

High Survivorship After Hip Arthroscopy to Treat Femoroacetabular Impingement Syndrome With Capsular Plication

Factors Associated With Inferior Outcomes and Failure

SHANE J. NHO, MD, MS / GREGORY L. CVETANOVICH, MD / WILLIAM H. NEAL, BS / BENJAMIN D. KUHN, MD
JOSHUA D. HARRIS, MD / ALEXANDER E. WEBER, MD / RICHARD C. MATHER, MD, MBA

References

1. Bozic KJ, Chan V, Valone FH, 3rd, Feeley BT, Vail TP. Trends in hip arthroscopy utilization in the United States. *J Arthroplasty*. 2013;28(8 Suppl):140-143.
2. Byrd JW. Hip arthroscopy: surgical indications. *Arthroscopy*. 2006;22(12):1260-1262.
3. Philippon M, Schenker M, Briggs K, Kuppersmith D. Femoroacetabular impingement in 45 professional athletes: associated pathologies and return to sport following arthroscopic decompression. *Knee Surg Sports Traumatol Arthrosc*. 2007;15(7):908-914.
4. Gupta A, Redmond JM, Stake CE, Dunne KF, Domb BG. Does primary hip arthroscopy result in improved clinical outcomes?: 2-year clinical follow-up on a mixed group of 738 consecutive primary hip arthroscopies performed at a high-volume referral center. *Am J Sports Med*. 2016;44(1):74-82.
5. Frank RM, Lee S, Bush-Joseph CA, Kelly BT, Salata MJ, Nho SJ. Improved outcomes after hip arthroscopic surgery in patients undergoing T-capsulotomy with complete repair versus partial repair for femoroacetabular impingement: a comparative matched-pair analysis. *Am J Sports Med*. 2014;42(11):2634-2642.
6. Shindle MK, Voos JE, Nho SJ, Heyworth BE, Kelly BT. Arthroscopic management of labral tears in the hip. *J Bone Joint Surg Am*. 2008;90 Suppl 4:2-19.
7. Weber AE, Harris JD, Nho SJ. Complications in hip arthroscopy: a systematic review and strategies for prevention. *Sports Med Arthrosc*. 2015;23(4):187-193.
8. Frank RM, Lee S, Bush-Joseph CA, Salata MJ, Mather RC, 3rd, Nho SJ. Outcomes for hip arthroscopy according to sex and age: a comparative matched-group analysis. *J Bone Joint Surg Am*. 2016;98(10):797-804.
9. Harris JD, McCormick FM, Abrams GD, Gupta AK, Ellis TJ, Bach BR, Jr., Bush-Joseph CA, Nho SJ. Complications and reoperations during and after hip arthroscopy: a systematic review of 92 studies and more than 6,000 patients. *Arthroscopy*. 2013;29(3):589-595.
10. Federer AE, Taylor DC, Mather RC, 3rd. Using evidence-based algorithms to improve clinical decision making: the case of a first-time anterior shoulder dislocation. *Sports Med Arthrosc*. 2013;21(3):155-165.
11. McCormick F, Nwachukwu BU, Alpaugh K, Martin SD. Predictors of hip arthroscopy outcomes for labral tears at minimum 2-year follow-up: the influence of age and arthritis. *Arthroscopy*. 2012;28(10):1359-1364.
12. McCarthy JC, Jarrett BT, Ojeifo O, Lee JA, Bragdon CR. What factors influence long-term survivorship after hip arthroscopy? *Clin Orthop Relat Res*. 2011;469(2):362-371.
13. Philippon MJ, Briggs KK, Carlisle JC, Patterson DC. Joint space predicts THA after hip arthroscopy in patients 50 years and older. *Clin Orthop Relat Res*. 2013;471(8):2492-2496.
14. Skendzel JG, Philippon MJ, Briggs KK, Goljan P. The effect of joint space on midterm outcomes after arthroscopic hip surgery for femoroacetabular impingement. *Am J Sports Med*. 2014;42(5):1127-1133.
15. Larson CM, Giveans MR, Taylor M. Does arthroscopic FAI correction improve function with radiographic arthritis? *Clin Orthop Relat Res*. 2011;469(6):1667-1676.
16. Chandrasekaran S, Darwish N, Gui C, Lodhia P, Suarez-Ahedo C, Domb BG. Outcomes of hip arthroscopy in patients with tonnis grade-2 osteoarthritis at a mean 2-year follow-up: evaluation using a matched-pair analysis with tonnis grade-0 and grade-1 cohorts. *J Bone Joint Surg Am*. 2016;98(12):973-982.
17. Bogunovic L, Gottlieb M, Pashos G, Baca G, Clohisy JC. Why do hip arthroscopy procedures fail? *Clin Orthop Relat Res*. 2013;471(8):2523-2529.
18. Ross JR, Larson CM, Adeoye O, Kelly BT, Bedi A. Residual deformity is the most common reason for revision hip arthroscopy: a three-dimensional CT study. *Clin Orthop Relat Res*. 2015;473(4):1388-1395.
19. Larson CM, Giveans MR, Stone RM. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: mean 3.5-year follow-up. *Am J Sports Med*. 2012;40(5):1015-1021.
20. Freeman CR, Azzam MG, Leunig M. Hip preservation surgery: surgical care for femoroacetabular impingement and the possibility of preventing hip osteoarthritis. *J Hip Preserv Surg*. 2014;1(2):46-55.
21. Krych AJ, Thompson M, Knutson Z, Scoon J, Coleman SH. Arthroscopic labral repair versus selective labral debridement in female patients with femoroacetabular impingement: a prospective randomized study. *Arthroscopy*. 2013;29(1):46-53.

22. Kuhns BD, Weber AE, Levy DM, Bedi A, Mather RC, 3rd, Salata MJ, Nho SJ. Capsular management in hip arthroscopy: an anatomic, biomechanical, and technical review. *Front Surg*. 2016;3:13.
23. Wylie JD, Beckmann JT, Maak TG, Aoki SK. Arthroscopic capsular repair for symptomatic hip instability after previous hip arthroscopic surgery. *Am J Sports Med*. 2016;44(1):39-45.
24. Abrams GD, Hart MA, Takami K, Bayne CO, Kelly BT, Espinoza Orias AA, Nho SJ. Biomechanical evaluation of capsulotomy, capsulectomy, and capsular repair on hip rotation. *Arthroscopy*. 2015;31(8):1511-1517.
25. Lee S, Cvetanovich GL, Mascarenhas R, et al. Ability to return to work without restrictions in workers compensation patients undergoing hip arthroscopy. *J Hip Preserv Surg*. 2017;4(1):30-38.
26. Saltzman BM, Kuhns BD, Basques B, et al. The influence of body mass index on outcomes after hip arthroscopic surgery with capsular plication for the treatment of femoroacetabular impingement. *Am J Sports Med*. 2017;45(10):2303-2311.
27. Cvetanovich GL, Harris JD, Erickson BJ, Bach BR, Jr., Bush-Joseph CA, Nho SJ. Revision hip arthroscopy: a systematic review of diagnoses, operative findings, and outcomes. *Arthroscopy*. 2015;31(7):1382-1390.
28. Malviya A, Raza A, Jameson S, James P, Reed MR, Partington PF. Complications and survival analyses of hip arthroscopies performed in the National Health Service in England: a review of 6,395 cases. *Arthroscopy*. 2015;31(5):836-842.
29. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev*. 2015;4:1.
30. Weber AE, Jacobson JA, Bedi A. A review of imaging modalities for the hip. *Curr Rev Musculoskelet Med*. 2013;6(3):226-234.
31. Clohisey JC, Carlisle JC, Beaulé PE, Kim YJ, Trousdale RT, Sierra RJ, Leunig M, Schoenecker PL, Millis MB. A systematic approach to the plain radiographic evaluation of the young adult hip. *J Bone Joint Surg Am*. 2008;90 Suppl 4:47-66.
32. Notzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. *J Bone Joint Surg Br*. 2002;84(4):556-560.
33. Tonnis D, Heinecke A, Nienhaus R, Thiele J. [Predetermination of arthrosis, pain and limitation of movement in congenital hip dysplasia (author's transl)]. *Z Orthop Ihre Grenzgeb*. 1979;117(5):808-815.
34. Martin RL, Kelly BT, Philippon MJ. Evidence of validity for the hip outcome score. *Arthroscopy*. 2006;22(12):1304-1311.
35. Martin RL, Philippon MJ. Evidence of reliability and responsiveness for the hip outcome score. *Arthroscopy*. 2008;24(6):676-682.
36. Byrd JW. Hip arthroscopy: patient assessment and indications. *Instr Course Lect*. 2003;52:711-719.
37. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am*. 1969;51(4):737-755.
38. Philippon MJ, Schenker ML, Briggs KK, Kuppersmith DA, Maxwell RB, Stubbs AJ. Revision hip arthroscopy. *Am J Sports Med*. 2007;35(11):1918-1921.
39. Ricciardi BF, Fields K, Kelly BT, Ranawat AS, Coleman SH, Sink EL. Causes and risk factors for revision hip preservation surgery. *Am J Sports Med*. 2014;42(11):2627-2633.
40. Larson CM, Ross JR, Stone RM, Samuelson KM, Schelling EF, Giveans MR, Bedi A. Arthroscopic management of dysplastic hip deformities: predictors of success and failures With comparison to an arthroscopic FAI cohort. *Am J Sports Med*. 2016;44(2):447-453.
41. Nwachukwu BU, Fields K, Chang B, Nawabi DH, Kelly BT, Ranawat AS. Preoperative outcome scores are predictive of achieving the minimal clinically important difference after arthroscopic treatment of femoroacetabular impingement. *Am J Sports Med*. 2017;45:612-619.
42. Sawyer GA, Briggs KK, Dornan GJ, Ommen ND, Philippon MJ. Clinical outcomes after arthroscopic hip labral repair using looped versus pierced suture techniques. *Am J Sports Med*. 2015;43(7):1683-1688.
43. Horisberger M, Brunner A, Herzog RF. Arthroscopic treatment of femoral acetabular impingement in patients with preoperative generalized degenerative changes. *Arthroscopy*. 2010;26(5):623-629.
44. Philippon MJ, Schroder ESG, Briggs KK. Hip arthroscopy for femoroacetabular impingement in patients aged 50 years or older. *Arthroscopy*. 2012;28(1):59-65.
45. Lavernia CJ, Alcerro JC, Brooks LG, Rossi MD. Mental health and outcomes in primary total joint arthroplasty. *The Journal of arthroplasty*. 2012;27:1276-1282.
46. Hossain M, Parfitt DJ, Beard DJ, et al. Does pre-operative psychological distress affect patient satisfaction after primary total hip arthroplasty? *BMC Musculoskeletal Disorders*. 2011;12:122.
47. Potter MQ, Wylie JD, Sun GS, Beckmann JT, Aoki SK. Psychologic distress reduces preoperative self-assessment scores in femoroacetabular impingement patients. *Clinical Orthopaedics and Related Research*. 2014;472(6):1886-1892.
48. Kamath AF, Componovo R, Baldwin K, Israelite CL, Nelson CL. Hip arthroscopy for labral tears: review of clinical outcomes with 4.8-year mean follow-up. *Am J Sports Med*. 2009;37(9):1721-1727.
49. Hoppe DJ, de Sa D, Simunovic N, Bhandari M, Safran MR, Larson CM, Ayeni OR. The learning curve for hip arthroscopy: a systematic review. *Arthroscopy*. 2014;30(3):389-397.
50. Dietrich F, Ries C, Eiermann C, Miehle W, Sobau C. Complications in hip arthroscopy: necessity of supervision during the learning curve. *Knee Surg Sports Traumatol Arthrosc*. 2014;22(4):953-958.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Multimodal Analgesia

Reducing Opioid Consumption for Patients Undergoing Spinal Surgery

BENJAMIN KHECHEN, BA / BRITTANY E. HAWS, BS / PHILIP K. LOUIE, MD / KAITLYN L. CARDINAL, BS
JORDAN A. GUNTIN, BS / ASOKUMAR BUVANENDRAN, MD / FRANK M. PHILLIPS, MD / KERN SINGH, MD

References

1. Morris BJ, Mir HR. The opioid epidemic: impact on orthopaedic surgery. *J Am Acad Orthop Surg*. 2015;23(5):267-271.
2. Chai G, Xu J, Osterhout J, et al. New opioid analgesic approvals and outpatient utilization of opioid analgesics in the United States, 1997 through 2015. *Anesthesiology*. 2018;128(5):953-966.
3. *International Narcotics Control Board Report 2008*. United Nations Pubns2009.
4. Rudd R, Aleshire N, Zibbell J, Gladden R. *Increases in Drug and Opioid Overdose Deaths — United States, 2000–2014*. 2016.
5. Lanser P, Gesell S. Pain management: the fifth vital sign. *Healthc Benchmarks*. 2001;8(6):68-70, 62.
6. Jha AK, Orav EJ, Zheng J, Epstein AM. Patients' perception of hospital care in the United States. *N Engl J Med*. 2008;359(18):1921-1931.
7. Meier B. 3 officials are sentenced in case involving OxyContin. *The New York Times* Jul 21; 2007;C: 4.
8. Cicero TJ, Inciardi JA, Munoz A. Trends in abuse of Oxycontin and other opioid analgesics in the United States: 2002-2004. *J Pain*. 2005;6(10):662-672.
9. Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. *JAMA*. 2011;305(13):1299-1301.
10. Lee D, Armaghani S, Archer KR, et al. Preoperative opioid use as a predictor of adverse postoperative self-reported outcomes in patients undergoing spine surgery. *J Bone Joint Surg Am*. 2014;96(11):e89.
11. Luo X, Pietrobon R, Sun SX, Liu GG, Hey L. Estimates and patterns of direct health care expenditures among individuals with back pain in the United States. *Spine (Phila Pa 1976)*. 2004;29(1):79-86.
12. Manchikanti L. Epidemiology of low back pain. *Pain Physician*. 2000;3(2):167-192.
13. Manchikanti L, Singh V, Falco FJ, Benyamin RM, Hirsch JA. Epidemiology of low back pain in adults. *Neuromodulation*. 2014;17 Suppl 2:3-10.
14. Walid MS, Hyer L, Ajjan M, Barth AC, Robinson JS. Prevalence of opioid dependence in spine surgery patients and correlation with length of stay. *J Opioid Manag*. 2007;3(3):127-128, 130-122.
15. Armaghani SJ, Lee DS, Bible JE, et al. Preoperative narcotic use and its relation to depression and anxiety in patients undergoing spine surgery. *Spine (Phila Pa 1976)*. 2013;38(25):2196-2200.
16. Papanastassiou I, Anderson R, Barber N, Conover C, Castellvi AE. Effects of preoperative education on spinal surgery patients. *SAS J*. 2011;5(4):120-124.
17. Mobbs RJ, Sivabalan P, Li J. Minimally invasive surgery compared to open spinal fusion for the treatment of degenerative lumbar spine pathologies. *J Clin Neurosci*. 2012;19(6):829-835.
18. Parker SL, Lerner J, McGirt MJ. Effect of minimally invasive technique on return to work and narcotic use following transforaminal lumbar inter-body fusion: a review. *Prof Case Manag*. 2012;17(5):229-235.
19. Mathiesen O, Dahl B, Thomsen BA, et al. A comprehensive multimodal pain treatment reduces opioid consumption after multilevel spine surgery. *Eur Spine J*. 2013;22(9):2089-2096.
20. Garcia RM, Cassinelli EH, Messerschmitt PJ, Furey CG, Bohlman HH. A multimodal approach for postoperative pain management after lumbar decompression surgery: a prospective, randomized study. *J Spinal Disord Tech*. 2013;26(6):291-297.
21. Rajpal S, Gordon DB, Pellino TA, et al. Comparison of perioperative oral multimodal analgesia versus iv pca for spine surgery. *J Spinal Disord Tech*. 2010;23(2):139-145.
22. Buvanendran A, Thillainathan V. Preoperative and postoperative anesthetic and analgesic techniques for minimally invasive surgery of the spine. *Spine (Phila Pa 1976)*. 2010;35(26 Suppl):S274-280.
23. Vendittoli PA, Makinen P, Drolet P, et al. A multimodal analgesia protocol for total knee arthroplasty. *J Bone Joint Surg Am*. 2006;88(2):282-289.
24. Young A, Buvanendran A. Recent advances in multimodal analgesia. *Anesthesiol Clin*. 2012;30(1):91-100.
25. Ranawat AS, Ranawat CS. Pain management and accelerated rehabilitation for total hip and total knee arthroplasty. *J Arthroplasty*. 2007;22(7 suppl):12-15.
26. Ahn J, Bohl DD, Tabaraee E, Basques BA, Singh K. Current trends in outpatient spine surgery. *Clin Spine Surg*. 2016;29(9):384-386.
27. Kehlet H, Dahl JB. The value of "multimodal" or "balanced analgesia" in postoperative pain treatment. *Anesth Analg*. 1993;77(5):1048-1056.
28. An HS, Simpson JM, Stein R. Outpatient laminotomy and discectomy. *J Spinal Disord Tech*. 1999;12(3):192-195.
29. Baird EO, Egorova NN, McAnany SJ, Qureshi SA, Hecht AC, Cho SK. National trends in outpatient surgical treatment of degenerative cervical spine disease. *Global Spine J*. 2014;4(3):143-150.

30. Bekelis K, Missios S, Kakoulides G, Rahmani R, Simmons N. Selection of patients for ambulatory lumbar discectomy: results from four US states. *Spine J*. 2014;14(9):1944-1950.
31. Chin KR, Coombs AV, Seale JA. Feasibility and patient-reported outcomes after outpatient single-level instrumented posterior lumbar interbody fusion in a surgery center: preliminary results in 16 patients. *Spine*. 2015;40(1):E36-E42.
32. Pugely AJ, Martin CT, Gao Y, Mendoza-Lattes SA. Outpatient surgery reduces short-term complications in lumbar discectomy: an analysis of 4310 patients from the ACS-NSQIP database. *Spine*. 2013;38(3):264-271.
33. Zahrawi F. Microlumbar discectomy: is it safe as an outpatient procedure? *Spine*. 1994;19(9):1070-1074.
34. Oka Y, Murata A, Nishijima J, et al. Circulating interleukin 6 as a useful marker for predicting postoperative complications. *Cytokine*. 1992;4(4):298-304.
35. Buvanendran A, Kroin JS, Berger RA, et al. Upregulation of prostaglandin E2 and interleukins in the central nervous system and peripheral tissue during and after surgery in humans. *Anesthesiology*. 2006;104(3):403-410.
36. Cruickshank AM, Fraser WD, Burns HJ, Van Damme J, Shenkin A. Response of serum interleukin-6 in patients undergoing elective surgery of varying severity. *Clin Sci (Lond)*. 1990;79(2):161-165.
37. Buvanendran A, Kroin JS. Multimodal analgesia for controlling acute postoperative pain. *Curr Opin Anaesthesiol*. 2009;22(5):588-593.
38. K. Murata, M. Yoshimoto, T. Takebayashi, K. Ida, K. Nakano, Yamashita. T. Effect of cryotherapy after spine surgery. *Asian Spine J*. 2014;8(6):753-758.
39. Fountas KN, Kapsalaki EZ, Johnston KW, Smisson HF, Vogel RL, Robinson JS Jr. Postoperative lumbar microdiscectomy pain: minimalization by irrigation and cooling. *Spine (Phila Pa 1976)*. 1999;24(18):1958-1960.
40. Brander B, Munro B, Bromley LM, Hetreed M. Evaluation of the contribution to postoperative analgesia by local cooling of the wound. *Anaesthesia*. 1996;51:1021-1025.
41. Katzung BG, Masters S, Trevor AJ. *Basic and Clinical Pharmacology*. 13th ed. New York, NY: McGraw-Hill Education; 2014.
42. Lee SK, Lee JW, Choy WS. Is multimodal analgesia as effective as postoperative patient-controlled analgesia following upper extremity surgery? *Orthop Traumatol Surg Res*. 2013;99(8):895-901.
43. Jo CH, Shin JS, Huh J. Multimodal analgesia for arthroscopic rotator cuff repair: a randomized, placebo-controlled, double-blind trial. *Eur J Orthop Surg Traumatol*. 2014;24(3):315-322.
44. Lamplot JD, Wagner ER, Manning DW. Multimodal pain management in total knee arthroplasty: a prospective randomized controlled trial. *J Arthroplasty*. 2014;29(2):329-334.
45. Baratta JL, Gandhi K, Viscusi ER. Perioperative pain management for total knee arthroplasty. *J Surg Orthop Adv*. 2014;23(1):22-36.
46. Rajpal S, Gordon DB, Pellino TA, et al. Comparison of perioperative oral multimodal analgesia versus IV PCA for spine surgery. *J Spinal Disord Tech*. 2010;23(2):139-145.
47. Garcia RM, Cassinelli EH, Messerschmitt PJ, Furey CG, Bohlman HH. A multimodal approach for postoperative pain management after lumbar decompression surgery: a prospective, randomized study. *J Spinal Disord Tech*. 2013;26(6):291-297.
48. Bohl DD, Louie PK, Shah N, et al. Multimodal versus patient-controlled analgesia after an anterior cervical decompression and fusion. *Spine (Phila Pa 1976)*. 2016;41(12):994-998.
49. Singh K, Bohl DD, Ahn J, et al. Multimodal analgesia versus intravenous patient-controlled analgesia for minimally invasive transforaminal lumbar interbody fusion procedures. *Spine (Phila Pa 1976)*. 2017;42(15):1145-1150.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Decisions and Incisions

Lessons Learned in Building a Value-Driven Practice

KAMRAN S. HAMID, MD, MPH

References

1. Porter ME. What is value in health care? *New Engl J Med*. 2010;363(26):2477-81.
2. Nwachukwu BU, Hamid KS, Bozic KJ. Measuring value in orthopaedic surgery. *JBJS Rev*. 2013;1(1).
3. Hamid KS, Nwachukwu BU, Poehling GG. Lights, camera, action: How to make arthroscopy a star in value-based health care. *Arthroscopy*. 2013;29(12):1900-1.
4. Hamid KS, Nwachukwu BU, Ellis SJ. Competing in value-based health care: Keys to winning the foot race. *Foot Ankle Int*. 2014;35(5):519-28.
5. Hamid KS, Nwachukwu BU, Bozic KJ. Decisions and incisions: A value-driven practice framework for academic surgeons. *J Bone Joint Surg Am*. 2017;99(10):e50.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Vertebral Osteitis as the Sole Manifestation of SAPHO Syndrome

A Case Report and Review of the Literature

BRYCE A. BASQUES, MD / MARINOS KONTZIALIS, MD / DAVID F. FARDON, MD

References

1. Chamot AM, Benhamou CL, Kahn MF, Beranek L, Kaplan G, Prost A. Acne-pustulosis-hyperostosis-osteitis syndrome. Results of a national survey. 85 cases. *Revue du rhumatisme et des maladies osteo-articulaires*. 1987 Mar;54(3):187-96. Epub 1987/03/01.
2. Takigawa T, Tanaka M, Nakahara S, Sugimoto Y, Ozaki T. SAPHO syndrome with rapidly progressing destructive spondylitis: two cases treated surgically. *Eur Spine J*. 2008 Sep;17 Suppl 2:S331-7. Epub 2008/04/05.
3. Hayem G, Bouchaud-Chabot A, Benali K, Roux S, Palazzo E, Silbermann-Hoffman O, Kahn M-F, Meyer O. SAPHO syndrome: A long-term follow-up study of 120 cases. *Semin Arthritis Rheum*. 29(3):159-71.
4. Court C, Charlez C, Molina V, Clerc D, Miquel A, Nordin JY. Isolated thoracic spine lesion: is this the presentation of a SAPHO syndrome? A case report. *Eur Spine J*. 2005 Sep;14(7):711-5. Epub 2004/10/14.
5. Boutin RD, Resnick D. The SAPHO syndrome: an evolving concept for unifying several idiopathic disorders of bone and skin. *Am J Roentgenol*. 1998 Mar;170(3):585-91. Epub 1998/03/10.
6. Benhamou CL, Chamot AM, Kahn MF. Synovitis-acne-pustulosis hyperostosis-osteomyelitis syndrome (SAPHO). A new syndrome among the spondyloarthropathies? *Clin Exp Rheumatol*. 1988 Apr-Jun;6(2):109-12. Epub 1988/04/01.
7. Kotilainen P, Gullichsen RE, Saario R, Manner I, Kotilainen E. Aseptic spondylitis as the initial manifestation of the SAPHO syndrome. *Eur Spine J*. 1997;6(5):327-9. Epub 1997/01/01.
8. McGauvran AM, Kotsenas AL, Diehn FE, Wald JT, Carr CM, Morris JM. SAPHO Syndrome: Imaging Findings of Vertebral Involvement. *Am J Neuroradiol*. 2016 Aug;37(8):1567-72.
9. Peffers G, James SL, Stirling A, Jobanputra P. Thoracic spine osteitis: a distinct clinical entity, a variant of SAPHO or late-onset non-bacterial osteitis? *Rheumatology*. 2012 Jan;51(1):191-3.
10. Rukavina I. SAPHO syndrome: a review. *J Child Orthop*. 2015 Feb;9(1):19-27. Epub 2015/01/15.
11. Paparo F, Revelli M, Semprini A, Camellino D, Garlaschi A, Cimmino MA, Rollandi GA, Leone A. Seronegative spondyloarthropathies: what radiologists should know. *La Radiologia Medica*. 2014 Mar;119(3):156-63. Epub 2013/11/26.
12. Mester AR, Makó EK, Karlinger K, Györke T, Tarján Z, Márton E, Kiss K. Enteropathic arthritis in the sacroiliac joint. Imaging and differential diagnosis. *Eur J Radiol*. 2000 2000/09/01;35(3):199-208.
13. Laredo JD, Vuillemin-Bodaghi V, Boutry N, Cotten A, Parlier-Cuau C. SAPHO syndrome: MR appearance of vertebral involvement. *Radiology*. 2007 Mar;242(3):825-31.
14. Leone A, Cassar-Pullicino VN, Casale R, Magarelli N, Semprini A, Colosimo C. The SAPHO syndrome revisited with an emphasis on spinal manifestations. *Skeletal Radiol*. 2015 Jan;44(1):9-24. Epub 2014/10/22.
15. Depasquale R, Kumar N, Lalam RK, Tins BJ, Tyrrell PN, Singh J, Cassar-Pullicino VN. SAPHO: What radiologists should know. *Clin Radiol*. 2012 Mar;67(3):195-206. Epub 2011/09/24.
16. Takigawa T, Tanaka M, Nakanishi K, Misawa H, Sugimoto Y, Takahata T, Nakahara H, Nakahara S, Ozaki T. SAPHO syndrome associated spondylitis. *Eur Spine J*. 2008 Oct;17(10):1391-7. Epub 2008/07/22.
17. Toussiroit E, Dupond JL, Wendling D. Spondylodiscitis in SAPHO syndrome. A series of eight cases. *Ann Rheum Dis*. 1997 Jan;56(1):52-8. Epub 1997/01/01.
18. Firinu D, Garcia-Larsen V, Manconi PE, Del Giacco SR. SAPHO Syndrome: Current Developments and Approaches to Clinical Treatment. *Curr Rheumatol Rep*. 2016 Jun;18(6):35. Epub 2016/04/25.
19. Firinu D, Murgia G, Lorrain MM, Barca MP, Peralta MM, Manconi PE, del Giacco SR. Biological treatments for SAPHO syndrome: an update. *Inflamm Allergy Drug Targets*. 2014;13(3):199-205. Epub 2014/05/23.
20. Cianci F, Zoli A, Gremese E, Ferraccioli G. Clinical heterogeneity of SAPHO syndrome: challenging diagnose and treatment. *Clin Rheum*. 2017 Jul 19. Epub 2017/07/21.
21. Colina M, Govoni M, Orzincolo C, Trotta F. Clinical and radiologic evolution of synovitis, acne, pustulosis, hyperostosis, and osteitis syndrome: a single center study of a cohort of 71 subjects. *Arthritis Rheum*. 2009 Jun 15;61(6):813-21. Epub 2009/05/30.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Dynamic 3-Dimensional Mapping of Isometric Attachment Sites on the Lateral Aspect of the Knee for Anterolateral Ligament Reconstruction

BRIAN FORSYTHE, MD / AVINESH AGARWALLA, BS / DREW A. LANSDOWN, MD / RICHARD PUZZITIELLO, BS
NIKHIL N. VERMA, MD / BRIAN J. COLE, MD, MBA / BERNARD R. BACH JR, MD / NOZOMU INOUE, MD, PHD

References

1. Claes S, Bartholomeeusen S, Bellemans J. High prevalence of anterolateral ligament abnormalities in magnetic resonance images of anterior cruciate ligament-injured knees. *Acta Orthop Belg.* 2014;80(1):45-49.
2. Helito CP, Helito PV, Costa HP, Demange MK, Bordalo-Rodrigues M. Assessment of the Anterolateral Ligament of the Knee by Magnetic Resonance Imaging in Acute Injuries of the Anterior Cruciate Ligament. *Arthroscopy.* 2017;33(1):140-146.
3. Parsons EM, Gee AO, Spiekerman C, Cavanagh PR. The Biomechanical Function of the Anterolateral Ligament of the Knee: Response. *Am J Sports Med.* 2015;43(8):NP22.
4. Rasmussen MT, Nitri M, Williams BT, et al. An In Vitro Robotic Assessment of the Anterolateral Ligament, Part 1: Secondary Role of the Anterolateral Ligament in the Setting of an Anterior Cruciate Ligament Injury. *Am J Sports Med.* 2016;44(3):585-592.
5. Claes S, Vereecke E, Maes M, Victor J, Verdonk P, Bellemans J. Anatomy of the anterolateral ligament of the knee. *J Anat.* 2013;223(4):321-328.
6. Nitri M, Rasmussen MT, Williams BT, et al. An In Vitro Robotic Assessment of the Anterolateral Ligament, Part 2: Anterolateral Ligament Reconstruction Combined With Anterior Cruciate Ligament Reconstruction. *Am J Sports Med.* 2016;44(3):593-601.
7. Kanamori A, Zeminski J, Rudy TW, Li G, Fu FH, Woo SL. The effect of axial tibial torque on the function of the anterior cruciate ligament: a biomechanical study of a simulated pivot shift test. *Arthroscopy.* 2002;18(4):394-398.
8. Thauinat M, Clowez G, Saithna A, et al. Reoperation Rates After Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction: A Series of 548 Patients From the SANTI Study Group With a Minimum Follow-up of 2 Years. *Am J Sports Med.* 2017;45(11):2569-2577.
9. Sonnery-Cottet B, Daggett M, Lutz C, Imbert P, Thauinat M. Outcomes After Combined ACL and ALL Reconstruction: Response. *Am J Sports Med.* 2015;43(7):NP17-18.
10. Dodds AL, Halewood C, Gupte CM, Williams A, Amis AA. The anterolateral ligament: Anatomy, length changes and association with the Segond fracture. *Bone Joint J.* 2014;96-B(3):325-331.
11. Kennedy MI, Claes S, Fuso FA, et al. The Anterolateral Ligament: An Anatomic, Radiographic, and Biomechanical Analysis. *Am J Sports Med.* 2015;43(7):1606-1615.
12. Neri T, Palpacuer F, Testa R, et al. The anterolateral ligament: Anatomic implications for its reconstruction. *Knee.* 2017;24(5):1083-1089.
13. Runer A, Birkmaier S, Pamminger M, et al. The anterolateral ligament of the knee: A dissection study. *Knee.* 2016;23(1):8-12.
14. Patel RM, Brophy RH. Anterolateral Ligament of the Knee: Anatomy, Function, Imaging, and Treatment. *Am J Sports Med.* 2017;363546517695802.
15. Daggett M, Ockuly AC, Cullen M, et al. Femoral Origin of the Anterolateral Ligament: An Anatomic Analysis. *Arthroscopy.* 2016;32(5):835-841.
16. Imbert P, Lutz C, Daggett M, et al. Isometric Characteristics of the Anterolateral Ligament of the Knee: A Cadaveric Navigation Study. *Arthroscopy.* 2016;32(10):2017-2024.
17. Helito CP, Helito PV, Bonadio MB, et al. Evaluation of the Length and Isometric Pattern of the Anterolateral Ligament With Serial Computer Tomography. *Orthop J Sports Med.* 2014;2(12):2325967114562205.
18. Van de Velde SK, Kernkamp WA, Hosseini A, LaPrade RF, van Arkel ER, Li G. In Vivo Length Changes of the Anterolateral Ligament and Related Extra-articular Reconstructions. *Am J Sports Med.* 2016;44(10):2557-2562.
19. DePhillipo NN, Cinque ME, Chahla J, Geeslin AG, LaPrade RF. Anterolateral Ligament Reconstruction Techniques, Biomechanics, and Clinical Outcomes: A Systematic Review. *Arthroscopy.* 2017;33(8):1575-1583.
20. Caterine S, Litchfield R, Johnson M, Chronik B, Getgood A. A cadaveric study of the anterolateral ligament: re-introducing the lateral capsular ligament. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(11):3186-3195.
21. Chahla J, Menge TJ, Mitchell JJ, Dean CS, LaPrade RF. Anterolateral Ligament Reconstruction Technique: An Anatomic-Based Approach. *Arthrosc Tech.* 2016;5(3):e453-457.
22. Smith JO, Yasen SK, Lord B, Wilson AJ. Combined anterolateral ligament and anatomic anterior cruciate ligament reconstruction of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(11):3151-3156.

23. Wagih AM, Elguindy AM. Percutaneous Reconstruction of the Anterolateral Ligament of the Knee With a Polyester Tape. *Arthrosc Tech*. 2016;5(4):e691-e697.
24. Helito CP, Bonadio MB, Gobbi RG, et al. Combined Intra- and Extra-articular Reconstruction of the Anterior Cruciate Ligament: The Reconstruction of the Knee Anterolateral Ligament. *Arthrosc Tech*. 2015;4(3):e239-244.
25. Sidles JA, Larson RV, Garbini JL, Downey DJ, Matsen FA, 3rd. Ligament length relationships in the moving knee. *J Orthop Res*. 1988;6(4):593-610.
26. Nawabi DH, Tucker S, Schafer KA, et al. ACL Fibers Near the Lateral Intercondylar Ridge Are the Most Load Bearing During Stability Examinations and Isometric Through Passive Flexion. *Am J Sports Med*. 2016;44(10):2563-2571.
27. Wieser K, Furnstahl P, Carrillo F, Fucentese SF, Vlachopoulos L. Assessment of the Isometry of the Anterolateral Ligament in a 3-Dimensional Weight-Bearing Computed Tomography Simulation. *Arthroscopy*. 2017;33(5):1016-1023.
28. Schon JM, Moatshe G, Brady AW, et al. Anatomic Anterolateral Ligament Reconstruction Leads to Overconstraint at Any Fixation Angle: Response. *Am J Sports Med*. 2016;44(10):NP58-NP59.
29. Sonnery-Cottet B. Editorial Commentary: Do We Need to Look for Isometry in Anterolateral Ligament Reconstruction? *Arthroscopy*. 2017;33(5):1024-1025.
30. Sonnery-Cottet B, Thaunat M, Freychet B, Pupim BH, Murphy CG, Claes S. Outcome of a Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction Technique With a Minimum 2-Year Follow-up. *Am J Sports Med*. 2015;43(7):1598-1605.
31. Schon JM, Moatshe G, Brady AW, et al. Anatomic Anterolateral Ligament Reconstruction of the Knee Leads to Overconstraint at Any Fixation Angle. *Am J Sports Med*. 2016;44(10):2546-2556.
32. Spencer L, Burkhart TA, Tran MN, et al. Biomechanical analysis of simulated clinical testing and reconstruction of the anterolateral ligament of the knee. *Am J Sports Med*. 2015;43(9):2189-2197.
33. Nicholls M, Aspelund T, Ingvarsson T, Briem K. Nationwide study highlights a second peak in ACL tears for women in their early forties. *Knee Surg Sports Traumatol Arthrosc*. 2017.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Engaging Patients in Technology-Driven Times

Introducing a Patient Engagement Text-Messaging Bot Into an Orthopedic Surgery Practice

KEVIN J. CAMPBELL, MD / PHILLIP K. LOUIE, MD / DANIEL D. BOHL, MD, MPH / BRETT R. LEVINE MD, MS / TAD GERLINGER, MD

References

1. Goyal N, Chen AF, Padgett SE, et al. Otto Aufranc Award: a multicenter, randomized study of outpatient versus inpatient total hip arthroplasty. *Clin Orthop Relat Res.* 2017;475(2):364-372. doi:10.1007/s11999-016-4915-z.
2. Pollock M, Somerville L, Firth A, Lanting B. Outpatient total hip arthroplasty, total knee arthroplasty, and unicompartmental knee arthroplasty: a systematic review of the literature. *JBJS Rev.* 2016;4(12):1. doi:10.2106/JBJS.RVW.16.00002.
3. Irizarry T, DeVito Dabbs A, Curran CR. Patient portals and patient engagement: a state of the science review. *J Med Internet Res.* 2015;17(6):e148. doi:10.2196/jmir.4255.
4. Coulter A, Ellins J. Effectiveness of strategies for informing, educating, and involving patients. *BMJ.* 2007;335(7609):24-27. doi:10.1136/bmj.39246.581169.80.
5. Coulter A. Patient engagement--what works? *J Ambul Care Manage.* 2012;35(2):80-89. doi:10.1097/JAC.0b013e318249e0fd.
6. Greene J, Hibbard JH. Why does patient activation matter? An examination of the relationships between patient activation and health-related outcomes. *J Gen Intern Med.* 2012;27(5):520-526. doi:10.1007/s11606-011-1931-2.
7. Domecq JP, Prutsky G, Elraiyah T, et al. Patient engagement in research: a systematic review. *BMC Health Serv Res.* 2014;14(1):89. doi:10.1186/1472-6963-14-89.
8. Manary MP, Boulding W, Staelin R, Glickman SW. The patient experience and health outcomes. *N Engl J Med.* 2013;368(3):201-203. doi:10.1056/NEJMp1211775.
9. Centers for Medicare Medicaid Services CMS. Patient Engagement Playbook. <https://www.healthit.gov/playbook/pe/>.
10. Levitas D. International Data Corporation (IDC). *Always Connected: How Smartphones and Social Keep Us Engaged.* 2013.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Establishing Maximum Medical Improvement After Anatomic Total Shoulder Arthroplasty

RICHARD PUZZITIELLO, BS / AVINESH AGARWALLA, BS / JOSEPH LIU, MD / GREGORY L. CVETANOVICH, MD
ANTHONY A. ROMEO, MD / BRIAN FORSYTHE, MD / NIKHIL VERMA, MD

References

1. Routman HD, Flurin P-H, Wright TW, Zuckerman JD, Hamilton MA, Roche CP. Reverse Shoulder Arthroplasty Prosthesis Design Classification System. *Bulletin of the Hospital for Joint Diseases*. 2015;73(Supplement):S5-S13.
2. Padegimas EM, Maltenfort M, Lazarus MD, Ramsey ML, Williams GR, Namdari S. Future Patient Demand for Shoulder Arthroplasty by Younger Patients: National Projections. *Clinical Orthopaedics and Related Research*®. 2015;473(6):1860-1867. 10.1007/s11999-015-4231-z
3. Keehan SP, Cuckler GA, Sisko AM, et al. National Health Expenditure Projections, 2014–24: Spending Growth Faster Than Recent Trends. *Health Affairs*. 2015;34(8):1407-1417. 10.1377/hlthaff.2015.0600
4. Callahan CD, Adair D, Bozic KJ, Manning BT, Saleh JK, Saleh KJ. Orthopaedic Surgery Under National Health Reform: An Analysis of Power, Process, Adaptation, and Leadership AOA Critical Issues. *JBJS*. 2014;96(13):e111. 10.2106/jbjs.m.01067
5. Mather RC, Bozic KJ. Value-based care. *Journal of Shoulder and Elbow Surgery*. 2013;22(12):1599-1600. <https://doi.org/10.1016/j.jse.2013.10.007>
6. Ring D, Bozic KJ. Value-based Healthcare: The Value of Considering Patient Preferences and Circumstances in Orthopaedic Surgery. *Clinical Orthopaedics and Related Research*. 2016;474(3):633-635. 10.1007/s11999-015-4648-4
7. Jaeschke R, Singer J, Guyatt G. *Measurement of Health Status: Ascertaining the Minimal Clinically Important Difference*. Vol 101990.
8. Tilburt JC, Montori VM, Shah ND. What Is Value in Health Care? *New England Journal of Medicine*. 2011;364(13):e26. 10.1056/NEJMc1101108
9. Carter MJ, Mikuls TR, Nayak S, Fehringer EV, Michaud K. Impact of Total Shoulder Arthroplasty on Generic and Shoulder-Specific Health-Related Quality-of-Life Measures: A Systematic Literature Review and Meta-Analysis. *JBJS*. 2012;94(17):e127. 10.2106/jbjs.k.00204
10. Sayegh ET, Mascarenhas R, Chalmers PN, Cole BJ, Romeo AA, Verma NN. Surgical Treatment Options for Glenohumeral Arthritis in Young Patients: A Systematic Review and Meta-analysis. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*. 2015;31(6):1156-1166.e1158. <https://doi.org/10.1016/j.arthro.2014.11.012>
11. Raiss P, Bruckner T, Rickert M, Walch G. Longitudinal Observational Study of Total Shoulder Replacements with Cement: Fifteen to Twenty-Year Follow-up. *JBJS*. 2014;96(3):198-205. 10.2106/jbjs.m.00079
12. Schoch B, Werthel JD, Schleck CD, et al. Optimizing follow-up after anatomic total shoulder arthroplasty. *Journal of Shoulder and Elbow Surgery*. 2017;26(6):997-1002. <https://doi.org/10.1016/j.jse.2016.10.024>
13. Teeny SM, York SC, Mesko JW, Rea RE. Long-term follow-up care recommendations after total hip and knee arthroplasty: Results of the american association of hip and knee surgeons' member survey. *The Journal of Arthroplasty*. 2003;18(8):954-962. <https://doi.org/10.1016/j.arth.2003.09.001>
14. Werner BC, Burrus MT, Begho I, Gwathmey FW, Brockmeier SF. Early revision within 1 year after shoulder arthroplasty: patient factors and etiology. *Journal of Shoulder and Elbow Surgery*. 2015;24(12):e323-e330. <https://doi.org/10.1016/j.jse.2015.05.035>
15. Zuke AW, Leroux ST, Gregory PB, et al. Establishing Maximal Medical Improvement After Arthroscopic Rotator Cuff Repair. *The American Journal of Sports Medicine*. 2017:0363546517707963. 10.1177/0363546517707963
16. Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertain the minimal clinically important difference. *Control Clin Trials*. 1989;10(4):407-415.
17. Werner BC, Chang B, Nguyen JT, Dines DM, Gulotta LV. What Change in American Shoulder and Elbow Surgeons Score Represents a Clinically Important Change After Shoulder Arthroplasty? *Clinical Orthopaedics and Related Research*®. 2016;474(12):2672-2681. 10.1007/s11999-016-4968-z
18. Simovitch R, Flurin P-H, Wright T, Zuckerman JD, Roche CP. Quantifying success after total shoulder arthroplasty: the minimal clinically important difference. *Journal of Shoulder and Elbow Surgery*. 2018;27(2):298-305. 10.1016/j.jse.2017.09.013
19. Leggin BG, Michener LA, Shaffer MA, Brenneeman SK, Iannotti JP, Williams Jr GR. The Penn Shoulder Score: Reliability and Validity. *Journal of Orthopaedic & Sports Physical Therapy*. 2006;36(3):138-151. 10.2519/jospt.2006.36.3.138
20. Tashjian RZ, Hung M, Keener JD, et al. Determining the minimal clinically important difference for the American Shoulder and Elbow Surgeons score, Simple Shoulder Test, and visual analog scale (VAS) measuring pain after shoulder arthroplasty. *Journal of Shoulder and Elbow Surgery*. 2017;26(1):144-148. <https://doi.org/10.1016/j.jse.2016.06.007>

21. Wong SE, Zhang AL, Berliner JL, Ma CB, Feeley BT. Preoperative patient-reported scores can predict postoperative outcomes after shoulder arthroplasty. *Journal of Shoulder and Elbow Surgery*. 2016;25(6):913-919. <https://doi.org/10.1016/j.jse.2016.01.029>
22. Cheah JW, Sing DC, McLaughlin D, Feeley BT, Ma CB, Zhang AL. The perioperative effects of chronic preoperative opioid use on shoulder arthroplasty outcomes. *Journal of Shoulder and Elbow Surgery*. 2017;26(11):1908-1914. <https://doi.org/10.1016/j.jse.2017.05.016>
23. Churchill RS, Chuinard C, Wiater JM, et al. Clinical and Radiographic Outcomes of the Simpliciti Canal-Sparing Shoulder Arthroplasty System: A Prospective Two-Year Multicenter Study. *JBJS*. 2016;98(7):552-560. 10.2106/jbjs.15.00181
24. Clinton J, Franta AK, Lenters TR, Mounce D, Matsen FA. Nonprosthetic glenoid arthroplasty with humeral hemiarthroplasty and total shoulder arthroplasty yield similar self-assessed outcomes in the management of comparable patients with glenohumeral arthritis. *Journal of Shoulder and Elbow Surgery*. 2007;16(5):534-538. <https://doi.org/10.1016/j.jse.2006.11.003>
25. Gascoyne TC, McRae SMB, Parashin SL, et al. Radiostereometric analysis of keeled versus pegged glenoid components in total shoulder arthroplasty: a randomized feasibility study. *Canadian Journal of Surgery*. 2017;60(4):273-279. 10.1503/cjs.001817
26. Glanzmann MC, Kolling C, Schwyzer H-K, Flury M, Audigé L. Radiological and functional 24-month outcomes of resurfacing versus stemmed anatomic total shoulder arthroplasty. *International Orthopaedics*. 2017;41(2):375-384. 10.1007/s00264-016-3310-4
27. Levy JC, Everding NG, Gil CC, Stephens S, Giveans MR. Speed of recovery after shoulder arthroplasty: a comparison of reverse and anatomic total shoulder arthroplasty. *Journal of Shoulder and Elbow Surgery*. 2014;23(12):1872-1881. <https://doi.org/10.1016/j.jse.2014.04.014>
28. Litchfield RB, McKee MD, Balyk R, et al. Cemented versus uncemented fixation of humeral components in total shoulder arthroplasty for osteoarthritis of the shoulder: a prospective, randomized, double-blind clinical trial—A JOINTs Canada Project. *Journal of Shoulder and Elbow Surgery*. 2011;20(4):529-536. <https://doi.org/10.1016/j.jse.2011.01.041>
29. Razmjou H, Holtby R, Christakis M, Axelrod T, Richards R. Impact of prosthetic design on clinical and radiologic outcomes of total shoulder arthroplasty: A prospective study. *J Shoulder Elbow Surg*. 2013;22(2):206-214. 10.1016/j.jse.2012.04.016
30. Razmjou H, Stratford P, Kennedy D, Holtby R. Pattern of recovery following total shoulder arthroplasty and humeral head replacement. *BMC Musculoskeletal Disorders*. 2014;15:306. 10.1186/1471-2474-15-306
31. Sandow MJ, David H, Bentall SJ. Hemiarthroplasty vs total shoulder replacement for rotator cuff intact osteoarthritis: how do they fare after a decade? *Journal of Shoulder and Elbow Surgery*. 2013;22(7):877-885. 10.1016/j.jse.2012.10.023
32. Scalise JJ, Ciccone J, Iannotti JP. Clinical, Radiographic, and Ultrasonographic Comparison of Subscapularis Tenotomy and Lesser Tuberosity Osteotomy for Total Shoulder Arthroplasty. *JBJS*. 2010;92(7):1627-1634. 10.2106/jbjs.g.01461
33. Uschok S, Magosch P, Moe M, Lichtenberg S, Habermeyer P. Is the stemless humeral head replacement clinically and radiographically a secure equivalent to standard stem humeral head replacement in the long-term follow-up? A prospective randomized trial. *Journal of Shoulder and Elbow Surgery*. 2017;26(2):225-232. <https://doi.org/10.1016/j.jse.2016.09.001>
34. Angst F, Goldhahn J, Drerup S, Aeschlimann A, Schwyzer H-K, Simmen BR. Responsiveness of six outcome assessment instruments in total shoulder arthroplasty. *Arthritis Care & Research*. 2008;59(3):391-398. 10.1002/art.23318
35. Lynn J, McKethan A, Jha AK. Value-based payments require valuing what matters to patients. *JAMA*. 2015;314(14):1445-1446. 10.1001/jama.2015.8909
36. Marjoua Y, Butler CA, Bozic KJ. Public Reporting of Cost and Quality Information in Orthopaedics. *Clinical Orthopaedics and Related Research*. 2012;470(4):1017-1026. 10.1007/s11999-011-2077-6
37. Porter ME. What Is Value in Health Care? *New England Journal of Medicine*. 2010;363(26):2477-2481. 10.1056/NEJMp1011024
38. Favard L, Katz D, Colmar M, Benkalfate T, Thomazeau H, Emily S. Total shoulder arthroplasty – Arthroplasty for glenohumeral arthropathies: Results and complications after a minimum follow-up of 8 years according to the type of arthroplasty and etiology. *Orthopaedics & Traumatology: Surgery & Research*. 2012;98(4, Supplement):S41-S47. <https://doi.org/10.1016/j.otsr.2012.04.003>
39. Choi T, Horodyski M, Struk AM, Sahajpal DT, Wright TW. Incidence of early radiolucent lines after glenoid component insertion for total shoulder arthroplasty: a radiographic study comparing pressurized and unpressurized cementing techniques. *Journal of Shoulder and Elbow Surgery*. 2013;22(3):403-408. <https://doi.org/10.1016/j.jse.2012.05.041>
40. Terwee CB, Roorda LD, Dekker J, et al. Mind the MIC: large variation among populations and methods. *Journal of Clinical Epidemiology*. 2010;63(5):524-534. <https://doi.org/10.1016/j.jclinepi.2009.08.010>

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

The Insulin-Like Growth Factor-1 Receptor/Protein Kinase B Pathway Has Opposing Effects on Nutlin-Induced Apoptosis

BATZAYA DAVADELGER, PHD / RICARDO E. PEREZ, BS / YALU ZHOU, MS
LEI DUAN, MD / STEVEN GITELIS, MD / CARL G. MAKI, PHD

References

1. Haupt Y, Maya R, Kazaz A, Oren M. Mdm2 promotes the rapid degradation of p53. *Nature*. 1997;387(6630):296-9.
2. Kubbutat MH, Jones SN, Vousden KH. Regulation of p53 stability by Mdm2. *Nature*. 1997;387(6630):299-303.
3. Vousden KH, Prives C. Blinded by the Light: The Growing Complexity of p53. *Cell*. 2009;137(3):413-31.
4. Laptenko O, Prives C. Transcriptional regulation by p53: one protein, many possibilities. *Cell Death and Diff*. 2006;13(6):951-61.
5. Vassilev LT, Vu BT, Graves B, et al. In vivo activation of the p53 pathway by small-molecule antagonists of MDM2. *Science*. 2004;303(5659):844-8.
6. Tovar C, Graves B, Packman K, et al. MDM2 small-molecule antagonist RG7112 activates p53 signaling and regresses human tumors in preclinical cancer models. *Cancer Res*. 2013;73(8):2587-97.
7. Tovar C, Rosinski J, Filipovic Z, et al. Small-molecule MDM2 antagonists reveal aberrant p53 signaling in cancer: implications for therapy. *Proc Natl Acad Sci*. 2006;103(6):1888-93.
8. Hasegawa H, Yamada Y, Iha H, et al. Activation of p53 by Nutlin-3a, an antagonist of MDM2, induces apoptosis and cellular senescence in adult T-cell leukemia cells. *Leukemia*. 2009;23(11):2090-101.
9. Kitagawa M, Aonuma M, Lee SH, Fukutake S, McCormick F. E2F-1 transcriptional activity is a critical determinant of Mdm2 antagonist-induced apoptosis in human tumor cell lines. *Oncogene*. 2008;27(40):5303-14.
10. Shen H, Maki CG. Persistent p21 expression after Nutlin-3a removal is associated with senescence-like arrest in 4N cells. *J Biol Chem*. 2010;285(30):23105-14.
11. Shen H, Moran DM, Maki CG. Transient nutlin-3a treatment promotes endoreduplication and the generation of therapy-resistant tetraploid cells. *Cancer Res*. 2008;68(20):8260-8.
12. Huang B, Deo D, Xia M, Vassilev LT. Pharmacologic p53 activation blocks cell cycle progression but fails to induce senescence in epithelial cancer cells. *Mol Cancer Res*. 2009;7(9):1497-509.
13. Denduluri SK, Idowu O, Wang Z, et al. Insulin-like growth factor (IGF) signaling in tumorigenesis and the development of cancer drug resistance. *Genes & Diseases*. 2015;2(1):13-25.
14. Abedini MR, Muller EJ, Bergeron R, Gray DA, Tsang BK. Akt promotes chemoresistance in human ovarian cancer cells by modulating cisplatin-induced, p53-dependent ubiquitination of FLICE-like inhibitory protein. *Oncogene*. 2009;29(1):11-25.
15. Parcellier A, Tintignac LA, Zhuravleva E, Hemmings BA. PKB and the mitochondria: AKTing on apoptosis. *Cellular Signalling*. 2008;20(1):21-30.
16. Zhang X, Tang N, Hadden TJ, Rishi AK. Akt, FoxO and regulation of apoptosis. *Biochimica et biophysica acta*. 2011;1813(11):1978-86.
17. Pene F, Claessens YE, Muller O, et al. Role of the phosphatidylinositol 3-kinase/Akt and mTOR/P70S6-kinase pathways in the proliferation and apoptosis in multiple myeloma. *Oncogene*. 2002;21(43):6587-97.
18. Rashmi R, DeSelm C, Helms C, et al. AKT inhibitors promote cell death in cervical cancer through disruption of mTOR signaling and glucose uptake. *PLoS One*. 2014;9(4):e92948.
19. Kim J, Kundu M, Viollet B, Guan KL. AMPK and mTOR regulate autophagy through direct phosphorylation of Ulk1. *Nature Cell Biol*. 2011;13(2):132-41.
20. Zhu N, Gu L, Li F, Zhou M. Inhibition of the Akt/survivin pathway synergizes the antileukemia effect of nutlin-3 in acute lymphoblastic leukemia cells. *Molecular Cancer Ther*. 2008;7(5):1101-9.
21. Saiki AY, Caenepeel S, Yu D, et al. MDM2 antagonists synergize broadly and robustly with compounds targeting fundamental oncogenic signaling pathways. *Oncotarget*. 2014;5(8):2030-43.
22. Xiong L, Kou F, Yang Y, Wu J. A novel role for IGF-1R in p53-mediated apoptosis through translational modulation of the p53-Mdm2 feedback loop. *J Cell Biol*. 2007;178(6):995-1007.
23. Davaadelger B, Duan L, Perez RE, Gitelis S, Maki CG. Crosstalk between the IGF-1R/AKT/mTORC1 pathway and the tumor suppressors p53 and p27 determines cisplatin sensitivity and limits the effectiveness of an IGF-1R pathway inhibitor. *Oncotarget*. 2016;7(19):27511-26.
24. Boehme KA, Kulikov R, Blattner C. p53 stabilization in response to DNA damage requires Akt/PKB and DNA-PK. *Proc Natl Acad Sci (USA)*. 2008;105(22):7785-90.

25. Vadysirisack DD, Baenke F, Ory B, Lei K, Ellisen LW. Feedback control of p53 translation by REDD1 and mTORC1 limits the p53-dependent DNA damage response. *Mol Cell Biol*. 2011;31(21):4356-65.
26. Duan L, Perez RE, Davaadelger B, Dedkova EN, Blatter LA, Maki CG. p53-regulated autophagy is controlled by glycolysis and determines cell fate. *Oncotarget*. 2015;6(27):23135-56.
27. Ottaviani G, Jaffe N. The etiology of osteosarcoma. *Cancer Treatment Research*. 2009;152:15-32.
28. O'Day K, Gorlick R. Novel therapeutic agents for osteosarcoma. *Expert Review Anticancer Ther*. 2009;9(4):511-23.
29. Kempf-Bielack B, Bielack SS, Jurgens H, et al. Osteosarcoma relapse after combined modality therapy: an analysis of unselected patients in the Cooperative Osteosarcoma Study Group (COSS). *J Clin Oncol*. 2005;23(3):559-68.
30. O'Reilly KE, Rojo F, She QB, Solit D, Mills GB, Smith D, Lane H, Hofmann F, Hicklin DJ, Ludwig DL, Baselga J, Rosen N. mTOR inhibition induces upstream receptor tyrosine kinase signaling and activates AKT. *Cancer Res*. 2006;66(3):1500-8.
31. Russell RC, Yuan H-X, Guan K-L. Autophagy regulation by nutrient sensing. *Cell Res*. 2014;24:42-57.
32. Kim YC, Guan K-L. mTOR: a pharmacologic target for autophagy regulation. *J Clin Invest*. 2015;125(1):25-32.
33. Werner H, Karnieli E, Rauscher FJ, LeRoith D. Wild-type and mutant p53 differentially regulate transcription of the insulin-like growth factor I receptor gene. *Proc Natl Acad Sci USA*. 1996;93:8318-8323.
34. Goetz EM, Shankar B, Zou Y, Morales JC, Luo X, Araki S, Bachoo R, Mayo LD, Boothman DA. ATM-dependent IGF-1 induction regulates secretory clusterin expression after DNA damage and in genetic instability. *Oncogene*. 2011;30:3745-3754.
35. Ryan KM, Vousden KH. p53 and metabolism. *Nature Reviews Cancer* 2009;9:691-700.
36. Huang J, Dibble CC, Matsuzaki M, Manning BD. The TSC1-TSC2 complex is required for proper activation of mTOR complex 2. *Mol Cell Biol*. 2008;28(12):4104-15.
37. Hay N. p53 strikes mTORC1 by employing sestrins. *Cell Metabolism*. 2008;3(3):184-185.
38. Manfe V, Biskup E, Rosbjerg A, Kamstrup M, Gulddammer S, Lerche CM, Lauenborg BT, Odum N, Gniadecki R. miR-122 regulates p53/AKT signaling and the chemotherapy-induced apoptosis in cutaneous T-cell lymphoma. *PLoS ONE*. 7(1):e29541.

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.

Early Results of Patient-Reported Outcomes Measurement Information System Scores in Patients Undergoing Surgery for Metastatic Bone Disease

A Multicenter, Prospective Study

ALAN T. BLANK, MD / DANIEL M. LERMAN, MD / SARA SHAW, BS / FARNAZ DADRASS, BS
YUE ZHANG, PHD / WEI LIU, MPH / MAN HUNG, PHD / KEVIN B. JONES, MD / R. LOR RANDALL, MD

References

1. Schulman KL, Kohles J. Economic burden of metastatic bone disease in the U.S. *Cancer*. 2007;109(11):2334-2342.
2. Yabroff KR, Lund J, Kepka D, Mariotto A. Economic burden of cancer in the United States: estimates, projections, and future research. *Cancer Epidemiol Biomarkers Prev*. 2011;20:2006-2014.
3. American Cancer Society. Cancer Facts & Figures 2005. Available at: <http://www.cancer.org/acs/groups/content/@nho/documents/document/caff2005f4pwsecuredpdf.pdf>. Accessed February 1, 2016.
4. Li S, Peng Y, Weinhandl ED, Blaes AH, Cetin K, Chia VM, Stryker S, Pinzone JJ, Acquavella JE, Arneson TJ. Estimated number of prevalent cases of metastatic bone disease in the US adult population. *Clin Epidemiol*. 2012;4:87-93.
5. Damron TA, Morgan H, Prakash D, Grant W, Aronowitz J, Heiner J. Critical evaluation of Mirels' rating system for impending pathologic fractures. *Clin Orthop Relat Res*. 2003;415(suppl):S201-S207.
6. Harrington KD. Orthopedic surgical management of skeletal complications of malignancy. *Cancer*. 1997;80(8 suppl):1614-1627.
7. Arvinus C, Parra JL, Mateo LS, Maroto RG, Borrego AF, Stern LL. Benefits of early intramedullary nailing in femoral metastases. *Int Orthop*. 2014;38:129-132.
8. Blank AT, Lerman DM, Patel NM, Rapp TB. Is prophylactic intervention more cost-effective than the treatment of pathologic fractures in metastatic bone disease? *Clin Orthop Relat Res*. 2016;474(7):1563-1570.
9. Gitelis S, Sheinkop MB, Hammerberg K, Brugliera P. The role of prophylactic surgery in the management of metastatic hip disease. *Orthopedics*. 1982;8:1004-1011.
10. McLaughlin H. Intramedullary fixation of pathologic fractures. *Clin Orthop*. 1953;2:108-114.
11. Wedin R, Bauer HCF, Rutqvist LE. Surgical treatment for skeletal breast cancer metastases. *Cancer* 2001;92(2):257-262.
12. Capanna R, Ruggieri P, Biagini R, et al. The effect of quadriceps excision on functional results after distal femoral resection and prosthetic replacement of bone tumors. *Clin Orthop Relat Res*. 1991;(267):186-196.
13. Davis AM, Wright JG, Williams JI, Bombardier C, Griffin A, Bell RS. Development of a measure of physical function for patients with bone and soft tissue sarcoma. *Qual Life Res*. 1996;5(5):508-516.
14. Kirkinis MN, Lyne CJ, Wilson MD, Choong PF. Metastatic bone disease: A review of survival, prognostic factors and outcomes following surgical treatment of the appendicular skeleton. *Eur J Surg Oncol*. 2016;42(12):1787-1797.
15. Steensma M, Boland PJ, Morris CD, Athanasian E, Healey JH. Endoprosthetic treatment is more durable for pathologic proximal femur fractures. *Clin Orthop Relat Res*. 2012;470:920-926.
16. Uchida A, Myoui A, Araki N, Yoshikawa H, Ueda T, Aoki Y. Prosthetic reconstruction for periacetabular malignant tumors. *Clin Orthop Relat Res*. 1996;(326):238-245.
17. Cella D, Riley W, Stone A, et al. The patient-reported outcomes measurement information system (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. *J Clin Epidemiol*. 2010;63(11):1179-1194.
18. Hung M, Baumhauer JE, Latt LD, et al. Validation of PROMIS (R) physical function computerized adaptive tests for orthopaedic foot and ankle outcome research. *Clin Orthop Relat Res*. 2013;471(11):3466-3474.
19. Hinds PS, Nuss SL, Ruccione KS, et al. PROMIS pediatric measures in pediatric oncology: Valid and clinically feasible indicators of patient-reported outcomes. *Pediatr Blood Cancer*. 2013;60(3):402-408.
20. Jensen RE, Potosky AL, Reeve BB, et al. Validation of the PROMIS physical function measures in a diverse US population-based cohort of cancer patients. *Qual Life Res*. 2015;24(10):2333-2344.
21. Basch E, Abernethy AP, Mullins CD, et al. Recommendations for incorporating patient-reported outcomes into clinical comparative effectiveness research in adult oncology. *J Clin Oncol*. 2012;30(34):4249-4255.
22. <http://www.healthmeasures.net/score-and-interpret/t-score-maps>

No sources of support in the forms of grants, equipment, or other items were received for this study. The authors report no conflict of interest. The authors' personal disclosure information can be accessed through the AAOS Orthopedic Disclosure Program at www.aaos.org.