# Syndesmosis Malreduction is Rarely Predictive for Revision Surgery: A Systematic Review

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INTRODUCTION:

Syndemosis malreduction characterizes variation in the tibiofibular relationship based on specified parameters. There is ubiquitous disagreement on the parameters used to determine postoperative malreduction. Minor variations may exist between the intact and injured ankle, and presenting symptomology may be due to factors outside of variations in the tibiofibular relationship. With no accepted standard for determining malreduction, it is unclear whether these diagnoses are a valuable discriminator for clinical decision making.

Currently there is a dearth of understanding of syndesmosis revision surgery. The literature has demonstrated the importance of identifying malreduction without providing corresponding evidence for revision surgery which is intended to correct the malreduction. The clinical detriment of malreduction is evident and reported rates of malreduction are commonly above 20%. Therefore, there is reasonable expectation for similar rates of revision surgery. A clearer understanding of syndesmosis revision surgery will serve as an important evaluator for the success of the primary repair and facilitate identification of the indications which may require revision surgery.

Our primary objective was to review the literature for rates of syndesmosis revision surgery. Secondarily we aimed to determine the validity and predictive values of a malreduction protocol when used as a screening test for syndesmosis revision surgery.

METHODS:

A systematic review was performed adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analyses) guidelines. Criteria for inclusion were studies with 1) subjects over 18 years of age, 2) a minimum of 10 cases, 3) a minimum of 12 months of follow up, 4) reporting which could be reasonably interpreted as describing a secondary procedure for revision of the syndesmosis repair, and 5) a protocol for determining malreduction, including imaging modality and specified measurements.

Included studies were grouped according to the stated protocol for determining malreduction. Group 1 used unilateral radiograph (N = 579), group 2 used bilateral radiograph (N = 183), and group 3 used bilateral computed tomography (CT) scan (N = 357).

RESULTS:

Across the 19 studies included in this review (N = 1,119, mean age 40.8 years, mean follow up 21.2 months), the pooled rate of malreduction was 9.23% (range 0 to 42%, SD = 12.8) and the pooled rate of revision was 0.95% (range 0 to 6%, SD = 1.17). A rate of revision of 0% was reported by 13 of the 19 (68%) studies included in this review.

Rates of malreduction were significantly greater ($P = .02$) in studies that used a bilateral imaging protocol (18.1%, range 0 to 42%, SD = 12.77) compared to studies that used a unilateral imaging protocol (3%, range 0 to 25%, SD = 7.83). Rates of revision were not significantly different ($P = .88$) between these groups.

All studies in group 3 utilized the CT scan protocol of >2mm side-to-side difference as the threshold for malreduction. Across these studies, there was a mean malreduction rate of 23.6% (range 10 to 42%, SD = 10.76) and a mean revision rate of 0.4% (range 0 to 2%, SD = 0.82).The sensitivity of the malreduction criteria as a screening test for revision surgery was 100%. The specificity was 78%, positive predictive value was 2% and the negative predictive value was 100%.

DISCUSSION AND CONCLUSION:

The current results demonstrate very low rates of syndesmosis revision surgery. Further, there is a large disparity between rates of postoperative malreduction and rates of revision surgery. The reasons for this are unclear. Therefore, it is reasonable to postulate that malreduction may primarily be a radiographic finding based on variable tolerances which do not often indicate the need for revision surgery.

A common protocol for determining malreduction is a >2mm difference in side-to-side comparison on CT scan. As illustrated by a sensitivity of 100%, all surgically revised patients had malreduced syndesmosis. The low specificity (78%) was due to the high number of malreductions which did not require revision surgery. Therefore, it is reasonable to question the value of routine CT scan evaluation of postoperative reduction status. With a PPV of 2%, the presence of malreduction is extremely non-predictive for revision surgery. High rates of false positives can lead to over-treatment and unnecessary costs which not only burden the healthcare system but can also present a scenario of uncertainty for the patient and surgeon.

Our results demonstrate the rarity of syndesmosis revision surgery especially compared to the reported rates of malreduction. Although syndesmosis revision surgery is rare, it remains an unsolved problem as the main driver for revision surgery does not appear to be the prevalently reported diagnosis of malreduction. Therefore, it is reasonable to question the value of attaining routine postoperative CT scan for reduction assessment. Based on the current findings, the commonly reported protocol of >2mm difference is sensitive enough to detect side-to-side differences but not specific enough to identify patients who may require revision surgery.

| Study | LOE* | Cases | F/U* | Malreduction* | Revision* | Outcomes* |
|---|---|---|---|---|---|---|
| Kotwal, 2016 | II | 36 | 24 | 42% | 0% | AOFAS 90 |
| Kortekangas, 2015 | I | 43 | 24 | 10% | 0% | OM 83, VAS 1.2 |
| Sanders, 2019 | I | 103 | 12 | 27% | 2% | OM 83 |
| Little, 2015 | III | 45 | 12 | 18% | 0% | NR |
| Schottel, 2014 | III | 130 | 22 | 21% | 0% | NR |
| | | | | | | |
| **Total/Mean** | | 357 | 22 | 23.6% | 0.4% | |

*LOE - level of evidence, F/U - follow up in months, reported rates of malreduction and revision, reported means for American Orthopaedic Foot and Ankle Surgeons (AOFAS) score, visual analog scale (VAS) for pain, Olerud-Molander (OM) score, NR - not reported, outcomes listed are only those used for pooled analysis

Table: Studies that used a malreduction protocol with bilateral CT scan (group 3)

| | Revision surgery | No revision surgery | | Total |
|---|---|---|---|---|
| **Malreduced** | 2 | 119 | | 121 |
| **Not malreduced** | 0 | 410 | | 410 |
| | | | | |
| **Total** | 2 | 529 | | 531 |

Sensitivity = true positive/(true positive + false negative) = 100%
Specificity = true negative/(true negative + false positive) = 78%
Positive predictive value = true positive/(true positive + false positive) = 2%
Negative predictive value = true negative/(true negative + false negative) = 100%