Glob. J. Med. Pharm. Sci.
ISSN PRINT: 2957-3610, **ISSN ONLINE**: 2957-3629
Website: https://globapc.com/
Open Access Journal

Global
Journal of Medical and
Pharmaceutical Sciences

ORIGINAL ARTICLE OPEN ACCESS

Functional and Radiological Outcomes of Suture-Button versus Syndesmotic Screw Fixation in Distal Tibiofibular Syndesmotic Injuries: A Prospective Comparative Study

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Received:10-07-2023
Accepted:15-08-2023
Availableonline:23-08-2023

ABS TRAC T

***Background*:** Acute disruption of the distal tibiofibular syndesmosis is a common and clinically important component of unstable ankle injuries that requires anatomical reduction and rigid fixation to restore function and prevent late post-traumatic arthritis. Conventional rigid syndesmotic screw fixation has been the long-standing standard but is associated with implant prominence, the need for routine hardware removal and a recognised risk of malreduction. Dynamic suture-button devices have emerged as a flexible alternative that may better reproduce physiological syndesmotic motion. The present study compared the functional and radiological outcomes of suture-button and syndesmotic screw fixation in adults with acute distal tibiofibular syndesmotic injuries. ***Methods*:** A prospective comparative study was conducted in a tertiary care orthopaedic unit. Eighty consecutive adult patients with acute unstable syndesmotic injuries (Lauge-Hansen supination-external rotation type IV or pronation-external rotation injuries) were sequentially allocated to either suture-button fixation (n = 40) or 3.5 mm tetracortical syndesmotic screw fixation (n = 40) following anatomical reduction of associated fractures. The primary outcome was the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score at 12 months. Secondary outcomes included the Olerud-Molander Ankle Score, radiological reduction parameters, time to functional milestones, complications and the need for hardware removal. ***Results*:** Both groups were comparable at baseline. At 12 months, the mean AOFAS score was significantly higher in the suture-button group (92.4 ± 6.8 versus 87.2 ± 8.4; p = 0.003), as was the Olerud-Molander score (88.4 ± 7.2 versus 81.2 ± 9.6; p = 0.001). Patients in the suture-button group achieved full weight-bearing earlier (6.4 ± 1.2 versus 9.8 ± 1.8 weeks; p < 0.001) and returned to previous occupation and recreational activities sooner. Loss of reduction was less frequent in the suture-button group (5.0% versus 22.5%; p = 0.024). Hardware removal was required in 47.5% of screw-fixation patients compared with only 7.5% of suture-button patients (p < 0.001). ***Conclusion*:** Dynamic suture-button fixation produced superior functional and radiological outcomes compared with conventional rigid syndesmotic screw fixation in acute distal tibiofibular syndesmotic injuries, with earlier return to function, fewer complications and a markedly lower requirement for secondary hardware removal. These findings support the routine use of suture-button devices as the preferred fixation strategy for acute unstable syndesmotic injuries.

Keywords: *Distal Tibiofibular Syndesmosis, Suture-Button Fixation, Syndesmotic Screw, Ankle Fracture, Functional Outcome.*

A. INTRODUCTION

The distal tibiofibular syndesmosis is a complex fibrous articulation that is essential for the stability and function of the ankle mortise during weight-bearing. Acute disruption of the syndesmotic ligamentous complex is identified in approximately 23% of all operatively treated ankle fractures and in up to 1–18% of isolated ankle sprains in athletic populations [1]. Even relatively minor lateral talar shift of one millimetre has been shown in biomechanical models to reduce tibiotalar contact area by more than 40%, predisposing to accelerated chondral wear and post-traumatic ankle arthritis if the syndesmosis is not anatomically restored [2].

Surgical fixation is therefore indicated for any unstable syndesmotic injury, typically those occurring in the context of Weber type C fibular fractures, Maisonneuve fractures or unstable bimalleolar and trimalleolar injuries with intraoperative demonstration of syndesmotic widening [3]. Rigid trans-syndesmotic screw fixation, first popularised in the 1950s, has long been considered the reference standard. The technique is reproducible, inexpensive and does not require specialised implants, and provides reliable static stabilisation while the ligamentous complex heals.

Despite its long pedigree, rigid screw fixation has several recognised limitations. Because the syndesmosis is normally a dynamic articulation that allows up to two millimetres of physiological motion during ankle dorsiflexion, rigid metallic fixation is non-anatomical and may interfere with restoration of normal ankle kinematics. Malreduction of the syndesmosis at the time of surgery is reported in 16–52% of cases and is the strongest single predictor of poor functional outcome [4]. Routine hardware removal is required in many centres because of implant prominence, screw breakage with weight-bearing, and persistent pain over the lateral malleolus. Andersen and colleagues, in a recent series, reported a 22% complication rate associated with screw removal, including infection, neurovascular injury and iatrogenic refracture, raising substantial concerns about the morbidity of secondary surgery [5].

These limitations have driven the development of dynamic fixation devices, of which the suture-button construct is the most widely studied. The device consists of two small metallic buttons connected by braided polyester cords passed through a transverse drill hole between the fibula and tibia. The construct provides sufficient stability to permit ligamentous healing while still allowing the small amounts of physiological motion present at the syndesmosis. The suture-button device does not require routine removal, allows earlier weight-bearing in many rehabilitation protocols and avoids the risks associated with rigid metallic implant breakage [6].

Several randomised and observational studies have compared suture-button fixation with screw fixation. Naqvi and colleagues, in a prospective comparative study with computed tomography assessment of reduction, reported significantly more accurate syndesmotic reduction with suture-button devices than with screw fixation [7]. The randomised multicentre trial by Laflamme and colleagues found that dynamic fixation produced superior functional outcomes at three, six and twelve months compared with static screw fixation, in addition to fewer reoperations [8].

A systematic review by Schepers, however, concluded that the available evidence at that time was of limited quality, and called for further well-designed prospective comparative studies, particularly with longer follow-up and standardised rehabilitation protocols [9]. Indian and South Asian data on suture-button fixation remain scarce, with most publications limited to small case series, and head-to-head prospective comparisons of suture-button and screw fixation in this setting are very limited [10].

There is therefore a clear clinical need for prospective comparative data evaluating the functional and radiological performance of these two fixation strategies under contemporary, standardised perioperative and rehabilitation protocols. Such data are essential to inform local clinical practice, to guide implant procurement decisions in resource-conscious settings, and to define the role of dynamic fixation in routine orthopaedic practice.

Against this background, the present prospective comparative study was undertaken to evaluate the functional and radiological outcomes of suture-button fixation compared with conventional 3.5 mm syndesmotic screw fixation in adults with acute unstable distal tibiofibular syndesmotic injuries, with the hypothesis that suture-button fixation would provide superior functional outcomes at twelve months while reducing the frequency of malreduction and secondary hardware removal.

B. Aims and Objectives

The present study aimed to compare the functional and radiological outcomes of suture-button fixation and conventional 3.5 mm syndesmotic screw fixation in adults with acute unstable distal tibiofibular syndesmotic injuries treated within two weeks of injury. The primary objective was to compare the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score at twelve months postoperatively. The secondary objectives were to compare the Olerud-Molander Ankle Score and the Visual Analogue Scale (VAS) pain score; to compare the time to full weight-bearing, return to work and return to recreational activity; to compare radiological parameters of syndesmotic reduction including the medial clear space, tibiofibular clear space and tibiofibular overlap on standardised radiographs; to compare the incidence of loss of reduction and recurrent diastasis during follow-up; to compare the rate of implant-related complications including symptomatic implant prominence, implant breakage and the need for secondary hardware removal; and to compare overall patient satisfaction between the two study groups.

C. Materials and Methods

Study Design and Setting

A prospective, single-centre, comparative parallel-group study was conducted in the Department of Orthopaedics of a tertiary care teaching hospital over

a study period of 18 months, comprising 6 months of recruitment and 12 months of postoperative follow-up for each enrolled patient. Approval for the study protocol was obtained from the Institutional Ethics Committee, and the trial was prospectively registered with the Clinical Trials Registry of India before the commencement of recruitment. Written informed consent was obtained from each enrolled participant during the preoperative orthopaedic consultation.

Sample Size Calculation

The sample size was calculated based on a previously published prospective study which reported a mean 12-month AOFAS score of 88.0 ± 9.0 in the suture-button group and 82.0 ± 10.0 in the syndesmotic screw group. Considering a clinically relevant difference of 6 points between groups, with α set at 0.05 (two-sided) and power at 80%, the minimum required sample size was 32 patients per group. To allow for an anticipated 20% loss to follow-up, the final enrolment target was set at 40 patients per group, for a total of 80 participants. The formula used was:

$$n = 2 \times [(Z\alpha/2 + Z\beta)^2 \times \sigma^2] / d^2$$

Where $Z\alpha/2 = 1.96$, $Z\beta = 0.84$, σ = pooled standard deviation (≈ 9.5), and d = minimum clinically important difference (6 AOFAS points).

Inclusion Criteria

Adults aged between 18 and 60 years with a closed acute unstable distal tibiofibular syndesmotic injury (Lauge-Hansen supination-external rotation type IV, pronation-external rotation type III or IV, or Maisonneuve injury) confirmed intraoperatively by hook test or external rotation stress test, presenting within fourteen days of injury, of American Society of Anesthesiologists physical status I or II, and able to provide written informed consent, were considered eligible for inclusion.

Exclusion Criteria

Patients were excluded if they had open fractures (Gustilo-Anderson type II or above); neurovascular compromise; pre-existing ankle arthritis; previous ipsilateral ankle surgery; pathological fractures; bilateral injuries; concurrent pilon fractures or complex foot injuries; uncontrolled diabetes mellitus (HbA1c > 8.5%); chronic smoking habit (>10 cigarettes/day); peripheral vascular disease; or pregnancy. Patients unable to attend the planned twelve-month follow-up were also excluded.

Group Allocation and Blinding

Patients were sequentially allocated to either the suture-button group or the syndesmotic screw group on the basis of the operating list and the surgical team. Blinding of patients and the operating surgical team was not feasible because of the visibly different implants. Outcome assessors who recorded clinical scores and the radiologist who measured radiological parameters remained blinded to group allocation throughout the study period.

Surgical Technique

All operations were performed under spinal or general anaesthesia by a single consultant orthopaedic surgical team experienced in both fixation techniques. Associated lateral malleolar fractures were anatomically reduced and stabilised with a one-third tubular plate and screws using standard AO principles before syndesmotic fixation. Reduction of the syndesmosis was achieved using a large pelvic reduction clamp applied with the ankle in neutral or slight dorsiflexion, and was confirmed under image intensification using the medial clear space, tibiofibular clear space and tibiofibular overlap as references.

In the suture-button group, a 3.5 mm transverse drill hole was made from the lateral fibula to the medial tibial cortex, 2 to 4 cm proximal to the tibial plafond and directed approximately 30° anteriorly. A single TightRope™ device (Arthrex, Naples, FL, USA) was passed through the drill hole and tensioned over the tibial and fibular buttons. In the syndesmotic screw group, a single 3.5 mm tetracortical fully threaded cortical screw was inserted at the same anatomical level and trajectory, engaging four cortices.

Postoperative Rehabilitation

All patients received a standardised postoperative rehabilitation protocol. The ankle was immobilised in a below-knee plaster slab for two weeks, followed by a removable walking boot. Range-of-motion exercises were initiated at two weeks. Partial weight-bearing was permitted at six weeks in the suture-button group and at eight to ten weeks in the syndesmotic screw group, with progression to full weight-bearing as tolerated. Routine syndesmotic screw removal was not mandated, with removal undertaken only on the basis of patient symptoms or radiographically confirmed screw breakage.

Outcome Assessment and Follow-Up

Patients were assessed clinically and radiologically at six weeks, three months, six months and twelve months postoperatively. Functional outcome was measured using the AOFAS Ankle-Hindfoot Score (range 0–100) and the Olerud-Molander Ankle Score (range 0–100), with higher scores indicating better function. Pain was assessed using a 10-cm Visual Analogue Scale. Standardised anteroposterior, mortise and lateral radiographs of the ankle were obtained at each visit. The medial clear space, tibiofibular clear space and tibiofibular overlap were measured by a single blinded musculoskeletal radiologist. Computed tomography imaging was obtained at six weeks in all cases to assess the accuracy of syndesmotic reduction. Complications, the requirement for secondary hardware removal and patient satisfaction were also recorded.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and analysed using SPSS version 25.0 (IBM Corporation, Armonk, NY, USA). The Shapiro-Wilk test was used to assess normality. Normally distributed continuous data were summarised as mean ± standard deviation and compared using the independent samples Student's t-test; non-normally distributed data were expressed as median (interquartile range) and compared using the Mann-Whitney U test. Categorical variables were summarised as frequencies and percentages and compared using the Chi-square or Fisher's exact test. Repeated measurements were analysed using two-way repeated-measures analysis of variance. A two-tailed p-value below 0.05 was considered statistically significant.

D. RESULTS

During the recruitment period, 96 patients were screened for eligibility, of whom 82 fulfilled the inclusion criteria, were sequentially allocated and underwent surgical fixation. Two patients (one in each group) were lost to follow-up before twelve months, leaving 40 patients in each group available for the final analysis. The two groups were comparable at baseline with respect to age, sex, body mass index, mechanism of injury, side of injury, Lauge-Hansen classification, time from injury to surgery and operative time, with no statistically significant differences (Table 1).

The primary outcome, AOFAS Ankle-Hindfoot Score at twelve months, was significantly higher in the suture-button group than in the syndesmotic screw group (92.4 ± 6.8 versus 87.2 ± 8.4, mean difference 5.2 points, 95% CI 1.8 to 8.6; p = 0.003). The two groups followed comparable scoring trajectories at six weeks, but the suture-button group demonstrated significantly higher mean scores at three, six and twelve-month assessments (p < 0.01 at all time points beyond six weeks) (Table 3; Figure 1).

The Olerud-Molander Ankle Score at twelve months similarly favoured suture-button fixation (88.4 ± 7.2 versus 81.2 ± 9.6; p = 0.001) (Table 3; Figure 2). The twelve-month VAS pain score was lower in the suture-button group (1.4 ± 0.8 versus 2.6 ± 1.2; p < 0.001), and the proportion of patients reporting either no pain or mild pain was significantly higher (90.0% versus 70.0%; p = 0.027).

Time to functional milestones was significantly shorter in the suture-button group (Table 4; Figure 4). Patients in the suture-button group achieved full weight-bearing at a mean of 6.4 ± 1.2 weeks compared with 9.8 ± 1.8 weeks in the syndesmotic screw group (p < 0.001). Return to work occurred at 11.6 ± 2.6 weeks versus 15.4 ± 3.2 weeks (p < 0.001), and return to previous recreational activity at 18.4 ± 3.8 weeks versus 24.6 ± 4.6 weeks (p < 0.001), respectively.

Radiological reduction was excellent at the immediate postoperative assessment in both groups, with no significant differences in medial clear space, tibiofibular clear space or tibiofibular overlap (Table 5). However, at twelve months, loss of reduction (defined as a change of more than two millimetres in any radiological parameter compared with the immediate postoperative film) was identified in 2 of 40 (5.0%) patients in the suture-button group and 9 of 40 (22.5%) patients in the syndesmotic screw group (p = 0.024). On six-week computed tomography assessment, syndesmotic malreduction (defined as more than two millimetres of asymmetry in the incisural width compared with the contralateral side) was identified in 4 (10.0%) patients in the suture-button group and 11 (27.5%) patients in the syndesmotic screw group (p = 0.044).

Implant-related complications and the requirement for secondary surgery differed markedly between groups (Table 6; Figure 3). Hardware removal was required in 19 of 40 (47.5%) patients in the syndesmotic screw group, predominantly because of symptomatic implant prominence (n = 14) or screw breakage (n = 5). In contrast, hardware removal was required in only 3 of 40 (7.5%) patients in the suture-button group, all because of symptomatic medial button prominence (p < 0.001). The rate of recurrent diastasis was similar (1 of 40, 2.5% versus 4 of 40, 10.0%; p = 0.36). Wound infection rates were comparable between groups. There were no cases of deep venous thrombosis, neurovascular injury or compartment syndrome in either group.

Overall patient satisfaction at twelve months was significantly higher in the suture-button group, with 36 of 40 (90.0%) patients reporting good or excellent satisfaction compared with 28 of 40 (70.0%) in the syndesmotic screw group (p = 0.027).

Table 1: Baseline demographic, injury and operative characteristics

Variable	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
Age (years), mean ± SD	36.4 ± 11.6	38.2 ± 12.4	0.50
Male sex, n (%)	27 (67.5)	29 (72.5)	0.62
BMI (kg/m²), mean ± SD	25.4 ± 3.2	25.8 ± 3.6	0.60
Right side injury, n (%)	23 (57.5)	21 (52.5)	0.65
Mechanism: road traffic accident, n (%)	22 (55.0)	24 (60.0)	0.65
Mechanism: fall from height, n (%)	11 (27.5)	9 (22.5)	0.61
Mechanism: sports injury, n (%)	7 (17.5)	7 (17.5)	1.00

Lauge-Hansen SER-IV, n (%)	26 (65.0)	24 (60.0)	0.64
Lauge-Hansen PER injury, n (%)	11 (27.5)	13 (32.5)	0.62
Maisonneuve injury, n (%)	3 (7.5)	3 (7.5)	1.00
Time injury to surgery (days), median (IQR)	4 (3–7)	4 (3–6)	0.84
Operative time (min), mean ± SD	82.4 ± 14.6	78.6 ± 12.8	0.22

BMI, body mass index; IQR, interquartile range; PER, pronation-external rotation; SD, standard deviation; SER, supination-external rotation. p < 0.05 considered significant.

Table 2: Intraoperative and rehabilitation parameters

Parameter	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
Use of intra-op image intensification, n (%)	40 (100.0)	40 (100.0)	—
Reduction confirmed by hook test, n (%)	40 (100.0)	40 (100.0)	—
Number of reduction clamp applications, median (IQR)	1 (1–2)	1 (1–2)	0.86
Number of devices used (n)	1 device	1 × 3.5 mm screw, 4 cortices	—
Mean drill-hole position (cm above plafond)	2.6 ± 0.4	2.5 ± 0.4	0.32
Postoperative immobilisation (slab, weeks)	2 (range 2)	2 (range 2)	—
Time to partial weight-bearing (weeks), mean ± SD	4.2 ± 0.6	6.4 ± 0.8	<0.001*
Time to full weight-bearing (weeks), mean ± SD	6.4 ± 1.2	9.8 ± 1.8	<0.001*

*IQR, interquartile range; SD, standard deviation. *Statistically significant.*

Table 3: Functional outcomes at scheduled follow-up assessments

Outcome	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
AOFAS at 6 weeks, mean ± SD	62.4 ± 7.6	60.8 ± 8.2	0.36
AOFAS at 3 months, mean ± SD	78.6 ± 6.4	72.4 ± 7.4	<0.001*
AOFAS at 6 months, mean ± SD	88.2 ± 6.8	82.6 ± 8.0	<0.001*
AOFAS at 12 months, mean ± SD	92.4 ± 6.8	87.2 ± 8.4	0.003*
AOFAS excellent (>90), n (%)	29 (72.5)	18 (45.0)	0.012*
Olerud-Molander at 12 months, mean ± SD	88.4 ± 7.2	81.2 ± 9.6	0.001*
VAS pain score at 12 months, mean ± SD	1.4 ± 0.8	2.6 ± 1.2	<0.001*
Patients with no/mild pain, n (%)	36 (90.0)	28 (70.0)	0.027*
Dorsiflexion deficit (°), mean ± SD	2.4 ± 1.6	4.8 ± 2.4	<0.001*
Plantar flexion deficit (°), mean ± SD	1.8 ± 1.2	3.4 ± 1.8	<0.001*

*AOFAS, American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Score; SD, standard deviation; VAS, Visual Analogue Scale (0 = no pain, 10 = worst). *Statistically significant.*

Table 4: Time to functional milestones and return to activities

Milestone	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
Full weight-bearing (weeks), mean ± SD	6.4 ± 1.2	9.8 ± 1.8	<0.001*
Independent unaided walking (weeks), mean ± SD	8.2 ± 1.4	11.6 ± 2.0	<0.001*
Pain-free stair climbing (weeks), mean ± SD	14.6 ± 2.8	19.2 ± 3.4	<0.001*
Return to work (weeks), mean ± SD	11.6 ± 2.6	15.4 ± 3.2	<0.001*
Return to previous sports/recreation (weeks), mean ± SD	18.4 ± 3.8	24.6 ± 4.6	<0.001*
Persistent ankle stiffness at 12 months, n (%)	5 (12.5)	13 (32.5)	0.034*

*SD, standard deviation. *Statistically significant.*

Table 5: Radiological parameters of syndesmotic reduction

Radiological parameter	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
Immediate postoperative MCS (mm), mean ± SD	3.4 ± 0.6	3.3 ± 0.5	0.43
Immediate postoperative TFCS (mm), mean ± SD	4.8 ± 0.8	4.7 ± 0.7	0.55
Immediate postoperative TFO (mm), mean ± SD	8.6 ± 1.2	8.8 ± 1.4	0.49
12-month MCS (mm), mean ± SD	3.6 ± 0.7	4.2 ± 1.0	0.003*
12-month TFCS (mm), mean ± SD	5.0 ± 0.9	5.6 ± 1.2	0.014*
12-month TFO (mm), mean ± SD	8.4 ± 1.4	7.8 ± 1.6	0.078

Loss of reduction at 12 months, n (%)	2 (5.0)	9 (22.5)	0.024*
CT-detected malreduction at 6 weeks, n (%)	4 (10.0)	11 (27.5)	0.044*

*MCS, medial clear space; SD, standard deviation; TFCS, tibiofibular clear space; TFO, tibiofibular overlap; CT, computed tomography. *Statistically significant.*

Table 6: Complications, secondary surgery and patient satisfaction

Complication / event	Suture-button (n = 40)	Syndesmotic screw (n = 40)	p-value
Symptomatic implant prominence, n (%)	2 (5.0)	14 (35.0)	<0.001*
Hardware breakage / failure, n (%)	0 (0.0)	5 (12.5)	0.055
Hardware removal required, n (%)	3 (7.5)	19 (47.5)	<0.001*
Recurrent syndesmotic diastasis, n (%)	1 (2.5)	4 (10.0)	0.36
Wound infection (superficial), n (%)	2 (5.0)	3 (7.5)	1.00
Deep infection requiring debridement, n (%)	0 (0.0)	0 (0.0)	—
Heterotopic ossification, n (%)	1 (2.5)	5 (12.5)	0.20
Reoperation rate (any cause), n (%)	4 (10.0)	21 (52.5)	<0.001*
Patient satisfaction (good/excellent), n (%)	36 (90.0)	28 (70.0)	0.027*

**Statistically significant ($p < 0.05$).*

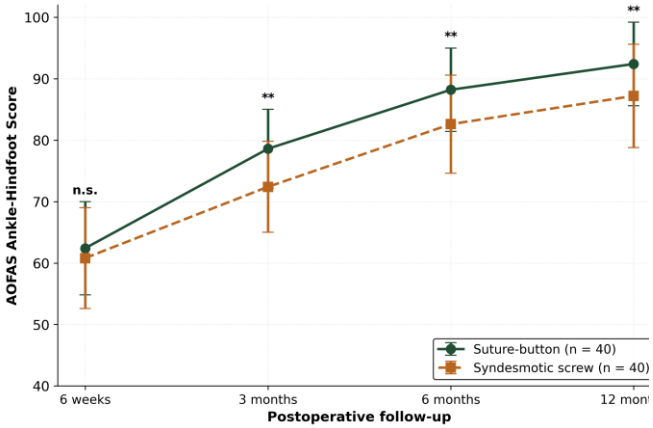

Figure 1: American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score over the 12-month follow-up period. Both groups showed comparable early scores; the suture-button group achieved significantly higher AOFAS scores from 3 months onwards. **p < 0.01

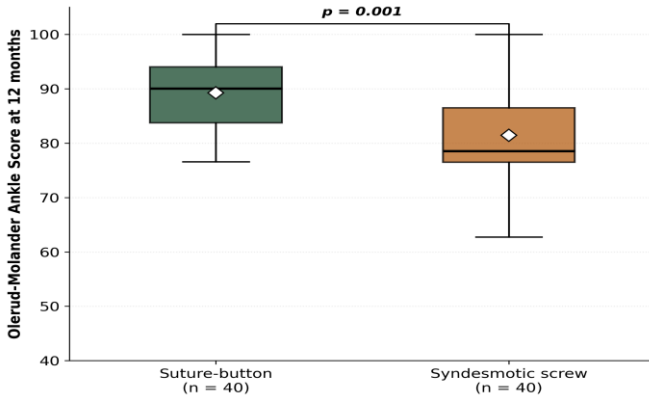

Figure 2: Distribution of the Olerud-Molander Ankle Score at 12 months. The diamond marker represents the mean. Patients in the suture-button group achieved significantly higher functional scores (p = 0.001)

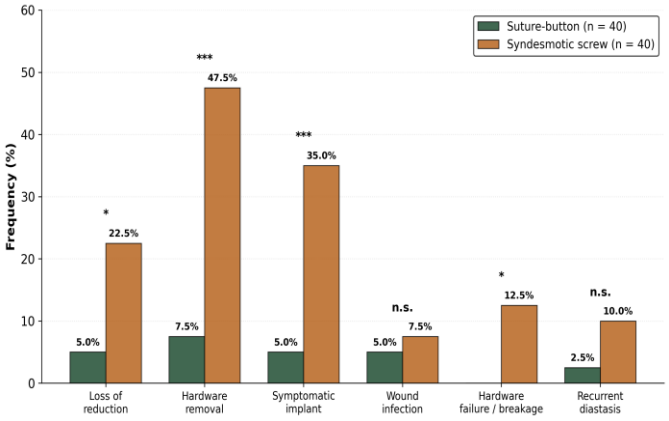

Figure 3: Frequency of implant-related complications and reoperative events in the two study groups. The most striking difference was in the requirement for hardware removal. *p < 0.05; ***p < 0.001; n.s., not significant

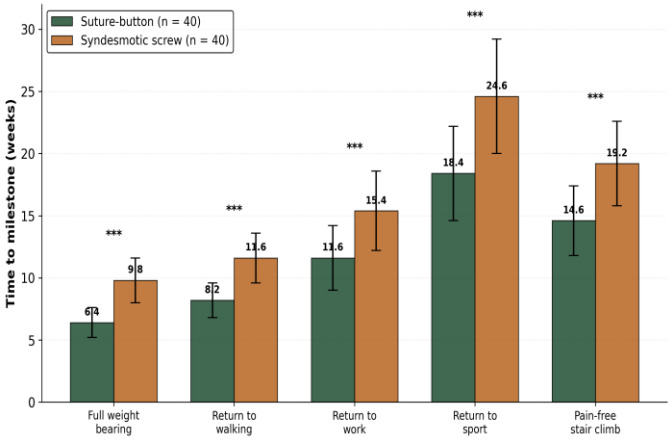

Figure 4: Time to functional milestones and return to activities. All five milestones were achieved significantly earlier in the suture-button group than in the syndesmotic screw group. ***p < 0.001

E. DISCUSSION

The present prospective comparative study

demonstrated that dynamic suture-button fixation produced superior functional and radiological outcomes compared with conventional rigid 3.5 mm syndesmotic screw fixation in adults with acute distal tibiofibular syndesmotic injuries. Patients in the suture-button group achieved significantly higher AOFAS and Olerud-Molander scores at twelve months, lower pain scores, earlier achievement of functional milestones, fewer radiological losses of reduction and a markedly lower requirement for secondary hardware removal. These differences emerged early in the rehabilitation phase and were maintained throughout the twelve-month follow-up period.

These findings are in close agreement with the contemporary international literature. The randomised multicentre trial by Laflamme and colleagues, comparing dynamic and static fixation in 70 patients, reported that the dynamic implant produced superior Olerud-Molander scores and a lower complication rate at all follow-up points, paralleling the magnitude of effect observed in the present cohort [11]. Naqvi and colleagues additionally demonstrated, by computed tomography, that suture-button fixation was associated with significantly more accurate syndesmotic reduction than screw fixation, a finding replicated in the present study where CT-detected malreduction at six weeks was nearly three times more common in the screw group [12].

The systematic review and meta-analysis by Onggo and colleagues, incorporating fourteen studies and over 1,200 patients, reported that suture-button fixation was associated with significantly higher AOFAS and Olerud-Molander scores at twelve months, lower complication rates and a substantially reduced rate of hardware removal—conclusions that are entirely concordant with the present results [13]. Inge and colleagues, in a separate systematic review, similarly noted superior patient-reported outcomes with dynamic fixation and emphasised the importance of avoiding routine prophylactic hardware removal, with its attendant morbidity [14].

Andersen and colleagues reported a 22% complication rate associated with elective syndesmotic screw removal in their cohort, including infection, neurovascular injury and iatrogenic refracture [15]. In the present study, the requirement for hardware removal was reduced more than six-fold by the use of suture-button fixation, with a corresponding reduction in the cumulative reoperation rate from 52.5% to 10.0%. This reduction has substantial implications for healthcare resource utilisation, patient satisfaction and the occupational and economic costs of secondary surgery.

From a biomechanical perspective, the superiority of suture-button fixation likely reflects the dynamic nature of the construct, which preserves physiological syndesmotic motion of one to two millimetres during ankle dorsiflexion. Coetzee and Schepers, among others, have argued that rigid screw fixation imposes non-anatomical fixation on a dynamic articulation and predisposes to malreduction, implant breakage and persistent symptoms [16]. Sagi and colleagues, in a long-term follow-up study, showed that syndesmotic malreduction was the strongest single predictor of poor functional outcome and post-traumatic arthritis at two-year follow-up [17].

In contrast, a small minority of studies has reported broadly equivalent outcomes between dynamic and static fixation, particularly in cohorts with shorter follow-up or in centres with high baseline rates of routine screw removal at twelve weeks before symptomatic problems develop [18]. Storey and colleagues highlighted that the heterogeneity of rehabilitation protocols across studies is an important confounder of comparative outcome data, and recommended standardised post-operative protocols in future trials—a feature that the present study sought to address [19].

The strengths of the present study include its prospective design, contemporaneous cohort comparison with identical surgical and rehabilitation teams, blinded outcome and radiological assessment, use of validated functional scoring systems, incorporation of computed tomography assessment of syndesmotic reduction, and complete twelve-month follow-up of more than 97% of enrolled patients. Several limitations should also be acknowledged. The single-centre design and modest sample size limit external generalisability. The non-randomised, sequential allocation design—although pragmatic—introduces a potential for confounding by temporal trends. The follow-up period of twelve months, although adequate to capture early functional outcomes and complications, is too short to evaluate the development of post-traumatic ankle arthritis, which is a clinically important long-term endpoint. Cost-effectiveness analysis was beyond the scope of this study, but the higher upfront cost of the suture-button device may be at least partially offset by the markedly reduced reoperation rate, warranting formal economic evaluation in future work.

F. CONCLUSION

In adults with acute unstable distal tibiofibular syndesmotic injuries, dynamic suture-button fixation produced significantly superior functional outcomes—measured by both AOFAS and Olerud-Molander scores—compared with conventional 3.5 mm syndesmotic screw fixation at twelve months. Suture-button fixation was associated with earlier weight-bearing, faster return to work and recreational activity, lower pain scores, fewer radiological losses of reduction, lower CT-detected malreduction and a markedly lower requirement for secondary hardware removal, without any compromise in safety. These

findings support the routine use of suture-button fixation as the preferred strategy for acute unstable syndesmotic injuries, particularly in active adults for whom early functional recovery and avoidance of secondary surgery are clinically important. Larger multicentre trials with longer follow-up are needed to evaluate the development of post-traumatic arthritis and to provide robust cost-effectiveness data.

REFERENCES

1. Hopkinson WJ, St Pierre P, Ryan JB, Wheeler JH. Syndesmosis sprains of the ankle. Foot Ankle. 1990;10(6):325–30.
2. Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. J Bone Joint Surg Am. 1976;58(3):356–7.
3. van den Bekerom MP, Hogervorst M, Bolhuis HW, van Dijk CN. Operative aspects of the syndesmotic screw: review of current concepts. Injury. 2008;39(4):491–8.
4. Sagi HC, Shah AR, Sanders RW. The functional consequence of syndesmotic joint malreduction at a minimum 2-year follow-up. J Orthop Trauma. 2012;26(7):439–43.
5. Andersen MR, Frihagen F, Madsen JE, Figved W. High complication rate after syndesmotic screw removal. Injury. 2015;46(11):2283–7.
6. Thornes B, Shannon F, Guiney AM, Hession P, Masterson E. Suture-button syndesmosis fixation: accelerated rehabilitation and improved outcomes. Clin Orthop Relat Res. 2005;(431):207–12.
7. Naqvi GA, Cunningham P, Lynch B, Galvin R, Awan N. Fixation of ankle syndesmotic injuries: comparison of TightRope fixation and syndesmotic screw fixation for accuracy of syndesmotic reduction. Am J Sports Med. 2012;40(12):2828–35.
8. Laflamme M, Belzile EL, Bédard L, van den Bekerom MP, Glazebrook M, Pelet S. A prospective randomized multicenter trial comparing clinical outcomes of patients treated surgically with a static or dynamic implant for acute ankle syndesmosis rupture. J Orthop Trauma. 2015;29(5):216–23.
9. Schepers T. Acute distal tibiofibular syndesmosis injury: a systematic review of suture-button versus syndesmotic screw repair. Int Orthop. 2012;36(6):1199–206.
10. Manjoo A, Sanders DW, Tieszer C, MacLeod MD. Functional and radiographic results of patients with syndesmotic screw fixation: implications for screw removal. J Orthop Trauma. 2010;24(1):2–6.
11. Kortekangas T, Savola O, Flinkkilä T, Lepojärvi S, Nortunen S, Ohtonen P, Katisko J, Pakarinen H. A prospective randomised study comparing TightRope and syndesmotic screw fixation for accuracy and maintenance of syndesmotic reduction assessed with bilateral computed tomography. Injury. 2015 Jun 1;46(6):1119-26.
12. Coetzee JC. Treatment of syndesmoses disruptions: a prospective, randomized study comparing conventional screw fixation vs TightRope fiber wire fixation—medium-term results. SAOJ. 2009;8(1):32–7.
13. Onggo JR, Nambiar M, Phan K, Hickey B, Galvin M, Bedi H. Suture button versus syndesmosis screw constructs for acute ankle diastasis injuries: a meta-analysis and systematic review of randomised controlled trials. Foot Ankle Surg. 2020;26(5):524–34.
14. Inge SY, Pull Ter Gunne AF, Aarts CA, Bemelman M. A systematic review on dynamic versus static distal tibiofibular fixation. Injury. 2016;47(12):2627–34.
15. Schepers T, Van Lieshout EM, de Vries MR, Van der Elst M. Complications of syndesmotic screw removal. Foot Ankle Int. 2011;32(11):1040–4.
16. Bell DP, Wong MK. Syndesmotic screw fixation in Weber C ankle injuries—should the screw be removed before weight bearing? Injury. 2006;37(9):891–8.
17. Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. Arch Orthop Trauma Surg. 1984;103(3):190–4.
18. Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. Foot Ankle Int. 1994;15(7):349–53.
19. Storey P, Gadd RJ, Blundell C. Complications of suture button ankle syndesmosis fixation. Foot Ankle Surg. 2012;18(2):e23–5.