

# Open vs. Minimally Invasive Bunion Correction: Meta-analysis and Systematic Review

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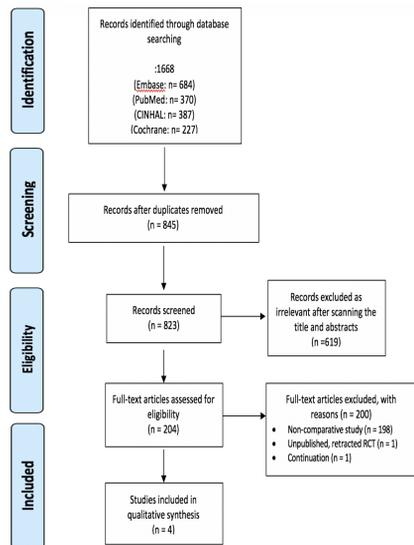
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## Literature Review and Purpose

Surgical treatment of hallux valgus or bunion deformity is well documented in the literature. Traditional metatarsal head osteotomies are typically performed via open incision (1,2).

Open techniques have been routinely performed with mixed results (3-5). Recent data suggests minimally invasive head procedures provide similar correction while increasing patient satisfaction (6-8). To date there remains a paucity in the literature directly comparing these two procedure types. Our study aims to conduct a meta-analysis and systematic review to further investigate and compare inter-metatarsal angle (IMA), post-operative pain, and patient satisfaction between Open and MIS procedures.

## Methods



In accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement standards, a systematic review was carried out. Comprehensive search of MEDLINE, EMBASE, Cochrane, CINAHL databases was conducted. Only retrospective/comparative studies were included. The literature search, data extraction and quality assessment was performed by a member of the UF Health Library research faculty and two independent researchers. In cases of a dispute for inclusion a third researcher was used to finalize the decision.

Table 1:

Newcastle-Ottawa Quality Assessment

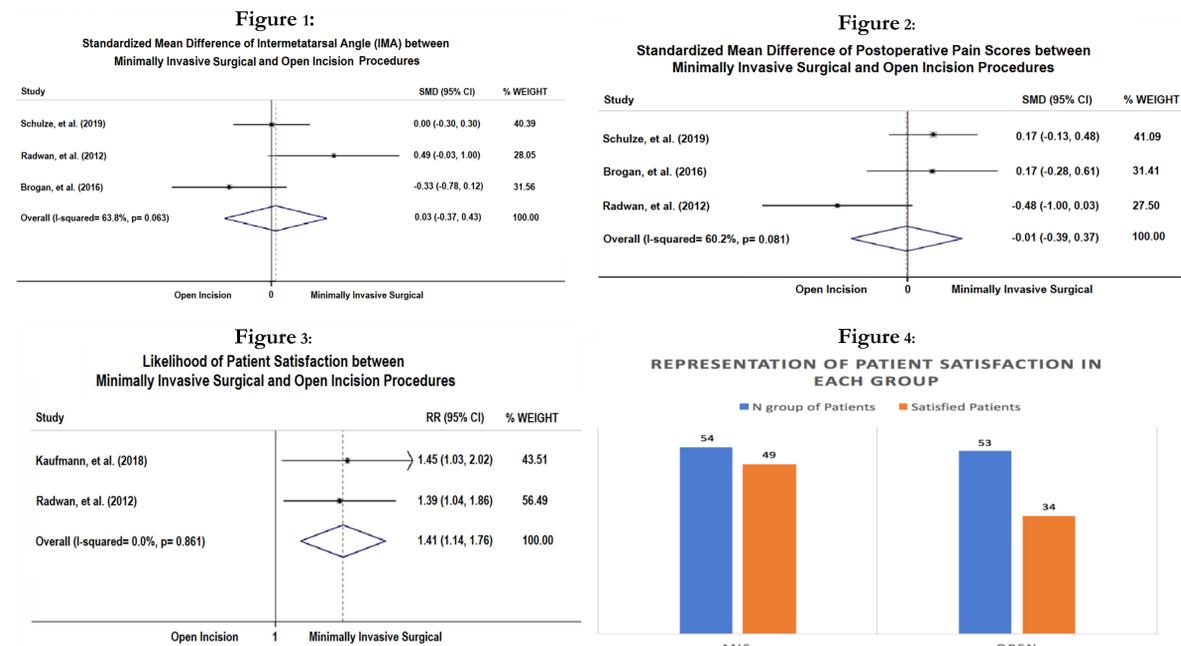
Study	Selection	Comparability	Outcome	Quality
Brogan	☆☆☆☆	☆	☆☆☆	Good
Radwan	☆☆☆☆	☆	☆☆☆	Good
Kaufmann	☆☆☆☆	☆☆	☆☆	Good
Schulze	☆☆☆☆	☆☆	☆☆☆	Good

The Newcastle-Ottawa scale was developed to determine quality of studies (see table 1). Good quality was deemed if 3 or 4 stars were found in selection AND 1 or 2 stars in comparability AND 2 or 3 stars in outcome. Fair quality was deemed if 2 stars were found in selection AND 1 or 2 stars in comparability AND 2 or 3 stars in outcome. Poor quality was deemed if 0 or 1 star was found in selection OR 0 stars in comparability OR 0 or 1 star in outcome.

## Analysis

Continuous variables were analyzed and reported as Standardized Mean Difference (SMD) with 95% confidence interval (95% CI) and p value, while categorical variables were analyzed and reported as Relative Risk (RR) with 95% CI and p value. The decision to use a fixed effect model (FEM) or a random effect model (REM) was determined by the I<sup>2</sup> value. A presence of moderate heterogeneity (I<sup>2</sup>=50%) or greater required the use of REM to control for between-study variability when outputting summary estimates. Each model's results are presented along with I<sup>2</sup> statistic and corresponding p-values. Prior to analysis, linear transformations were used to convert pain scales to 0-100, with 100 representing the most severe pain. All analyses were performed with STATA statistical software (Release 15. College Station, TX: StataCorp LLC.)

## Results



The SMD for inter-metatarsal angle (IMA) and pain scores was derived using available data from three separate studies. Using a REM to assess IMA, there was no significant difference between Open Incision and Minimally Invasive Surgical procedures, SMD 0.03 (95% CI, -0.37 to 0.43; p=0.88) (Figure 1). Heterogeneity was shown to exist between the three studies that measured IMA (I<sup>2</sup>=63.8%). Similarly, the SMD for post-operative pain scores did not show a significant difference between the groups (SMD -0.01; 95% CI -0.39 to 0.37; p= 0.96; I<sup>2</sup>=60.2%) (Figure 2). A relative risk estimate was calculated for patient satisfaction using available data from two studies. Using a FEM, the results show a 41% higher likelihood of patient satisfaction favoring Minimally Invasive Surgical procedure (RR 1.41; 95% CI 1.14 to 1.76; p= 0.002) (Figures 3 and 4). Statistical homogeneity is represented by an I<sup>2</sup>= 0.0%, signifying the variation in effect sizes between these two studies is what would be expected from the inherent sampling error.

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## Discussion

Overall no significant difference was found between IMA correction and post-operative pain in studies that included these parameters. It is probable that IMA correction would be similar between the techniques due to the similar nature of the procedure. Head osteotomies are typically performed with linear cuts that allow translation of the metatarsal head, which typically do not vary between MIS and Open techniques. Also, most bunion deformity corrections in these studies were performed on mild to moderate deformities.

Previous studies suggest pain scores to be similar between MIS and Open techniques, as was the case in this analysis (6). This may be due to a number of reasons, for example: similar technique, pre-operative pain levels, varying post-operative analgesia to name a few.

In studies that included patient satisfaction there was a 41% higher likelihood of patients favoring MIS. Proponents of MIS technique in all surgical specialties cite less operative trauma as the factor leading to decreased recovery and rehabilitation periods (6,8). This factor combined with the aesthetic post-operative outcomes could owe to the significant difference in patient satisfaction found in our analysis.

True MIS technique for bunion correction requires a steep learning curve but may be considered for patients with mild to moderate deformities based on the results of this analysis (7). More studies directly comparing MIS vs Open technique for bunion correction are needed to further determine the role of MIS bunionectomies in foot and ankle surgery.

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