

Superior Capsular Reconstruction—Technical Marvel or Fading Fashion?



Superior capsular reconstruction (SCR) has quickly become a widely used technique for shoulder surgeons seeking to improve outcomes for patients suffering from massive irreparable rotator cuff tears. Initially described by Teruhisa Mihata in 2012¹ as a technique to restore function and improve pain in the context of lack of availability of reverse total shoulder replacement in Japan, it has become a mainstay treatment for some that have adopted its use in their routine practice.

The “S curve” of technology and product design has been described as a model for understanding how an industry/technology/product develops over time and effort.² Each “S curve” can be divided into a lower portion, a middle portion, and a top portion, resulting in a maturation point. The lower portion reflects early innovation, often resulting in high levels of competition to determine the dominant design. The middle portion reflects growth and is driven by the ability to overcome major technical obstacles and satisfy demand. This phase also represents full market acceptance. The top portion of the “S curve” represents the natural limit of the technology/product within the market, whereby maturation occurs, and innovation becomes incremental. At the maturation point, there is an opportunity for discontinuity, where a new technology that disrupts the industry starts a new “S curve.”

The SCR may indeed follow the technology “S curve.” The lower portion represents the original innovation of the technique by Mihata.^{3,4} The middle, growth, portion represents its increased use, initially in Japan and Korea. As the first “S curve” reaches maturation, it is disrupted by a new “S curve,” brought about by the application of dermal allografts. This new “S curve” has a middle portion of vast growth characterized by innovation of techniques aimed at simplifying the execution and reducing the risks (donor-site morbidity/failure of fixation). As this second “S curve” reaches maturation, publications questioning the indications and efficacy of the SCR become more prevalent (Fig 1).^{5,6}

For some, the tale of the SCR is one of creative innovation that has revolutionized the management of a complex problem. However, it can be seen as a cautionary tale of how industry forces, clinical

champions, and surgical enthusiasm can prevail despite a lack of robust scientific evaluation. Mihata’s original technique involved using a large harvested fascia lata autograft, doubled/tripled over, and attached to the glenoid and humeral head. The first report in the English literature was in 2013, reporting on 24 cases performed between 2007 and 2009.³ Soon after, modifications of the technique by renowned shoulder surgeons introduced the use of dermal allograft as a substitute for fascia lata autograft.^{7,8} Later, techniques using long head of biceps autograft have been described.⁹ Simplifications aimed at addressing the significant technical challenge of the original technique have been proposed.^{10,11}

The majority of the scientific literature on SCR comprises technical articles on biomechanical principles, various modifications, observational studies, or review articles of observational studies.¹²⁻¹⁵ To date, no randomized controlled trials comparing SCR with simple debridement, biceps tenotomy, and partial repair have been reported. Many remain sceptical of the efficacy of the technique. The hesitancy of adoption may be based on rationale, lack of persuasive narrative as to the biomechanical properties of the superior capsule, or technical difficulties/challenges in execution. The current options available to surgeons treating patients with massive irreparable cuff tears are plentiful, with no clear consensus on which strategy is superior.¹⁶ This is likely due to lack of clinical equipoise and, as such, lack of Level I studies.¹⁷

Yuval Noah Harari taught us that “Humans have always been better at inventing tools than using them wisely.”¹⁸ We may liken the SCR to another tool, now defunct and thrown into the trashcan of surgical techniques of old, the thermal capsulorrhaphy for shoulder instability. Like the SCR, this technique gained popularity as a solution for a complex problem, multidirectional instability. Similar to SCR, the narrative was clear and easy to comprehend: the capsule is lax, and therefore, “shrinking” it, would help. Unlike the SCR, however, thermal capsulorrhaphy was technically easy to execute. Unlike the SCR, aside from the cost of the radiofrequency ablation device, very few consumables were required. Similar to SCR, however,

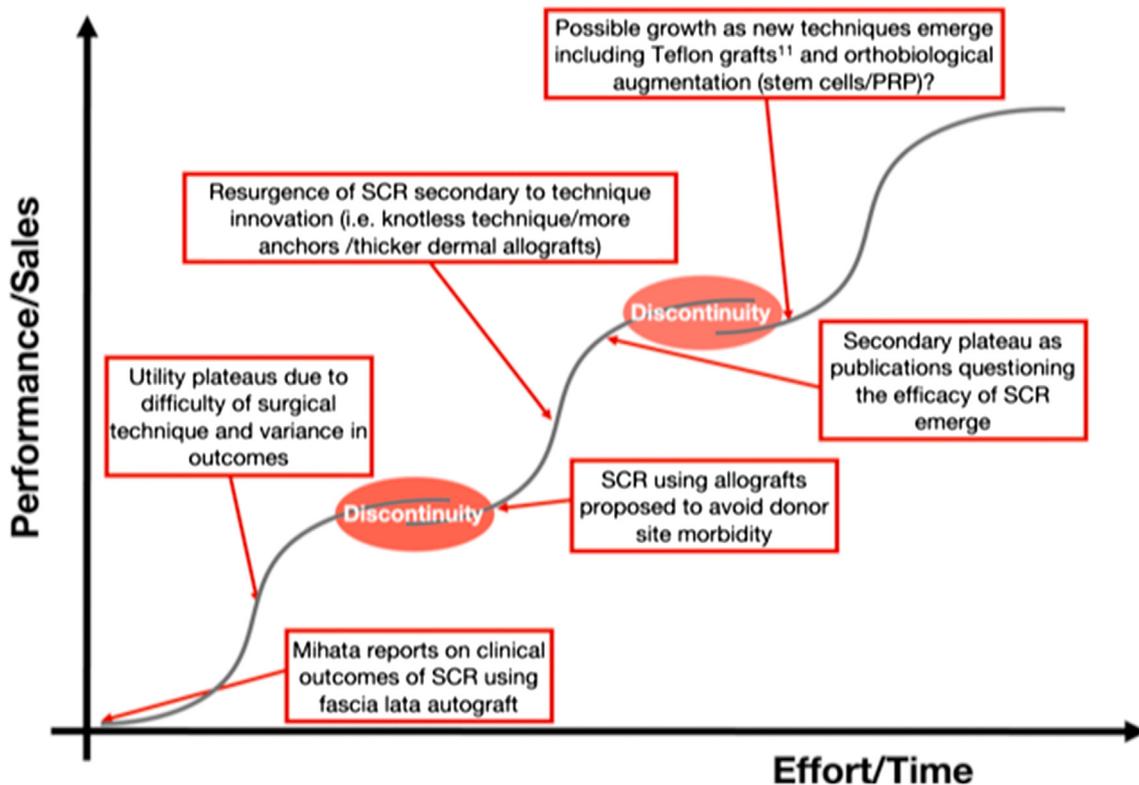


Fig 1. The proposed “S curve” of the SCR. (PRP, platelet-rich plasma; SCR, superior capsular reconstruction.)

its use was followed by countless observational studies demonstrating its “success.”^{19,20} Nearly 10 years after the first scientific article on this technique, it was abandoned.

While it did not take a Level I study to demonstrate this technique was not effective,²¹ surgeons and patients alike are still dealing with the aftermath of this harmful technique. Where SCR and thermal capsulorrhaphy may indeed differ is that SCR may not be harmful in most cases. However, its clinical effectiveness and treatment effect over and beyond partial repair,²² tuberopecty,²³ and biceps tenotomy²⁴ has yet to be demonstrated. Another example is the InSpace balloon, an alternative strategy for massive irreparable rotator cuff tears. Ten years after the first report,²⁵ a recent high-level study²⁶ demonstrated that the implantation of an expensive InSpace balloon did not add any clinical benefit over a simple and inexpensive debridement.

Our goal is not to dissuade surgeons from performing SCR for their patients but rather as a call to the community that we can do better. It is essential to let reason prevail. Before the widespread adoption of a technique influenced by market forces, there should be at least one high-quality randomized controlled trial demonstrating its clinical and cost-effectiveness.²⁷ Without this, we are beholden to make the mistakes of old, perpetually innovating new treatments without proper

scientific evaluation. The true cost of which will never be fully appreciated.

Alexandre Lädermann, M.D.
 Division of Orthopaedics and Trauma Surgery
 La Tour Hospital
 Faculty of Medicine
 University of Geneva
 Division of Orthopaedics and Trauma Surgery
 Department of Surgery
 Geneva University Hospitals
 Geneva, Switzerland

Mustafa Rashid, M.D.
 Wrightington Hospital
 Wigan, Lancashire
 United Kingdom

Note: The authors report the following potential conflicts of interest or sources of funding: FORE (Foundation for Research and Teaching in Orthopedics, Sports Medicine, Trauma and Imaging in the Musculoskeletal System) Grant #2022-28. Full ICMJE author disclosure forms are available for this letter online, as [supplementary material](#).

References

- Mihata T, McGarry MH, Pirolo JM, Kinoshita M, Lee TQ. Superior capsule reconstruction to restore superior stability in irreparable rotator cuff tears: A biomechanical cadaveric study. *Am J Sports Med* 2012;40:2248-2255.
- Burkhart SS. Expanding the frontiers of shoulder arthroscopy. *J Shoulder Elbow Surg* 2011;20:183-191.
- Mihata T, Lee TQ, Watanabe C, et al. Clinical results of arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. *Arthroscopy* 2013;29:459-470.
- Mihata T, McGarry MH, Kahn T, Goldberg I, Neo M, Lee TQ. Biomechanical effect of thickness and tension of fascia lata graft on glenohumeral stability for superior capsule reconstruction in irreparable supraspinatus tears. *Arthroscopy* 2016;32:418-426.
- Ciccotti M, Horan MP, Nolte PC, Elrick BP, Millett PJ. Outcomes after arthroscopic rotator cuff repair using margin convergence versus superior capsular reconstruction: Should candidates for margin convergence be treated with superior capsular reconstruction? *Orthop J Sports Med* 2021;9:23259671211050624.
- Cromheecke M, Garret J, Deranlot J, et al. Low healing rates and moderate functional outcome after arthroscopic superior capsular reconstruction using a porcine xenograft. *Knee Surg Sports Traumatol Arthrosc* 2022;30:2528-2534.
- Adams CR, Denard PJ, Brady PC, Hartzler RU, Burkhart SS. The arthroscopic superior capsular reconstruction. *Am J Orthop* 2016;45:320-324.
- Burkhart SS, Denard PJ, Adams CR, Brady PC, Hartzler RU. Arthroscopic superior capsular reconstruction for massive irreparable rotator cuff repair. *Arthrosc Tech* 2016;5:e1407-e1418.
- Boutsiadis A, Chen S, Jiang C, Lenoir H, Delsol P, Barth J. Long head of the biceps as a suitable available local tissue autograft for superior capsular reconstruction: "The Chinese way." *Arthrosc Tech* 2017;6:e1559-e1566.
- Läderrmann A, Denard PJ, Barth J, et al. Superior capsular reconstruction for irreparable rotator cuff tears: Autografts versus allografts. *Orthop Traumatol Surg Res* 2021;107:103059.
- Okamura K, Abe M, Yamada Y, et al. Arthroscopic superior capsule reconstruction with Teflon felt synthetic graft for irreparable massive rotator cuff tears: Clinical and radiographic results at minimum 2-year follow-up. *J Shoulder Elbow Surg* 2021;30:625-634.
- Baek CH, Kim JG. Shoulder superior capsular reconstruction hybrid graft thickness greater than preoperative acromiohumeral distance increases graft retear rate and subacromial erosion. *Arthroscopy* 2022;38:1784-1792.
- Cohn MR, Vadhera AS, Garrigues GE, Verma NN. Superior capsular reconstruction: Proposed biomechanical advantages. *Arthroscopy* 2022;38:20-21.
- Shin SJ, Lee S, Hwang JY, Lee W, Koh KH. Superior capsular reconstruction using acellular dermal allograft combined with remaining rotator cuff augmentation improved shoulder pain and function at 1 year after the surgery. *Arthroscopy* 2022;38:1089-1098.
- Tibone JE, Mansfield C, Kantor A, et al. Human dermal allograft superior capsule reconstruction with graft length determined at glenohumeral abduction angles of 20 degrees and 40 degrees decreases joint translation and subacromial pressure without compromising range of motion: A cadaveric biomechanical study. *Arthroscopy* 2022;38:1398-1407.
- Läderrmann A, Collin P, Athwal GS, Scheibel M, Zumstein MA, Nourissat G. Current concepts in the primary management of irreparable posterosuperior rotator cuff tears without arthritis. *EFORT Open Rev* 2018;3:200-209.
- Werthel JD, Vigan M, Schoch B, et al. Superior capsular reconstruction—A systematic review and meta-analysis. *Orthop Traumatol Surg Res* 2021;107:103072.
- Yuval NH. *21 lessons for the 21st century*. New York: Spiegel & Grau, 2018.
- Savoie FH 3rd, Field LD. Thermal versus suture treatment of symptomatic capsular laxity. *Clin Sports Med* 2000;19:63-75. vi.
- Fitzgerald BT, Watson BT, Lapoint JM. The use of thermal capsulorrhaphy in the treatment of multidirectional instability. *J Shoulder Elbow Surg* 2002;11:108-113.
- D'Alessandro DF, Bradley JP, Fleischli JE, Connor PM. Prospective evaluation of thermal capsulorrhaphy for shoulder instability: Indications and results, two- to five-year follow-up. *Am J Sports Med* 2004;32:21-33.
- Greiner S, Kaeaeab M, Voss A, Lawton R, Bhide P, Achenbach L. Comparison of superior capsular reconstruction and partial infraspinatus repair: A matched-pair analysis of irreparable rotator cuff tears. *Orthop J Sports Med* 2021;9:2325967120984264.
- Cunningham G, Nicodeme-Paulin E, Smith MM, Holzer N, Cass B, Young AA. The greater tuberosity angle: A new predictor for rotator cuff tear. *J Shoulder Elbow Surg* 2018;27:1415-1421.
- Walch G, Edwards TB, Boulahia A, Nove-Josserand L, Neyton L, Szabo I. Arthroscopic tenotomy of the long head of the biceps in the treatment of rotator cuff tears: Clinical and radiographic results of 307 cases. *J Shoulder Elbow Surg* 2005;14:238-246.
- Savarese E, Romeo R. New solution for massive, irreparable rotator cuff tears: the subacromial "biodegradable spacer." *Arthrosc Tech* 2012;1:e69-74.
- Metcalfe A, Parsons H, Parsons N, et al. Subacromial balloon spacer for irreparable rotator cuff tears of the shoulder (START:REACTS): A group-sequential, double-blind, multicentre randomised controlled trial. *Lancet* 2022;399:1954-1963.
- Läderrmann A, Eurin R, Alibert A, Bensouda M, Bothorel H. Measuring patient value after total shoulder arthroplasty. *J Clin Med* 2021;10:5700.