J Shoulder Elbow Surg (2019) 28, 396–398

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

WHAT I HAVE LEARNED

Innovation in shoulder surgery: the impact on our patients

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Joe Zuckerman did his orthopedic training at the University of Washington, followed by a fellowship in adult reconstructive surgery at Brigham and Women's Hospital. He joined the faculty at Hospital for Joint Diseases in New York in 1984 and became chairman of the orthopedic department in 1994. In 1997 he was named chairman of the NYU Department of Orthopedic Surgery and helped form the successful merger of the two groups. He is most proud of having trained more than 350 residents at NYU Langone Health and NYU School of Medicine. He has been recognized by NYU with the Distinguished Teaching Medal and Master Educator Award. Zuckerman served as President of the American Shoulder and Elbow Surgeons (2003-2004) and was President of the American Academy of Orthopaedic Surgeons from 2009 to 2010.—WJM

If you ask an orthopedic surgeon who has been in practice for more than 15 years whether the surgery they are performing today is similar to the surgery they were performing at the completion of their training, the vast majority will tell you they are doing things much differently. This should not be a surprise. In medicine, we are constantly striving to do things "better."

When I finished my training more than 30 years ago at the University of Washington, my shoulder experience included total shoulder arthroplasty (using a polyethylene glenoid component and a monoblock humeral component), open rotator cuff repairs, proximal humeral fracture fixation using plates and screws, open instability repairs, and shoulder arthroscopy in its earliest forms (using an arthroscope designed for the knee and required the operating surgeon to look through the eye piece). And there was no doubt that the patients we cared for benefitted from the surgical procedures we performed.

Now, 30 years later, the landscape of shoulder surgery looks quite different. Each year, the NYU Langone orthopedic surgery residency program graduates 14 residents. This year's graduating class will quite possibly not have performed an open rotator cuff repair or an open instability repair. They will have used many different techniques to address the "irreparable rotator cuff tear," used open reduction and internal fixation for many proximal humeral and clavicular fractures, and gained an extensive experience with shoulder arthroplasty using implant designs that provide options to treat a wide range of glenohumeral pathology and failed arthroplasty procedures. And I expect that 15 or 20 years from now, their armamentarium of shoulder surgery will be much different than it is today.

In 1984, I coauthored the article on "Complications About the Glenohumeral Joint Related to the Use of Screws and Staples."[11] Although this compilation of cases clearly showed the complications that can result from the use of metal implants about the shoulder, during the next 10 years as techniques of arthroscopic shoulder stabilization were developed, the initial fixation devices were, indeed, metal staples.

Further development led to the use of nitinol anchors, which were lower profile. However, as we all know, these devices caused significant untoward effects when incorrectly inserted or as a result of migration. With this recognized,

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1058-2746/$ - see front matter
https://doi.org/10.1016/j.jse.2018.02.078

nonmetal bioabsorbable tacks were developed that were designed to avoid the complications associated with metal implants. Nonetheless, issues related to foreign body reaction caused some patients to develop significant complications and ultimately led to the discontinuation of their use in favor of other implants.[4,8] Now we have a variety of implants available which, when inserted correctly, will not only be tolerated biologically but provide very successful outcomes. However, getting to this end point included some missteps along the way, with an important effect on our patients.

Continuing in the area of instability surgery, I am certain many of us remember the initial enthusiasm about the use of thermal probes for the treatment of shoulder instability. Many became proponents of this technique before we recognized the unfortunate complications that resulted. The development of glenohumeral chondrolysis after thermal capsulorrhaphy became well recognized, leading to the complete discontinuation of this treatment.[5,7,10] More significant were the patients—young patients—who developed significant chondrolysis and joint destruction necessitating additional operative procedures, including arthroplasty, at a very young age. Thermal capsulorrhaphy was an example of a procedure that had a short life span and could not be improved. It was quickly dropped from our armamentarium because of the cost to our patients.

The use of intra-articular pain pumps was similarly received with enthusiasm as a mechanism to keep patients comfortable postoperatively and facilitate outpatient arthroscopic procedures. Unfortunately, these intra-articular pain pumps also led to glenohumeral chondrolysis and joint destruction—in young patients.[1,9] As a result, another treatment was completely discontinued, as it should have been.

Comparing the changes in shoulder surgery from a point in time in the 1980s to today only provides part of the story. The success of surgical procedures we consider standard today were developed over time in which "trial and error" was a common theme. New implants and new techniques often require further development and refinement after their initial use as we identify ways to improve the procedure or the device itself. In this context, recognizing that the common thread throughout these "refinements" is the patients we treat is most important.

We have developed new techniques and refined current techniques using the well-known learning curve, and at each point on this learning curve is one of our patients—for better or for worse. Now I am not suggesting that in our efforts to "improve" we did so with anything less than the absolute professionalism required of our profession. However, it is important to appreciate the cost of our innovations and to do so it is helpful to examine some of the steps—and missteps—along the way.

The concept of the "learning curve" is an interesting one. It is well documented that when a surgeon uses a new technique, experience (cases) is required to become proficient. This is true no matter how much experience may be gained in the cadaver laboratory. Consider our transition from open rotator cuff repairs to arthroscopic subacromial decompression and miniopen repairs to all arthroscopic repairs. As responsible as we wanted to be, can anyone really say our first 5 all-arthroscopic rotator cuff repairs were performed as well as our last 5 open rotator cuff repairs? I certainly could not. But with increasing experience, we traverse the learning curve, and a new technique is added to our armamentarium. However, it is important to recognize that despite our best intentions, concerns, empathy, compassion, and professionalism, this comes at a cost that is borne primarily by our patients.

When I learned about Laurent LaFosse's subscapularis-sparing shoulder arthroplasty technique, I was intrigued. My colleague travelled to France to observe Dr. LaFosse and returned with more information and insight that would allow us to begin using the procedure. We spent some time in the cadaver laboratory to gain experience, and we scrubbed together on the first few to enhance the learning. There is no doubt that during the course of performing the first 25 arthroplasties using this technique, the procedures took longer and were more of a struggle than the standard technique. Nonetheless, after performing a sufficient number cases, I was far more comfortable performing the approach and also learned to refine my indications for its use.

We enrolled patients in a prospective randomized study of the subscapularis-sparing approach compared with the standard subscapularis tenotomy approach.[2] The results for clinical outcomes, reoperations, and complications were comparable with an average of 3-year follow-up. Time will tell whether the long-term results are also comparable. And if they are not—if the subscapularis-sparing group has a higher revision rate than the standard group—what do we say to the patients on whom we used the approach?

In 1988, my department chairman returned from a visit to France during which he met Paul Grammont and learned about his reverse total shoulder arthroplasty (RTSA). He told me I should visit Dr. Grammont and learn more about this technique. So, I travelled to France in May 1988 and spent 2 days with Dr. Grammont. He was an incredibly gracious host, particularly considering he did not know me, we had no previous relationship, and I was just a young aspiring shoulder specialist. It was an interesting visit. The RTSA I observed was far different than the procedure that eventually emerged approximately 10+ years later.

I returned to New York uncertain about the technology, the technique, and the indications. Since that time, the implant design, technique, and most importantly, the indications evolved and became the foundation of the Grammont-design RTSA that is now a major component of the shoulder arthroplasties performed throughout the world. However, the evolution from 1988 to 2003, when it was released for use in the United States, represented a learning curve in which patients were the laboratory to achieve the end result. To further illustrate this point, consider RTSA as we know it today.

In 2018, it is well recognized that RTSA has been a major advance in our ability to treat degenerative and traumatic conditions of the glenohumeral joint and failed previous arthroplasty. When one considers the results of reverse total

shoulder arthroplasty as performed today compared with when it was first released for use in 2003, the differences are quite evident. Initially, there was a much higher rate of infection, instability, and device failure.[3,6] However, we worked through these issues, recognizing the factors that predisposed to infection and the causes of instability, and we redesigned implants to minimize the risk of failure. Now we have a much more successful procedure with a far lower complication rate. However, getting to this point included many patients who required the reoperations as a result of infection, instability, and fixation failure. Their role in the development of RTSA and the effect on their lives should not be underestimated.

When you look back over the innovations that have taken place in shoulder surgery during the past 30 years, there have clearly been many "wins," but there have also been some "losses." The story I have described about shoulder surgery can also be written for most orthopedic subspecialty areas—and quite possibly most medical specialties. In that sense we are not unique. The next 30 years of shoulder surgery will, in all probability, provide a similar landscape.

We will continue to "innovate," and in most situations, the result will be improved outcomes for the benefit of our patients. As we progress through the development phase of what we do, it is essential that we do so in a responsible way. We should be learning from past experiences so these experiences guide our future approaches. Each one of us is responsible for providing the best patient care we can and "to do no harm." As we continue to improve our techniques and procedures, remembering the lessons we have learned will be increasingly important.

Disclaimer

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

References

1. Anderson SL, Buchko JZ, Taillon MR, Ernst MA. Chondrolysis of the glenohumeral joint after infusion of bupivacaine through an intra-articular pain pump catheter: a report of 18 cases. Arthroscopy 2010;26:451-61. http://dx.doi.org/10.1016/j.arthro.2010.01.022
2. Boileau P, Watkinson D, Hatzidakis A, Hovorka I. The Grammont reverse shoulder prosthesis: results in cuff tear arthritis, fracture sequelae and revision arthroplasty. J Shoulder Elbow Surg 2006;15:527-40. http://dx.doi.org/10.1016/j.jse.2006.01.003
3. Frankle M, Siegal S, Pupello D, Saleem A, Mighell M, Vasey W. The reverse shoulder prosthesis for glenohumeral arthritis associated with severe rotator cuff deficiency: a minimum two-year follow-up study of sixty patients. J Bone Joint Surg Am 2005;87:1697-705. http://dx.doi.org/10.2106/JBJS.D.02813
4. Freehill MQ, Harms DJ, Huber SM, Atlihan D, Buss DD. Poly-L-lactic acid tack synovitis after arthroscopic stabilization of the shoulder. Am J Sports Med 2003;31:643-7. http://dx.doi.org/10.1177/03635465030310050201.
5. Good CR, Shindle MK, Kelly BT, Wanich T, Warren RF. Glenohumeral chondrolysis after shoulder arthroscopy with thermal capsulorrhaphy. Arthroscopy 2007;23:797, e1-5. http://dx.doi.org/10.1016/j.arthro.2007.03.092
6. Kwon YW, Zuckerman JD. Subscapularis sparing total shoulder arthroplasty: a prospective, double blinded, randomized clinical trial." Presented at: Annual Open Meeting—American Shoulder and Elbow Surgeons, San Diego, CA, October 7, 2017.
7. Levine WN, Clark AM Jr, D'Alessandro DF, Yamaguchi K. Chondrolysis following arthroscopic thermal capsulorrhaphy to treat shoulder instability. A report of two cases. J Bone Joint Surg Am 2005;87:616-21. http://dx.doi.org/10.2106/JBJS.D.02158
8. Sassmannshausen G, Sukay M, Mair SD. Broken or dislodged poly-L-lactic acid bioabsorbable tacks in patients after SLAP lesion surgery. Arthroscopy 2006;22:615-9. http://dx.doi.org/10.1016/j.arthro.2006.03.009
9. Serrato JA Jr, Fleckenstein CM, Hasan SS. Glenohumeral chondrolysis associated with use of an intra-articular pain pump delivering local anesthetics following manipulation under anesthesia: a report of four cases. J Bone Joint Surg Am 2011;93:e99(1-8). http://dx.doi.org/10.2106/JBJS.J.01604
10. Wong KL, Williams GR. Complications of thermal capsulorrhaphy of the shoulder. J Bone Joint Surg Am 2001;83-A(Suppl. 2 Pt 2):151-5.
11. Zuckerman JD, Matsen FA. Complications about the glenohumeral joint related to the use of screws and staples. J Bone Joint Surg Am 1984;66:175-80.