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Editorial

"In My Experience...Biologic Augmentation of Rotator Cuff Repairs with Autologous Bursa"

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The author reviews his multiyear experience using hte patient's own tissue to augment surgery for rotstor cuff problems.

Biologic augmentation for rotator cuff repair is an important topic now in the shoulder world. For me, this journey really started at the beginning of my career about over twenty years ago as I came out of fellowship, and I went into practice, not all of my rotator cuff repairs were doing great. Not all of them were healing very well. I thought there could be another way to try to do this biologically. When I say that, what I wanted to do is not have an exogenous, but to use an autologous solution to this problem because I knew that the path of exogenous growth factors and other types of healing sources would be a long process, a very expensive process, and I didn't think many people would be interested in that at that time.

Platelet-rich plasma (PRP) was one of the first things we started looking at evaluating. We have done a lot of basic science and cell biology work showing that there's no question PRP does a great job of having stem cells, bone cells, capsular cells, and fibroblasts proliferate. Those cells are able to adhere and they have anti-inflammatory characteristics, so all good and autologous. However, if you look at the literature, in humans, there's almost an equal pile of literature that shows that it helps and an equal pile of literature that shows that it may not help. From that we then said, "how about trying to find other stem cells?" When we talk about stem cells, we really like to talk about them being progenitor cells, because stem cells are farther off the line, as we would say. We're really talking about mesenchymal cells, which are farther down the line, they're a little bit more advanced, but can still differentiate into bone, tendon, cartilage, and fat.

We started with the proximal humerus, trying to withdraw that bone marrow from the proximal humerus. We then started to look at how fast we could then concentrate that, as opposed to just taking bone marrow, but how fast could we concentrate the bone marrow so that we just were able to obtain the progenitor cells. Once again, we were able to find, surprisingly to me, that we were able to get quite a few of them. However, the other problem that we faced was trying to have those cells stay in the area that we wanted them to be, in other words, either above or below the rotator cuff without getting washed out by the arthroscopic fluid, without getting washed out by the bursa or whatever. So, we added PRP platelet poor plasma and we were able to make a fibrin clot. Originally, we thought that fibrin clot would be kind of the answer to our dreams because it stays for six weeks, and then it goes away. We could

a Dr. Augustus "Gus" Mazzocca was appointed the medical director of Mass General Brigham Sports Medicine and the chief of Mass General's Sports Medicine Service in May of 2022. He has created and directs the Bioskills, Biomechanics and Cell Biology Laboratories within the Department of Orthopaedic Surgery at Massachusetts General Hospital. Alongside these posts, Dr. Mazzocca serves on the faculty of orthopaedic surgery at Harvard Medical School. Dr. Mazzocca earned his Bachelor of Science degree in biology from Denison University, a Master of Science in applied physiology from Springfield College and his medical degree from the University of Connecticut School of Medicine. He completed an internship and residency with the Department of Orthopaedic Surgery at the University of Connecticut School of Medicine, as well as a fellowship in Sports, Shoulder and Elbow Surgery at Rush University in Chicago.

Dr. Mazzocca has dedicated his non-clinical life to education, research and his family, which is most important to him. He comes to Mass General from the University of Connecticut Health Center, where he started as an assiatnt professor and worked his way up to the Chairman and director of the UCONN Health Musculoskeletal Institute. As a professor, he was the Orthopaedic Teacher of the Year in 2013 and 2021.

Dr. Mazzocca played an active mentor role in UCONN's Orthopaedic Residency program since 2002, serving at times as director and assistant director of the program. He has served on numerous masters and PhD committees and has mentored hundreds of fellows, residents and other graduate students over his long career.

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put it underneath the rotator cuff repair without worrying about having it negatively affect healing.

However, although we worked on it for quite some time, it was still variable. The ability for us to make an autologous fibrin clot using human thrombin was not nearly as good as when we used exogenous thrombin such as bovine thrombin. We also looked at our clinical outcomes with the augmentation with that concentrated bone marrow and we still found that we had about a 20-25% non-healing rate. That doesn't mean that we had 25% of all my rotator cuffs doing awful. It just meant that if you looked at the rotator cuff repair MRIs in six months, there was a gap. We were disappointed by this and at the University of Connecticut, there was Dr. Nathaniel Dyment who was doing a lot of work on tendon healing. He was able to use different types of cells and found by his work that the cells that were healing tendon were not coming from the bone and were not coming from the tendon but were actually coming from the peritenon. Then we started looking for where's the peritenon of the supraspinous and interspinous in the rotator cuff.

We were not able to find a peritenon such as you would find for the Achilles or Patella. What we did find was bursa. Now, this was not a new idea. Uhthoff in 1991 had talked about it. Frank Goethe in Germany had talked about it. What we did was we started looking at the bursa. We compared the bursa cells to concentrated bone marrow and found that there were more cells in the bursa, progenitor cells than in the concentrated bone marrow. They were able to differentiate, proliferate, and migrate. We were excited by this and that's what got us on this kind of bursa research. The bursa is there. You have to remove it so you can see the rotator cuff. What we were able to do was withdraw that, grind it up on the back table. We did a number of studies showing how to elicit or get the cells from the bursa tissue so that they're just cells.

We found that if you just take the bursa tissue, the cells don't actually migrate out. They just stay in their matrix. But if you grind it up, then they would. We did a whole bunch of different ways to grind it up. Homogenization, collagenase, all different ways. We found that just with scissors grinding up or a shaver did relatively fairly well.

So now we have the bursa. We have the fibrin clot. Since around 2018, we've been using the bursa with the fibrin clot both underneath and above the rotator cuff repair. The problem are two-folds still to this day. One, the fibrin clot is variable. Sometimes it's a good clot, a hardy clot where it's easy to position it into the area that you want and sometimes it's not. It's loose and it comes out of your cannulas. So, after all of this work and all the expense of collecting blood from the patient, spinning it down, obtaining the PRP, obtaining the PPP, obtaining the autologous thrombin, mixing it together, we would have this watery clot that would come out our cannulas. This was frustrating and an obvious issue to make this procedure reproducible.

The second problem is the application. So how do we get it where we want it to go? The bursa is actually thick. So, you really can't get it reliably through, say, a 12-gauge needle. Sometimes there'll be a bigger piece of tissue that gets stuck in there and so by putting in a needle, which is a common way that some of these biologics are applied, that wasn't as reliable as we wanted. So as far as prime time right now, we're still working, and we need help on the application of bursa to the area. We think it has progenitor cells that will use the body's own signals to try to help heal and augment. We think it's very affordable since we don't have to have any significant processing on it, which means that all patients can possibly benefit from it, but we still need to work on how to reproducibly get it to where we want it to go.

People ask whether this approach can close a gap. It's not going to close a gap. This is for primary augmentation. When I first started on this journey, I was like, listen, revision rotator cuff repairs do even worse than primary. So if I can make an impact on the revision world, that would be significant. We could show that with less patients needing revision surgery. Dr. Russ Warren, who was always a great mentor and encouraged me, would say, get away from the revision. Try to prevent the failures. So that's kind of why we went to the primary. So that's why we've been motivated to try to make it as cost effective as we could so that you could do it in a surgery center. You could do it in the main operating room. You could do it anywhere because you've got to get that tissue anyway. And if we can actually reproducibly apply this in a sustainable manner, I think it would be very good because the cells are there. But it won't close a gap. We really use it for primary rotator cuff repairs. Our goal is to make this an inexpensive reliable all autologous biologic augmentation. We are still working!!

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