Outcomes of Humerus Nonunion Surgery in Patients Whose Initial Fracture was Treated Nonsurgically

Alexander Hysong, Noah James Harrison, Samuel Posey, Ziqing Yu, Andrew Chen[1], Patrick Pallitto, Joseph R Hsu, William T. Obremskey[2], John David Adams, Komi Eddie Afetse, Randi Alexander, Rodney Yeboah Arthur, Sharon N Babcock, Gisele Bailey, Claire Bartel[3], Amy A Bauer, Kayla Rose Bell, Nelly Bellamy, Anna Lauren Bickers, Ainsley Katherine Bloomer, Laura E Blum, Michael J Bosse, Lucy Charlotte Bowers, Matthew Braswell[4], Maggie Brownrigg, Landon Bulloch, David Stoddy Carey, Christine Churchill[5], Samuel Cohen-Tanugi[6], Mario Cuadra, Jana M Davis, Malcolm DeBaun, Jarrod Edward Dumpe, Hassan Farooq[7], Michael J Gardner[8], Steven Thomas Greene[9], Erica Grochowski, Luke Harmer, Stephen A Hemmerly, Anna Hemminger, Mary Sims Hershey, Kate Elizabeth Hickson, Martha B Holden, Zachery Lynn Hong, Christopher Joseph Jamero, Tracy Jones Johns[10], Josef Jolissaint[11], Jenna K Jones, Madhav A Karunakar, Ana Katsafanas, Laurence Kempton[12], Kamryn McKenzie King, Nathaniel T. Koutlas, Shreyas Kudrimoti, Cara Lai, Scott M Lewis, Luke A Lopas, David Macknet[13], Clayton Maschhoff, Julia Mastracci, Richard Randall McKnight, Laura McLean, Joseph Michalski, Anna Noel Miller[14], Matt Morris, Susan Marie Odum[12], Alexander G Padovano, Tyler J Pease, Daniel Pereira, Katheryn Marianne Peterson, Kayla Pfaff, Kevin Daniel Phelps[12], Sarah Pierrie[15], Hannah R Pollock, James Colin Rachal, Risa Reid[16], Lisa Reider, Olivia Rice[16], Jessica C Rivera, Elsa Beatriz Rodriguez, Tamar Roomian, Marc Schatz, Ryan Seltzer, Rachel Seymour[5], Ishani Sharma, Jigyasa Sharma, Elaine Shing[4], Stephen H Sims[17], Rebecca G Snider[18], Gabriel James Sowards, Lisa Stang, Thomas Scott Stang, Amber Nicole Stanley, Gabriella Stribling, Juliette Sweeney, Stephanie Lewis Tanner[19], Lauren Maccormick Tatman[20], Bailee Taylor, Merritt Thompson[21], Julie G Titter, Noelle Lily Van Rysselberghe[22], Harsh Wadhwa[22], Meghan Wally[12], Madison E Watts, Andrew Donald Wohler, Catherine Young, Robert D Zura[23]

[1]UNC Orthopaedics, [2]Vanderbilt Ortho Inst, [3]Georgetown University, [4]Atrium Health Mercy, [5]Atrium Health, [6]Carolinas Medical Center - Atrium Health, [7]Loyola University Health System, [8]Stanford University Sugery, [9]University of Mississippi Medical Center, [10]Atrium Health Navicent Medical Center, [11]Orthocarolina/Cmc, [12]Atrium Health Musculoskeletal Institute, [13]Atrium Health System, [14]Washington University In St. Louis, [15]San Antonio Military Medical Center, [16]Carolinas Medical Center, [17]Carolinas Med Ctr, [18]Prisma Health, [19]Prisma Health - Upstate, [20]University of Minnesota, [21]Augusta University Medical Center, [22]Stanford University, [23]LSU Health New Orleans

INTRODUCTION: Nonunions develop following nonsurgical management of humerus fractures in approximately 10-20% of fractures. The only large case series of humerus nonunions to date reported is a single surgeon review and had a union rate of 91.5% after nonunion surgery in patients whose initial fracture treatment was nonsurgical (n = 59). We created the largest dataset of patients with humerus nonunion whose initial fracture was treated nonsurgically, with the aim of better describing generalizable union rates following nonunion surgery and the risk factors for developing a recalcitrant nonunion in this population.

METHODS: Nine tertiary academic medical centers retrospectively reviewed their electronic health records to identify patients with humerus nonunions that were treated surgically. Only patients ≥18 years of age whose initial fracture was treated nonsurgically were included in this study. In addition to measuring union rates, we performed a univariate regression analysis to determine potential risk factors for development of recalcitrant nonunion (defined as failure to unite with a minimum follow up of 6 months after nonunion surgery).

RESULTS: We identified 120 patients that met inclusion criteria from a database of 2,012 long bone nonunions. Following nonunion surgery, 95 (79.2%) achieved union, while 25 (20.8%) developed recalcitrant nonunion. Thirty-six (30.0%) experienced one or more complication(s), including 9 (7.5%) that developed an infection. Only current smoking status (p=0.0073) and having a complication (p=0.0001) were significantly associated with development of recalcitrant nonunion. Interestingly, nonunion type, addition/choice of bone graft during nonunion surgery, initial fracture location, initial OTA fracture classification, body mass index, and diabetes status were not associated with development of recalcitrant nonunion.

DISCUSSION AND CONCLUSION: We found in patients with humeral nonunion whose initial fracture was managed nonsurgically, only 4 in 5 achieved union following nonunion surgery. Also, nearly 1 in 3 will experience a complication. Smoking and the development of a complication after nonunion surgery were associated with development of recalcitrant nonunion. Interestingly, the use and choice of bone graft was not associated with a difference in surgical outcomes. The success of nonunion repair should be discussed with the patient when considering nonsurgical management. In addition, surgeons and patients should carefully weigh the risks and benefits prior to pursuing surgical management of humerus nonunion. Further research is necessary to improve outcomes and optimize treatment strategies for humerus nonunion.