

# Not the Last Word

## The Myths of Femoroacetabular Impingement

Joseph Bernstein MD

**F**emoroacetabular impingement (FAI) qualifies as a hot topic, in both senses of the word: Much discussed and very controversial. The American Academy of Orthopaedic Surgeons [2] defines FAI as “a condition where the bones of the hip are abnormally shaped. Because

they do not fit together perfectly, the hip bones rub against each other and cause damage to the joint.”

In his attempt to sort the claims made about FAI into “fact, fiction, or fantasy,” Rubin [24] agreed that some patients have “FAI morphology.” Nevertheless, he concluded, some of the other statements made are more aptly designated as fiction or fantasy.

Logical errors can veer us into the realm of fiction or the world of fantasy. For example, Bedi and Kelly [5] citing two previously published studies [9, 30] wrote “Approximately 90% of patients with labral pathology have underlying structural abnormalities in femoral and/or acetabular morphology.” No matter how accurate that statement may be, it does not establish that FAI is itself a pathological condition, let alone one that “results in progressive labral ... injury” [13]. The inference that FAI causes labral tears starts from an observation of the number of patients with FAI morphology that have labral tears, and not the other way around.

Imagine a social scientist who visits prisons all across the country and interviews a large cohort of convicted murderers. He notices that more than 90% of them shared a single attribute. Is this attribute causally linked to

homicide? Well, not if the attribute is also shared by many nonmurderers, such as the presence of a Y chromosome. That most murderers are men is a different statement than saying that most men are murderers. Likewise, if the prevalence of the “cam-type” FAI deformity alone is 24% [23] among people without symptoms, one cannot blame FAI anatomy for later problems.

Note that causality also requires a temporal relationship, with the cause coming before the effect. Strictly speaking, we would want to know the number of patients with FAI morphology that go on to have labral tears. As a nonhip expert, I would guess that acetabular overgrowth could be a reactive phenomenon, just as subchondral sclerosis in the tibia—a response to peak stress—may be seen after meniscal tears, and not a cause of them.

Yet for the moment, let us accept the idea from Ganz and colleagues [10] that FAI morphology is “a cause for osteoarthritis of the hip.” One can concede that point without agreeing with the related claim that “early surgical intervention ... may decelerate the progression of the degenerative process.”

It may be easier to recognize this overreach by using a nonorthopaedic

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example: Global warming. Like FAI, global warming is a hot topic (literally). The earth is warming, some say; the warming is caused by pollution; and accordingly, the United States needs a carbon tax to limit the production of so-called “greenhouse gases” [19]. In my view, that is logical overreach. Reasonable people can accept the premise of rising temperatures—and even the assertion that people are responsible—without acceding to a carbon tax. That is because even if the globe is warming, and even if human pollution is the cause, it still can be true that the damage is irreversible, or that unilateral action by a single country is insufficient, or that there are simply better solutions than new taxes.

This is also the case with FAI. Even if FAI anatomy were to be proven as a cause of hip arthritis, it does not necessarily follow that surgery can meaningfully and efficiently affect the natural history of the disease. As we know, people with fat around the waist are at higher risk for cardiovascular disease than those who carry it in the hips [26], but nobody has been brave enough to propose in public that liposuction modifies those risks. Those who promise to affect the natural history of FAI with early intervention may likewise be overstating their case.

It is imperative that FAI researchers take care to avoid propounding not only what Rubin termed “fiction” and “fantasy” but even modest overstatement. Their credibility is on the line.

The observation that “approximately 90% of patients with labral pathology have underlying structural abnormalities in femoral and/or acetabular morphology” [5, 9, 30] is informative, just as it is informative to learn that most murderers are male. Observing that male sex seems to be an almost-necessary condition for violent crime can stimulate hypotheses for further testing (on the role of testosterone in aggression, for example). Similarly, observing that FAI anatomy seems to be an almost-necessary condition for labral tears can open important lines of investigation about the causes and perhaps treatments of hip arthropathy. Yet those prevalence data do not support all of the claims made on behalf of FAI—or even the assertion that FAI causes labral tears.

A more modest approach is needed.

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The “Not the Last Word” column in this issue of *Clinical Orthopaedics and Related Research*® demonstrates

truth-in-advertising. Dr. Bernstein’s opinion piece on the sometimes overreaching claims made regarding the role FAI in the genesis of hip osteoarthritis (OA) will not be the last word on this topic. Neither will this commentary. A quick PubMed search shows more than 1000 publications addressing this topic, but with exponential growth: 10 years ago (2004), there were seven articles on FAI; last year there were 233. Luckily, the prevalence of hip OA did not increase by a factor of 33 in the same decade. Bernstein advocates a “modest approach”: That future FAI researchers design studies to truthfully address causation and the role of intervention, that unproved biases not be allowed to undermine scientific foundations, and perhaps most importantly, that we readers do not lazily accept (and potentially act on) convenient claims without critical review.

Bernstein cleverly hides the sometimes intimidating language of study design, Bayesian theory, and outcomes research in analogies and simple examples. But when he conducts a thought experiment using homicidal felons, he is really challenging the reader to recognize that association does not prove causation, and that results of case-control studies are more dangerous to generalize than conclusions from pro-

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spective, randomized trials. His tongue-in-cheek suggestion that liposuction would automatically reduce cardiovascular risk in the obese harkens back to Jonathan Swift's satirical "Modest Proposal," which "proved" having the poor Irish sell their children as food to the rich would decrease the burden of these youngsters on their impoverished parents, while simultaneously redistributing wealth and addressing a food shortage [28]. Nevertheless, the liposuction analogy succinctly warns how easy it is to propose interventions based on false premises.

The skeptic (or in this case, the believer) may ask: "What is the danger of acting on preliminary conclusions that may not be scientifically established, but which make logical sense?" After all, anyone who treats FAI surgically will attest to its ability to relieve pain for many patients (who often return for an operation on the contralateral side). If a possible side effect of proximal femoral osteoplasty and labral resection or repair is to slow progression of future osteoarthritis, even better. History reveals the answer. Not long ago, meniscal tears in the knee were managed by total meniscectomy, which we subsequently learned predisposes to osteoarthritis [1, 29]. Now it appears that arthroscopic debridement of diseased cartilage and bone may not benefit arthritic knees [16]. Interesting. Removing damaged fibrocartilage and

reshaping bone contours may not live up to their advanced billing. Where have we heard that before?

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I read with interest Dr. Bernstein's commentary regarding FAI. Much of the controversy can be attributed to the literature's lack of appropriate definitions and classification for FAI subtypes. FAI morphology is simply a number of radiographic parameters based on static imaging studies, whereas hip impingement is a complex dynamic process that results from variable proximal femoral and acetabular/pelvic anatomy, combined with varying types of activities and ROM requirements [25].

Dr. Bernstein states that an association between FAI and labral tears "does not establish that FAI is itself a pathological condition, let alone one that results in progressive labral ... injury." It is true that a number of studies have shown that FAI parameters are prevalent in asymptomatic cohorts [11, 17]. However, if one digs deeper, there are a number of studies that support that FAI is pathologic with attention to the magnitude of deformity. In a cross-sectional, population

based study of more than 4000 individuals, a deep acetabular socket (global overcoverage) and pistol grip deformity (cam impingement) were significant risk factors for the development of OA [12]. In another study of National Football League (NFL) prospects, larger cam-type deformities were predictive of hip joint related symptoms [17]. Two additional studies have reported that larger cam type deformities are associated with greater degrees of chondral and labral damage as assessed intra-operatively [4, 15].

Although these studies are not without flaws, it appears that more significant FAI deformities, particularly in association with certain high demand activities, are associated with a higher risk of labro-chondral injury and potential for future degenerative hip disease. Dr. Bernstein states: "Note also that causality also requires a temporal relationship, with the cause coming before the effect". In fact, a recent study evaluating cam-type FAI secondary to slipped capital femoral epiphysis in 121 patients with a minimum 20 years followup found radiographic evidence of arthritis in all patients [7]. Of significant interest, the degree of OA in early adulthood directly related to the magnitude of the deformity. Dr. Bernstein then makes an interesting comparison of FAI to dichotomous variables such as male sex and homicide. Although thought

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provoking, the assumption that FAI is a single attribute is flawed. In fact, FAI represents a spectrum of disease patterns and more of a continuous variable with varying degrees of deformity.

Finally, I agree that if FAI potentially leads to hip OA, stating that surgical correction of FAI will have an effect on this natural history without further studies is unfounded. Similar to other orthopaedic disorders lacking this evidence (ACL reconstruction and development of OA), randomized controlled trials are required to support this notion. However, a change in the natural history of a disorder is not necessarily required in order to support treatment of the disorder. Instead, improvement in outcomes and quality of life should suffice, and systematic reviews evaluating surgical treatment of FAI support these improvements [3, 6, 8, 14, 18, 20]. I do believe a modest and evidence based approach is critical and that a promising research foundation exists thus far.

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Dr. Bernstein is correct in stating FAI is a “hot topic.” The notion of bony impingement of the hip has been

published in the peer-reviewed literature as early as 1936 [27]. Experienced hip arthroscopists believe in the relationship between FAI and chondrolabral damage [15]. The hip is examined through the arthroscope as it is moved through a predetermined motion at risk. (Video 1; Supplemental material is available with the online version of *CORR*®). You see the convexity of the femoral head-neck junction conflicting at the chondrolabral junction. The damage pattern of the labrum depends on the type of impingement (cam, pincer, combined).

Additionally, there are several studies in the literature that look at the numbers as Dr. Bernstein suggests. He mentioned that 24% of people have FAI morphology [23], however, this study did not determine if labral tears were present. In 88 asymptomatic youth athletes, 65% had an alpha angle of greater than 55° and 70% had labral tears [21]. In a study of asymptomatic adults, we found that 95% of participants with FAI bony abnormalities (osseous bumps, fibrocystic changes of the femoral head/neck junction, and/or acetabular rim edema), had a labral tear [22]. The relationship between FAI and labral tears continues to be described.

As Dr. Bernstein stated, the observation that “approximately 90% of patients with labral pathology have underlying structural abnormalities in

femoral and/or acetabular morphology” is informative. Still, one study documented up to 95% of asymptomatic patients with bony abnormalities had labral tears [21]. It is unclear when and if these patients become symptomatic. However, in patients who seek treatment for hip pain, an alpha angle > 55° has been an excellent predictor of labral tears. These kinds of findings have encouraged researchers to continue look more closely at the relationship between FAI and labral pathology.

The use of the word “cause” should always be used cautiously in medicine. I agree with Dr. Bernstein that statements should be modest when discussing this relationship. The literature supports the idea that a consequence of FAI is damage to labral tissue and chondral surfaces; however, the strongest evidence is visualization of the chondral/labral conflict due to FAI.

## References

1. Allen PR, Denham RA, Swan AV. Late degenerative changes after meniscectomy. Factors affecting the knee after operation. *J Bone Joint Surg Br.* 1984;66:666–671.
2. American Academy of Orthopaedic Surgeons. Femoroacetabular impingement (FAI). Available at: <http://ortho.info.aaos.org/topic.cfm?topic=A00571>. Accessed July 25, 2014.

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3. Ayeni OR, Adamich J, Farrokhyar F, Simunovic N, Crouch S, Philippon MJ, Bhandari M. Surgical management of labral tears during femoroacetabular impingement surgery: a systematic review. *Knee Surg Sports Traumatol Arthrosc.* 2014;22:756–762.
4. Beaulé PE, Hynes K, Parker G, Kemp KA. Can the alpha angle assessment of cam impingement predict acetabular cartilage delamination? *Clin Orthop Relat Res.* 2012;470:3361–3367.
5. Bedi A, Kelly BT. Femoroacetabular impingement. *J Bone Joint Surg Am.* 2013;95:82–92.
6. Botser IB, Smith TW Jr, Nasser R, Domb BG. Open surgical dislocation versus arthroscopy for femoroacetabular impingement: A comparison of clinical outcomes. *Arthroscopy.* 2011;27:270–278.
7. Castañeda P, Ponce C, Villareal G, Vidal C. The natural history of osteoarthritis after a slipped capital femoral epiphysis/the pistol grip deformity. *J Pediatr Orthop.* 2013;33:S76–S82.
8. Clohisy JC, St John LC, Schutz AL. Surgical treatment of femoroacetabular impingement: A systematic review of the literature. *Clin Orthop Relat Res.* 2010;468:555–564.
9. Dolan MM, Heyworth BE, Bedi A, Duke G, Kelly BT. CT reveals a high incidence of osseous abnormalities in hips with labral tears. *Clin Orthop Relat Res.* 2011;469:831–838.
10. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res.* 2003;417:112–120.
11. Gerhardt MB, Romero AA, Silvers HJ, Harris DJ, Watanabe D, Mandelbaum BR. The prevalence of radiographic hip abnormalities in elite soccer players. *Am J Sports Med.* 2012;40:584–588.
12. Gosvig KK, Jacobsen S, Sonne-Holm S, Palm H, Troelsen A. Prevalence of malformations of the hip joint and their relationship to sex, groin pain, and risk of osteoarthritis: a population-based survey. *J Bone Joint Surg Am.* 2010;92:1162–1169.
13. Groh MM, Herrera J. A comprehensive review of hip labral tears. *Curr Rev Musculoskelet Med.* 2009;2:105–117.
14. Harris JD, Erickson BJ, Bush-Joseph CA, Nho SJ. Treatment of femoroacetabular impingement: a systematic review. *Curr Rev Musculoskelet Med.* 2013;6:207–218.
15. Johnston TL, Schenker ML, Briggs KK, Philippon MJ. Relationship between offset angle alpha and hip chondral injury in femoroacetabular impingement. *Arthroscopy.* 2008;24:669–675.
16. Kirkley A, Birmingham TB, Litchfield RB, Giffin JR, Willits KR, Wong CJ, Feagan BG, Donner A, Griffin SH, D’Ascanio LM, Pope JE, Fowler PJ. A randomized trial of arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med.* 2008;359:1097–1107.
17. Larson CM, Sikka RS, Sardelli MC, Byrd JW, Kelly BT, Jain RK, Givens MR. Increasing alpha angle is predictive of athletic-related “hip” and “groin” pain in collegiate National Football League prospects. *Arthroscopy.* 2013;29:405–410.
18. Matsuda DK, Carlisle JC, Arthurs SC, Wierks CH, Philippon MJ. Comparative systematic review of the open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. *Arthroscopy.* 2011;27:252–269.
19. Metcalf GE. Designing a carbon tax to reduce U.S. greenhouse gas emissions. *Rev Environ Econ Policy.* 2009;3:63–83.
20. Ng VY, Arora N, Best TM, Pan X, Ellis TJ. Efficacy of surgery for femoroacetabular impingement: A systematic review. *Am J Sports Med.* 2010;38:2337–2345.
21. Philippon MJ, Ho CP, Briggs KK, Stull J, LaPrade RF. Prevalence of increased alpha angles as a measure of cam-type femoroacetabular impingement in youth ice hockey players. *Am J Sports Med.* 2013;41:1357–1362.
22. Register B, Pennock AT, Ho CP, Strickland CD, Lawand A, Philippon MJ. Prevalence of abnormal hip findings in asymptomatic participants: a prospective, blinded study. *Am J Sports Med.* 2012;40:2720–2724.
23. Reichenbach S, Jüni P, Werlen S, Nüesch E, Pfirrmann CW, Trelle S, Odermatt A, Hofstetter W, Ganz R, Leunig M. Prevalence of cam-type deformity on hip magnetic resonance imaging in young males: A cross-sectional study. *Arthritis Care Res.* 2010;62:1319–1327.
24. Rubin DA. Femoroacetabular impingement: fact, fiction, or fantasy? *AJR Am J Roentgenol.* 2013;201:526–534.

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25. Sankar WN, Nevitt M, Parvizi J, Felson DT, Agricola R, Leunig M. Femoroacetabular impingement: defining the condition and its role in the pathophysiology of osteoarthritis. *J Am Acad Orthop Surg.* 2013;21:S7–S15.
26. Seidell JC, Pérusse L, Després J-P, Bouchard C. Waist and hip circumferences have independent and opposite effects on cardiovascular disease risk factors: the Quebec Family Study. *Am J Clin Nutr.* 2001;74:315–321.
27. Smith-Petersen MN. Treatment of malum coxae senilis, old slipped upper capital femoral epiphysis, intrapelvic protrusion of the acetabulum, and coxae plana by means of acetabuloplasty. *J Bone Joint Surg Am.* 1936;18:869–880.
28. Swift J. The Project Gutenberg EBook of A Modest Proposal, by Jonathan Swift. Available at: <http://www.gutenberg.org/files/1080/1080-h/1080-h.htm>. Accessed August 19, 2014.
29. Tapper EM, Hoover NW. Late results after meniscectomy. *J Bone Joint Surg Am.* 1969;51:517–526.
30. Wenger DE, Kendall KR, Miner MR, Trousdale RT. Acetabular labral tears rarely occur in the absence of bony abnormalities. *Clin Orthop Relat Res.* 2004; 426:145–150.