

Articular Cartilage

Independent Study
Course 30.2.3

Ann Smith, PT, DPT, OCS, PCS

Dayton Children's Hospital

Dayton, Ohio

CONTINUING PHYSICAL THERAPY EDUCATION



REFERENCES

1. Buchanan WW. William Hunter (1718-1783). *Rheumatology (Oxford)*. 2003;42(10):1260-1261.
2. Müller B, Kohn, D. Indication for and performance of articular cartilage drilling using the Pridie method. *Orthopade*. 1999;28(1):4-10.
3. American Physical Therapy Association House of Delegates. APTA Vision Statement for the Physical Therapy Profession. apta.org/vision. Accessed February 28, 2020.
4. Pike AN, Patzkowski JC, Bottoni CR. Meniscal and chondral pathology associated with anterior cruciate ligament injuries. *J Am Acad Orthop Surg*. 2019;27(3):75-84. doi: 10.5435/JAAOS-D-17-00670.
5. Dumont GD, Padalecki JR, Okoro N, Wilson PL. Meniscal and chondral injuries associated with pediatric anterior cruciate ligament tears relationship of treatment time and patient-specific factors. *Am J Sports Med*. 2012;40(9):2128-2133. doi: 10.1177/0363546512449994. Epub 2012 Jun 22.
6. Osteoarthritis Fact Sheet. *Center for Disease Control and Prevention*. <https://www.cdc.gov/arthritis/basics/osteoarthritis.htm>. Accessed February 28, 2020.
7. Anderson DD, Chubinskaya S, Guilak F, et al. Post-traumatic osteoarthritis: improved understanding and opportunities for early intervention. *J Orthop Res*. 2011;29(6):802-809. doi: 10.1002/jor.21359. Epub 2011 Feb 11.
8. Grande DA, Schwartz JA, Brandel E, Chahine NO, Sgaglione N. Articular cartilage repair: where we have been, where we are now, and where we are headed. *Cartilage*. 2013;4(4):281-285. doi: 10.1177/1947603513494402.
9. Hadley CJ, Shi WJ, Murphy H, Tjoumakaris FP, Salvo JP, Freedman KB. The clinical evidence behind biologic therapies promoted at annual orthopaedic meetings: a systematic review. *Arthroscopy*. 2019;35(1):251-259. doi: 10.1016/j.arthro.2018.05.037. Epub 2018 Nov 16.
10. Goldring MB. Chondrogenesis, chondrocyte differentiation, and articular cartilage metabolism in health and osteoarthritis. *Ther Adv Musculoskel Dis*. 2012;4(4):269-285. doi: 10.1177/1759720X12448454.
11. Malekar MM, Clark RB, Votta B, Giles WR. The resting potential and K⁺ currents in primary human articular chondrocytes. *Front Physiol*. 2018;9:974. doi: 10.3389/fphys.2018.00974. eCollection 2018.
12. Moskalewski S, Hyc A, Jankowska-Steifer E, Osiecka-Iwan A. Formation of synovial joints and articular cartilage. *Folia Morph (Warsz)*. 2013;72(3):181-187.
13. Verbruggen, SW, Kainz, B, Shelmerdine SC, et al. Stresses and strains on the human fetal skeleton during development. *J R Soc Interface*. 2018;15(138):20170593.
14. Carter DR, van der Muelen MCH, Beupre' GS. Mechanical factors in bone growth and development. *Bone*. 1996;18(1 Suppl):5S-10S.
15. Bhosale AM, Richardson JB. Articular cartilage: structure, injuries and review of management. *Br Med Bull*. 2008;87:77-95. doi: 10.1093/bmb/ldn025. Epub 2008 Aug 1.
16. Sophia Fox AJ, Bedi A, Rodeo SA. The basic science of articular cartilage: structure, composition, and function. *Sports Health*. 2009;1(6):461-468.
17. Goldring MB, Goldring SR. Articular cartilage and subchondral bone in the pathogenesis of osteoarthritis. *Ann NY Acad Sci*. 1992;(2010):230-237.
18. Mankin HJ, Mow VC, Buckwalter JA, Iannotti JP, Ratcliffe A. Form and function of articular cartilage. In: Simon, SR ed. *Orthopaedic Basic Science*. Columbus, OH: American Academy of Orthopedic Surgeons; 1994:1-45.
19. Haider MA, Schugart RC, Setton LA, Guilak F. A mechano-chemical model for the passive swelling response of an isolated chondron under osmotic loading. *Biomech Modeling Mechanobiol*. 2006;5(2-3):160-171. Epub 2006 Mar 7.
20. Hsueh MF, Kraus VB, Önnérjord, P. Cartilage matrix remodeling differs by disease state and joint type. *Eur Cells Materials*. 2017;34:70-82. doi: 10.22203/eCM. v034a05.
21. Thomas CM, Fuller CJ, Whittles CE, Sharif M. Chondrocyte death by apoptosis is associated with the initiation and severity of articular cartilage degradation. *Int J Rheum Dis*. 2011;14(2):191-198. doi: 10.1111/j.1756-185X.2010.01578.x. Epub 2010 Oct 26.
22. Brand-Saberi B, Epperlein HH, Romanos GE, Christ B. Distribution of extracellular matrix components in nuchal skin from fetuses carrying trisomy 18 and trisomy 21. *Cell Tissue Res*. 1994;277(3):465-475.
23. Eyre DR, Wu JJ, Fernandes RJ, Pietka TA, Weis MA. Recent developments in cartilage research: matrix biology of the collagen II/IX/XI heterofibril network. *Biochem Soc Trans*. 2002;30(Pt 6):893-899.
24. Yanagishita M. Function of proteoglycans in the extracellular matrix. *Acta Pathol Jpn*. 1993;43(6):283-293.
25. Roughley PJ, Mort JS. The role of aggrecan in normal and osteoarthritic cartilage. *J Exp Orthop*. 2014;1(1):8. doi: 10.1186/s40634-014-0008-7. Epub 2014 Jul 16.
26. Lane Smith R, Trindale MC, Ikenoue T, et al. Effects of shear stress on articular chondrocyte metabolism. *Biorheology*. 2000;37(1-2):95-107.
27. Carballo CB, Nakagawa Y, Sekiya I, Rodeo SA. Basic science of articular cartilage. *Clin Sports Med*. 2017;36(3):413-425. doi: 10.1016/j.csm.2017.02.001. Epub 2017 Apr 26.

28. Colnot C, Lu C, Hu D, Helms JA. Distinguishing the contributions of perichondrium, cartilage, and vascular endothelium to skeletal development. *Dev Biol*. 2004;269(1):55-69.
29. Decker RS. Articular cartilage and joint development from embryogenesis to adulthood. *Semin Cell Dev Biol*. 2017;62:50-56. doi: 10.1016/j.semcd.2016.10.005. Epub 2016 Oct 20.
30. Kato K, Bhattaram P, Penzo-Méndez A, Gadi A, Lefebvre V. SOXC transcription factors induce cartilage growth plate formation in mouse embryos by promoting noncanonical WNT signaling. *J Bone Miner Res*. 2015;30(9):1560-1571. doi: 10.1002/jbm.2504. Epub 2015 May 21.
31. Caldwell KL, Wang J. Cell-based articular cartilage repair: the link between development and regeneration. *Osteoarthritis Cartilage*. 2015;23(3):351-362. doi: 10.1016/j.joca.2014.11.004. Epub 2014 Nov 11.
32. Karimian E, Chagin AS, Sävendahl L. Genetic regulation of the growth plate. *Front Endocrinol (Lausanne)*. 2012;2:113. doi: 10.3389/fendo.2011.00113. eCollection 2011.
33. O'Rahilly R, Gardner E. The timing and sequence of events in the development of the limbs in the human embryo. *Anat Embryol (Berl)*. 1974;148(1):1-23.
34. Handorf AM, Li WJ. Fibroblast growth factor-2 primes human mesenchymal stem cells for enhanced chondrogenesis. *PLoS One*. 2011;6(7):e22887. doi: 10.1371/journal.pone.0022887. Epub 2011 Jul 27.
35. Tickle C, Towers M. Sonic hedgehog signaling in limb development. *Front Cell Dev Biol*. 2017;5:14. doi: 10.3389/fcell.2017.00014. eCollection 2017.
36. van de Lest CH, Bruma PA, Van Weeren PR. The influence on the composition of developing equine joints. *Biorheology*. 2002;39(1-2):183-191.
37. Hampl JS, Taylor CA, Johnston CS. Vitamin C deficiency and depletion in the United States: the Third National Health and Nutrition Examination Survey, 1988 to 1994. *Am J Public Health*. 2004;94(5):870-875.
38. Ostrowska M, Włodzimierz M, Prochorec-Sobieszek M, Nieciecki M, Sudol-Szopinska I. Cartilage and bone damage in rheumatoid arthritis. *Reumatologia*. 2018;56(2):111-120. doi: 10.5114/reum.2018.75523. Epub 2018 May 9.
39. Simkin PA. Consider the tidemark. *J Rheumatol*. 2012;39:890-892.
40. Frantz C, Stewart KM, Weaver VM. The extracellular matrix at a glance. *J Cell Sci*. 2010;123(pt 24):4195-4200. doi: 10.1242/jcs.023820.
41. van der Kraan PM, Buma P, van Kuppevelt T, van den Berg WB. Interaction of chondrocytes, extracellular matrix and growth factors: relevance for articular cartilage tissue engineering. *Osteoarthritis Cartilage*. 2002;10(8):631-637.
42. Klika V, Gaffney EA, Chen YC, Brown CP. An overview of multiphase cartilage mechanical modelling and its role in understanding function and pathology. *J Mech Behav Biomed Mater*. 2016;62:139-157. doi: 10.1016/j.jmbbm.2016.04.032. Epub 2016 May 11.
43. Emons J, Chagin AS, Sävendahl L, Karperien M, Wit JM. Mechanisms of growth plate maturation and epiphyseal fusion. *Hormone Res Paediatr*. 2011;75(6):383-391. doi: 10.1159/000327788. Epub 2011 May 4.
44. Dover C, Kiely N. Growth plate injuries and management. *Orthop Trauma*. 2015;29:261-267.
45. Mithoefer K, Hambly K, Logerstedt D, Ricci M, Silvers H, Della Villa S. Current concepts for rehabilitation and return to sport after knee articular cartilage repair in the athlete. *J Orthop Sports Phys Ther*. 2012;42(3):254-273. doi: 10.2519/jospt.2012.3665. Epub 2012 Feb 29.
46. Jones G, Ding C, Glisson M. Knee articular cartilage development in children: a longitudinal study of the effect of sex, growth, body composition and physical activity. *Pediatr Res*. 2003;54(2):230-236. Epub 2003 May 7.
47. Vanwanseele B, Eckstein F, Knecht H, Spaepen A, Stüssi E. Longitudinal analysis of cartilage atrophy in the knees of patients with spinal cord injury. *Arthritis Rheum*. 2003; 3377-3381.
48. American Academy of Orthopaedic Surgeons. Overuse injuries in children. <https://orthoinfo.aaos.org/en/diseases--conditions/overuse-injuries-in-children/>. Accessed February 28, 2020.
49. Oeppen RS, Connolly SA, Bencardino JT, Jaramillo D. Acute injury of the articular cartilage and subchondral bone: a common but unrecognized lesion in the immature knee. *AJR Am J Roentgenol*. 2004;182(1):111-117.
50. Seeley MA, Kneseck M, Vanderhave K. Osteochondral injury after acute patellar dislocation in children and adolescents. *J Pediatric Orthop*. 2013;33(5):511-518. doi: 10.1097/BPO.0b013e318288b7a0.
51. Martin JA, Buckwalter MD. Roles of articular cartilage aging and chondrocyte senescence in the pathogenesis of osteoarthritis. *Iowa Orthop J*. 2001;21:1-7.
52. Salzmann GM, Niemeyer P, Hochrein A, Stoddart M, Angele P. Articular cartilage repair of the knee in children and adolescents. *Orthop J Sports Med*. 2018;6(3):2325967118760190. doi: 10.1177/2325967118760190. eCollection 2018 Mar.
53. Arøen A, Løken S, Heir S, et al. Articular cartilage lesions in 993 consecutive knee arthroscopies. *Am J Sports Med*. 2004;32(1):211-215.
54. McAdams TR, Mithoefer K, Scopp JM, Mandelbaum BR. Articular cartilage injury in athletes. *Cartilage*. 2010;1(3):165-179. doi: 10.1177/1947603509360210.
55. Lattermann C, Conley CE, Johnson DL, et al. Select biomarkers on the day of anterior cruciate ligament reconstruction predict poor patient-reported outcomes

- at 2-year follow-up: a pilot study. *Biomed Res Int.* 2018;9387809. doi: 10.1155/2018/9387809. eCollection 2018.
56. Svoboda S, Trump JR, Reilly J, et al. WOMAC pain scores at the time of ACL injury are associated with concentrations of serum and urine biomarkers of Type 2 collagen degradation at the time of ACL reconstruction. *Orthop J Sports Med.* 2017;5.
 57. Lattermann C, Proffitt M, Huston L, et al. Multicenter Orthopaedic Outcome Network early anti-inflammatory Treatment in patients with acute ACL tear" (MOON-AAA) clinical trial. *Orthop J Sports Med.* 2016;4.
 58. Vernon L, Abadin A, Wilensky D, Huang CY, Kaplan L. Subphysiological compressive loading reduces apoptosis following acute impact injury in a porcine cartilage model. *Sports Health.* 2014;6:81-88. doi: 10.1177/1941738113504379.
 59. Clements KM, Bee ZC, Crossingham GV, Adams MA, Sharif M. How severe must repetitive loading be to kill chondrocytes in articular cartilage? *Osteoarthritis Cartilage.* 2001;9:499-507.
 60. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA.* 2014;311(8):806-814. doi: 10.1001/jama.2014.732.
 61. Cao JJ. Effects of obesity on bone metabolism. *J Orthop Surg Res.* 2011;6:30. doi: 10.1186/1749-799X-6-30.
 62. Pascual-Garrido A, Daley E, Verma NN, Cole BJ. A comparison of the outcomes for cartilage defects of the knee treated with biologic resurfacing versus focal metallic implants. *Arthroscopy.* 2017;33(2):364-373. doi: 10.1016/j.arthro.2016.07.010. Epub 2016 Sep 20.
 63. Zanon G, Di Vico G, Marullo M. Osteochondritis dissecans of the knee. *Joints.* 2014;2(1):29-36. eCollection 2014 Jan-Mar.
 64. Beck NA, Lawrence TR, Nordin JD, DeFor TA, Tompkins M. ACL tears in school-aged children and adolescents over 20 years. *Pediatrics.* 2017;139(3):e20161877. doi: 10.1542/peds.2016-1877.
 65. Pike AN, Patzkowski JC, Bottoni CR. Meniscal and chondral pathology associated with anterior cruciate ligament injuries. *J Am Acad Orthop Surg.* 2019;27(3):75-84. doi: 10.5435/JAAOS-D-17-00670.
 66. Lang PJ, Sugimoto D, Micheli LJ. Prevention, treatment and rehabilitation of anterior cruciate ligament injuries in children. *Open Access J Sports Med.* 2017;8:133-141.
 67. Lohmander LS, Östenberg A, Englund M, Roos H. High prevalence of knee osteoarthritis, pain, and functional limitations in female soccer players twelve years after anterior cruciate ligament injury. *Arthritis Rheum.* 2004;50(10):3145-3152.
 68. Lohmander LS, Englund PM, Dahl LL, Roos EM. The long-term consequence of anterior cruciate ligament and meniscus injuries: osteoarthritis. *Am J Sports Med.* 2007;35(10):1756-1769.
 69. Wall EJ, Vourazeris J, Myer GD, Emery KH, Divine JG. The healing potential of stable juvenile osteochondritis dissecans knee lesions. *J Bone Joint Surg Am.* 2008;90(12):2655-2664. doi: 10.2106/JBJS.G.01103.
 70. Ratzlaff CR, Liang MH. Prevention of injury-related knee osteoarthritis: opportunities for the primary and secondary prevention of knee osteoarthritis. *Arthritis Res Ther.* 2010;12:215. doi: 10.1186/ar3113. Epub 2010 Aug 31.
 71. Yen Y, Cascio B, O'Brien L, Stalzer S, Millett PJ, Steadman JR. Treatment of osteoarthritis of the knee with microfracture and rehabilitation. *Med Sci Sports Exerc.* 2008;40(2):200-205.
 72. Marks R. Osteoarthritis and articular cartilage: biomechanics and novel treatment paradigms. *Adv Aging Res.* 2014;3:297-309.
 73. Negrin LL, Vécsei V. Do meta-analyses reveal time-dependent differences between the clinical outcomes achieved by microfracture and autologous chondrocyte implantation in the treatment of cartilage defects of the knee? *J Orthop Sci.* 2013;18(6):940-948. doi: 10.1007/s00776-013-0449-3. Epub 2013 Aug 10.
 74. Flanigan DC, Harris JD, Trinh TQ, Siston RA, Brophy RH. Prevalence of chondral defects in athletes' knees: a systematic review. *Med Sci Sports Exerc.* 2010;42(10):1795-1801. doi: 10.1249/MSS.0b013e3181d9eea0.
 75. Jeukendrup RM, Roth AK, Peters RJR, et al. Polymers in cartilage defect repair of the knee: current status and future prospects. *Polymers (Basel).* 2016;8(6):pii E219. doi: 10.3390/polym8060219.
 76. Brittberg M, Gomoll AH, Canseco JA, Far J, Lind M, Hui J. Cartilage repair in the degenerative ageing knee. *Acta Orthopaedica.* 2016;87(sup363):26-38. doi: 10.1080/17453674.2016.1265877. Epub 2016 Dec 2.
 77. Kane P, Frederick R, Tucker B, et al. Surgical restoration/repair of articular cartilage injuries in athletes. *Phys Sportsmed.* 2013;41(2):75-86. doi: 10.3810/psm.2013.05.2017.
 78. Steadman JR, Briggs KK, Rodrigo JJ, Kocher MS, Gill TJ, Rodkey WG. Outcomes of microfracture for traumatic chondral defects of the knee: average 11-year follow-up. *Arthroscopy.* 2003;19(5):477-484.
 79. Erggelet C, Vavken P. Microfracture for the treatment of cartilage defects in the knee joint – a golden standard? *J Clin Orthop Trauma.* 2016;7(3):145-152. doi: 10.1016/j.jcot.2016.06.015. Epub 2016 Jun 28.
 80. Devitt BM, Bell SW, Webster KE, Feller JA, Whitehead TS. Surgical treatments of cartilage defects of the knee: systematic review of randomized controlled trials. *Knee.*

- 2017;24(3):508-517. doi: 10.1016/j.knee.2016.12.002. Epub 2017 Feb 8.
81. Mithoefer K, Williams III RJ, Warren RF, Wickiewicz TL, Marx RG. High-impact athletics after knee articular cartilage repair: a prospective evaluation of the microfracture technique. *Am J Sports Med.* 2006;34:1413.
 82. Steadman JR, Miller BS, Karas SG, Schlegel TF, Briggs KK, Hawkins RJ. The microfracture technique in the treatment of full-thickness chondral lesions of the knee in National Football League players. *J Knee Surg.* 2003;16:83-86.
 83. Kane MS, Lau K, Crawford DC. Rehabilitation and postoperative management practices after osteochondral allograft transplants to the distal femur: a report from the metrics od osteochondral allografts (MOCA) study group 2016. *Sports Health.* 2017;9(6):555-563.
 84. Rowland R, Colello M, Wyland D. Osteochondral autograft transfer procedure: arthroscopic technique and technical pearls. *Arthrosc Tech.* 2019;8(7):e713-e719. doi: 10.1016/j.eats.2019.03.006. eCollection 2019 Jul.
 85. Rambani R, Venkatesh R. Current concepts in articular cartilage repair. *J Arthroscopy Joint Surg.* 2014;1(2):59-65.
 86. Nakagawa Y, Mukai A, Setoguchi Y, Goto T, Furukawa T, Nakamura T. Clinical outcomes of donor sites after osteochondral graft harvest from healthy knees. *Orthop J Sports Med.* 2017;5(10):232596711732525.
 87. Richter DL, Schenck RC, Wascher DC, Treme G. Knee articular cartilage repair and restoration techniques: a review of the literature. *Sports Health.* 2016;8(2):153-160.
 88. Solheim E, Hegna J, Strand T. Randomized study of long-term (15-17 years) outcome after microfracture versus mosaicplasty in knee articular cartilage defects. *Am J Sports Med.* 2018;46(4):826-831. doi: 10.1177/0363545517745281. Epub 2017 Dec 18.
 89. Noyes FR, Mayfield W, Barber-Westin SD, Albright JC, Heckmann TP. Opening wedge high tibial osteotomy: an operative technique and rehabilitation program to decrease complications and promote early union and function. *Am J Sports Med.* 2006;34:1262-1273.
 90. DiBartola AC, Wright BM, Magnussen RA, Flanigan DC. Clinical outcomes after autologous chondrocyte implantation in adolescent's knees: a systematic review. *Arthroscopy.* 2016;9:1905-1916.
 91. Medical Services Advisory Committee. Matrix induced autologous chondrocyte implantation and autologous chondrocyte implantation. <http://www.msac.gov.au/internet/msac/publishing.nsf/Content/1140-public>. Accessed February 28, 2020.
 92. Mistry H, Connock M, Pink J, et al. Autologous chondrocyte implantation in the knee: systematic review and economic evaluation. *Health Technol Assess.* 2017;21(6):1-294. doi: 10.3310/hta21060.
 93. DiBartola AC, Everhart JS, Magnussen RA, et al. Correlation between histological outcome and surgical cartilage repair technique in the knee: a meta-analysis. *Knee.* 2016;23:344-349. doi: 10.1016/j.knee.2016.01.017. Epub 2016 Feb 18.
 94. Minas T, Von Keudell AV, Bryant T, Gomoll AH. The John Install Award: a minimum 10-year outcome study of autologous chondrocyte implantation. *Clin Orthop Relat Res.* 2014;472(1): 41-51. doi: 10.1007/s11999-013-3146-9.
 95. Hunziker EB, Lippuner K, Keel MJB, Shintani N. An educational review of cartilage repair: precepts & practice-myths & misconceptions – progress & prospects. *Osteoarthritis Cartilage.* 2015;23(3):334-350. doi: 10.1016/j.joca.2014.12.011. Epub 2014 Dec 19.
 96. Huang BJ, Hu JC, Athanasiou KA. Cell-based tissue engineering strategies used in the clinical repair of articular cartilage. *Biomaterials.* 2016;98:1-22. doi: 10.1016/j.biomaterials.2016.04.018. Epub 2016 Apr 26.
 97. Kennedy MI, Whitney K, Evans T, LaPrade RF. Platelet-rich plasma and cartilage repair. *Curr Rev Musculoskelet Med.* 2018;11(4):573-582. doi: 10.1007/s12178-018-9516-x.
 98. Fice MP, Miller JC, Christian R, et al. The role of platelet-rich plasma in cartilage pathology: an updated systematic review of the basic science evidence. *Arthroscopy.* 2019;35(3):961-976. doi: 10.1016/j.arthro.2018.10.125. Epub 2019 Feb 4.
 99. Richardson SM, Kalamegam G, Pushparaj PN, et al. Mesenchymal stem cells in regenerative medicine: focus on articular cartilage and intervertebral disc regeneration. *Methods.* 2016;99:69-80. doi: 10.1016/jymeth.2015.09.015. Epub 2015 Sep 15.
 100. Krauppal R. Current concepts in the articular cartilage repair and regeneration. *J Orthop.* 2017;14(2):A1-A3. doi: 10.1016/j.jor.2017.05.001. eCollection 2017 Jun.
 101. Ha CW, Park YB, Kim SH, Lee HJ. Intra-articular mesenchymal stem cells om osteoarthritis of the knee: a systematic review of clinical outcomes and evidence of cartilage repair. *Arthroscopy.* 2019;35(1):277-288. doi: 10.1016/j.arthro.2018.07.028. Epub 2018 Nov 16.
 102. Gigante A, Cecconi S, Calcagno S, Busilacchi A, Enea D. Arthroscopic knee cartilage repair with covered microfracture and bone marrow concentrate. *Arthroscopy Techniques* 2012;1(2):e175-e180. doi.org/10.1016/j.eats.2012.07.001.
 103. Cotter E, Wang K, Yanke A, Chubinskya S. Bone marrow aspirate concentrate for cartilage defects of the knee: from bench to bedside evidence. *Cartilage.* 2018; 9(2):161-170. doi: 10.1177/1947603517741169.
 104. Grawe BM, Sugiyuchi F, Bedi A, Rodeo S. Biology of anterior cruciate ligament graft healing. In: Noyes FR, ed. *Noyes' Knee Disorders Surgery, Rehabilitation, Clinical Outcomes.* Philadelphia, PA: Elsevier; 2017:111-124.