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Suture-Button versus Syndesmotic Screw in the Treatment of Distal Tibiofibular Syndesmosis Injury

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ABSTRACT

Background: Distal tibiofibular syndesmosis injury is either isolated injury or accompanied with ankle fractures. Isolated syndesmosis injury occurs in up to 11% of ankle sprains.

Objective: The aim of the current study was to use a custom-made suture button (SB) compared to 4.5 mm syndesmotic screws (SS).

Patients and methods: This prospective study was carried out in Orthopedic Surgery Department, Zagazig University Hospital. Forty patients with tibiofibular syndesmotic injury were equally divided to the SB group or the SS group. We used a custom-made suture button consists of two buttons connected by a fiber wire.

Results: Age and BMI did not significantly differ across groups. Male gender predominated in both groups. There was no significant difference between groups regarding AOFAS immediately postoperatively, but SB group was significantly higher than SS group at 6 weeks and 6 months. There was no significant difference between groups regarding VAS immediately postoperatively, but SB group was significantly lower than SS group at 6 weeks and 6 months. **Conclusion:** In comparison to the SS approach, the SB technique yields better functional outcomes and reduced incidence of fractured implants and joint mal-reduction. Therefore, at present moment, the SB approach is advised for the treatment of syndesmosis injuries.

Keywords: Tibiofibular Syndesmosis Injury, Suture button, Syndesmotic screws.

INTRODUCTION

A total of 10% to 13% of all ankle fractures result in a distal tibiofibular syndesmosis damage [1,2]. The syndesmosis preserves the tibiofibular connection, stabilizing the ankle mortise. For many years, the syndesmotic screws (SS) has been the preferred way of stabilizing syndesmotic injuries [3,4]. The objective of an early recovery to full range of motion (ROM) and weight-bearing may be hampered by the use of a stiff screw to reconstruct the dynamic function of the syndesmotic ligaments [5,6].

The dynamic suture button (SB), which was first presented ten years ago, has been recommended as a way to treat syndesmotic injuries [7-9].

In order to evaluate the clinical and radiological outcomes following the stabilization of a damaged syndesmosis with SB with those with the use of one or two 4.5-mm quad cortical SS, this study compared the two approaches. The AOFAS scores of the patients receiving SB treatment will be higher, and their VAS scores for pain while walking and resting will be lower (better).

The aim of the current study was to use a custom made SB compared to 4.5 mm SS.

PATIENTS AND METHODS

This prospective study was carried out in Orthopedic Surgery Department, Zagazig University Hospital. Forty patients with tibiofibular syndesmotic injury were randomized to the SB group (n= 20) or the SS group (n= 20).

Inclusion criteria: Patients between the ages of 18 and 70 who have an ankle fracture of type 44-C.
OTA/AO with an acute traumatic damage to the syndesmosis.

Exclusion criteria: Multiple injuries, late diagnosis, open fracture, polytrauma, incapacity to provide permission, symptomatic ankle osteoarthritis, lower extremity neurologic impairment, and recent or past injuries to the lower extremities that might hinder rehabilitation were exclusion factors.

Operative Assessment:

Every patient's individual file and secret passcode kept all information private. All provided information is solely utilized in the present study. The investigation was conducted in accordance with the fundamentals of ethical clinical practice. The used methods of the study including methods of diagnosis and preoperative evaluation, methods of treatment and post-operative follow up and methods of post-operative evaluation.

All studied patients were subjected to complete history taking. Personal data included age, sex, occupation and special habits, tighter with date and time of trauma, and the risk factors for chronic disease. A thorough clinical examination was conducted, and clinical outcomes were assessed using the AOFAS ankle-hind foot scale, VAS, and VAS scores for pain during walking and daily activities. The AOFAS ankle-hind foot scale is divided into three parts that describe pain, function, and alignment and incorporates both subjective and objective factors into a numerical scale of 0 to 100 points, with 100 being the best result.

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Radiographic measurements:

Radiographs of the wounded ankle's mortise and lateral structures were taken right away following surgery, six weeks later, and six months later.

Pre-operative investigations:

Complete blood count, ESR, CRP and coagulation profile. On the lateral radiographs, the distance between fracture ends of the fibula was recorded as lateral fibular distance. Two plane radiographs of the ankle (lateral and mortise) were taken bilaterally for comparing and deciding if there was tibiofibular syndesmosis. These radiographs were taken by radiology technicians with the traditional tube cassette distance of 100 cm (1 m).

Surgical procedure:

We used a custom made suture button consists of two buttons connected by a fiber wire. The medial part of the button that corresponds to medial suface of the tibea measures 12 mm x 3 mm. For the lateral part of the button we had two options, one similar to the medial part and used in cases with isolated syndesmosis injury, the other option is buttom measures 8mm x 6mm and used in cases associated with ankle fracture to fit in ahole of the plate.The device is pre-operatively assembled and kept sterilized. Patients were postioned on the operation table, supine, with the afflicted limb's buttock supported by a sandbag. Longitudinal cut was done along the fibula's posterior edge. Prior to reduction and stabilization of the syndesmosis, open reduction and internal fixation of malleolar fractures is performed. Using a reduction clamp, the syndesmosis is decreased closed. Fluoroscopy is used to guide the reduction of the syndesmosis and the placement of the implant.

A 4.5-mm cortical syndesmotic screw that was completely threaded and self-tapping was used to treat the patients in the SS group. With the ankle in a neutral posture, a 3.2-mm hole is drilled through 4 cortices close to the tibiofibular joint. The screw was going to be taken out 10 to 12 weeks following the operation.

In the same spot as in the SS group, a 3.5-mm hole is bored in the SB group. From the lateral side, a guide-needle with pull-through sutures is inserted into the hole. Flipped over to rest on the medial cortex of the tibia is the oblong button. Once the lateral button is securely in place on the cortex or, if a plate is present, on it, the plate, the sutures are tightened and a knot is tied **(Figure 1)**.

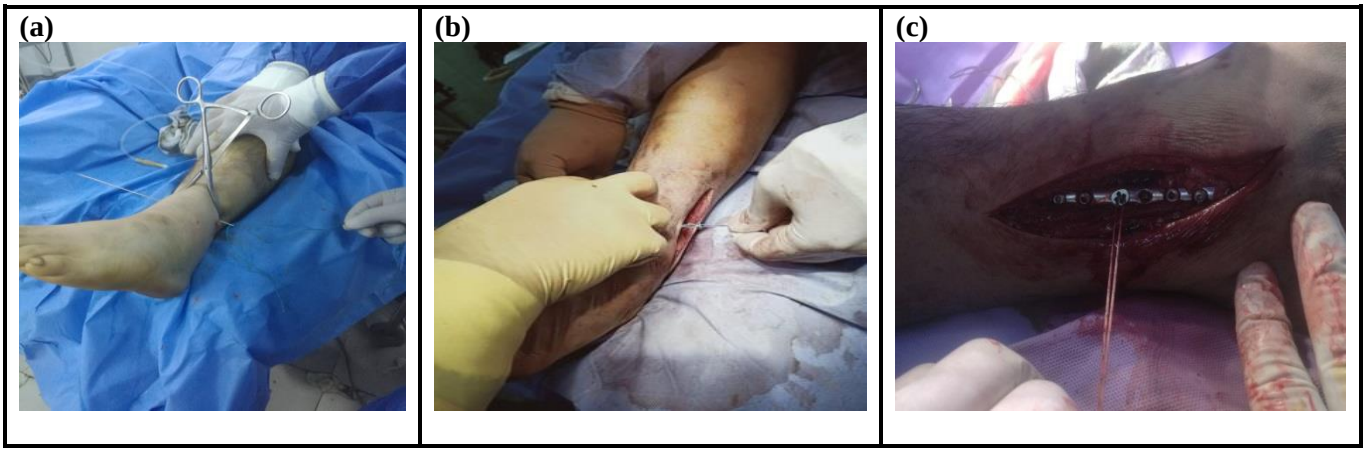

Figure (1): Surgical process demonstrating (a) the insertion of a guide needle with pull-through sutures from the lateral side, (b) the oblong button being flipped over to rest on the medial cortex of the tibia, and (c) the tightening of the sutures.

Ethical approval:

Zagazig Medical Ethics Committee of the Zagazig Faculty of Medicine gave its approval to this study. All participants gave written consent after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

Software SPSS V. 22.0 is used to analyze the data. The following tests were employed to determine if differences were significant, depending on the kind of data: difference and association of qualitative variable by Chi square test (X2), quantitative continues group representation by mean SD or median, and Range. Quantifiable independent groups' differences were compared using t test or Mann Whitney. P value less than 0.05 was regarded as significant.

RESULTS

Age was distributed as 45.3 (SD 11.81) and 42.95 (SD 10.61) respectively between SB and SS with no significant difference between groups, also BMI was distributed as 26.5 (SD 1.66) and 26.46 (SD 1.39).

There was no significant difference in sex across groups, and males predominated in both **(Table 1)**.

Table (1): Demographic data of the study groups.

Variable			SB group (N=20)	SS Group (N=20)	t/X^2	P-value
Age mean ± SD			45.3±11.81	42.95±10.61	0.662	0.512
BMI mean ± SD			26.5±1.66	26.46±1.39	0.083	0.935
Sex	**Male**	**N**	15	16	0.143	0.705
		%	75.0	80.0		
	Female	**N**	5	4		
		%	25.0	20.0		
Total		**N**	**20**	**20**	---	
		%	**100.0**	**100.0**		

There was no significant variation in side distribution since both groups were almost equal, no significant difference was detected also in type of fracture and the highest distributed type in both groups was posterior malleolar fracture, and regarding the accompanying injuries, there were no appreciable differences **(Table 2)**.

Table (2): Fracture and injury characters distribution between groups.

Variable			Group		Total	X^2	P-value
			SB group	SS group			
Side	**Left**	**N**	9	10	19	0.11	0.75
		%	45	50	47.5		
	Right	**N**	11	10	21		
		%	55	50	52.5		
Type	**Maisonneuve fracture**	**N**	3	4	7	0.45	0.92
		%	15	20	17.5		
	Medial malleolar fracture	**N**	5	6	11		
		%	25	30	27.5		
	Posterior malleolar fracture	**N**	10	8	18		
		%	50	40	45		
	Medial and posterior malleolar fractures	**N**	2	2	4		
		%	10	10	10		
Associated injuries	**No**	**N**	16	17	33	0.17	0.67
		%	80	85	82.5		
	Yes	**N**	4	3	7		
		%	20	15	17.5		
Total		**N**	20	20	40		
		%	100	100	100		

AOFAS did not substantially differ across groups immediately following surgery, but at 6 weeks and 6 months, the SB group considerably outperformed the SS group **(Figure 2)**.

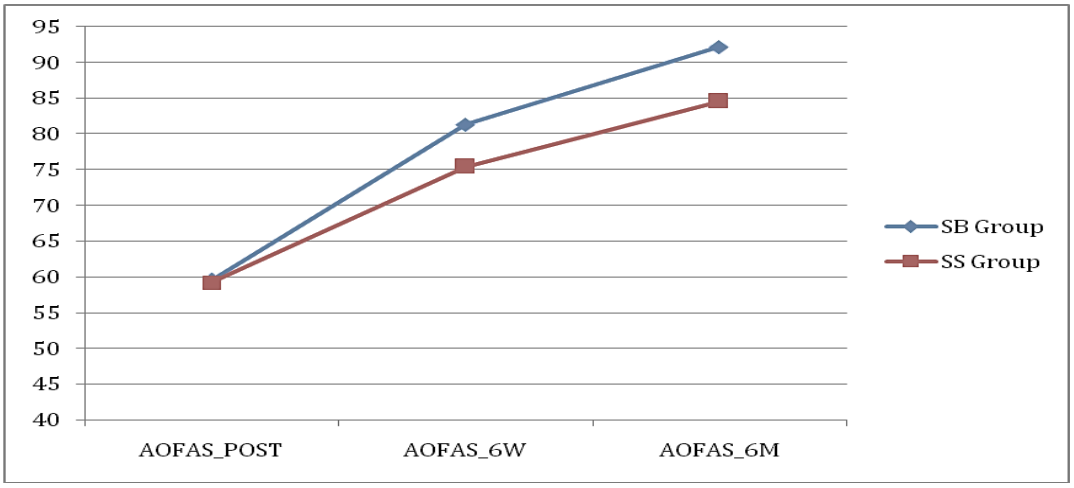

Figure (2): AOFAS score distribution between groups at different times.

In terms of VAS, there was no significant difference between the groups immediately postoperatively, but at 6 weeks and 6 months, the SB group considerably outperformed the SS group **(Table 3)**.

Table (3): VAS score at walking distribution between groups at different times.

Variable	SB group (N=20)	SS Group (N=20)	Mann Whitney	P-value
VAS walking POST	2 (1-4)	3 (2-4)	-0.246	0.807 (NS)
VAS walking 6W	1 (0-2)	2 (1-3)	-2.538	0.015 (S)
VAS_walking_6M	0 (0-1)	1 (1-2)	-4.265	0.00 (HS)

Immediately following surgery, there was no significant difference between the groups in terms of VAS; however, at 6 weeks and 6 months, the SB group's VAS was considerably lower than that of the SS group **(Figure 3)**.

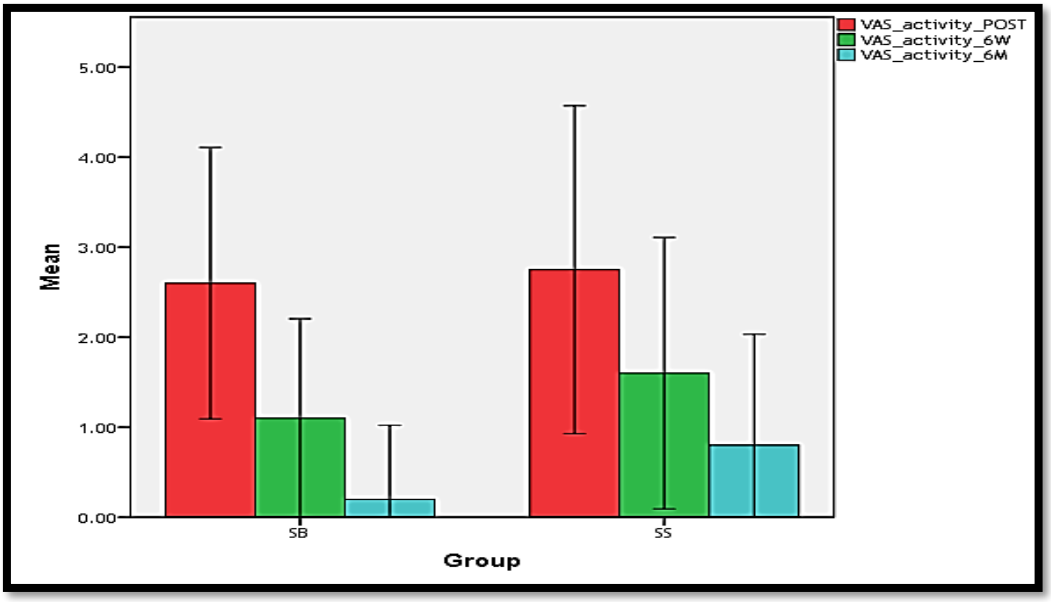

Figure (3): VAS score at daily activity distribution between groups at different times.

Immediately following surgery, there was no discernible difference between the groups, but at six weeks and six months, the SB group had much worse results than the SS group **(Table 4)**.

Table (4): Difference at radiological assessment between injured and healthy side distribution between groups at different times

Variables	SB group (N=20)	SS Group (N=20)	t-test	P-value
Difference post	0.24±0.09	0.36±0.12	-0.849	0.401 (NS)
Difference 6W	0.2±0.07	1.45±0.42	-7.648	0.000 (HS)
Difference 6M	0.10±0.04	2.0±0.67	-10.782	0.00 (HS)

A case of 42 years old patient came to ER after motorcycle accident AP and lateral x-ray of the ankle were obtained and he has lateral malleolous fracture with syndesmotic injury. The fracture was fixed using plate and screws and the syndesmosis was repaired using single suture buttons. X-ray obtained 6 weeks and 6 months after surgery and no complication was revealed **(Figure 4)**.

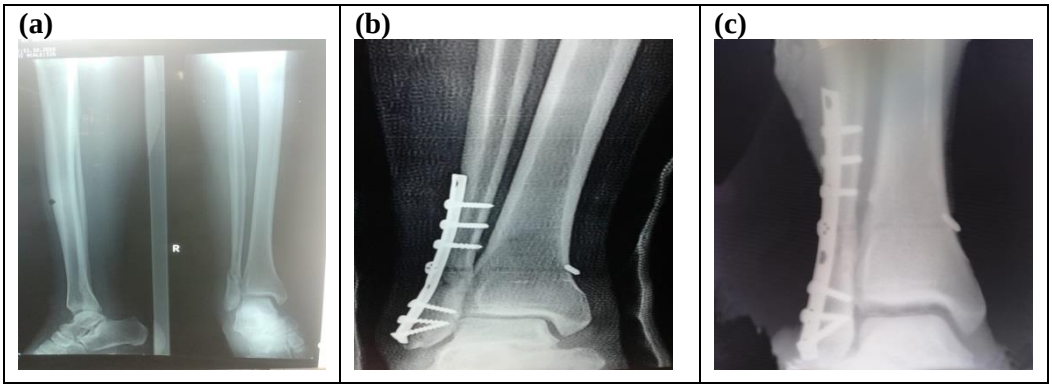

Figure (4): A case of 42 years old patient came to ER after motorcycle accident. (a) preoperative x-ray showing lateral malleolus injury with syndesmotic injury, (b) post-operative AP x-ray done 6 weeks after surgery with plate and screws and syndesmosis suture button fixing, (c) 6 month follow-up demonstrating healed Lat, malleolus damage, and syndesmosis suture button fixing.

DISCUSSION

Unstable syndesmotic injuries require operative treatment with "dynamic" (suture button) or rigid fixation (plate or screw/washer). The degree of the damage may occasionally determine this [9]. These two fixations have recently been contrasted. Therefore, there is no clear consensus about the best kind of syndesmotic fixation to utilize, the length of time it should last, or if it must be followed by other types of soft tissue ligament repair or not [10].

The aim of work is to evaluate the results of suture button fixation compared to syndesmotic screw fixation. We used a custom made suture button consists of two buttons connected by a fiber wire. The medial part of the button that corresponds to medial surface of the tibia measures 12 mm x^3 mm. For the lateral part of the button we had two options, one similar to the medial part and used in cases with isolated syndesmosis injury, the other option is button measures 8mm x 6mm and used in cases associated with ankle fracture to fit in a hole of the plate .The device is pre-operatively assembled and kept sterilized.

In our study, age was distributed as 45.3 (SD 11.81) and 42.95 (SD 10.61) respectively between SB and SS with no significant difference between groups, also BMI was distributed as 26.5 (SD 1.66) and 26.46 (SD 1.39) with no discernible variation across groups. There was no discernible difference between the groups in terms of sex, and both groups were predominately made up of men. **Sipahioglu *et al.*** [11] evaluated the radiological and clinical results of operative treatment of ankle fractures in 21 patients (15 males [72%] and 6 females [28%]) who required syndesmotic stabilization. The patients' ages varied from 22 to 67. The average age was 42.8 years (SD 13.1). When treating ankle syndesmosis injuries, **Shimozono *et al.*** [12] examined the clinical results of SB and SS fixation procedures. There were no age or sex disparities between the groups at the baseline.

In our study, 3 patients (15%) in the SB group and 10 (50%) in the SS group had Maisonneuve fracture screw fixation. In the SB group, 5 patients (25%) and 6 (30%) patients, respectively, had a concomitant medial malleolar fracture that was screw-fixed. The posterior malleolar screw was fixed in 10 patients in the SB group (50%) and 8 patients in the SS group (40%) respectively. At the time of enrolment, there were 2 patients (10%) in the SS group who had both medial and posterior malleolar fractures.

Sipahioglu *et al.* [11] stated that the type of fracture was lateral malleolar fracture in 1 patient (5%), medial malleolar fracture in 1 patient (5%), bimalleolar in 15 patients (71%), and trimalleolar in 4 patients (19%) where there was also distal tibiofibular diastasis in all patients. Two patients had Type 1 open fracture, one patient had also ipsilateral open tibial fracture, and one patient had at the same time contralateral hand phalanx fracture.

Clinical and radiological outcomes of individuals with acute syndesmotic damage treated with SB vs those treated with a single quadricortical SS were studied by **Andersen *et al.*** [13]. A concurrent medial malleolar fracture was screw-fixed in 17 patients (35%) in the SS group and 13 patients (27%) in the SB group. The posterior malleolar screw was fixed in three patients in the SS group and one patient in the SB group. The fibular fracture was plate-fixed in 32 patients (65%) in the SS group and 31 patients (65%) in the SB group. At the time of enrolment, the SS group had a higher proportion of patients with concurrent medial and posterior molar fractures as well as osteochondral abnormalities.

In our study, mean AOFAS score was 59.5 in the SB group versus 59.2 in the SS group postoperatively (P= 0.698), 81.3 versus 75.4 at 6 weeks (P= 0.003) and 92.25 versus 84.55 at 1 year (P<0.001). As a result, there was no difference in the groups' AOFAS scores immediately following surgery, but the SB group's scores were considerably higher than those of the SS group at 6 weeks and 6 months. According to **Norman *et al.*** [14], in some cases, the lowest clinically significant difference is one-half of the SD. The AOFAS scale was chosen as the main outcome measure despite not being validated due to its popularity. The scale has a drawn flak for its slow response time, failure to show

substantive clinical distinctions, lack of accuracy, and biased data output.

Additionally, the AOFAS scale incorporates metrics based on both examiner-obtained data and patient-reported metrics. **Schepers *et al.*** [7] compared the functional outcome, biomechanical properties, complication rate, and when a suture-button device used to repair syndesmotic disturbances with a syndesmotic screw requires implant removal. They came to the conclusion that, in comparison to the use of an SS repair, the use of an SB repair results in a functional outcome as determined by the AOFAS score that is equivalent, an earlier return to work, and a less frequent need for implant removal.

Also, **Andersen *et al.*** [13] found that at all follow-up intervals, the median AOFAS score was greater in the SB group. At 6 weeks, there were 64 in the SB group vs 58 in the SS group (P= 0.16), 89 against 87 at 6 months (P= 0.008), 96 against 87 at 1 year (P<0.001), and 96 against 86 at 2 years (P= 0.001). **Shimozono *et al.*** [12] evaluated the functional outcomes using the AOFAS score, showing a statistically significant difference favoring the SB.

In current study, there was no significant difference at radiological evaluation between injured and healthy side distribution between groups instantly postoperatively, but SB group was significantly lower than SS group at 6 weeks and 6 months. As a result, utilizing an SB is recommended because it doesn't need to be removed. Additionally, at certain facilities, screws are not regularly removed since the idea is to restore rotational mobility by breaking the screw or allowing bone to resorb around the screw in the fibula. **Zhang *et al.*** [15] compared between SB fixation and screw fixation. The patients in the screw fixation group had a noticeably higher rate of loss of reduction, even though adequate reduction was achieved following surgery in both groups, with the exception of one patient in the SS group who needed a corrective surgery (screw removal and new screw positioning, with good final reduction).

Pogliacomi *et al.* [16] stated that patients who underwent surgery for Weber type B and C ankle fractures and had the screws removed compared to those who did not show any differences in functional or radiological outcomes. They provided a radiological evaluation summary. Following surgery and one year later, the tibiofibular clean space (typical 0-5 mm) measurements were identical in both groups.

We can state that the SB treatment, in comparison to the SS approach, allows for more physiological mobility between the distal fibula and tibia while retaining enough stability, which promotes a quicker recovery to full weight bearing and superior clinical results. Given that improper syndesmotic reduction negatively affects clinical outcomes following ankle fractures, this may be explained by the better syndesmotic reduction in the suture-button group. The syndesmosis may be able to move more freely and self-center more effectively thanks to the SB, which may facilitate anatomic reduction.

Coetzee and Ebeling [17] when they examined the usage of two SB (TightRope) devices with two quad-cortical SS devices of varied sizes, they discovered that the SB group had a greater range of motion.

Naqvi *et al.* [18] using CT scans of both ankles to evaluate syndesmotic screw and TightRope fixation, they detected no mal-reduction in the Tight Rope fixation group; the average follow-up period was 2.5 years. Since there is no need to remove the implant with the suture-button approach, recurring syndesmotic diastasis is theoretically less likely to happen.

Shimozono *et al.* [12] demonstrated that in addition to achieving better functional results, the SB approach also has fewer incidences of damaged implants and joint mal-reduction. As a result, in contrast to the SS approach, the SB technique is advised for the treatment of syndesmosis injuries.

CONCLUSION

According to our research, patients who had SB treatment had higher AOFAS scores as well as lower (better) VAS scores for pain while walking and discomfort while resting. Additionally, there was less radiographic broadening in the SB group. As a consequence, we can say that as compared to the SS approach, the SB technique produces better functional outcomes and reduced incidence of damaged implants and joint mal-reduction. Therefore, at present moment, the SB approach is advised for the treatment of syndesmosis injuries.

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Competing interests: Nil.

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