</sup> performed by 13 surgeons in Figure 2. Their repairs were reported for four AP tear lengths: small = <1cm (N=122), medium = 1-3cm (N=418), large=3-5 cm (N=290) and massive= >5cm (N=95). 95% of repairs were arthroscopic using single/double row repairs. Suture anchor usage ranged from 1 to 7, with a mean of 2.8±1.32 per case. Average anchor usage for AP length is <3cm was 2.36 (SD=.99) and 3.48 (SD=1.22) for RCTs >3cm. 42% of tears were >3cm. These results are compared to TL-anchor average use in this study in Figure 2. When AP tear length is <3cm there appears to be no difference in anchor usage. When AP length is ≥3cm there is a savings in anchor use per case of approximately one anchor per case.



**Figure 2** Average anchor usage as a function of AP tear length reported by Derwin et al.<sup>11</sup> compared to the TL-anchor use reported here.

## Conclusion

The use of triple-loaded anchors can result in significant savings for repair of large RC tears defined as either AP length > 3 cm or tear area ≥3cm<sup>2</sup>. The use of AP\*LM as a measure of tear size is more descriptive than AP length as it encompasses the number of tendons involved in the tear. Cost savings result from the elimination of one anchor per case for large tears.

## Acknowledgments

None.

## Conflicts of interest

The authors declare there is no conflict of interest.

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