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Anterior Positional Fault of the Fibula after Sub-Acute Anterior Talofibular Ligament Injury

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Abstract. [Purpose] The purpose of this study was to examine the position of the distal fibula in subjects with sub-acute lateral ankle sprain (LAS) and to determine if a relationship exists between the amount of swelling and fibular position. [Subjects] The subjects participating in this study were ten patients with unilateral sub-acute LAS (the isolated anterior talofibular ligament injury: LAS group) and ten healthy persons (control group). [Methods] We measured subject's fibular position and the amount of ankle swelling. The fibular position was measured as the distance between the lowest point of the lateral malleolus and the vertical line through the posterior margin of the calcaneus. Swelling was measured by the figure-of eight methods. [Results] The fibular position within the LAS group was significantly more anterior in the sprained ankles (43.7 ± 8.3 mm) than in the contralateral uninjured ankles (38.8 ± 7.6 mm). Additionally, sprained ankles were significantly more anterior than the side-matched ankle of the controls (37.4±4.2 mm). Spearman's rank correlation coefficient revealed a positive correlation between fibular position and swelling (r=0.688). [Conclusion] The ankles with more swelling had a more anteriorly positioned fibula. This positional fault may be acutely maintained by the swelling.
Key words: Sub-acute ankle sprain, Tibiofibular joint, Correlation coefficient

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INTRODUCTION

A lateral ankle sprain (LAS) is one of the most common injuries among athletes and other active young adults[1,2].

Of particular concern is the high proportion (up to 70%) of patients who suffer from repetitive ankle sprains and chronic symptoms after the initial injury[3]. Several studies have examined fibular position in subjects with ankle instability[4–8]. However, the results of these studies are inconclusive. The results suggest the development of anterior and posterior positional faults in individuals with ankle instability. Furthermore, a few reports have examined[9] fibular position in subjects after acute or sub-acute ankle sprain. We developed an instrument to quantify the alignment of the lateral malleolus of the fibula and the medial malleolus of the tibia using digital calipers[10]. This is a mechanical instrument which is very easy to use, and has excellent reliability. The purpose of this study was to examine the position of the distal fibula in relation to the posterior margin of the calcaneus in subjects with sub-acute LAS and to determine if a relationship exists between the amount of swelling and fibular position.

SUBJECTS AND METHODS

Ten subjects with unilateral sub-acute LAS (LAS group: 10 females, age=14.2 ± 1.7 years) and ten subjects with no previous history of ankle injury (control group: 10 females, age=14.8 ± 1.6 years) were participated in this study. Orthopedic surgeons working in our clinic initially examined the injured subjects. All subjects provided written informed consent before data collection. The mean grade of ankle sprain suffered by the subjects was 1.8 ± 0.4 on a 3-category scale, and all the subjects were diagnosed as having isolated anterior talofibular ligament (ATFL) injury. Measurements were taken between 2 and 12 days after injury (mean = 7.4 ± 2.8 days). All subjects with healthy ankles were recruited from patients being treated for diseases other than ankle injury until we had an equal number of females in both the LAS and the control groups.

The position of the fibular was measured with the instruments we developed, using previously reported methods10). The test-retest reliability (ICC (1, 1) = 0.97, SEM = 2.86) was previously reported10). The measuring instrument consisted of the pedestal and the device created by using a caliper (carbon fiber digital caliper, Shinwa Rules Co. Ltd. Niigata, Japan; minimum reading, 0.1 mm). The prop was allowed to stand vertically on the 4 corners of the pedestal. Moreover, the heel cup was installed at the pedestal. In the device, it is possible to insert vertical caliper and slide the caliper along the column. Using the device and the pedestal, we measured the exact distance between the reference point and the measurement point.

Subjects were seated with their hip, knee and ankle joints at 90°. A pad for fixation was then placed under the thigh to help maintain a neutral position. After the heel was in contact with the heel cup, the subject placed their foot on the pedestal, so that the line connecting the center of the heel and the second toe of the foot was positioned at 10° internal rotation from the vertical line of the frontal plane (refer to ankle radiographic methods[11]). Subjects were observed to ensure that no rotations of the lower extremity occurred during testing. The lowest point of the lateral malleolus was measured by palpation and marked.

After the marking and positioning, measurements were taken to determine the position of the measurement sites. A vertical line through the posterior margin of the calcaneus was defined as the reference line. The distance between the reference line and the lowest point of the lateral malleolus was recorded in 0.1 millimeters using the digital caliper. The same examiner performed the positioning and took measurements for all subjects.

Refer to the previous study[9], the figure-of eight methods[12] was used to measure swelling. Subject's ankles were positioned in the neutral position. In the beginning, the tape measure was placed midway between the anterior tibialis tendon and the lateral malleolus. The tape measure was then placed around the foot, distal to the navicular tuberosity, across the anterior tibialis tendon, and back around the heel. The measurement was recorded in millimeters for both the right and left ankles.

The date did not fit a normal distribution so non-parametric statistics were used. To test for side-to-side differences within both the LAS group and the control group, the Wilcoxon signed rank test was used. To test for differences between the injured ankles of the LAS group and the side-matched ankles of the control group, and the uninjured ankles of the LAS group and the side matched ankles of the control group, the Mann-Whitney test was used. Bivariate correlations using Spearman's rank correlation coefficient were made between the amount of side-to-side difference in swelling and the corresponding difference in fibular position of the LAS group. The level of significance chosen for this study was 5% ($p<0.05$).

RESULTS

The Wilcoxon signed rank test revealed significant differences within the ankles of the LAS group ($p=0.007$). The injured ankle of the LAS group had a mean fibular position of 43.7 ± 8.3 mm anterior to the posterior margin of the calcaneous compared to 38.8 ± 7.6 mm for the contralateral uninjured ankle. There were no significant side-to-side differences within the control group ($p=0.508$).

The Mann-Whitney test revealed a significant difference between the injured ankle of the LAS group and the side matched ankle of the control group ($p=0.048$). There were no significant differences between the uninjured ankle of the LAS group and the side matched ankle of the control group ($p=0.182$) (Table 1).

Spearman's rank correlation coefficient revealed a statistically significant positive correlation between the side-to-side differences in fibular position and swelling ($r=0.688$, $p=0.028$).

Table 1. Mean ± SD (range) of fibular position for the LAS group (n = 10) and the control group (n = 10)

Group	Ankle	Mean ± SD	range
LAS	Sub-acute *1,*2	43.7 ± 8.3	32.1–59.0
	Opposite	38.8 ± 7.6	27.5–46.9
Control	Matched	37.4 ± 4.2	34.0–47.0
	Opposite	38.2 ± 4.2	33.4–47.8

*1 ; Significant difference from the opposite ankles of the LAS group ($p < 0.05$). *2 ; Significant difference from the matched ankles of the control group ($p < 0.05$)

DISCUSSION

There was a statistically significant difference in the fibular position of the subjects with sub-acute LAS. Our findings suggest an anterior positional fault was present in those with sub-acute LAS in comparison to their contralateral ankles and side-matched controls. Furthermore our effect size was high (0.85) between the ankles of the LAS group, and high (0.53) between the LAS ankles and the side-matched control ankles. Based on our effect sizes, we believe the altered position of the fibula is clinically significant.

Few data have been presented in the literature regarding positional faults of the fibula in sub-acute LAS. Hubberd[9] examined the positional fault of the fibula in sub-acute LAS, and found 82% of the subjects had an anterior positional fault of the fibula. Our present findings suggest that all subjects with sub-acute LAS have anterior positional fault of the fibula. Our data were limited to LAS subjects with ATFL injury, which may be the cause of the difference with the results of the previous research. It will be necessary to investigate the relationship of the direction of movement of the fibula and ligament rupture sites.

Previous research[13,14] has demonstrated positive outcomes with distal fibula and talar mobilization after ankle sprains. However, there is no generally accepted opinion about positional faults of the fibula after LAS[4–9]. Our data suggest that subjects with greater differences in fibular position have more swelling as measured by differences in ankle girth. Therefore, over time, as the swelling improves, the position of the fibula may change. If the exact position of the fibula could be identified, manual therapy techniques such as fibular mobilization may become more effective treatments. It will be necessary to conduct longitudinal studies examining changes in the distal fibular position after acute ankle injury to resolve this issue.

REFERENCES

1) Balduini FC, Tetzlaff J: Historical perspectives on injuries of the ligaments of the ankle. Clin Sports Med.1982, 1: 3–12.
2) Jackson DW, Ashley RD, Powell JW: Ankle sprains in young athletes: relation of severity and disability. Clin Orthop, 1974, 101: 201–215.
3) McKay GD, Goldie PA, Payne WR, et al.: Ankle injuries in basketball: injury rate and risk factors.Br J Sports Med, 2001, 35: 103–108.

4) Hubbard TJ, Hertel J, Sherbondy P: Fibular position in individuals with self-reported chronic ankle instability. J Orthop Sports Phys Ther, 2006, 36: 3–9.
5) Mavì A, Yildirim H, Gunes H, et al.: The fibular incisura of the tibia with recurrent sprained ankle on magnetic resonance imaging. Saudi Med. J, 2002, 23: 845–849.
6) Wikstrom EA, Hubbard TJ: Talar positional fault in persons with chronic ankle instability. Arch Phy Med Rehabil, 2010, 91: 1267–1271.
7) Berkowitz MJ, Kim DH: Fibular position in relation to lateral ankle instability. Foot Ankle Int, 2004, 25: 318–321.
8) Eren OT, Kucukkaya M, Kabukcuoglu Y, et al.: The role of a posteriorly positioned fibula in ankle sprain. Am J Sports Med, 2003, 31: 995–998.
9) Hubbard TJ, Hertel J: Anterior positional fault of the fibula after sub-acute lateral ankle sprains. Man Ther. 2008, 13: 63–67.
10) Fukuhara T, Sakamoto M, Nakazawa R, et al.: Evaluation of the alignment of the tibial malleolus and lateral malleolus of the fibula. J Phys Thera Sci, 2011, 26: 919–921.
11) Kamata M: General X-ray protocols. 6th edition; Kanehara & Co.,Ltd, 2004, p 106.
12) Tatro-Adams D, McGann SF, Carbone W: Reliability of the figure-of-eight method of ankle measurement. J Orthop Sports Phys Ther, 1995, 22: 161–163.
13) Green T, Refshauge K, Crosbie J, et al.: A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains. Phys Ther, 2001, 81: 984–994.
14) Collins N, Teys P, Vicenzino B: The initial effects of a Mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains. Man Ther, 2004, 9: 77–82.