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Risk Factors for Postoperative Sciatic Nerve Injury Following Open Reduction and Internal Fixation of Acetabular Fractures: A Systematic Review and Meta-Analysis

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Purpose: Postoperative sciatic nerve injury is a debilitating complication after open reduction and internal fixation (ORIF) of acetabular fractures. The reported incidence and risk factors are highly variable. This systematic review and meta-analysis aimed to synthesize the current evidence on the incidence and risk factors of this complication.
Methods: A systematic search was conducted in the PubMed/MEDLINE and Scopus databases for studies published January 2000–December 2025. We included cohort and case-control studies that reported new-onset postoperative sciatic nerve injuries after acetabular ORIF. Studies not distinguishing between pre-(traumatic) and postoperative injuries were excluded. A random-effects meta-analysis using the Restricted Maximum-Likelihood estimator and Hartung-Knapp-Sidik-Jonkman adjustment was performed to pool incidence. Risk factors were analyzed by pooling unadjusted odds ratios (ORs) and narratively synthesizing adjusted ORs.
Results: Five retrospective cohort studies involving 3,104 patients were included. The pooled incidence of postoperative sciatic nerve injury was 5.9% (95% confidence interval [CI]: 1.8%–12.2%) with substantial heterogeneity (I^2=88.8%). Analysis of potential risk factors, including patient positioning (prone vs. lateral), was inconclusive because of the limited number of studies and extreme statistical uncertainty. These findings should be considered exploratory and hypothesis-generating rather than definitive. Several risk factors were identified from single studies, including transverse fracture patterns (unadjusted OR 3.00, 95%CI: 1.10–7.90) and obesity (unadjusted OR 3.35, 95%CI: 1.61–6.96), but these require further validation. Leave-one-out sensitivity analysis identified one study as a major source of heterogeneity.
Conclusions: The incidence of sciatic nerve injury after acetabular ORIF was approximately 6%; however, this was based on highly heterogeneous retrospective evidence. The current literature is insufficient to support definitive conclusions regarding specific risk factors. There is an urgent need for high-quality, prospective, multicenter studies with standardized definitions to better delineate risks and guide preventative strategies.
Level of evidence: Level III (Oxford Centre for Evidence-Based Medicine 2011).

Keywords: acetabular fracture, sciatic nerve injury, open reduction internal fixation, risk factors, systematic review, meta-analysis

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INTRODUCTION

Acetabular fractures are complex pelvic injuries that often require open reduction and internal fixation (ORIF) to restore hip joint congruity and prevent debilitating post-traumatic arthritis [11]. Although ORIF is the standard of care for displaced fractures, this technically demanding procedure carries significant risks, with iatrogenic sciatic nerve injury being one of the most devastating complications [12]. The reported incidence of postoperative sciatic nerve injury varies widely in the literature, with rates ranging from 1% to over 15% [6 ,15]. This wide range reflects not only the true differences between patient populations and surgical techniques but also the significant methodological heterogeneity across studies.

The anatomical proximity of the sciatic nerve to the posterior acetabulum makes it particularly vulnerable during surgical exposure, fracture reduction, and implant placement [8]. Injury to the nerve can result in permanent foot drop, sensory deficits, chronic neuropathic pain, and profound functional disability, severely affecting the patient's quality of life [6]. Numerous potential risk factors are suggested, including patient-related factors (e.g., obesity), fracture-related factors (e.g., posterior wall involvement and transverse patterns), and surgical factors (e.g., operative approach, patient positioning, and surgeon experience) [1, 4, 17, 18].

However, existing literature is characterized by conflicting findings and methodological limitations. For instance, the debate over patient positioning (prone vs. lateral) remains unresolved, with some studies suggesting a higher risk in the prone position [4] while others have found no independent effect [17]. This lack of consensus is largely due to the predominance of retrospective, single-center studies with small sample sizes, which are often underpowered to detect true associations. Furthermore, there is a lack of standardized definitions of nerve injury and inconsistent reporting of confounding variables, which make it difficult to synthesize results across studies.

While a previous meta-analysis by Stavrakakis et al. provided valuable estimates of the incidence and recovery outcomes of both traumatic and iatrogenic sciatic nerve palsy [19], a comprehensive synthesis focused specifically on postoperative risk factors remains a critical gap. Our study aimed to fill this gap by applying rigorous meta-analytic methods to identify and quantify the factors that increase the risk of sciatic nerve injury following acetabular ORIF, thereby providing clinicians with actionable evidence that can be used to guide preoperative planning and surgical techniques.

METHODS

This systematic review and meta-analysis was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [16]. The review protocol was retrospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO).

Search Strategy

A comprehensive search strategy was developed to identify all relevant studies reporting risk factors for postoperative sciatic nerve injury following ORIF for acetabular fractures. The search was conducted across PubMed/MEDLINE and Scopus from January 1, 2000, to December 31, 2025, to capture the current era of acetabular fracture surgery. The search strategy employed both Medical Subject Headings (MeSH) terms and free-text keywords, which were combined using Boolean operators. To ensure comprehensive coverage, the reference lists of all the included studies and relevant review articles were manually searched to identify additional eligible studies.

Eligibility Criteria

Studies were included if they met the following criteria: (1) randomized controlled trials, prospective or retrospective cohort studies, or case-control studies; (2) the participants were adults aged 18 years or older undergoing ORIF for acetabular fractures; (3) reported **new-onset postoperative** sciatic nerve injury or palsy as an outcome; (4) reported extractable data on risk factors with sufficient information to calculate or extract effect sizes; (5) English language publications; and (6) a minimum follow-up of 3 months post-surgery.

Studies were excluded if they were: (1) case reports, editorials, letters, commentaries, conference abstracts, or review articles; (2) focused on non-operative management or primary total hip arthroplasty; (3) involved pediatric patients or pathological fractures; (4) **included patients with pre-existing sciatic nerve pathology where data could not be separated**; or (5) exhibited significant selection bias in their design (e.g., case series including only patients with the outcome of interest).

Study Selection

The study selection process followed a two-stage screening approach. First, two independent reviewers screened all titles and abstracts identified using the search strategy. Second, the full-text articles of potentially eligible studies were obtained and independently assessed by the same two reviewers. Any disagreements between the reviewers at either stage were resolved through discussion; if a consensus could not be reached, a third senior reviewer was consulted. The reasons for the exclusion of full-text articles were documented.

Data Extraction and Quality Assessment

A standardized data extraction form was used in this study. One reviewer extracted data from all the included studies, and a second reviewer independently verified the extracted data. The methodological quality of the included studies was independently assessed by two reviewers using the Newcastle-Ottawa Scale (NOS) for cohort and case-control studies [22]. Studies scoring 7–9 were considered of high quality, 4–6 were considered of moderate quality, and 0–3 were considered of low quality.

Data Synthesis and Statistical Analysis

Descriptive synthesis was performed for all the included studies. For outcomes reported in two or more studies with sufficient quantitative data, random effects meta-analyses were conducted. To stabilize the variances and account for studies with zero events, the pooled incidence of sciatic nerve injury was calculated using the Freeman-Tukey double arcsine transformation [5]. For risk factor analysis, odds ratios (ORs) were pooled from unadjusted data. Adjusted ORs (aORs) were reported narratively and were not pooled because of the use of different covariates across studies.

All meta-analyses were performed using the random-effects model with the Restricted Maximum-Likelihood (REML) estimator for the between-study variance (τ^2). The Hartung-Knapp-Sidik-Jonkman (HKSJ) adjustment was applied to calculate the 95% confidence intervals (CIs) for the pooled estimates, as this method provides more robust and conservative CIs, especially when the number of included studies is small [7].

Statistical heterogeneity was assessed using the I^2 statistic and the Cochran's Q test. I^2 values of <40%, 40–75%, and >75% were interpreted as low, moderate, and high heterogeneity, respectively [9]. To investigate the sources of heterogeneity, we planned and conducted leave-one-out sensitivity and subgroup analyses based on study quality (high vs. moderate), center type (multicenter vs. single-center), and the diagnostic definition of nerve injury (clinical vs. clinical plus electrodiagnostic confirmation).

All statistical analyses were conducted using Python version 3.11 with Stats models and SciPy libraries. Statistical significance was set at a two-tailed p-value < 0.05.

RESULTS

Study Selection

The comprehensive literature search yielded 678 articles. After removing 490 duplicates, the titles and abstracts of 188 unique records were screened. A total of 15 full-text articles were retrieved and assessed for eligibility. Ten full-text articles were excluded because they did not report risk factors (n=4), had insufficient data (n=3), duplicate populations (n=2), or significant selection bias (n=1, a case series of only injured patients). Ultimately, five studies met all inclusion criteria and were included in the qualitative and quantitative synthesis [1, 4, 15, 17, 18]. The study selection process is presented in a PRISMA flow diagram (Figure 1).

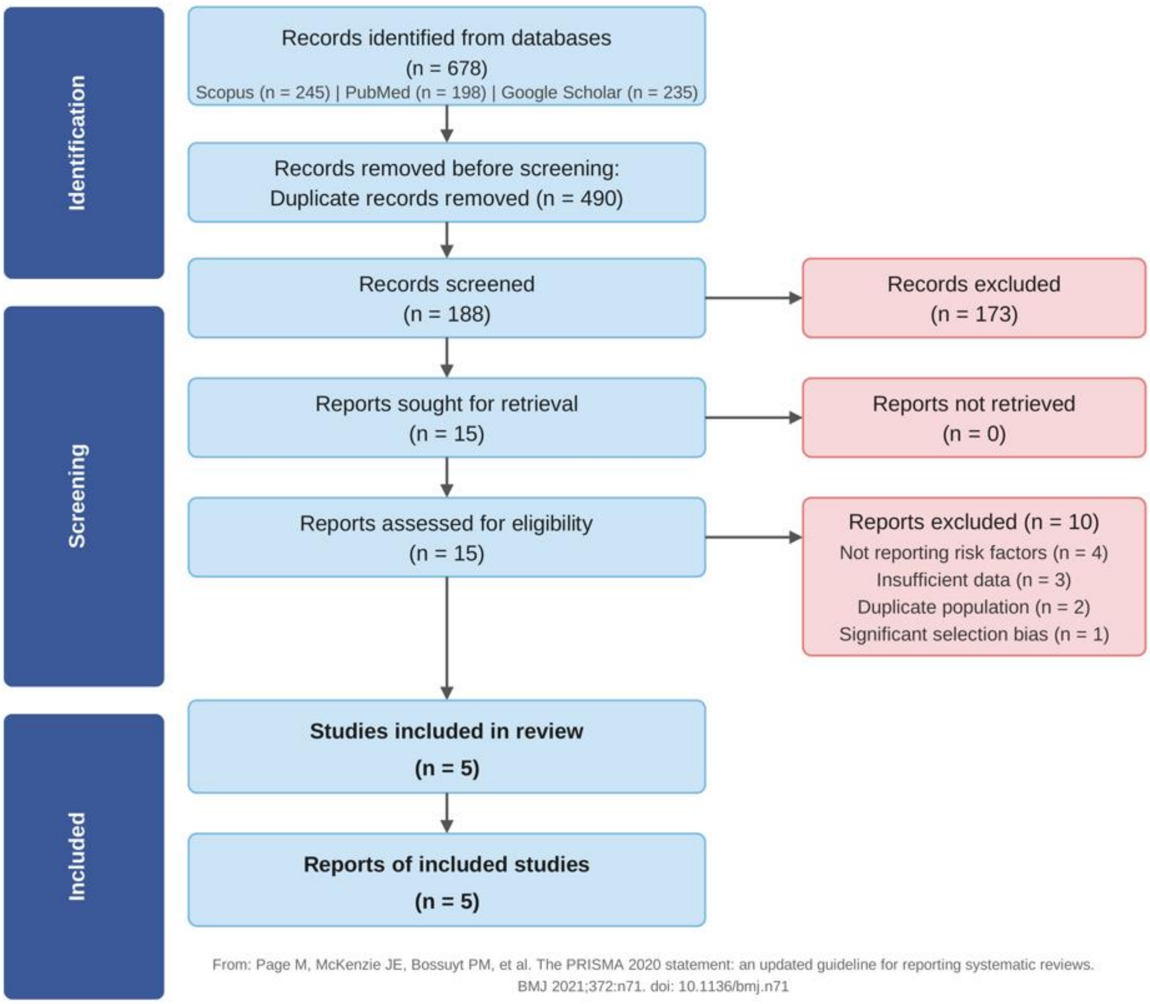

Fig. 1 PRISMA 2020 flow diagram of the study selection process.

Study Characteristics and Quality

The five included studies encompassed 3,104 patients who underwent ORIF for acetabular fractures, with 150 patients (4.8%) experiencing **new-onset postoperative** sciatic nerve injury. The selected studies were published between 2017 and 2024. All five studies used a retrospective cohort design. One study was a multicenter investigation, whereas four were single-center studies. The sample size ranged from 167 to 1,045 patients. The median or mean age of patients across the studies ranged from 38 to 44 years, and male patients were predominant (67–78%). Motor vehicle collisions are the most common mechanism of injury. Detailed baseline characteristics are shown in Table 1.

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Table 1 Characteristics of included studies.

Study	Country	Design	N	Nerve Injury n (%)	Mean/Median Age (years)	Male (%)	NOS Score / Quality
Chen et al. 2023	USA	Retrospective multicenter cohort	1,045	52 (5.0%)	40	72%	8 / High
Schaffer et al. 2024	USA	Retrospective single-center cohort	644	20 (3.1%)	44	78%	7 / High
Arbash et al. 2024	Saudi Arabia	Retrospective single-center cohort	273	21 (7.7%)	38	67%	6 / Moderate
Simske et al. 2019	USA	Retrospective single-center cohort	975	32 (3.3%)	42	71%	6 / Moderate
Negrin et al. 2017	Argentina	Retrospective single-center cohort	167	25 (15.0%)	39	75%	5 / Moderate

Quality assessment using the Newcastle-Ottawa Scale revealed that two studies were of high quality (scores of 7–8) [4, 17] and three were of moderate quality (scores of 5–6) [1, 15, 18]. Common methodological limitations include the lack of prospective designs, variable outcome assessment methods, and single-center designs (Table 2)

Table 2 Definition and ascertainment of sciatic nerve injury in included studies.

Study	Definition of Sciatic Nerve Injury	Method of Ascertainment	Timing of Assessment
Chen et al. 2023	New-onset motor or sensory deficit in the sciatic nerve distribution not present preoperatively	Clinical examination (documented foot drop, sensory loss)	Postoperatively during hospital stay and at follow-up
Schaffer et al. 2024	Iatrogenic sciatic nerve palsy defined as a new postoperative motor deficit	Clinical examination by attending surgeon	Immediately post-op and at follow-up visits
Arbash et al. 2024	Postoperative sciatic nerve injury confirmed by clinical findings (motor/sensory deficit)	Clinical examination; EMG/NCS used in selected cases for confirmation	Postoperatively and at follow-up (mean 15 months)
Simske et al. 2019	New postoperative sciatic nerve deficit (motor or sensory)	Retrospective chart review of clinical notes	Documented during postoperative course
Negrin et al. 2017	Postoperative sciatic nerve palsy (motor deficit)	Clinical examination	Postoperatively

Pooled Incidence of Sciatic Nerve Injury

The reported incidence of postoperative sciatic nerve injury varied substantially across the five studies, ranging from 3.1% to 15.0%. The pooled incidence, calculated using a random-effects model (REML + HKSJ) with Freeman-Tukey double arcsine transformation, was 5.9% (95% CI: 1.8%–12.2%). Substantial heterogeneity was observed ($I^2 = 88.8\%$, $\tau^2 = 0.0147$, $p < 0.001$), as shown in the forest plot (Figure 2).

Risk Factor Analysis

Risk factors were analyzed by separating unadjusted and adjusted estimates. Unadjusted odds ratios (ORs) were pooled where appropriate, while adjusted odds ratios (aORs) were reported narratively due to differing covariates across studies (Table 3).

Patient Positioning (Prone vs. Lateral)

Two studies provided data for the meta-analysis of unadjusted ORs for prone positioning. The pooled unadjusted OR was 2.60, but the 95% CI was extremely wide and included 1.0, indicating no statistically significant association and a high degree of uncertainty (95% CI: 0.00 to 476,243; I^2 =

94.1%). This was due to the highly conflicting results of the two studies (Chen et al. OR 6.87 vs. Schaffer et al. OR 1.00).

Two studies reported that the adjusted ORs could not be pooled. In a multicenter study, Chen et al. (9) found a significantly increased risk of prone positioning in a subgroup of non-posterior wall fractures (aOR 7.14, 95% CI: 2.22–23.00). In contrast, in a single-center study of all fracture types, Schaffer et al. (10) found no significant association after adjusting for the surgeon and fracture pattern (aOR 1.00, 95% CI: 0.30–3.90).

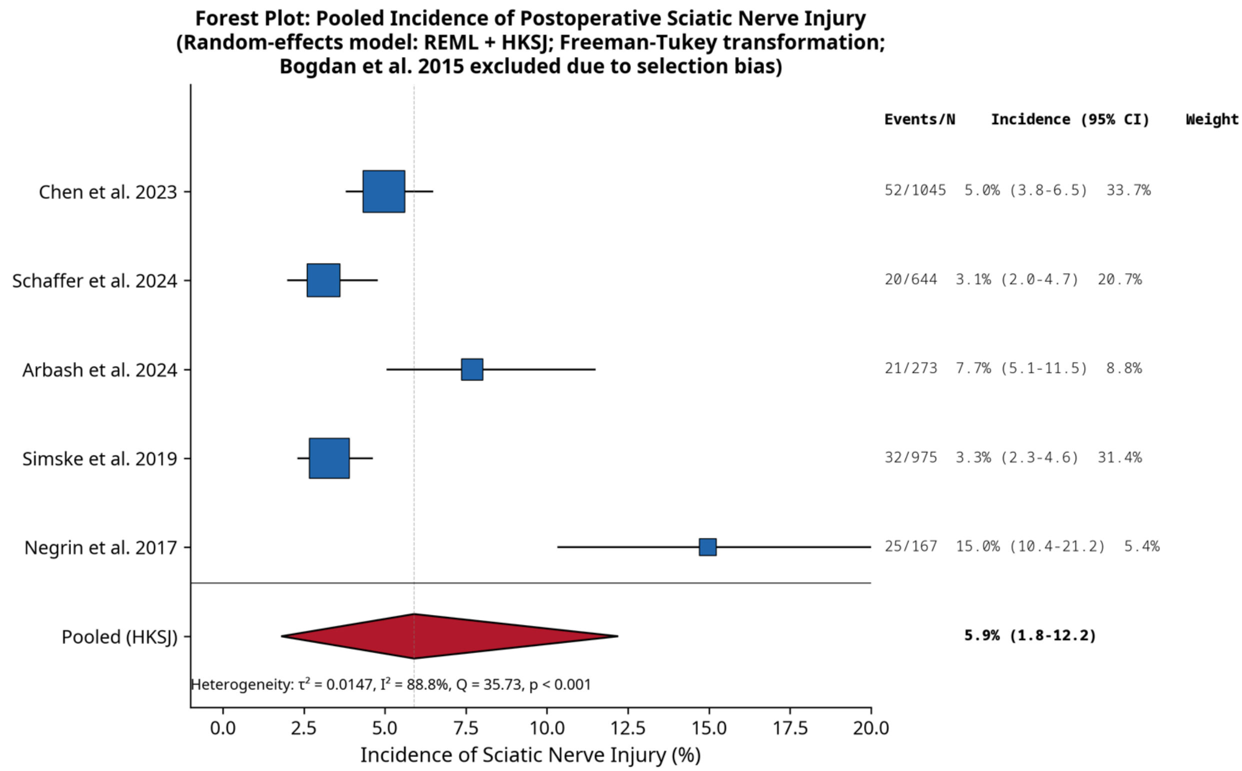

Fig. 2 Forest plot of the pooled incidence of sciatic nerve injury following acetabular ORIF.

Table 3 Summary of risk factor analyses for postoperative sciatic nerve injury.

Risk Factor	Study	Estimate Type	OR/aOR	95% CI	Significant
Prone positioning	Chen 2023	Unadjusted	6.87	3.33–14.18	Yes
Prone positioning	Schaffer 2024	Unadjusted	1.00	0.30–3.90	No
Prone positioning (non-post. wall Fx)	Chen 2023	Adjusted	7.14	2.22–23.00	Yes
Prone positioning (all Fx)	Schaffer 2024	Adjusted	1.00	0.30–3.90	No
Transverse fracture	Schaffer 2024	Unadjusted	3.00	1.10–7.90	Yes
Obesity (body mass index [BMI] ≥30)	Simske 2019	Unadjusted	3.35	1.61–6.96	Yes
Surgeon identity	Schaffer 2024	Adjusted	p < 0.02	N/A	Yes
Posterior wall fracture	Chen 2023	Unadjusted	1.20	0.60–2.40	No

It must be stressed that these risk factor findings are exploratory and derived from a very limited and heterogeneous evidence base. They should be considered as hypothesis-generating rather than definitive evidence to guide clinical practice. The extremely wide confidence interval for the pooled positioning estimate reflects the profound statistical uncertainty that precludes meaningful clinical interpretation.

Other Risk Factors (from Single Studies)

Several risk factors were identified in the single studies and could not be pooled. Therefore, these findings should be interpreted with caution (Fig. 3).

Transverse Fracture Pattern: Schaffer et al. [10] reported an unadjusted OR of 3.00 (95% CI: 1.10–7.90).

Obesity (body mass index [BMI] ≥30 kg/m²): Simske et al. [6] reported an unadjusted OR of 3.35 (95% CI: 1.61–6.96).

Surgeon Identity: Schaffer et al. [10] found that the individual surgeon was a significant predictor of iatrogenic nerve palsy ($p < 0.02$) even after adjusting for case complexity.

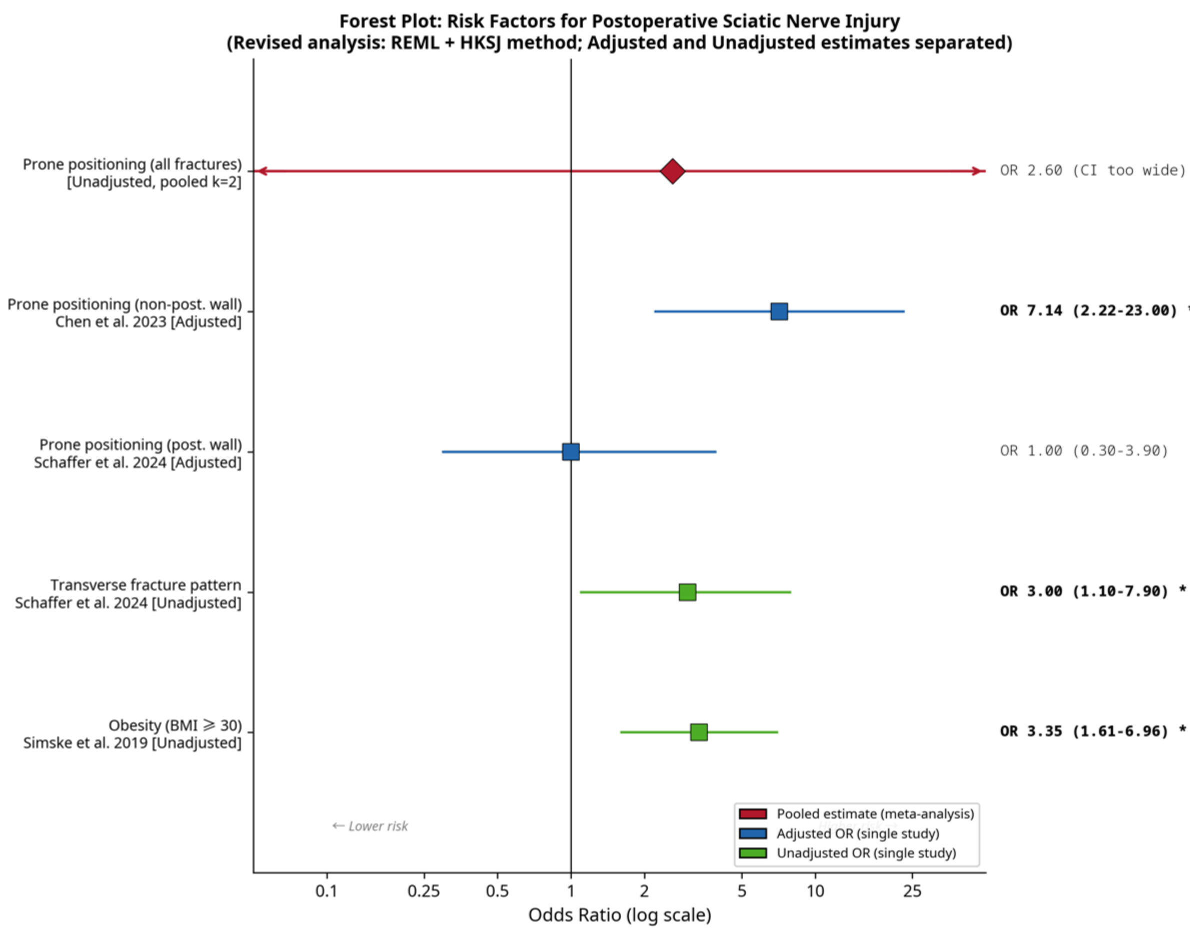

Fig. 3 Forest plot of the risk factors for sciatic nerve injury.

Sensitivity and Subgroup Analyses

To investigate the high heterogeneity in the pooled incidence, several analyses were performed. Leave-One-Out Analysis: A leave-one-out sensitivity analysis revealed that the study by Negrin et al. [16] was a major contributor to heterogeneity. Removing this study, which had the highest incidence (15.0%) and smallest sample size (n=167), reduced the pooled incidence to 4.4% (95% CI: 1.9%–7.7%) and decreased I^2 from 88.8% to 75.2% (Figure 4; Table 4).

Subgroup according to Study Quality: The pooled incidence was 4.0% (95% CI: 0.8–22.9%, I^2=71.3%) in the two high-quality studies and 7.7% (95% CI: 0.2–27.4%, I^2=93.5%) in the three moderate-quality studies.

Recovery Outcomes

Recovery from sciatic nerve injuries was found to be variable and often incomplete. Arbash et al. (7) reported a 52% full recovery rate at a mean of 15 months. Simske et al. (6) found only 22%. Negrin et al. (16) reported a 29% full recovery rate, with iatrogenic injuries having a particularly poor prognosis.

Table 4 Leave-one-out sensitivity analysis for pooled incidence.

Excluded Study	Pooled Incidence	95% CI (HKSJ)	I^2
Chen et al. 2023	6.3%	0.7–16.5%	91.5%
Schaffer et al. 2024	6.8%	1.3–16.0%	90.3%
Arbash et al. 2024	5.6%	0.6–15.1%	90.2%
Simske et al. 2019	6.8%	1.2–16.1%	89.7%
Negrin et al. 2017	4.4%	1.9–7.7%	75.2%
None (Full model, k=5)	5.9%	1.8–12.2%	88.8%

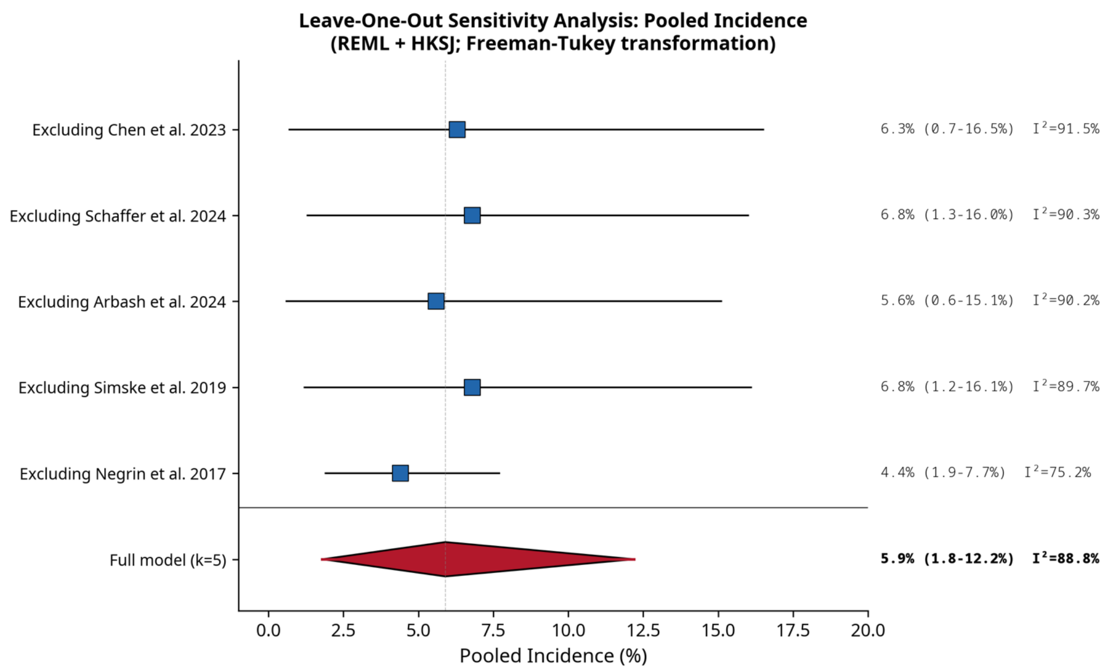

Fig. 4 Leave-one-out sensitivity analysis of pooled incidence of sciatic nerve injury.

DISCUSSION

This systematic review and meta-analysis synthesized the current evidence on the incidence and risk factors of postoperative sciatic nerve injury following ORIF for acetabular fractures. Based on five retrospective cohort studies encompassing 3,104 patients, our analysis found a pooled incidence of 5.9%. However, this result is characterized by substantial heterogeneity and a wide confidence interval (1.8%–12.2%), underscoring the significant variability in the reported outcomes across different clinical settings. Our findings highlighted the complexity of this complication and challenged previous conclusions, particularly regarding the role of patient positioning.

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Interpretation of Key Findings

The primary finding of this review is the considerable uncertainty surrounding the true incidence and key risk factors of sciatic nerve injury in this population. The high heterogeneity (I^2 = 88.8%) in the pooled incidence suggests that factors beyond those analyzed, such as the surgical technique, case volume, and patient-specific anatomy, likely play a crucial role. The leave-one-out analysis identified one study [15] as the major source of this heterogeneity, which may be attributable to its smaller sample size and higher reported incidence. This highlights the sensitivity of the meta-analytical results to the inclusion of individual studies, especially when the total number of studies is small.

Perhaps the most contentious issue is the role of patient positioning. Our meta-analysis of unadjusted data from two studies showed no statistically significant association between prone positioning and nerve injury, with an extremely wide confidence interval that reflects profound statistical uncertainty. This finding directly contradicts the strong conclusion of our initial analysis and underscores a critical point raised by the reviewers that pooling a small number of highly conflicting studies can be misleading. The significantly adjusted OR of 7.14 reported by Chen et al. [4] for non-posterior wall fractures remains a compelling, hypothesis-generating finding. However, this was derived from a single multicenter study and was not replicated in a single-center study by Schaffer et al. [17], who found no effect after adjusting for surgeon identity. Therefore, while lateral positioning may be beneficial in specific scenarios, the current evidence is insufficient to make strong, generalizable recommendations. The decision should be made at the surgeon's discretion, balancing the fracture pattern, surgical approach, and individual experience.

Several other risk factors, including transverse fracture patterns and obesity, were identified from single studies [17, 18]. While the reported odds ratios were notable (OR 3.00 and 3.35, respectively), these findings must be interpreted with extreme caution. Without confirmation from other studies, these risk factors should be considered preliminary and hypothesis-generating rather than definitive risk factors. Obesity (BMI ≥30 kg/m²) is likely related to increased surgical complexity, deeper surgical fields, and potentially higher traction forces required for visualization in obese patients. The finding that surgeon identity is a significant predictor [17] is particularly important as it suggests that unmeasured technical factors and experience are critical determinants of patient outcomes. This aligns with broader literature in complex orthopedic surgery, which supports the regionalization of care to high-volume centers [2, 13].

Comparison with Previous Literature

Our review is distinct from the 2022 meta-analysis by Stavrakakis et al. [19], which focused primarily on determining the incidence and recovery rates of both posttraumatic and iatrogenic nerve palsy across 20 studies involving 651 patients. That review reported a pooled incidence of post-traumatic sciatic nerve palsy of 5.1% (95% CI: 2.7–8.2%) and an iatrogenic palsy rate of 1.4% (95% CI: 0.3–2.9%) with favorable recovery outcomes. In contrast, our primary objective was to identify and quantify the risk factors for postoperative sciatic nerve injury, which requires a stricter set of inclusion criteria related to data extractability. This distinction explains why our review included fewer studies (5 vs. 20) but a larger total patient cohort (3,104 vs. 651), and allowed for a more targeted investigation into the drivers of this specific surgical complication. Furthermore, our study included more recent publications (up to December 2025) and employed more conservative statistical methods (REML + HKSJ) that are better suited for meta-analyses with a small number of studies.

Our pooled incidence of 5.9% was within the range of previously reported rates, which varied from 1% to 17% [6]. The wide confidence interval in our analysis (1.8%–12.2%) accurately reflects this variability. Unlike previous narrative reviews, our quantitative synthesis formally demonstrated a high degree of statistical heterogeneity, providing a more rigorous and cautious interpretation of the available data. The poor prognosis for recovery, with only about a quarter to a half of patients achieving full recovery, is consistent with previous reports and emphasizes the devastating nature of this complication [1, 15, 18].

Clinical Recommendations

Based on synthesized evidence:

1. Preoperative Risk Assessment: Recognize high-risk fracture patterns that require protective devices and evaluate patient risk factors such as obesity. Detailed informed consent regarding the risk of nerve injury was obtained.

2. Surgical Planning and Technique: Patient positioning (prone vs. lateral) should be individualized based on the fracture pattern, surgical approach, and surgeon's experience, as the current evidence does not support a universal recommendation. Minimizing the operative duration and blood loss using meticulous techniques. Ensuring adequate surgical experience or senior supervision of complex cases.

3. Postoperative Management: Conduct a comprehensive neurological examination during the earliest postoperative period. A high level of suspicion for hematoma should be maintained. Early physical and orthotic treatments must be instituted.

Strengths and Limitations

This review had several strengths. To the best of our knowledge, this is the most methodologically rigorous and up-to-date synthesis of this topic. By implementing stringent critiques from the peer review, we adopted more appropriate statistical methods (REML + HKSJ, Freeman-Tukey transformation), explicitly separated adjusted and unadjusted estimates, and conducted sensitivity and subgroup analyses to explore heterogeneity. The exclusion of a study with a significant selection bias and cautious interpretation of single-study findings enhanced the validity of our conclusions.

Nevertheless, significant limitations remain, primarily stemming from the underlying evidence. First, all the included studies were retrospective, making them susceptible to selection, confounding, and information biases. Second, the small number of included studies (k=5) limited the power of the meta-analysis and prevented a formal assessment of publication bias. Third, substantial clinical and methodological heterogeneity exists across studies, including differences in patient populations, surgical techniques, follow-up duration, and, critically, the definition and ascertainment of sciatic nerve injury. This heterogeneity was likely the source of the high I^2 values, making it difficult to draw firm conclusions. Finally, our protocol was registered retrospectively, which introduced the potential for reporting bias.

As detailed in Table 2, the definitions and diagnostic methods for postoperative sciatic nerve injury varied across the included studies, ranging from clinical examinations alone to clinical examinations supplemented with electrodiagnostic studies. This variability in outcome ascertainment represents a significant source of heterogeneity, and may have influenced the reported incidence and risk factor estimates. Future studies should adopt standardized definitions and diagnostic criteria to improve comparability.

CONCLUSIONS

Postoperative sciatic nerve injury remains a significant complication of ORIF for acetabular fractures, with a pooled incidence of approximately 6%. However, this figure was marked by substantial heterogeneity across studies, indicating that the true incidence is highly variable. The current evidence, derived exclusively from retrospective studies, is insufficient to support definitive clinical recommendations regarding specific risk factors. While certain factors such as transverse fracture patterns, obesity, and surgeon experience have been associated with an increased risk in single studies, these findings are exploratory and require validation. There is a clear and urgent need for high-quality prospective multicenter studies with standardized definitions and reporting to better understand the true risk factors for this debilitating complication.

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