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Risk factors for metatarsal fracture in minimally invasive hallux valgus surgery: A case-control study

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Introduction: Minimally invasive hallux valgus (HV) correction techniques, including percutaneous Chevron-Akin (PECA) and metaphyseal extra-articular transverse and Akin (META) osteotomies, offer favorable outcomes but are associated with unpredictable metatarsal fractures. This study identifies predictive factors for first metatarsal fractures following minimally invasive HV surgery.

Methods: This retrospective case-control study analyzed 370 patients (499 feet) who underwent minimally invasive HV correction between November 2017 and August 2024 at a tertiary orthopedic center. Cases from the learning curve, revision procedures, and patients lost to follow-up were excluded. Patients were classified by the presence or absence of a first metatarsal fracture, and logistic regression was conducted to identify associated risk factors.

Results: First metatarsal fractures occurred in 5.4% (27/499 feet), with Type II fractures being most common (40.7%). On multivariable logistic regression, both older age and simultaneous bilateral surgery were independently associated with fracture. The odds of fracture increased by 8.6% per year of age (OR 1.086, 95% CI 1.032-1.150, p = 0.003) and were higher in patients undergoing bilateral vs unilateral surgery (OR 4.02, 95% CI 1.75-9.80, p = 0.001). Bone mineral density (BMD) of the femur and lumbar spine was not associated with fracture risk.

Conclusion: Advanced age and bilateral surgery are key predictive factors for metatarsal fractures following minimally invasive hallux valgus correction. Tailoring surgical and postoperative strategies, especially in elderly patients, may help mitigate fracture risk. Further research should explore metatarsal-specific bone density, surgical biomechanics, and younger patient cohorts.

Keywords: Hallux valgus; Metatarsal bones; Minimally invasive surgical procedures.

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