Is it necessary to remove syndesmotic screw before weight-bearing ambulation?

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Abstract
In syndesmosis injury, whether the syndesmosis screw should be removed prior to weight-bearing remains controversial. The aim of this study was to compare the functional outcome between removed screw and retained groups and between recurrence of diastasis and no diastasis groups.

Fifty-six patients who had undergone open reduction and internal fixation due to syndesmosis injury were retrospectively evaluated and divided into four groups: (A) removed syndesmotic screw before weight-bearing (postoperative 3 months, n=28), (B) retained (n=28), (C) recurrence of diastasis (n=9), and (D) no diastasis (n=47). Radiological diastasis, American Orthopedic Foot Ankle Society Score (AOFAS), Short Form Health Survey-12 (SF-12), and complications (screw loosening and breakage) were evaluated between groups. AOFAS ankle-hindfoot score was 75.10 ± 10.40 in group A, 77.07 ± 10.60 in group B. SF-12 was 45.78 ± 5.68 in group A and 47.33 ± 5.83 in group B, showing no significant difference in AOFAS ankle-hindfoot score or SF-12 (P=.487, P=.319, respectively) between groups A and B. Radiological diastasis developed significantly (P=0.025) more in group A (8/28) compared to that in group B (1/28). However, screw loosening or breakage developed significantly (P=.001) more in group B (4/28) compared to that in group A (0/28). AOFAS ankle-hindfoot score was 70.33 ± 6.22 in group C and 76.50 ± 10.26 in group D. SF-12 was 49.85 ± 3.83 in group C and 47.40 ± 8.01 in group D, showing no significant difference between groups C and D in AOFAS ankle-hindfoot score or SF-12 (P=.908, P=.948, respectively).

Removal of syndesmotic screw before weight-bearing does not influence clinical outcomes. Although unrelated to clinical progress, recurrence of diastasis significantly increased in screw removed group. Therefore, removal of syndesmotic screw is unnecessary before weight-bearing.

Abbreviations: AOFAS = American Orthopedic Foot Ankle Society Score, CT = computed tomography, DTFS = distal tibiofibular syndesmosis, MCS = mental component summary, MRI = magnetic resonance imaging, PCS = physical component summary, SF-12 = Short Form Health Survey-12.

Keywords: removal of syndesmotic screw, syndesmosis injury, weight-bearing

1. Introduction
Ankle fracture is one of the most frequently encountered musculoskeletal injuries. Distal tibiofibular syndesmosis (DTFS) instability occurs in over 10% of ankle fractures.[11–13] DTFS is composed of anterior inferior tibiofibular ligament, posterior tibiofibular ligament, tibiofibular interosseous ligament, and transverse tibiofibular ligament.[4,3] Inconsistency of ankle surface due to injury of DTFS brings about instability of the ankle and change of contact load between tibia and fibula during walking state.[6] Finally, injury of DTFS can result in ankle arthritis. Therefore, anatomical restoration and stabilization of DTFS are essential to prevent posttraumatic degeneration and improving functional outcome.[7]

In general, surgical treatment for injury of DTFS is screw fixation at DTFS without exposure of the injured site. This treatment induces reduction of congruency and restoration. However, because retained screws for fixation of DTFS injury border the motion of ankle joint, these screws need to be removed for recovery of normal function of ankle.[8] Although studies focusing on the proper time (8–12 weeks after surgery) for removing screws have been published,[7,9,10] whether the syndesmotic screw should retain remains controversial. Therefore, the objective of this study was to evaluate outcomes of patients who were treated with syndesmotic screw for DTFS injury using clinical parameters and radiological parameters. We compared clinical outcomes between screw-removed and -retained groups and between recurred diastasis and non-recurred diastasis groups.
2. Materials and methods

2.1. Study design and ethical considerations

A retrospective study was carried out. This study was performed after obtaining approval from the Institutional Review Board (IRB) of Jeonbuk National University Research Council (IRB-2018–76).

2.2. Participants

Eighty-three patients who underwent screw fixation at Jeonbuk National University Hospital after DTFS injury from August 2010 to October 2016 were evaluated. Of them, 56 patients who were followed up for at least 24 months were included in this study. Patients with combined injury in the ipsilateral or contralateral lower limb who were followed up for <24 months were excluded. All patients provided informed consent. All surgeries were performed by one surgeon (K.B.L.).

2.3. Sample size

Patients whose screws were removed in 3 months were assigned into group A (n = 28). Patients whose screws were retained until 4 months after surgery were assigned into group B (n = 28). Among these 56 cases, those with recurrence of diastasis were assigned into group C (n = 9) while those without recurrence of diastasis were assigned into group D (n = 47).

2.4. Radiology evaluation

All patients were evaluated for ankle anteroposterior view and mortis view before surgery, after surgery, and at the last follow up. The diastasis of ankle was defined as below 10mm tibiofibular duplication and over 5 mm of tibiofibular interval according to Bonnin’s method in anteroposterior and mortis views.[17]

2.5. Clinical outcome measures

All patients were assessed for AOFAS and SF-12, the most frequently utilized measures for patient-reported outcomes after foot and ankle surgery.[11] Physical component summary (PCS) and mental component summary (MCS) at 1 month after surgery and the last follow up were also obtained. Data collection and measurement were performed by two orthopedic surgeons (Y.J. M. and K.B.L.)

2.6. Statistical analysis

Data are expressed as mean±standard deviation (SD). Significance of differences between groups A and B was determined using student’s unpaired t test while that between groups C and D was determined using Chi-squared test. A P-value of <.05 was considered statistically significant.

3. Results

3.1. Analysis of clinical results related to syndesmotic screw removal

The number of patients in group A (screws were removed in 3 months) was 28. The number of patients in group B (screws retained until 4 months after surgery) was also 28. AOFAS was 75.10 ± 10.40 in group A and 77.07 ± 10.60 in group B. SF12-PCS was 45.78 ± 5.68 in group A and 47.33 ± 5.83 in group B. SF12-MCS was 48.45 ± 4.3 in group A and 48.5 ± 10.04 in group B. Although group B tended to have higher number of these three indices, differences between the two groups were not statistically significant (Table 1, P = .487, P = .319, P = .475, respectively). The number of postoperative diastasis was 8 in group A (2.61 ± 1.09 mm) and 1 in group B (3.81 mm), showing significantly different difference between the two groups (P = .025). In group B, screw breakage occurred in one case (Fig. 1) and loosening occurred in two cases (Fig. 2). Mean AOFAS, SF12-PCS, and SF12-MCS were 60, 49, and 45.5 in patients with screw breakage and loosening, respectively. These values were relatively lower than those in patients without breakage or loosening, although differences between the two groups were not statistically significant.

Table 1

|                          | A (n = 28) | B (n = 28) | P   |
|--------------------------|-----------|-----------|-----|
| Gender (male/female)     | 23/5      | 26/2      | .233|
| Age                      | 39.14 ± 16.42 | 45.46 ± 18.25 | .178|
| Right/left foot          | 11/17     | 15/13     | .554|
| Recurred diastasis       | 8         | 1         | .025|
| AOFAS                    | 75.1 ± 10.4 | 77.07 ± 10.6 | .487|
| SF12-PCS                 | 45.78 ± 5.68 | 47.33 ± 5.83 | .319|
| SF12-MCS                 | 48.45 ± 4.30 | 48.5 ± 10.04 | .417|

Group A, screws were removed within 3 months (n = 28); group B, screws retained until four months after surgery (n = 28). AOFAS = American Orthopedic Foot Ankle Society Score, MCS = mental component summary, PCS = physical component summary, SF-12 = Short Form Health Survey-12. Values are presented as mean±SD.

3.2. Analysis of clinical results related to recurred diastasis

The number of patients was 9 in group C (recurrence of diastasis) and 47 in group D (no recurrence of diastasis). AOFAS was 70.33 ± 6.22 in group C and 76.50 ± 10.26 (P = .808) in group D. SF12-PCS was 49.85 ± 3.83 in group C and 47.40 ± 8.01 (P = .948) in group D. SF12-MCS was 44.47 ± 4.47 in group C and 46.97 ± 5.80 (P = .407) in group D. There were no statistically significant differences between the two groups (Table 2). In addition, no statistically significant differences were found in AOFAS or SF12 (SF12-PCS and SF12-MCS) according to size (P = .335, P = .251, P = .663), number (P = .335, P = .506, P = .475) or position (P = .743, P = .476, P = .623) of screws.

4. Discussion

After injury of DTFS with instability, syndesmotic screw fixation is performed. However, removal of the screw before weight-bearing ambulation is still in debate. Using radiological parameters and clinical parameters in patients treated with syndesmotic screw after DTFS injury, we found that there was no significant difference in clinical parameters between the group with screws removed within 3 months and the group with screws maintained for 4 months. Furthermore, recurred diastasis of ankle significantly increased in the group with screws removed within 3 months. Some studies have shown that the removal of syndesmotic screws can be performed about 3 to 4 months after surgery.
surgery, especially when patients have discomfort or limitation of ankle dorsiflexion due to these screws.\[^{[9, 10, 12]}\] However, many recent studies have shown that there is no particular advantage of removing syndesmotic screw within 3 months because the prognosis is similar between removal and retained groups. These studies also reported that there was an increasing tendency to perform follow-up evaluation without syndesmotic screw removal.\[^{[13-19]}\] Our results and other findings suggest that the removal of syndesmotic screw is unnecessary before weight-bearing if the patient does not complain of discomfort.

The occurrence of breakage and loosening of syndesmotic screw was increased in patients with a longer follow-up period. Miller et al reported that breakage and loosening of syndesmotic screw occurred at a frequency of 7% to 29%.\[^{[10]}\] We did not observe breakage or loosening of screw in the group with screws removed within 3 months. In contrast, we observed breakage and loosening screw in three cases in the group with screws maintained for more than 3 months. However, because recurred diastasis due to breakage and loosening of syndesmotic screw did not affect clinical parameter, follow-up was considered.

Epidemiologically, the majority of patients treated with DTFS injury in our institution were males, although there was no gender

| Table 2 |
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| Analysis of clinical results related to recurred diastasis. |
|   | C (n=9) | D (n=47) | P |
| Gender (male/female) | 7/2 | 42/5 | .344 |
| Age | 34.22±12.68 | 43.85±17.42 | .195 |
| Right/left foot | 6/3 | 20/27 | .234 |
| AOFAS | 70.33±6.22 | 76.5±10.26 | .808 |
| SF12-PCS | 49.85±3.83 | 47.4±8.01 | .948 |
| SF12-MCS | 44.47±4.47 | 46.97±5.8 | .407 |

Group C, recurrence of diastasis (n=9); group D, no recurrence of diastasis (n=47). AOFAS = American Orthopedic Foot Ankle Society Score, MCS = mental component summary, PCS = physical component summary, SF-12 = Short Form Health Survey-12. Values are presented as mean±SD.
difference between the groups we divided. In addition, age and
injured site (right/left foot) did not show any specific findings
between groups.

In this study, we diagnosed syndesmosis injury using plain
radiography which included AP and mortis view. Those injuries
might be difficult to diagnose by radiologic assessment due to
variations in anatomy and rotation of position by shooting angle.
Thus, we also used “Hook test” to assess the instability intra-
operatively by grasping the distal fibula with a bone clamp
attempting to distract the fibula from the tibia. [20] Although X-
ray shows significantly higher specificity than computed
tomography (CT) and magnetic resonance imaging (MRI), its
sensitivity is lower compared to other methods. [2,21] Therefore, a
further study needs to be conducted prospectively using MRI.

The limitation of this study was that relatively few cases were
included. Especially, the number of cases with recurrence of
diastasis was smaller than that of cases with non-recurrence.
Most cases had three cortical bone fixations. The position and
number of screws were uneven.

In summary, clinical outcomes were not different between
removed syndesmotic screw group and retained group within 3
months. Furthermore, there was no difference in clinical progress
between the group with breakage and loosening of screw and the
group without breakage or loosening of screw. Our results
suggest that removal of syndesmotic screw before weight-bearing
is unnecessary. Besides, the incidence of diastasis of ankle in the
group with syndesmotic screw removed was higher than that in
the non-removed group. However, we did not observe difference in
clinical progress between the two groups. There was no
correlation between removed or retained syndesmotic screw and
clinical progress. Thus, it would be meaningless to evaluate
results about syndesmosis fixation only with simple radiography.

Author contributions

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