Technical Note: Evaluation of Inferior Tibiofibular Joint Stability in Patients with Ankle Fracture by Standardized Intraoperative Ultrasound Stress Test

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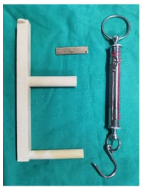
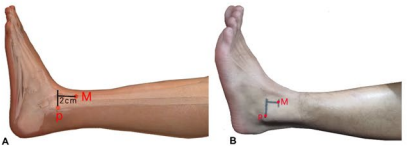
Purpose: The purpose of this study was to establish a standard method for dynamic evaluation of the stability of the inferior tibiofibular joint with intraoperative ultrasound, and to validate its use in surgery, assisting in determining the need for inferior tibiofibular joint fixation after ankle fixation.

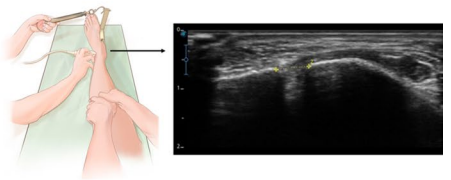
Methods: First we performed a standardized external rotation test under ultrasound in healthy subject to obtain the normal value distribution of inferior tibiofibular space (ITFS) width. Measuring parameters included: ITFS width in neutral position (N), ITFS width in external rotation position (E) at a torque of 7.2 N·m, stretch rate (E/N), and left/right side stretch rate (L/R). Next, patients with ankle fractures were selected as the intraoperative test objects. The healthy side ankle was pre-measured before surgery. After reduction and fixation of the fractures, a standard external rotation test under intraoperative ultrasound was performed on the injured ankle, compared with the preoperative measurement of the healthy side. Inferior tibiofibular joint stability after fracture reduction was determined based on the injured ankle's N, E, E/N, and injured/healthy side stretch rate (I/H), further guiding the inferior tibiofibular joint fixation.

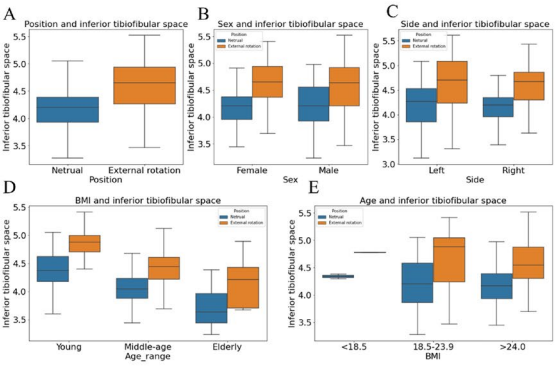
Results: We performed the ultrasonic external rotation test on 50 healthy subjects. The results showed that the average N was 4.10 ± 0.46 mm, E was 4.55 ± 0.49 mm, and E/N and L/R were 1.11 ± 0.03 and 1.00 ± 0.02, respectively. The 95% normal ranges of the measured parameters were as follows: N (3.2-5.0), E (3.59-5.51), E/N (1.05-1.17), and L/R (0.96-1.04). A standardized intraoperative ultrasound stress test was performed in 1 Weber C fracture and 2 Weber B fracture patients. In the Weber C case, after reduction and fixation of the fracture, N and E were 4.22 mm and 5.77 mm, and E/N and I/H were 1.37 and 1.27, respectively. The external rotation test was positive, leading to the fixation of the inferior tibiofibular joint. For the first Weber B case, the E/N and I/H were 1.20 and 1.09 respectively, which was also positive in the test. For the second Weber B case, E/N and I/H were 1.16 and 1.02, respectively, corresponding to negative results.

Conclusion: The standardized intraoperative ultrasound stress test allows for real-time, dynamic assessment of stability of the inferior tibiofibular joint after reduction and fixation of ankle fractures, which can guide the fixation of the lower tibiofibular screw, thus reducing the risk of traumatic arthritis after operation.









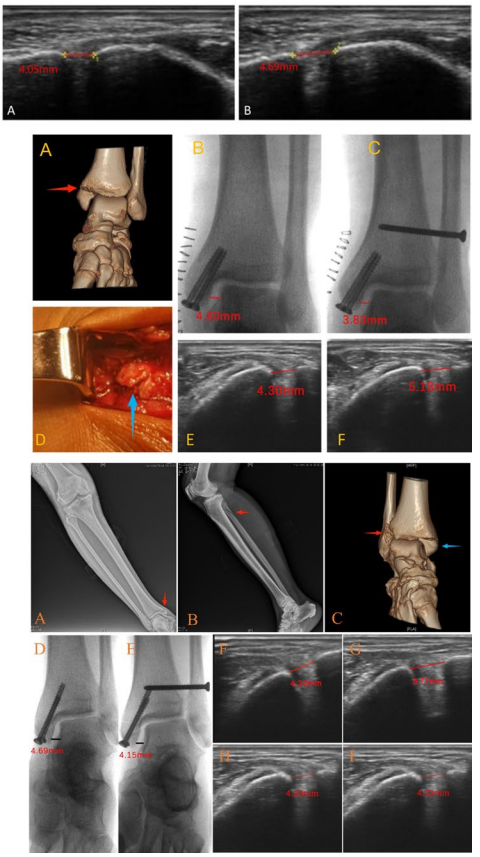


Table 1. Demographic characteristics of the normal group

n		Total=41
Sex, n (%)	Male	18 (43.9)
	Female	23 (56.1)
Age, median [Q1,Q3]		41 [26,54]
Height（cm）, mean (SD)		166.3 (7.1)
Weight（kg）, mean (SD)		68.6 (13.3)
BMI, mean (SD)		24.7 (3.7)

Table 2. The measurements of the normal group

n	Total=41
Left, Neutral （mm）, mean (SD)	4.20 (0.49)
Left, External rotation（mm）, mean (SD)	4.63 (0.55)
Right, Neutral（mm）, mean (SD)	4.16 (0.41)
Right, External rotation（mm）, mean (SD)	4.59 (0.44)
Average ,Neutral（mm）, mean (SD)	4.18 (0.44)
Average , External rotation（mm）, mean (SD)	4.61 (0.49)
Left side stretch rate (E/N), mean (SD)	1.10 (0.03)
Right side stretch rate (E/N), mean (SD)	1.10 (0.03)
Average stretch rate (E/N), mean (SD)	1.10 (0.03)
Left /Right side stretch rate (L/R), mean (SD)	1.00 (0.02)