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DOCTORAL THESIS

**The Role of Syndesmotic Screws in Distal Tibiofibular
Diastasis Management and Quality of Life**

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STUDY 1: AVOIDING THE REMOVAL OF SYNDESMOTIC SCREWS AFTER DISTAL TIBIOFIBULAR DIASTASIS REPAIR: A BENEFIT OR A DRAWBACK?

CONTEXT

Ankle fractures, particularly common among young men and older women, range from simple injuries to complex fracture-dislocations involving bone and surrounding soft tissues. Initial management of these severe injuries typically involves immediate closed reduction and temporary immobilization, followed by definitive synthesis through open reduction and internal fixation. The integrity of the distal syndesmotic tibiofibular ligament complex is vital for ankle joint stability and function, with improper management of syndesmotic injuries potentially leading to discomfort, joint wear, and even serious complications like post-traumatic osteoarthritis.

Syndesmotic damage is present in about 15% of all ankle fractures, often requiring surgical fixation due to altered joint kinematics. Traditionally, screw fixation has been the preferred method, though there's debate over the routine removal of these screws due to risks such as screw breakage, increased costs, and infection. Recently, computed tomography studies have suggested that screw removal might allow a malreduced syndesmosis to correct itself.

In response to these varied findings, alternatives to screw fixation, like implantable suture button devices, have gained attention. These devices allow for micromotion during healing and might eliminate the need for hardware removal, though they're not without drawbacks such as potential hardware irritation and infection. This study aims to report on the outcomes and complications in 308 patients treated with open reduction and internal trans-syndesmotic fixation for ankle fractures with dislocation, focusing on the effects of not removing the trans-syndesmotic fixation.

SUMMARY OF FINDINGS

In a study of 308 patients with ankle fractures and distal tibiofibular diastasis repaired with syndesmotic screws, 212 underwent a second surgery for screw removal, while the rest did not. The screw removal group was younger, with 59.9% aged 18–40 years, compared to 24.0% in the non-removal group. Additionally, the screw removal group had a higher proportion of men (60.8% vs. 45.8%). Most patients had a normal or slightly overweight body mass index, and substance use such as alcohol consumption and smoking was noted in both groups, with cardiovascular and metabolic diseases being the most common comorbidities.

Orthopedically, both groups had similar injury characteristics, with most injuries classified as the severe type C Danis–Weber ankle fractures. High-energy trauma was more common in the screw-removal group (60.4% vs. 46.9%). The screw-removal group also had a lower rate of ICU admissions (7.1% vs. 14.6%) and a shorter average ICU stay (3.2 days vs. 4.0 days). The first intervention hospitalization was longer for the non-removal group, but their total medical leave was shorter (15 days vs. 21 days), likely due to not undergoing a second surgery.

Regarding complications, there was no significant difference between the groups in terms of early degenerative joint disease, osteoarthritis, or wound infection. However, loss of reduction after surgery was more frequent in the screw-removal group (8.5% vs. 2.1%). Six months post-surgery, patients with screw removal had a better mean AOFAS score (92.6 vs. 88.4 out of 100), likely influenced by their younger age. Screw breakage was observed in 18 patients (18.8%) in the screw-removal group, but with no significant consequences.

The Lauge–Hansen classification indicated that most patients in both groups suffered a supination external rotation type of fracture. The range-of-motion assessment showed better results in the screw-removal group (45.3% vs. 34.4% showing excellent movement). No

significant differences were found using the Van Dijk osteoarthritis scale, with the most prevalent score being 1 in both groups.

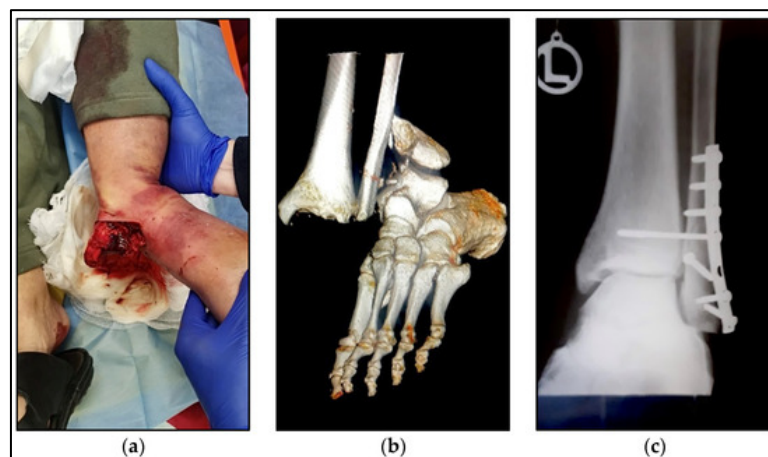
Radiographic changes at follow-up showed that the non-removal group had a smaller tibiofibular clear space (3.6 mm vs. 3.8 mm) and a lower Tibiofibular Clear Space (TCS) proportion change (7.3% vs. 15.6%). Additionally, the incisura fibularis change was smaller in the non-removal group (9.4% vs. 19.3%). These findings highlight the differences in outcomes based on whether the syndesmotic screw was removed or not post-repair of ankle fractures with distal tibiofibular diastasis.

Table 4. Differences in radiographic changes between two follow-ups in the study groups.

Variables (mean±SD)	Tibiofibular Screw removal (n=212)	Tibiofibular Screw non-removal (n=96)	p-value*
TOL	8.8 ± 1.7	8.4 ± 2.6	0.109
TCS	3.8 ± 1.0	3.6 ± 0.9	0.012
IFD	4.3 ± 0.8	4.1 ± 1.2	0.085
TOL change	18.4%	11.5%	0.126
TCS change	15.6%	7.3%	0.045
IFD change	19.3%	9.4%	0.028

* Student's t-test; TCS – tibiofibular clear space; TOL – tibiofibular overlap; IFD – Incisura fibularis depth; SD – Standard deviation.

Figure 1 – Examples of initial presentation and radiographic findings in severe ankle fractures that require talofibular trans-syndesmotic screws.



CONCLUSIONS

The current study did not identify many significant differences between patients with tibiofibular syndesmotic screw removal and those whose screw was not removed. The most significant orthopedic findings were a loss of reduction occurring more often when the tibiofibular screw was removed, as well as observing more significant radiographic changes in the same group regarding the tibiofibular clear space and incisura fibularis change. It seems that the costs of treatment are significantly reduced if a secondary intervention for screw removal is avoided, as well as a shorter medical leave for those who undergo a single intervention.

STUDY 2: CORRELATION BETWEEN ANKLE IMAGING FINDINGS AND SELF-REPORTED OUTCOMES: A LONGITUDINAL ASSESSMENT IN PATIENTS WITH TIBIOFIBULAR DIASTASIS.

CONTEXT

The ankle, a complex hinge joint crucial to human mobility and lower extremity function, is often at the center of various injuries, including tibiofibular diastasis. This type of injury, affecting the distal tibiofibular syndesmosis, requires careful evaluation for effective treatment. Advances in imaging techniques like X-ray, MRI, and CT scans have greatly improved the understanding and management of these injuries, guiding treatment decisions. However, these clinical evaluations may not always align with the patient's personal experiences and perceptions of their well-being.

To address this, self-reported assessment tools have become increasingly important in orthopedics. These tools, including questionnaires and scales, provide insights into the patient's pain, mobility, daily activities, and overall quality of life. They are particularly relevant in the case of tibiofibular diastasis, where imaging shows structural damage, but self-reported metrics offer a window into the patient's functional outcomes and subjective experiences, including quality of life, physical disability, and pain levels.

This study hypothesizes a significant correlation between imaging findings of the ankle and self-reported quality of life in patients with tibiofibular diastasis. The primary objective is to examine the association between ultrasound and radiographic findings at 2 and 6 months post-intervention and patient-reported surveys on quality of life, physical, and mental health. This approach aims to merge objective imaging data with subjective patient experiences, offering a more comprehensive understanding of tibiofibular diastasis and its impact.

RESULTS

In a study of 129 patients with ankle fractures treated with or without syndesmotic screw removal, 85 underwent screw removal and 44 received conservative treatment. The average age was similar between the groups, and there were no significant differences in the types of fractures or their classifications according to the Lauge–Hansen system.

Ultrasound and radiographic measurements revealed that the screw removal group had lower ankle dorsiflexion shear wave (SW) velocities, suggesting better mobility. The anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) also showed lower SW velocities in this group, indicating improved ligament conditions. Tibiofibular overlap (TOL) and tibiofibular clear space (TCS) were also lower in the screw removal group, suggesting differences in joint fixation quality. At 6 months post-intervention, significant differences persisted in ankle dorsiflexion SW velocity and TCS.

Survey analysis of quality of life showed that the screw removal group reported higher physical health scores in the SF-36 survey both at 2 and 6 months post-intervention, indicating better physical health status. However, there were no significant differences in mental health outcomes between the two groups. In the WHOQOL-BREF survey, the conservative approach group scored higher in the social domain at 2 months, but the screw removal group reported better physical quality of life at 6 months. Mental and environmental domains showed similar outcomes in both groups over time.

The Hospital Anxiety and Depression Scale (HADS) survey results at 2 months post-intervention indicated lower anxiety and total HADS scores in the screw removal group, but by 6 months, these differences were no longer significant, showing a convergence in mental health outcomes. Correlations between ultrasound/radiographic measurements and self-reported questionnaire scores were significant. Ultrasound ankle dorsiflexion showed strong negative correlations with the SF-36 Physical score and positive correlations with HADS Anxiety at both 2 and 6 months. Radiographic TCS correlated significantly with both the SF-36 Physical and the WHOQOL Physical domain. Overall, these findings suggest that screw

removal in ankle fractures is associated with better physical health and mobility, as indicated by both clinical measurements and patient-reported outcomes, although mental health outcomes were similar between the two treatment approaches over time.

Figure 2 – Analysis of HADS questionnaire results.

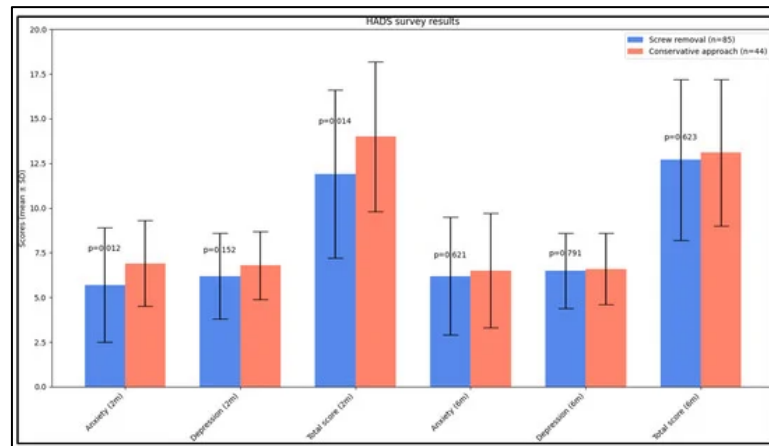
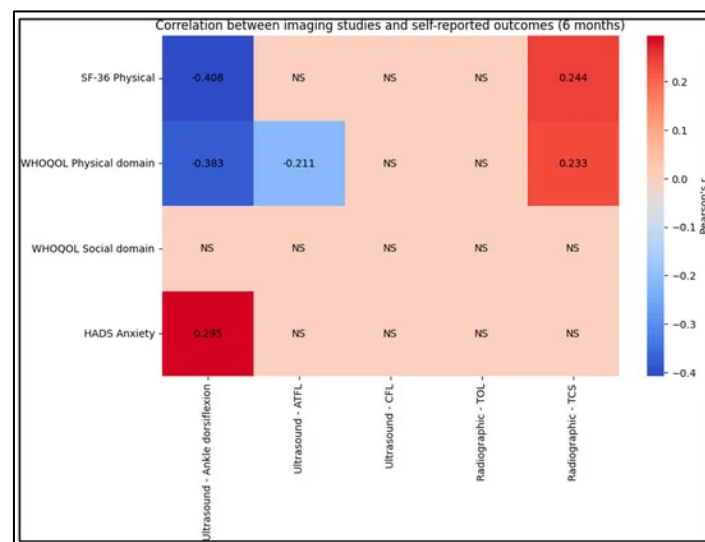


Figure 3 – Correlation analysis at 6 months.



CONCLUSIONS

The findings of this study demonstrate a significant relationship between imaging outcomes and self-reported quality-of-life measures in patients with tibiofibular diastasis, aligning with the study's purpose of exploring these associations. We found that screw removal leads to improved physical outcomes as evidenced by lower shear wave velocities and better radiographic metrics, indicative of enhanced mobility and joint stability. These improvements are reflected in the short-term reduction of anxiety levels. However, the study also reveals that mental health parameters, specifically anxiety and depression, converge between treatment groups by the 6-month mark. These insights provide valuable evidence to clinicians for making informed decisions in managing tibiofibular diastasis, emphasizing the need to consider both physical and psychological aspects of patient recovery.

STUDY 3: IMPACT OF SYNDESMOTIC SCREW REMOVAL ON QUALITY OF LIFE, MOBILITY, AND DAILY LIVING ACTIVITIES IN PATIENTS POST DISTAL TIBIOFIBULAR DIASTASIS REPAIR.

CONTEXT

The ankle, a complex hinge joint, is essential for human movement and lower extremity function. Its stability and function are maintained not only by the bones involved but also by a network of ligaments and soft tissues. The distal tibiofibular syndesmosis is particularly prone to injuries like tibiofibular diastasis, which can impair the ankle's integrity and necessitate precise evaluation before any clinical intervention.

Advanced imaging techniques such as X-rays, MRIs, and CT scans have significantly improved the understanding and management of distal tibiofibular injuries. These tools guide both conservative and surgical treatments but might not fully align with patients' experiences, functional outcomes, or overall well-being. To fill this gap, self-reported tools have become valuable in orthopedics, providing insights into the patient's pain, mobility, daily activities, and quality of life. They complement imaging by offering a perspective on functional outcomes and subjective experiences that can influence recovery.

This study aims to explore the correlation between ultrasound and radiographic findings of the ankle and self-reported quality of life in patients with tibiofibular diastasis. The primary goal is to investigate the relationship between imaging results at 2 and 6 months post-orthopedic intervention and patient-reported surveys on quality of life, physical, and mental health. This approach seeks to combine objective imaging data with subjective patient experiences to offer a more comprehensive understanding of the impact of tibiofibular diastasis.

RESULTS

In a study comparing syndesmotic screw removal with a conservative approach for ankle injuries, 93 patients underwent screw removal, while 51 chose the conservative method. The age and gender distribution between the groups was similar, with no significant difference in body mass index or other background characteristics like residence, marital status, income, education, or habits. Both groups also showed similar distributions of fracture types and patterns according to the Lauge–Hansen classification.

Patients who had the screw removed reported higher satisfaction with their mobility (average score 7.8 vs. 6.7) and less pain (average score 5.3 vs. 6.8) compared to those who received conservative treatment. However, both groups were equally likely to recommend their treatment approach to others and reported similar impacts on quality of life, with the screw removal group scoring slightly lower (6.9 vs. 7.1).

Despite these similarities, the screw removal group expressed greater confidence in their treatment choice and reported fewer limitations in daily activities. The differences in patient information regarding the advantages and disadvantages of screw removal versus retention were not statistically significant. In the SF-36 survey, the screw removal group reported a higher physical health score (55.9 vs. 53.3), but both groups had comparable mental health statuses.

The WHOQOL-BREF survey revealed a marginally better physical quality of life for the screw removal group and a trend towards better mental quality of life in the conservative group, though these differences were not statistically significant. The conservative approach group reported a better social quality of life, while the environmental quality of life was comparable between the treatments.

The Hospital Anxiety and Depression Scale (HADS) results showed lower anxiety levels in the screw removal group initially, but both groups had similar levels of depression postoperatively. Finally, female patients had a 20% reduced risk of low physical health perception, and higher anxiety levels were associated with lower physical health quality.

Elevated physical domain scores in the WHOQOL-BREF were linked to a greater risk of lower physical health quality, and patients with a higher Charlson Comorbidity Index were more likely to report lower physical health scores.

Figure 4 – Analysis of the SF-36 questionnaire results.

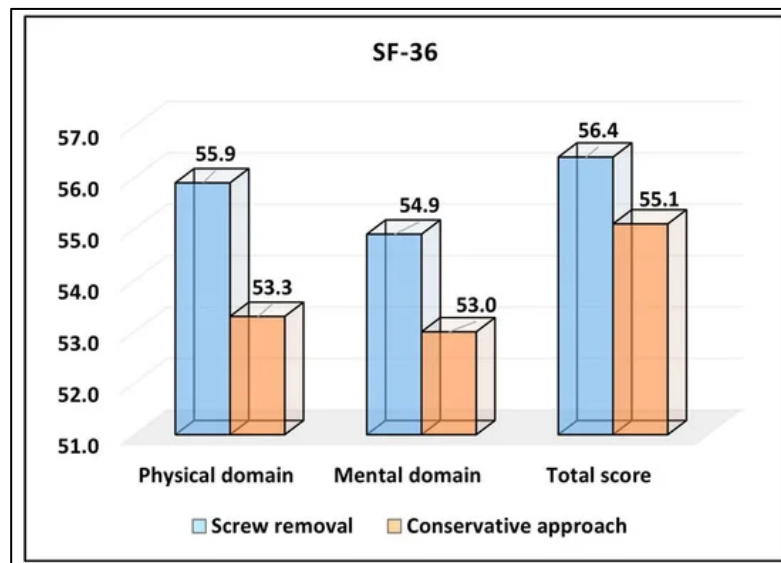
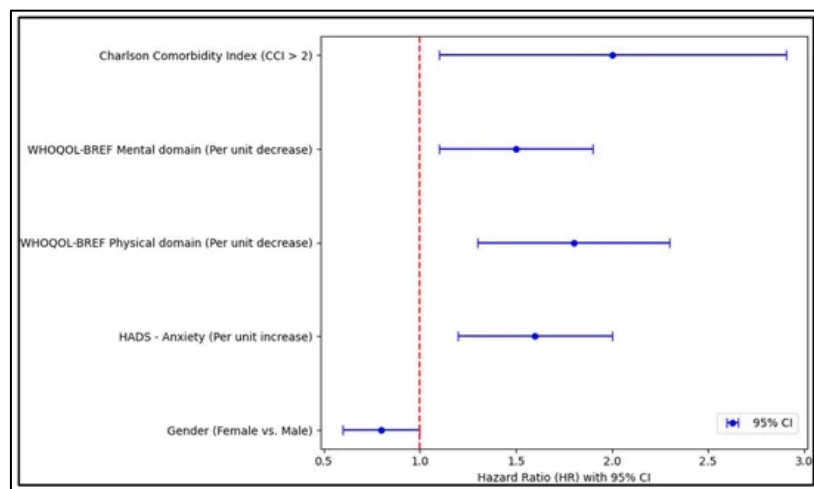


Figure 5 – Regression analysis results.



CONCLUSIONS

This study provided a comprehensive analysis of the outcomes related to the management of syndesmotic screws post distal tibiofibular diastasis repair. The postoperative removal of syndesmotic screws was found to have a favorable impact on several patient-centered outcomes. Specifically, patients who underwent screw removal exhibited enhanced mobility, superior ability to execute daily activities, and experienced reduced levels of postoperative pain and anxiety than those who adopted a conservative approach by retaining the screws. Notably, these benefits did not translate into a significant difference in the overall quality of life between the two groups. Despite these advancements in our understanding, the decision to remove or retain the screw should be personalized and tailored to individual patient needs, considering the multifaceted nature of postoperative recovery. The insights gleaned from this study augment the current orthopedic knowledge and serve as a significant reference for delivering patient-centric care in the context of distal tibiofibular diastasis repair.