

# THE RADIOGRAPHIC FEAR INDEX IS A USEFUL DIAGNOSTIC TOOL IN PATIENTS UNDERGOING HIP PRESERVATION SURGERY: A SYSTEMATIC REVIEW

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# Disclosures

- Dr. Olufemi R Ayeni declares that he has a non-financial conflict of interest as he is associated with the Speakers Bureau for Conmed and Stryker Canada. Dr. Ayeni holds a Tier 2 Canada Research Chair in Joint Preservation Surgery.
- The remaining authors have no conflicts of interest to declare

# Introduction

- Several radiographic parameters exist to aid in the diagnosis of hip dysplasia and impingement including the alpha angle, the lateral center edge angle (LCEA), and the acetabular inclination among others.
- The femoro-epiphyseal acetabular roof (FEAR) index is a novel radiographic marker established in 2017 designed to help distinguish between stable and unstable hips with borderline dysplasia.
- It is theorized that the growth and orientation of the femoral neck depends on the subcapital growth plate and that it orients itself perpendicular to the joint reactive forces acting on the hip according to the Heuter-Volkman principle.
- Therefore, a laterally opening or positive angle is more likely to represent a hip that is unstable while a medially opening or negative angle is more likely to represent a stable hip.

# Purpose

- The purpose of this review is to assess the utility of the FEAR index as a diagnostic tool in hip preservation surgery. We hypothesize that this parameter will be useful in distinguishing between stable and unstable hips and therefore aid in both diagnosis and treatment.

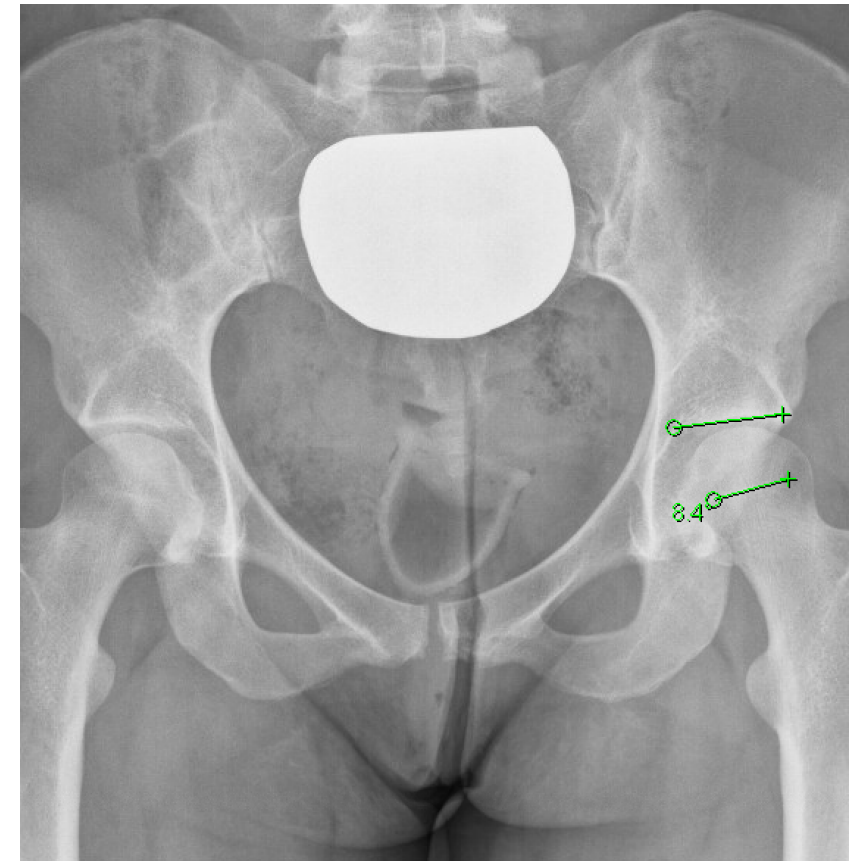


Figure depicting a laterally opening or positive FEAR index measurement

# Methods

Three online databases (MEDLINE, EMBASE, and PubMed) were searched from database inception to May 2022, for literature addressing the utility of the FEAR index in hip preservation surgery.

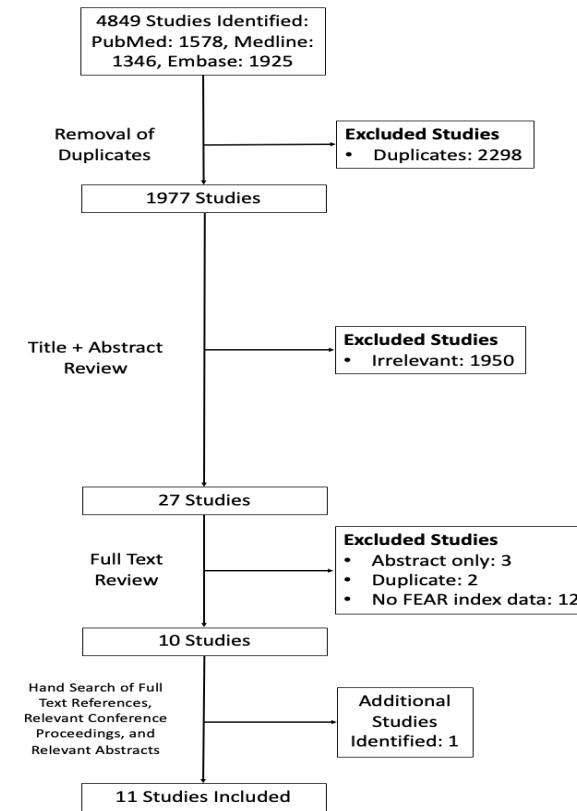
The inclusion criteria were as follows: (1) therapeutic studies of all levels of evidence; (2) English language studies; (3) human studies; and (4) studies reporting on the utility of the FEAR index in diagnosis of patients with either hip impingement or instability or studies correlating the FEAR index with postoperative patient reported outcomes. Exclusion criteria were: (1) cadaveric studies; (2) conference abstracts; (3) review papers; (4) technical guides; (5) textbook chapters; and (6) case series of less than 5 patients.

# Results

1) At the initial search, there were a total of 4,849 studies yielded across all the databases. After excluding duplicates, a systematic screening process was conducted yielding 11 papers that met the inclusion criteria.

2) Overall, there were a total of 1,458 patients and 1,512 hips that met the inclusion criteria for our review. The mean number of patients included across studies in this review was 132 (range: 36-267). The mean age of patients was 27.9 years (range: 13-59 years), of which 73% were female

3) The mean MINORS score for comparative studies was 17.6 (range: 16-22, representing good quality) while the MINORS score for the 1 non-comparative study was 12 (representing fair quality)



PRISMA Flow Chart

# Results

Among the 5 studies that evaluated patients with hip dysplasia, as defined by a LCEA less than 25 degrees, that differentiated between hip instability and hip impingement based on preoperative clinical, physical and radiographic examination with higher values predicting symptoms of instability and lower values predicting symptoms of impingement, the mean FEAR index in 319 patients in the instability group ranged from 3.01 to 13 degrees while the mean FEAR index in 239 patients in the impingement group ranged from -10 to -0.77 degrees degrees and the mean FEAR index in 105 patients in the control group ranged from -13 to -7.7 degrees.

One study defined a cutoff value of 5 degrees which correctly predicted treatment decision 79% of the time with an area under the curve (AUC) of 0.89, while another defined a cutoff of 2 degrees which correctly predicted treatment 90% of the time and the last study set a threshold of 3 degrees which provided an 80% sensitivity, 81% specificity and 0.86 AUC for correctly predicting treatment decision

# Results

The intra-observer agreement for the FEAR index was reported by 3/11 studies and the ICC ranged between 0.86 and 0.99 across studies. Furthermore, the inter-observer agreement was reported by 8/11 studies with ICC values which ranged from 0.778-1 across studies.

Of the 9 studies where it was reported, the FEAR index was calculated by a fellowship trained orthopedic surgeon in 4/9 studies, by an orthopedic fellow and medical student in 1/9 studies, by 2 research assistants in 1/9 studies, by 2 research assistants and a fellowship trained orthopedic surgeon in 1/9 studies, by a radiologist and an orthopedic surgeon in 1/9 studies and by 2 orthopedic fellows and an orthopedic resident in 1/9 studies.



# Discussion

The most important finding of this review was that the FEAR index is a reliable and reproducible radiographic tool that may be used to help differentiate between stable and unstable hips, which ultimately helps dictate optimal treatment strategy.

Given the variability in FEAR index cut off values across studies, there is no absolute consensus value that dictates treatment decision and surgeons must rather rely on relative values to guide decision-making. Specifically, in patients with borderline hip dysplasia, a FEAR index value range greater than 0 to 5 degrees may suggest symptoms of hip instability that would likely benefit from preservation surgery such as a PAO as opposed to arthroscopy only.

Overall, even in patients where the FEAR index would suggest symptoms of impingement, it is critically important to assess for other potential causes of hip instability such as capsular laxity and hip hypermobility using both history and physical examination.

# Strengths and Limitations

This review represents a comprehensive analysis of the available literature regarding the diagnostic utility of the FEAR index in hip preservation surgery. In addition, most included studies provided an adequate control group making it easier to compare FEAR index values and draw robust conclusions.

The main limitation of this review is the quality of available evidence regarding the FEAR index as most included studies comprised level 3 evidence. Inherent to this limitation, the novel nature of the FEAR index as a radiographic parameter in hip preservation surgery makes it difficult to draw meaningful conclusions until it gains consistent use and widespread acceptance amongst the hip preservation community.

# Conclusion

This review demonstrates that the FEAR index has a high agreement and consistent application, making it a useful diagnostic tool in hip preservation surgery particularly in patients with borderline dysplastic hips. However, given the variability in FEAR index cut off values across studies, there is no absolute consensus value that dictates treatment decision.

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