



WHAT I HAVE LEARNED

Discovery



Frederick A. Matsen III, MD*

Department of Orthopedics and Sports Medicine, University of Washington, Seattle, WA, USA

Rick Matsen has spent his entire orthopedic career at the University of Washington, except for 2 extended visits to New York with Dr. Charles Neer, which helped Dr. Matsen form the focus of his shoulder practice. He started a shoulder and elbow service at the University of Washington and was a founding member of the American Shoulder and Elbow Surgeons, later serving as its president in 1990-1991. He was also a long-standing chairman of orthopedics at the University of Washington. He is especially known for his textbook, *The Shoulder*, which he coauthored initially with Charles Rockwood and which is now in its fifth edition, as well as for developing the Simple Shoulder Test, a very simple patient-reported outcome measure. Matsen has trained over 50 fellows and hundreds of residents in shoulder and elbow surgery.—W.J.M.

The *Discovery* (Fig. 1) was a 38-foot “fly-boat” captained by John Ratcliffe that left England in 1606 carrying colonists to establish the colony of Jamestown. Captained by John Smith, she next explored the Chesapeake Bay region. Then, under the command of Samuel Argall, she set out for Bermuda but wound up being blown off course to Newfoundland. She next took part in the search for the Northwest Passage. During the 1610-1611 expeditions in the Canadian Arctic, her crew mutinied and set her captain, Henry Hudson, adrift in a small boat. He was not seen again.

In a sense, we are on board the *Discovery*. Our search for better ways to serve our patients leads us to establish new principles and practices, but we are sometimes blown off course, and occasionally we are set adrift. It may seem safer to stay home, doing things the way we were taught in residency and fellowship; Robert Fulghum warned: “be aware of wonder.”⁶ Helen Keller countered: “Security is mostly a superstition. It does not exist in nature, nor do the children of men as a whole experience it. Avoiding danger is no safer in the long run than outright exposure. Life is either a daring adventure, or nothing.”¹⁶

In our personal voyage on the *Discovery*, we must be certain that we follow a true compass that keeps our course headed toward the most cost-effective care for the patient-travelers who entrust to us their safe arrival at their desired destination. There are many conflicting magnetic fields, such as our own fiscal or reputational self-interest, that can cause our compass to tempt a suboptimal course. To be sure we stay on the right track, we must “follow every patient [we treat], long enough to determine whether or not the treatment has been successful, and then to inquire ‘if not, why not?’ with a view to preventing similar failures in [the] future.”⁴ Was the failure because the patient was a poor candidate for the procedure, because we did not obtain enough complex imaging before surgery, because the implants were not “fourth generation,” because the operation was not done well, or because the rehabilitation was not optimized? There is much to be learned from studying our own failures and those of others. While our voyage is a “daring adventure,” we should do all we can to avoid having it be risky business for our patients.

But patients are not our only co-voyagers. The next generations of shoulder and elbow surgeons are on board as well. We must teach them what we think we know but also point out that half of what we teach them will be proved incorrect; it is their challenge to figure out which half. We need to invite them to speak their truth to our power—to tell us old emperors when we have no clothes.²

*Reprint requests: Frederick A. Matsen III, MD, Shoulder and Elbow Surgery, Department of Orthopaedics and Sports Medicine, University of Washington Medical Center, 1959 NE Pacific St, Box 356500, Seattle, WA, USA 98195-6500.

E-mail address: matsen@uw.edu (F.A. Matsen).

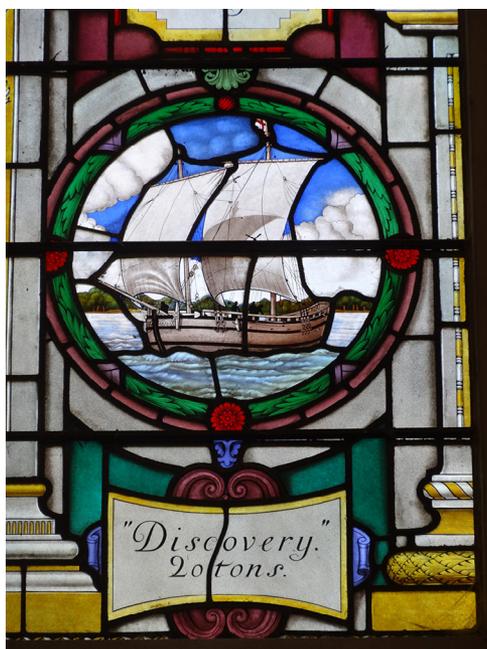


Figure 1 Stained glass window of *Discovery* in St Sepulchre-without-Newgate (attribution: Jonathan Cardy [own work] [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0>) via Wikimedia Commons]).

So, with this prologue, may I say that I am greatly honored to be among the folks Dr. Mallon has invited to reflect on their 40 years of shoulder and elbow practice. Along with our colleagues, we have the opportunity and indeed the responsibility to share some of the elements learned along our personal voyage with the younger adventurers who will soon captain the ship *Discovery*.

I was first brought on board by Charles Neer in 1975. He hosted my wife Anne, me, and our baby Susanna for 3 months in his Englewood, New Jersey, home. I'll never forget the daily early morning commute in his Cadillac across the George Washington Bridge to the hospital. These trips were filled with his perspective on life, tennis, surgical technique, and unsolved challenges. His first lesson in navigation was (in pointing to a patient's radiograph) as follows: "This is the shoulder but what's more important is the patient that has that shoulder." He reflected the perspective of another master of medicine, William Osler: "It is much more important to know what sort of a patient has a disease than to know what kind of a disease a patient has."³⁰ While it is now fashionable to characterize patients in terms of "grit," "resilience," "attitude," comorbidities, or depression, what is key is to learn whether the patient has a treatable problem and whether he or she is likely to realize an improved quality of his or her remaining life from the treatment we are considering. For simplicity, we like to group problems into 3 categories: A, we know the problem and know a treatment that is likely to work for this patient; B, we know the problem but are unsure of a treatment that is likely to work for this patient; and C, we

don't know the problem and don't know a treatment for it.³⁵ Everyone is safest if we stick with the A's.

Observing how patients fare after treatment (in our hands or those of others) has led to some important discoveries, some of which greatly simplify our approach to common shoulder pathologies. Some recent examples follow.

Rotator cuff

Shoulders with unrepaired rotator cuff tears (including my own) can function very well; the size of the cuff tear is not closely related to the comfort or function of the shoulder.¹⁵ Self-assessed shoulder comfort and function are not closely related to the integrity of a cuff repair.²⁸ Acromioplasty is rarely necessary in the surgical treatment of rotator cuff lesions.^{11,32}

Arthroplasty

The chances of a better outcome from shoulder arthroplasty can be predicted from a few preoperative variables.^{23,25} An anteroposterior radiograph in the plane of the scapula and an axillary view taken with the arm in a functional position of elevation (the "truth view") provide all the imaging information necessary to plan a shoulder arthroplasty; computed tomography scans are rarely necessary.²²

In shoulder arthroplasty, a standard-length smooth stemmed humeral component can almost always be securely fixed using impaction grafting, avoiding the problems associated with stress shielding, ingrowth prostheses, cement fixation, and prosthesis removal, should it become necessary.¹⁸ It is not necessary to "correct" glenoid retroversion when performing most total shoulder arthroplasties.³⁴

The goal of shoulder arthroplasty is to restore optimal mechanics, not to restore "normal anatomy." While preoperative examination and imaging may be helpful, the key to a successful arthroplasty is the intraoperative assessment of the mechanics of the shoulder reconstruction. When trial arthroplasty components reveal intraoperative posterior decentering of the humeral head, centering can usually be restored through the use of an anteriorly eccentric humeral head component without or with a rotator interval plication.¹⁰

The glenoid component remains the weakest link in shoulder arthroplasty.³³ Metal-backed glenoid components are associated with increased rates of surgical revision.³¹

In experienced hands and in appropriately selected and informed patients, the ream-and-run procedure can enable high levels of shoulder function for patients wishing to avoid the risks and limitations associated with a prosthetic glenoid component.^{20,37,38} This procedure can be effective even in the presence of glenoid retroversion, glenoid biconcavity, and posterior decentering—the bad arthritic triad.²⁷

The Simple Shoulder Test is an inexpensive, practical, and valid tool for characterizing the patient's self-assessed comfort and function before and sequentially after shoulder

arthroplasty.^{13,26} There is not good evidence that the current outcomes achieved with more “modern” approaches to anatomic total shoulder arthroplasty or reverse total shoulder arthroplasty are superior to those achieved a decade or so ago.³⁶

Infection

Standard definitions of “periprosthetic infection” derived for the hip and knee are not applicable to most cases of failed shoulder arthroplasty.¹⁴ *Cutibacterium* (formerly *Propionibacterium*) *acnes* is the organism most commonly recovered at the time of revision of failed shoulder arthroplasty—even in those revisions taking place years after the index procedure.^{19,29} This organism is also frequently recovered from the surgical field at primary arthroplasty despite standard skin and systemic antibiotic prophylaxis.^{17,24}

In a failed arthroplasty, *Cutibacterium* characteristically presents in a “stealth” manner rather than as an “obvious” infection; preoperative blood tests and joint aspiration do not reliably indicate the presence of this organism.⁹ Intraoperative cultures are necessary to distinguish *Cutibacterium*-associated arthroplasty failure from detritic synovitis.⁷ The presence of *Cutibacterium* is most reliably detected if 5 tissue or implant specimens are cultured on aerobic and anaerobic media and observed for 2-3 weeks.²¹ Culture results are most informative if they are reported in a semiquantitative manner rather than simply as “positive” or “negative.”¹ A single-stage revision is usually effective in managing a failed shoulder arthroplasty with cultures positive for *Cutibacterium*.¹²

Terre inconnue

While some discoveries have been made, there is a lot of unknown territory out there. Some examples follow.

Rotator cuff

What determines whether a rotator cuff tear is symptomatic? What evidence supports surgery for the treatment of rotator cuff conditions?⁵

Arthroplasty

In that prosthesis designs are changing each year, what is the relevance of long-term follow-up of prostheses that are no longer in use? Is there evidence that newer technologies, such as computer guidance, patient-specific instrumentation, short-stemmed or stemless humeral components, or augmented glenoid components, yield better clinical results for patients with arthritis in comparison with standard approaches? On an ongoing basis, how can we determine whether the increments in cost and complexity associated with new

technologies are offset by commensurate increases in the results realized by the patient?

While reverse total shoulder arthroplasties are commonly performed for instability, what can we do about the observation that instability accounts for over one-third of the revisions of failed reverse shoulder arthroplasties?³ Are the published results achieved in the hands of higher-volume surgeons relevant to the many low-volume arthroplasty surgeons who together perform the largest percentage of the total number of shoulder replacements?⁸

Infection

In that *Cutibacterium* lives in the dermis of many male patients and, as such, is released into the surgical wound at the time of shoulder arthroplasty, how can inoculation of implants with these biofilm-forming bacteria be prevented? Recognizing that *Cutibacterium* is commonly recovered at the surgical revision of failed shoulder surgery, in which cases is it the cause, the effect, or unrelated to the failure?

Conclusion

Clearly, our voyage of *Discovery* is just beginning and we need many brave captains to keep her on course. This brief summary indicates where we have been; the captains of the future will need to determine where we go from here. We wish them *bon courage!*

Disclaimer

The author, his immediate family, and any research foundations with which he is affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Ahsan ZS, Somerson JS, Matsen FA III. Characterizing the Propionibacterium load in revision shoulder arthroplasty: a study of 137 culture-positive cases. *J Bone Joint Surg Am* 2017;99:150-4. <http://dx.doi.org/10.2106/JBJS.16.00422>
2. Andersen HC. In: Tatar M, editor. The annotated Hans Christian Andersen. New York: W. W. Norton & Company; 2008.
3. Australian Orthopaedic Association National Joint Replacement Registry. Hip, knee & shoulder arthroplasty. Annual report 2016. Adelaide: Australian Orthopaedic Association; 2016. <<https://aoanjrr.sahmri.com/documents/10180/275066/Hip%2C%20Knee%20%26%20Shoulder%20Arthroplasty>>, accessed August 12, 2017.
4. Codman EA. The shoulder. Boston: Thomas Todd; 1934.
5. Coghlan JA, Buchbinder R, Green S, Johnston RV, Bell SN. Surgery for rotator cuff disease. London: Cochrane; 2008. <http://www.cochrane.org/CD005619/MUSKEL_surgery-for-rotator-cuff-disease>, accessed August 12, 2017.
6. Fulghum R, All I. All I really need to know I learned in kindergarten. New York: Ballantine Books; 1986.

7. Gorbaty J, Lucas RM, Matsen FA III. Detritic synovitis can mimic a Propionibacterium periprosthetic infection. *Int Orthop* 2016;40:95-8. <http://dx.doi.org/10.1007/s00264-015-3032-z>
8. Hasan SS, Leith JM, Smith KL, Matsen FA III. The distribution of shoulder replacement among surgeons and hospitals is significantly different than that of hip or knee replacement. *J Shoulder Elbow Surg* 2003;12:164-9. <http://dx.doi.org/10.1067/mse.2003.23>
9. Hsu JE, Bumgarner RE, Matsen FA III. Propionibacterium in shoulder arthroplasty: what we think we know today. *J Bone Joint Surg Am* 2016;98:597-606. <http://dx.doi.org/10.2106/JBJS.15.00568>
10. Hsu JE, Gee AO, Lucas RM, Somerson JS, Warme WJ, Matsen FA III. Management of intraoperative posterior decentering in shoulder arthroplasty using anteriorly eccentric humeral head components. *J Shoulder Elbow Surg* 2016;25:1980-8. <http://dx.doi.org/10.1016/j.jse.2016.02.027>
11. Hsu JE, Gorbaty J, Lucas R, Russ SM, Matsen FA III. Treatment of irreparable cuff tears with smoothing of the humeroscapular motion interface without acromioplasty. *Int Orthop* 2017;41:1423-30. <http://dx.doi.org/10.1007/s00264-017-3486-2>
12. Hsu JE, Gorbaty JD, Whitney IJ, Matsen FA III. Single-stage revision is effective for failed shoulder arthroplasty with positive cultures for Propionibacterium. *J Bone Joint Surg Am* 2016;98:2047-51. <http://dx.doi.org/10.2106/JBJS.16.00149>
13. Hsu JE, Russ SM, Somerson JS, Tang A, Warme WJ, Matsen FA III. Is the Simple Shoulder Test a valid outcome instrument for shoulder arthroplasty? *J Shoulder Elbow Surg* 2017;26:1693-700. <http://dx.doi.org/10.1016/j.jse.2017.03.029>
14. Hsu JE, Somerson JS, Vo KV, Matsen FA III. What is a "periprosthetic shoulder infection"? A systematic review of two decades of publications. *Int Orthop* 2017;41:813-22. <http://dx.doi.org/10.1007/s00264-017-3421-6>
15. Hsu JE, Tang A, Matsen FA III. Patient self-assessed shoulder comfort and function and active motion are not closely related to surgically documented rotator cuff tear integrity. *J Shoulder Elbow Surg* 2017;26:1938-42. <http://dx.doi.org/10.1016/j.jse.2017.05.011>
16. Keller H. *The Open Door*. Garden City, NY: Doubleday; 1957.
17. Lee MJ, Pottinger PS, Butler-Wu S, Bumgarner RE, Russ SM, Matsen FA III. Propionibacterium persists in the skin despite standard surgical preparation. *J Bone Joint Surg Am* 2014;96:1447-50. <http://dx.doi.org/10.2106/JBJS.M.01474>
18. Lucas RM, Hsu JE, Gee AO, Neradilek MB, Matsen FA III. Impaction autografting: bone-preserving, secure fixation of a standard humeral component. *J Shoulder Elbow Surg* 2016;25:1787-94. <http://dx.doi.org/10.1016/j.jse.2016.03.008>
19. Lucas RM, Whitney IJ, Wasserburger J, Matsen FA III. Loose glenoid components in revision shoulder arthroplasty: is there an association with positive cultures? *J Shoulder Elbow Surg* 2016;25:1371-5. <http://dx.doi.org/10.1016/j.jse.2015.12.026>
20. Matsen FA III. The ream and run: not for every patient, every surgeon or every problem. *Int Orthop* 2015;39:255-61. <http://dx.doi.org/10.1007/s00264-014-2641-2>
21. Matsen FA III, Butler-Wu S, Carofino BC, Jette JL, Bertelsen A, Bumgarner RE. Origin of Propionibacterium in surgical wounds and evidence-based approach for culturing Propionibacterium from surgical sites. *J Bone Joint Surg Am* 2013;95:e1811-7. <http://dx.doi.org/10.2106/JBJS.L.01733>
22. Matsen FA III, Gupta A. Axillary view: arthritic glenohumeral anatomy and changes after ream and run. *Clin Orthop Relat Res* 2014;472:894-902. <http://dx.doi.org/10.1007/s11999-013-3327-6>
23. Matsen FA III, Lin N, Gao H, Yuan S, Russ SM, Sampson PD. Factors affecting length of stay, readmission, and revision after shoulder arthroplasty: a population-based study. *J Bone Joint Surg Am* 2015;97:1255-63. <http://dx.doi.org/10.2106/JBJS.N.01107>
24. Matsen FA III, Russ SM, Bertelsen A, Butler-Wu S, Pottinger PS. Propionibacterium can be isolated from deep cultures obtained at primary arthroplasty despite intravenous antimicrobial prophylaxis. *J Shoulder Elbow Surg* 2015;24:844-7. <http://dx.doi.org/10.1016/j.jse.2014.10.016>
25. Matsen FA III, Russ SM, Vu PT, Hsu JE, Lucas RM, Comstock BA. What factors are predictive of patient-reported outcomes? A prospective study of 337 shoulder arthroplasties. *Clin Orthop Relat Res* 2016;474:2496-510. <http://dx.doi.org/10.1007/s11999-016-4990-1>
26. Matsen FA III, Tang A, Russ SM, Hsu JE. Relationship between patient-reported assessment of shoulder function and objective range-of-motion measurements. *J Bone Joint Surg Am* 2017;99:417-26. <http://dx.doi.org/10.2106/JBJS.16.00556>
27. Matsen FA III, Warme WJ, Jackins SE. Can the ream and run procedure improve glenohumeral relationships and function for shoulders with the arthritic triad? *Clin Orthop Relat Res* 2015;473:2088-96. <http://dx.doi.org/10.1007/s11999-014-4095-7>
28. McElvany MD, McGoldrick E, Gee AO, Neradilek MB, Matsen FA III. Rotator cuff repair: published evidence on factors associated with repair integrity and clinical outcome. *Am J Sports Med* 2015;43:491-500. <http://dx.doi.org/10.1177/0363546514529644>
29. McGoldrick E, McElvany MD, Butler-Wu S, Pottinger PS, Matsen FA III. Substantial cultures of Propionibacterium can be found in apparently aseptic shoulders revised three years or more after the index arthroplasty. *J Shoulder Elbow Surg* 2015;24:31-5. <http://dx.doi.org/10.1016/j.jse.2014.05.008>
30. Osler W, McCrae T. *The principles and practice of medicine*. New York: D. Appleton and Company; 1920. <<https://archive.org/details/principlesandpr00mccrgoog>>, accessed August 12, 2017.
31. Papadonikolakis A, Matsen FA III. Metal-backed glenoid components have a higher rate of failure and fail by different modes in comparison with all-polyethylene components: a systematic review. *J Bone Joint Surg Am* 2015;96:1041-7. <http://dx.doi.org/10.2106/JBJS.M.00674>
32. Papadonikolakis A, McKenna M, Warme W, Martin BI, Matsen FA III. Published evidence relevant to the diagnosis of impingement syndrome of the shoulder. *J Bone Joint Surg Am* 2011;93:1827-32. <http://dx.doi.org/10.2106/JBJS.J.01748>
33. Papadonikolakis A, Neradilek MB, Matsen FA III. Failure of the glenoid component in anatomic total shoulder arthroplasty: a systematic review of the English-language literature between 2006 and 2012. *J Bone Joint Surg Am* 2013;95:2205-12. <http://dx.doi.org/10.2106/JBJS.L.00552>
34. Service BC, Hsu JE, Somerson JS, Russ SM, Matsen FA III. Does postoperative glenoid retroversion affect the 2-year clinical and radiographic outcomes for total shoulder arthroplasty? *Clin Orthop Relat Res* 2017;475:2726-39. <http://dx.doi.org/10.1007/s11999-017-5433-3>
35. Sidles JA, Harryman DT II, Lippitt SB, Matsen FA III. Shoulder arthritis/rotator cuff tears: causes of shoulder pain. In: *Practical evaluation and management of the shoulder, diagnosis, treatment*. Seattle: Frederick A. Matsen III; 2012. <<http://shoulderarthritits.blogspot.com/2012/08/practical-evaluation-and-management-of.html>>, accessed August 12, 2017.
36. Somerson JS, Neradilek MB, Hsu JE, Service BC, Gee AO, Matsen FA III. Is there evidence that the outcomes of primary anatomic and reverse shoulder arthroplasty are getting better? *Int Orthop* 2017;41:1235-44. <http://dx.doi.org/10.1007/s00264-017-3443-0>
37. Somerson JS, Neradilek MB, Service BC, Hsu JE, Russ SM, Matsen FA III. Clinical and radiographic outcomes of the ream-and-run procedure for primary glenohumeral arthritis. *J Bone Joint Surg Am* 2017;99:1291-304. <http://dx.doi.org/10.2106/JBJS.16.01201>
38. University of Washington Department of Orthopaedics and Sports Medicine. Activities after ream and run, <<https://www.youtube.com/watch?v=7J7YraYsg9U>>; 2013, accessed August 12, 2017.