Comparison of Double Row Suture Anchor Technique Using Incline Mattress® Stitch with Other Suture Configurations in Rotator Cuff Repair

Andrew Bonett, M.S.M.S., University of Central Florida College of Medicine, Orlando, FL
Brad Homan, D.O., Chief of Surgery, Medical Director of Sports Medicine, Florida Hospital Celebration Health, Celebration, FL

UNIVERSITY OF CENTRAL FLORIDA
College *of* Medicine

INTRODUCTION

Different techniques for arthroscopic repair of rotator cuff injuries have been evolving rapidly in recent years. Consequently, research that includes long-term follow-ups and evaluation of post-operative outcomes is lacking. Since it is not possible to conduct a retrospective clinical study given the modernity of these techniques, most current research is focused on biomechanical data collection from open, ex vivo repairs of porcine or ovine models. Measured variables of interest in these studies often include area of footprint restoration, contact pressure distribution at the bone-tendon interface, tensile strength, and force/mode to failure, as these are the factors that most influence healing. It is thought that one of the most important factors in determining healing potential and repair strength is the initial restoration of the footprint area.

Since the development of double-row suture anchor techniques, studies have consistently shown that they restore the footprint area significantly more than conventional techniques. However, it is not known exactly which suture configuration best complements the DRSA technique, as repair failure often occurs at the suture-tendon interface.

AIM/HYPOTHESIS

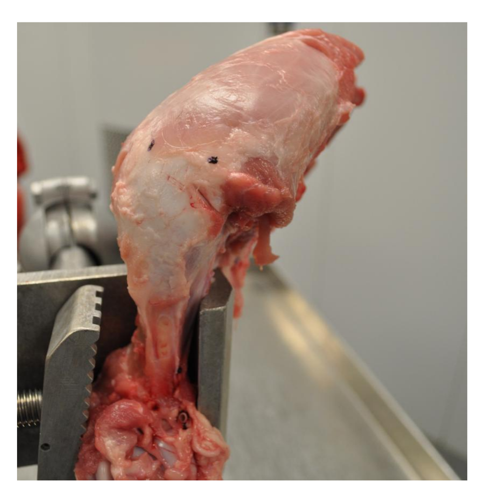
The purpose of this study was to evaluate some of the most popular techniques in practice today, paying special attention to the DRSA using an Incline Mattress® stitch (DRSA-im). The Incline Mattress® stitch was chosen because it is a novel suture configuration that was designed to pass through the tendon at an oblique angle. This not only allows for increased holding strength at the suture-tendon interface, but also a downward force as the sutures are tightened to provide more contact area and pressure at the bone-tendon interface. We decided to compare this configuration to three others: single row suture anchors using Incline Mattress® stitch (SRSA-im), DRSA with a Speed-Bridge configuration (DRSA-sb), and DRSA with a modified Mason-Allen stitch (DRSA-mMA).

This study aimed to provide biomechanical data to suggest that DRSA-im optimizes repair strength and durability. Our hypothesis was that the DRSA-im would perform comparably, if not superiorly, to the SRSA-im, DRSA-sb, and DRSA-mMA techniques when looking at mean footprint area restoration and mean contact pressure at the bone-tendon interface.

METHOD

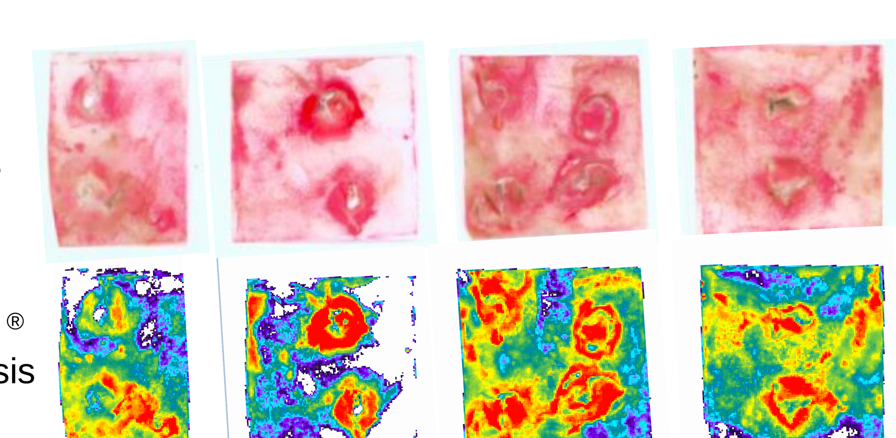
To obtain biomechanical data for this study, we used a porcine model and pressure-sensitive film (Prescale film, Super Low Pressure type, Fuji Photo Film Co Ltd, Tokyo, Japan).

- Four fresh-refrigerated and two fresh-frozen whole pigs
- 12 shoulders, four repair techniques, 3 trials per group
- Shoulders were dissected out and held by vise
- For each of the twelve trials:
  - Full-thickness, 2cm x 2cm supraspinatus tear was created using scalpel
  - Holes were bored in footprint for repair
  - Pressure-sensitive film was cut and approximated over anatomic footprint
  - Repair technique was completed with film between tendon and bone
  - Sutures were then released and the film carefully removed and sent for analysis
  - Each film was processed by Sensor Products, Inc. using Topaq® analysis, which provided the biomechanical data and images seen below



Dissected porcine shoulder held in place by vise just prior to creating full thickness tear. Marker spots denote borders of supraspinatus tendon. An anteroposterior incision was made between the markers followed by two parallel incisions going 2 cm medially.

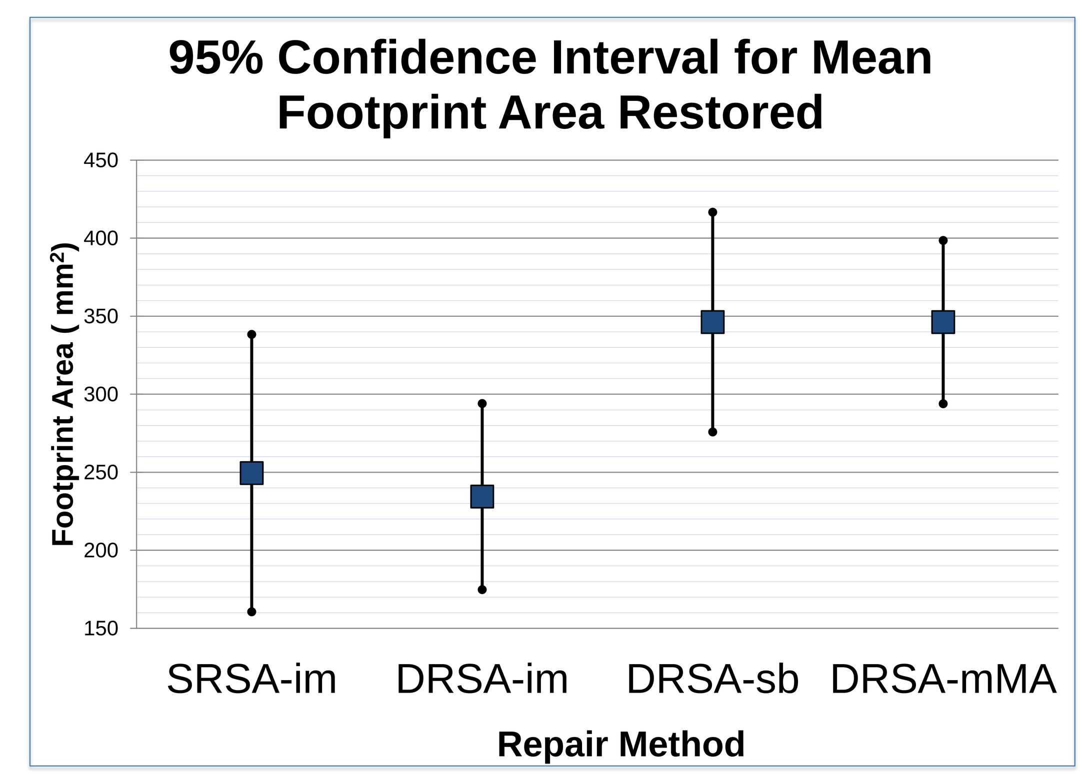
Close-up view of repaired supraspinatus tear using the SRSA-im technique. Note the pressure-sensitive film situated at the bone-tendon interface. The film was left in the repair for several minutes while the next specimen was prepared. The repair was then carefully released and the film extracted.



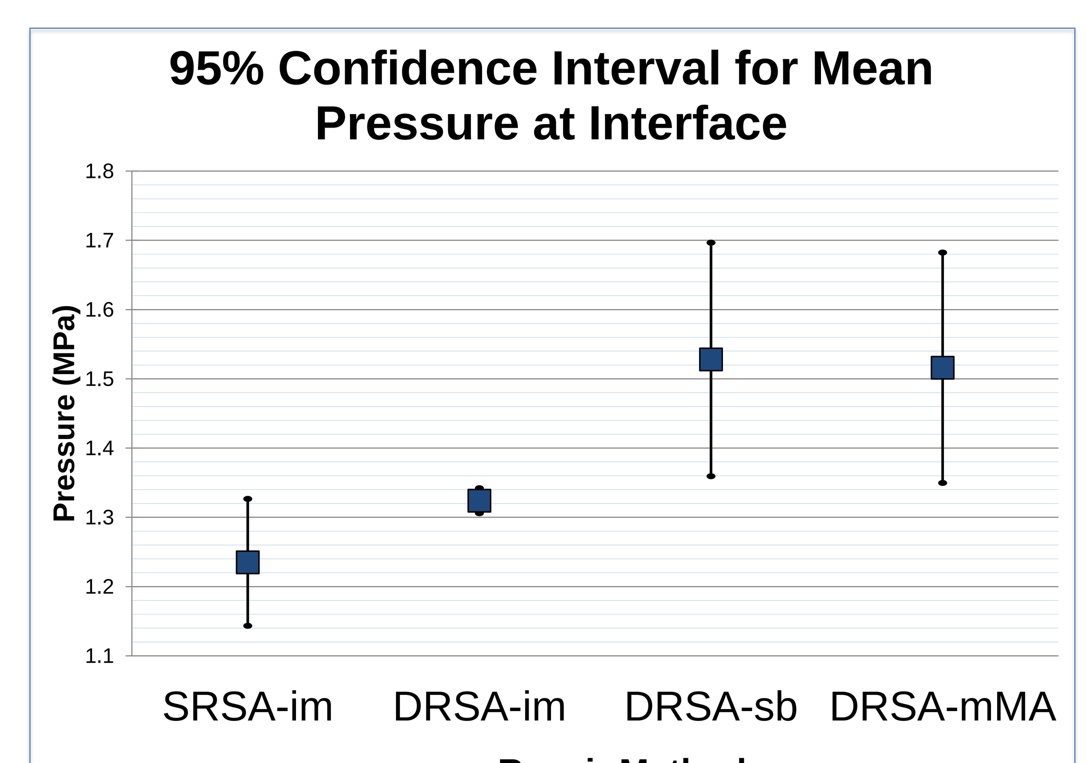
RESULTS

	Area (mm²)	% Contact	Pressure (MPa)
SRSA-im	249.46 ± 76.97	85.74	1.235 ± .081
DRSA-im	234.41 ± 51.65	88.44	1.324 ± .016
DRSA-sb	346.24 ± 60.98	95.15	1.528 ± .149
DRSA-mMA	346.23 ± 45.31	96.03	1.516 ± .147

Mean footprint area, percent of total area, and mean pressures



Mean footprint area restored for each repair technique, showing the standard errors of mean. While DRSA-im had the lowest mean footprint area as shown here, it should be noted that it restored 88.44% of the total area compared to 85.74% for SRSA-im.



Mean contact pressures for each technique, showing standard errors of mean. SRSA-im had the lowest mean pressure, which is consistent with the general theory that DRSA techniques allow for more pressure and less gap formation.

CONCLUSIONS

All four repair techniques provided relatively favorable biomechanical data. Our results support those in the past that identified DRSA to be superior to SRSA repairs. In regards to the suture configurations, data did not support our hypothesis that the DRSA-im technique would perform at least as well as the DRSA-sb and DRSA-mMA. Due to the limitations of the study, we were not able to establish with confidence which of the three DRSA configurations would most likely provide optimal healing, strength, and durability following repair of a human rotator cuff tear. Further research including more variables and a larger sample size is needed.

LIMITATIONS

- Porcine model used instead of cadaver model
- Unable to standardize size of film throughout trials
- Small sample size

ACKNOWLEDGMENTS

Thank you to the UCF College of Medicine, Dr. Brad Homan, Whitney Hartz, Tammy Simonson, Shannon Harrison, the Florida Hospital Nicholson Center, and Arthrex for making this study possible.

PUBLICATIONS

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Contact Info: Andrew Bonett, abo@knights.ucf.edu