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Retrospective study on radiological factors predictive of symptomatic psoas impingement development in protruding cups in primary hip arthroplasty

INTRODUCTION

Groin pain after total hip arthroplasty (THA) is a relatively rare condition, with reported incidence ranging from 0.4% to 18.3%. The most common intrinsic causes of groin pain include infection, aseptic loosening, impingement, and fractures. Iliopsoas (IP) tendinopathy following THA is an insidious and often underdiagnosed condition, affecting between 0.37% and 4.3% of implanted hips.

IP tendinopathy arises from friction, irritation, and mechanical stress on the tendon, often due to impingement. Both direct and indirect causes have been identified. In press-fit acetabular components, direct causes include prominent or malpositioned cups, lack of anterior bony coverage, and screw protrusion. Indirect causes, such as increased offset and leg length discrepancy, have been inconsistently reported in the literature.

Acetabular cup protrusion on axial imaging has been identified as the most sensitive and specific predictor of symptomatic IP impingement. However, cup prominence is also frequently seen in asymptomatic THAs. According to the literature, other radiological parameters—beyond cup prominence—may influence or predict the onset of IP impingement. Thus, cup protrusion alone seems to be a necessary but not sufficient condition for the development of IP tendinopathy.

The aim of this study is to compare a retrospective cohort of patients with acetabular cup protrusion who did not develop symptoms compatible with IP tendinopathy, with a group of patients who did present with symptomatic cup prominence and were treated with arthroscopic IP tenotomy. Post-THA CT scans were analyzed to identify which radiological or positional factors (e.g., inclination, version, offset, leg length discrepancy, and reaming technique) could predict the onset of IP impingement in patients with prominent acetabular cups.

OBJECTIVES, STUDY DESIGN, AND POPULATION

The objective of this study is to identify post-operative CT-based radiological predictors of symptomatic IP tendinopathy in patients with acetabular cup prominence. The analysis compares asymptomatic and symptomatic patients, the latter having undergone arthroscopic tenotomy for IP tendinopathy. All patients were treated at the IRCCS Istituto Ortopedico Rizzoli, Department of Orthopaedics, Trauma and Hip/Knee Arthroplasty and Revision Surgery, between 2000 and 2021.

This is a retrospective observational cohort study. The study population includes adult patients who underwent primary THA and subsequently had a post-operative CT scan performed for pain, clicking, or contralateral hip planning.

Inclusion criteria: primary THA, post-op CT scan available for pain, clicking or contralateral planning; minimum 5-year follow-up for the control group and history of IP tenotomy for the symptomatic group; complete clinical and radiological documentation.

Exclusion criteria: patient refusal; inadequate CT or CT performed for periprosthetic fracture, loosening, infection, or obvious wear; incomplete documentation; insufficient follow-up or resolved symptoms after conservative treatment.

ENDPOINTS AND OUTCOME MEASURES

The primary endpoint is the identification of CT-based radiological predictors of IP tendinopathy in patients with acetabular cup prominence after THA. These include acetabular version, inclination, offset, and reaming technique.

MATERIALS AND METHODS

This study evaluates the radiological predictors of symptomatic IP tendinopathy in a cohort of adults who underwent primary THA and exhibited acetabular cup prominence on post-operative CT. All patients were treated at the IRCCS Istituto Ortopedico Rizzoli between 2000 and 2021. Post-operative CT scans were reviewed, and cases with prominent acetabular cups were selected. Demographic, surgical, and follow-up data were retrieved from the medical records and routine clinical documentation.

Patients were stratified based on the presence or absence of IP tendinopathy. Symptomatic patients had to have undergone IP tenotomy after thorough diagnostic evaluation, including clinical tests, US-guided anesthetic injection (with failed response to multiple infiltrations), serial X-ray, CT, and lab testing to rule out other causes. This diagnostic workflow is supported by the international literature.

The control group included patients with cup prominence who remained asymptomatic during at least 5 years of follow-up.

COLLECTED VARIABLES

Demographic variables: sex, age at primary THA, operated side, underlying diagnosis.
Implant-related variables: cup type and size, stem type, head diameter, bearing couple, time between THA and CT.
Cup prominence variables: axial and sagittal prominence in mm.

CT-based outcome measures:

- Acetabular version (°)
- Contralateral acetabular version (°)
- Version difference (°)
- Cup inclination (°)
- Femoral offset (mm)
- Acetabular offset (mm)

- Global offset (cm)
- Contralateral global offset (cm)
- Offset difference (cm)
- Acetabular diameter (mm)
- Diameter mismatch (mm)
- Eccentric reaming (mm)

Measurements will be validated through intra- and inter-observer reliability testing. Outcomes will be analyzed to identify radiological predictors of IP tendinopathy. The ultimate goal is to define intraoperative positioning strategies to reduce the risk of developing symptoms.

DATA ANALYSIS

Quantitative variables will be expressed as mean, standard deviation, minimum, and maximum values. Qualitative variables will be reported as frequencies and percentages. Inter- and intra-observer reliability will be assessed using correlation statistics with 95% confidence intervals and standard error. Differences between symptomatic and asymptomatic patients will be evaluated using the Mann-Whitney U test for continuous and discrete variables, and Chi-square test for categorical variables. All analyses will be performed using IBM SPSS version 25 or later. Statistical significance is set at $p < 0.05$.

STUDY TIMELINE

Start date: Date of Ethical Committee (EC) approval.

- Step 1: Kickoff meeting within 2 months of EC approval to plan the project phases, data collection, storage, analysis, and publication.
- Step 2: Data collection from month 2 to 12 post-kickoff.
- Step 3: Data analysis with involvement of all investigators.
- Step 4: Data publication.

End date: Within 18 months from EC approval (12 months for data collection, 6 months for analysis and publication).

DATA COLLECTION AND STORAGE

Clinical data will be extracted from patient medical records and source documents. A standardized Case Report Form (CRF) will be used to collect relevant clinical and radiographic data. All data will be pseudo-anonymized using a unique patient code. The database will be stored in a password-protected computer accessible only to the investigators.

ETHICAL CONSIDERATIONS

The study protocol and all relevant documents will be submitted for approval to the competent authorities and Ethics Committee prior to study initiation. The study will comply with the principles of the most recent Declaration of Helsinki (Fortaleza, October 2013), as well as all applicable national and international regulations concerning clinical research. The protocol was written and the study will be conducted in accordance with ICH-GCP guidelines.

INFORMED CONSENT

As IRCCS Istituto Ortopedico Rizzoli is a recognized research institute, patient data used for research purposes are governed by Article 110-bis, paragraph 4 of the Italian Privacy Code (D.lgs 196/2003 as amended by D.lgs 101/2018). Therefore, specific consent for data processing is not required.

PRIVACY

All patients will be identified by a numerical code to ensure pseudo-anonymization. Data will be processed in compliance with current national and European privacy laws. Access to sensitive data will be restricted to study sponsors and designated personnel for monitoring/auditing purposes, the principal investigator and collaborators, the Ethics Committee, and relevant health authorities. Access to source documentation for audits or inspections will be granted while maintaining patient confidentiality.

FINAL REPORT AND PUBLICATION

The principal investigator commits to producing a final report and publishing the study results, regardless of outcomes, as described in the protocol. Any publication or dissemination (journals, conferences, seminars) will occur only after statistical processing and always in fully anonymous form.