

UC San Diego

UC San Diego Previously Published Works

Title

The Natural History of Meniscus Tears

Permalink

<https://escholarship.org/uc/item/34n156k7>

Journal

Journal of Pediatric Orthopaedics, 39(Supplement 1)

ISSN

0271-6798

Authors

Chambers, Henry G
Chambers, Reid C

Publication Date

2019-07-01

DOI

10.1097/bpo.0000000000001386

Peer reviewed

The Natural History of Meniscus Tears

Henry G. Chambers, MD* and Reid C. Chambers, DO†

Background: In order to determine whether treatments are effective in the treatment of meniscus tears, it is first necessary to understand the natural history of meniscus tears. The purpose of this paper is to review the literature to ascertain the natural history of meniscus tears in children and adolescents.

Methods: A search of the Pubmed and Embase databases was performed using the search terms “meniscus tears,” “natural history of meniscus tears,” “knee meniscus,” “discoid meniscus,” and “natural history of discoid meniscus tears.”

Results: A total of 2567 articles on meniscus tears, 28 articles on natural history of meniscus tears, 8065 articles on “menisci,” 396 articles on “discoid meniscus,” and only 2 on the “natural history of discoid meniscus” were found. After reviewing the titles of these articles and reviewing the abstracts of 237 articles, it was clear that there was little true long-term natural history data of untreated meniscus tears nor whether treating meniscus tears altered the natural history. Twenty-five articles were chosen as there was some mention of natural history in their studies.

Conclusions: There are few long-term data on untreated meniscal tears or discoid meniscus, or tears in children and adolescents. The literature suggests that there is a higher incidence of chondral injury and subsequent osteoarthritis, but there are many confounding variables which are not controlled for in these relatively short-term papers.

Key Words: meniscus, discoid meniscus, natural history

(*J Pediatr Orthop* 2019;39:S53–S55)

BACKGROUND

Injuries to the meniscus in children and adolescents are increasing in number and severity. It is possible that this is related to increased participation in sports in this population, but perhaps also due to a heightened suspicion of tears and ready access to imaging technology such as the availability of magnetic resonance imaging. There are few natural history studies of tears of the menisci which follow the patient throughout their lifetime. The question is what is the long-term effect of a meniscus tear and is

there any evidence that intervention can alter the natural history.

METHODS

A search of the PubMed and Embase databases was performed in August 2018 to identify studies in which the natural history of meniscus tears was discussed. The search terms were “meniscus tears,” “natural history of meniscus tears,” “knee meniscus,” “discoid meniscus,” and “natural history of discoid meniscus tears.” The title and abstract reviews were performed. If the title indicated that the article covered the natural history of meniscus tears, was in the English language and involved human subjects, then the abstract was reviewed. No limitations on the date of the publication were placed.

RESULTS

A total of 2567 articles on meniscus tears, 28 articles on natural history of meniscus tears, 8065 articles on “menisci,” 396 articles on “discoid meniscus,” and only 2 on the “natural history of discoid meniscus” were found. The review methodology was applied, leaving 237 articles appropriate for full review. Few long-term natural history reviews were available, leaving 25 articles appropriate for final review.

The importance of the menisci has been defined and redefined over the centuries. Sir Bland Sutton famously described the menisci in 1897 as “functionless remnants of leg muscle origin.”¹ More recent research has accentuated the significance of the menisci to knee stability, cartilage protection, and synovial health.² The natural history of a knee with a known meniscal injury has been reported to accelerate cartilage wear leading to early onset osteoarthritis.^{3,4} Biomechanical studies have demonstrated decreased contact pressure distribution and increased load rates per area in knees after total meniscectomy, which are associated with the higher risk of degenerative changes seen in longitudinal population studies.^{5,6,7}

Meniscal tear rates are reported around 60 per 100,000, but with multiple studies demonstrating asymptomatic meniscal tears, the true incidence is likely grossly underestimated.^{8,9} Males are more affected than females and a third of meniscal tears are associated with concomitant ligamentous injury, such as an anterior cruciate ligament rupture. The incidence of meniscal tears in the skeletally immature population is even more ill-defined as many traumatic tears under the age of 10 years are associated with the presence of a discoid meniscus. With the rise of early sports specialization, more girls playing

From the *San Diego, Rady Children’s Hospital, University of California, San Diego, CA; and †Cleveland Clinic, Cleveland, OH.

The authors have not received financial support for this manuscript. The authors declare no conflicts of interest.

Reprints: Henry G. Chambers, MD, San Diego, Rady Children’s Hospital, University of California, 3020 Children’s Way, MC 5062, San Diego, CA 92123. E-mail: hchambers@rchsd.org.

Copyright © 2019 Wolters Kluwer Health, Inc. All rights reserved. DOI: 10.1097/BPO.0000000000001386

sports, and the pressure to become elite athletes, there may be an increase in intra-articular knee pathology in this population. In addition, there may be meniscus tears which are asymptomatic and never come to the attention of medical professionals.¹⁰

It is important to understand the natural history of a meniscus tear if one is to determine the best way to treat a patient with a meniscus tear. The question remains about what to do with a torn meniscus in the pediatric population. Does repair, partial or complete meniscectomy affect the natural history?^{11–13} While this query appears simple, the complexity of the meniscus with its inherent biomechanical structure, function, and blood supply leads to poorly defined treatment options and outcomes. To add more complexity, not all meniscal tears are created equal and greater than a third may never be diagnosed. With the increased use and expanded role of magnetic resonance imaging in the diagnosis of pediatric knee pathology, more tears are being recognized and there is a paucity of data regarding treatment and long-term outcomes in the pediatric knee.

ANATOMY AND BIOMECHANICS

The menisci are a pair of nonsymmetric semicircular (crescent moon-shaped) fibrocartilaginous structures attached to the tibial plateau at their anterior and posterior ends. There is an attachment to the tibia through the meniscotibial ligament. They are composed mostly of type I collagen bundles with a complex network of fibers varying in orientation to provide structure and support. A majority of the fibers are circumferential and provide resistance to compression. Radially oriented fibers resist longitudinal tearing between the circumferential fibers. This structure develops over the first 10 years of life and at that point is similar in content and structure to adult menisci. During development, blood and nutrients are supplied from the periphery through the entire width of the meniscus until the 9 month postpartum, at which point the inner third will be avascular. Through the rest of development this avascular zone will increase until only the peripheral 10% to 30% is vascular. The argument to repair more central tears in the pediatric meniscus stems directly from this idea that it is relatively more vascular when compared with the adult meniscus.

Types of tears

Tears can be categorized according to their type (horizontal, radial, complex, bucket handle, root injuries, etc.) and/or according to their location (periphery, red-red, red-white, white-white: referring to the perceived vascularity of the area of the tear).¹⁴ There are hundreds of articles arguing for when or how to address these tears.

Treatment consists of partial meniscectomy, meniscal repair, complete meniscectomy, and even consideration of meniscal transplantation. This is not within the scope of this paper, however.

The question which remains unanswered is whether any of these treatments actually alters the natural history of meniscal injuries.^{15–18}

Associated Problems

Meniscus tears take on a special significance if there is an associated ligamentous lesion such as an anterior cruciate ligament tear or an articular cartilage injury. The question remains as to whether or not the meniscus is protective after one of those injuries or more likely that the meniscus is at risk when there is a ligamentous injury that is not treated. Malalignment problems such as increased rotation of the femur or tibia^{19,20} or increase varus or valgus of the knee may contribute to problems with meniscus tears—either leading to tears, nonhealing of repairs, or contributing to arthritis after meniscal tears.^{21,22}

The Discoid Meniscus

The discoid meniscus is an abnormally half moon-shaped, thicker meniscus which is usually present on the lateral side of the knee. It is possibly a congenital abnormality but could also be developmental secondary to abnormal ligamentous attachments. The discoid meniscus is present in ~3% to 6% of the general population and has a higher incidence in Asian countries. It is bilateral in up to 25% of patients. There are 3 types of discoid meniscus: incomplete, complete and Wrisberg type. The Wrisberg type is associated with absence of the meniscotibial ligament which makes it much more unstable. The natural history in a patient with a discoid meniscus is unknown. Certainly some patients have symptoms of clunking and even locking at a very young age, but some have pain which requires surgery.^{23–26} It is equally certain that many patients go through their entire lives with a discoid meniscus without any problems.

CONCLUSIONS

It is quite difficult to parse the natural history of meniscus tears from the current literature. There are patients who have meniscal injuries which are unrecognized, there are patients who have meniscal injuries with malalignment issues which may predispose to mechanical problems such as arthritis and most of the patients who have a symptomatic meniscus tear have surgical treatment of their injuries. There may be inflammatory chemicals in the knee which are upregulated when there is a meniscus tear leading to osteoarthritis. It is also unclear (and beyond the scope of this review) whether surgical intervention (meniscectomy vs. repair) alter the natural history of a meniscus tear. Many of the papers do not discuss how the patients were treated after their surgery to include physical therapy, return to sports, and few have long-term follow-up. It will be very difficult, in a setting where there are physicians who are adept at diagnosing meniscus tears, have access to advanced imaging and have the means to treat meniscus tears that any natural history study will ever be performed. Perhaps a study could be performed in an underserved area of the world, with capture of all of the variables contributing to long-term problems, but none has been performed at this time.

REFERENCES

1. Bland-Sutton J. *Ligaments: Their Nature and Morphology*. London: H.K. Lewis; 1897.

2. Messner K, Gao J. The menisci of the knee joint. Anatomical and functional characteristics, and a rationale for clinical treatment. *J Anat.* 1998;193:161–178.
3. Howell R, Kumar NS, Patel N, et al. Degenerative meniscus: pathogenesis, diagnosis, and treatment options. *World J Orthop.* 2014;5:597–602.
4. Vaziri A, Nayeb-Hashemi H, Singh A, et al. Influence of meniscectomy and meniscus replacement on the stress distribution in human knee joint. *Ann Biomed Eng.* 2008;36:1335–1344.
5. Lau BC, Vashon T, Janghala A, et al. The sensitivity and specificity of preoperative history, physical examination, and magnetic resonance imaging to predict articular cartilage injuries in symptomatic discoid lateral meniscus. *J Pediatr Orthop.* 2018;38:e501–e506.
6. Radin EL, de Lamotte F, Maquet P. Role of the menisci in the distribution of stress in the knee. *Clin Orthop Relat Res.* 1984;185:290–294.
7. Vautrin M, Schwartz C. Future of 34 meniscectomies after bucket-handle meniscus tear: a retrospective study with a follow-up over 22 years. *Eur J Orthop Surg Traumatol.* 2016;26:435–440.
8. Andrish JT. Meniscal injuries in children and adolescents: diagnosis and management. *J Am Acad Orthop Surg.* 1996;4:231–237.
9. Francavilla ML, Restrepo R, Zamora KW, et al. Meniscal pathology in children: differences and similarities with the adult meniscus. *Pediatr Radiol.* 2014;44:910–925; quiz 07–9.
10. Beals CT, Magnussen RA, Graham WC, et al. The prevalence of meniscal pathology in asymptomatic athletes. *Sports Med.* 2016;46:1517–1524.
11. Brucker PU, von Campe A, Meyer DC, et al. Clinical and radiological results 21 years following successful, isolated, open meniscal repair in stable knee joints. *Knee.* 2011;18:396–401.
12. Burks RT, Metcalf MH, Metcalf RW. Fifteen-year follow-up of arthroscopic partial meniscectomy. *Arthroscopy.* 1997;13:673–679.
13. Eijgenraam SM, Reijman M, Bierma-Zeinstra SMA, et al. Can we predict the clinical outcome of arthroscopic partial meniscectomy? A systematic review. *Br J Sports Med.* 2018;52:514–521.
14. Shieh A, Bastrom T, Roocroft J, et al. Meniscus tear patterns in relation to skeletal immaturity: children versus adolescents. *Am J Sports Med.* 2013;41:2779–2783.
15. Kraus T, Heidari N, Svehlik M, et al. Outcome of repaired unstable meniscal tears in children and adolescents. *Acta Orthop.* 2012;83:261–266.
16. Petty CA, Lubowitz JH. Does arthroscopic partial meniscectomy always cause arthritis? *Sports Med Arthrosc Rev.* 2012;20:58–61.
17. Salata MJ, Gibbs AE, Sekiya JK. A systematic review of clinical outcomes in patients undergoing meniscectomy. *Am J Sports Med.* 2010;38:1907–1916.
18. Tengroothenhuysen M, Meermans G, Pittoors K, et al. Long-term outcome after meniscal repair. *Knee Surg Sports Traumatol Arthrosc.* 2011;19:236–241.
19. Okoroha KR, Patel RB, Kadri O, et al. Abnormal tibial alignment is a risk factor for lateral meniscus posterior root tears in patients with anterior cruciate ligament ruptures. *Knee Surg Sports Traumatol Arthrosc.* 2019;27:590–595.
20. Habata T, Ishimura M, Ohgushi H, et al. Axial alignment of the lower limb in patients with isolated meniscal tear. *J Orthop Sci.* 1998;3:85–89.
21. Rao AJ, Erickson BJ, Cvetanovich GL, et al. The meniscus-deficient knee: biomechanics, evaluation, and treatment options. *Orthop J Sports Med.* 2015;3:2325967115611386.
22. Yoon KH, Lee SH, Bae DK, et al. Does varus alignment increase after medial meniscectomy? *Knee Surg Sports Traumatol Arthrosc.* 2013;21:2131–2136.
23. Ahn JH, Kim KI, Wang JH, et al. Long-term results of arthroscopic reshaping for symptomatic discoid lateral meniscus in children. *Arthroscopy.* 2015;31:867–873.
24. Ellis HB Jr, Wise K, LaMont L, et al. Prevalence of discoid meniscus during arthroscopy for isolated lateral meniscal pathology in the pediatric population. *J Pediatr Orthop.* 2017;37:285–292.
25. Lee YS, Teo SH, Ahn JH, et al. Systematic review of the long-term surgical outcomes of discoid lateral meniscus. *Arthroscopy.* 2017;33:1884–1895.
26. Smuin DM, Swenson RD, Dhawan A. Saucerization versus complete resection of a symptomatic discoid lateral meniscus at short- and long-term follow-up: a systematic review. *Arthroscopy.* 2017;33:1733–1742.