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ANATOMIC VARIATIONS

Morphological features of the posterior intermalleolar ligament

Mutsuaki Edama[1,2] · T. Takabayashi[1] · T. Inai[1] · R. Hirabayashi[1] · M. Ikezu[1] · F. Kaneko[1] · M. Kanta[1] · I. Kageyama[2]

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Abstract

Purpose In the present study, the posterior intermalleolar ligament (PIML) was classified by type using large-scale cadavers to provide basic information to help elucidate the mechanism of ankle joint posterior impingement syndrome.

Methods This investigation examined 100 legs from 49 Japanese cadavers (mean age at death, 79 ± 11 years; 58 sides from men, 42 from women). In the classification method, an absent PIML was classified as Type I, a PIML with one fiber bundle (attachment to one place) was Type II, a PIML with two fiber bundles (attachment to two places) was Type III, and a PIML with three fiber bundles (attachment to three or more places) was Type IV. Furthermore, according to other adhering tissues, they were further subdivided and classified by type.

Results There were various types of PIML: 19 (19%) Type I; 24 (24%) Type II; 23 (23%) Type III; and 34 (34%) Type IV. A PIML was present in 81 legs (81%). There were no significant differences between men and women and between left and right sides.

Conclusions The complex relationships of the PIML with the surrounding ligaments and tissues are considered to be among the factors that make interpretation of imaging findings difficult.

Keywords Posterior impingement syndrome · Gross anatomy · Large-scale cadavers

Introduction

Posterior impingement syndrome, presenting as posterolateral ankle pain with plantar flexion, occurs commonly in ballet dancers. The anatomic structures causing posterior impingement syndrome have been described and include the intermalleolar ligament, which is also known as the posterior intermalleolar ligament (PIML) [2, 4]. However, the PIML has been neglected in the anatomy literature, and drawings and pictures of it are inconsistently presented [7]. Moreover, significant discrepancies in the frequency of occurrence of the ligament have been reported by dissection and MRI examination. Its prevalence in anatomic studies varies widely: 56% (20/36 legs) [6], 72.5% (29/40 legs) [3], 81.8% (63/77 legs) [4], and 100% (20/20 legs) [1]. In radiological studies, the prevalence has been reported to be 19% (18/97 legs) [6], 48% (12/25 legs) [5], and 96% (25/26 legs) [4]. One of the likely reasons for this is that the morphological characteristics of the PIML have yet to be sufficiently clarified.

Therefore, in the present study, the PIML was classified by type using large-scale cadavers to provide basic information to help elucidate the mechanism of ankle joint posterior impingement syndrome.

Materials and methods

Cadavers

In this investigation, 100 legs from 49 Japanese cadavers (mean age at death, 79 ± 11 years; 58 sides from men, 42 from women; 51 sides from right, 49 sides from left) that had been switched to alcohol after placement in 10% formalin were examined. None showed signs of previous major surgery around the ankle.

✉ Mutsuaki Edama
edama@nuhw.ac.jp

[1] Institute for Human Movement and Medical Sciences, Niigata University of Health and Welfare, Shimami-cho 1398, Kita-ku, Niigata 950-3198, Japan

[2] Department of Anatomy, School of Life Dentistry at Niigata, Nippon Dental University, Niigata, Japan

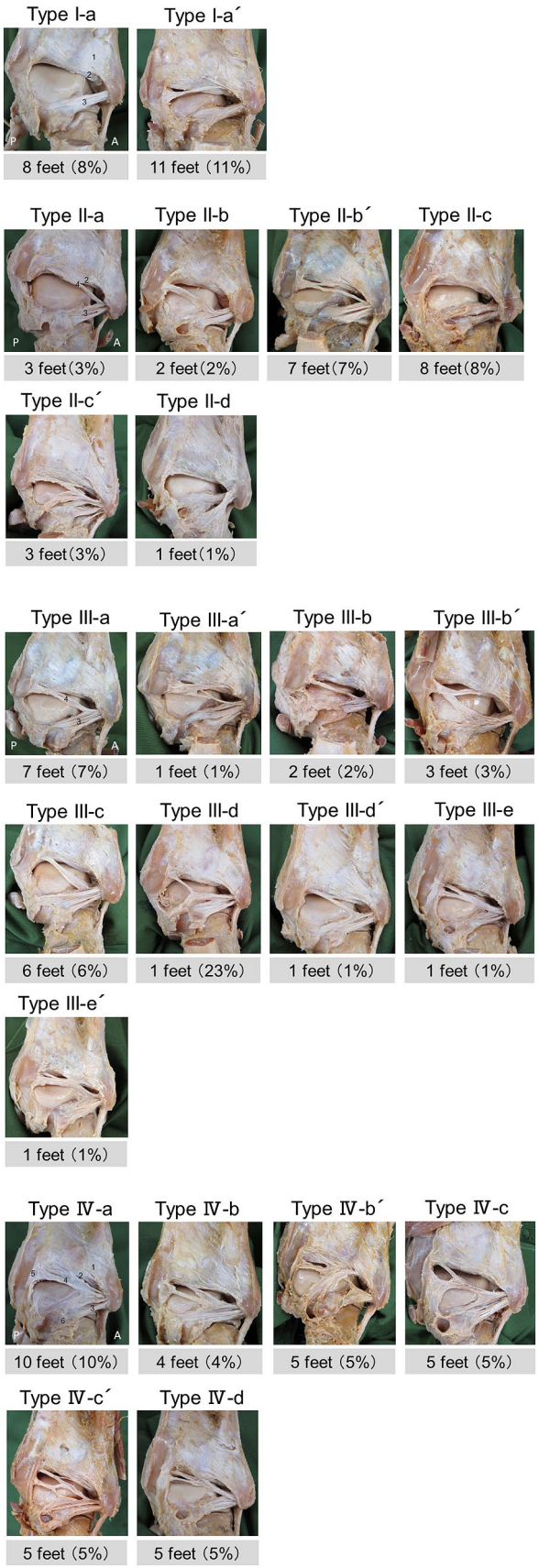

Fig. 1 Classification of the PIML. Type I-a: PIML absent. Type I-a′, PIML absent, but having the deep component of the PTIFL. Type II-a: PIML attaches to the deep component of the PTIFL. Type II-b: PIML attaches to the tibial malleolar insertion through the septum between the FDL and the TP. In Type II-b′, the deep component of the PTIFL is attached. Type II-c: PIML attaches to the talar insertion through the septum of the FHL. In Type II-c′, the deep component of the PTIFL is attached. Type II-d: PIML attached to the calcaneus. Type III-a: PIML attached to the deep component of the PTIFL and the tibial malleolar insertion through the septum between the FDL and the TP. In Type III-a′, the deep component of the PTIFL is attached. Type III-b: PIML attaches to the tibial malleolar insertion through the septum between the FDL and the TP and to the talar insertion through the septum of the FHL. In Type III-b′, the deep component of the PTIFL is attached. Type III-c: PIML attaches to the deep component of the PTIFL and to the talar insertion through the septum of the FHL. Type III-d: PIML attaches to the tibia and talar insertion through the septum of the FHL. In Type III-d′, the deep component of the PTIFL is attached. Type III-e: PIML attaches to the tibia and the tibial malleolar insertion through the septum between the FDL and the TP. In Type III-e′, the deep component of the PTIFL is attached. Type IV-a: PIML attaches to the tibia and the deep component of the PTIFL and to the tibial malleolar insertion through the septum between the FDL and the TP and to the talar insertion through the septum of the FHL. Type IV-b: PIML attaches to the deep component of the PTIFL and the tibial malleolar insertion through the septum between the FDL and the TP and to the talar insertion through the septum of the FHL. In Type IV-b′, the deep component of the PTIFL is attached. Type IV-c: PIML attaches to the tibia and the tibial malleolar insertion through the septum between the FDL and the TP and to the talar insertion through the septum of the FHL. In Type IV-c′, the deep component of the PTIFL is attached. Type IV-d: PIML attaches to the tibia and the deep component of the PTIFL and the tibial malleolar insertion through the septum between the FDL and the TP and to the talar insertion through the septum of the FHL. *PIML* posterior intermalleolar ligament, *PTFL* posterior talofibular ligament, *PTIFL* posterior tibiofibular ligament, *FDL* flexor digitorum longus, *TP* posterior tibial tendon, *FHL* flexor hallucis longus. 1: PTIFL, 2: the deep component of PTIFL, 3: PTFL, 4: PIML, 5: Tibial malleolar insertion through the septum between the FDL and the TP, 6: Tibia, 7: Talar insertion through the septum of the FHL

Methods

One author (first author) dissected the PIML alone. The lower limbs were cut 10 cm above the ankle to produce isolated specimens. The PIML, the posterior talofibular ligament (PTFL), and the posterior tibiofibular ligament (PTIFL) were carefully dissected after removal of skin, subcutaneous tissue, musculotendinous tissue, and crural fascia.

In the classification method, an absent PIML was classified as Type I, a PIML with one fiber bundle (attachment to one place) was Type II, a PIML with two fiber bundles (attachment to two places) was Type III, and a PIML with three or more fiber bundles (attachment to three or more places) was Type IV. Furthermore, according to adhering tissues, they were further subdivided and classified by type (Fig. 1).

Statistical analysis

The Chi-squared test was used to compare differences by sex, laterality, and presence of the dorsal calcaneocuboid ligament between types. The level of significance was 5%.

Results

Classification of the posterior intermalleolar ligament

There were various types of PIML (Fig. 1): Type I 19 (19%) legs; Type II 24 (24%) legs; Type III 23 (23%) legs; and Type IV 34 (34%) legs. The PIML was present in 81 legs (81%).

There were no significant differences between men and women and between left and right sides.

Discussion

The present study found that the prevalence of the PIML was 81% (81/100 legs). In the previous studies, its prevalence in anatomic studies varied widely: 56% (20/36 legs) [6], 72.5% (29/40 legs) [3], 81.8% (63/77 legs) [4], and 100% (20/20 legs) [1]. Similarly, in radiological studies, the prevalence also varied: 19% (18/97 legs) [6], 48% (12/25 legs) [5], and 96% (25/26 legs) [4]. Since there have been few previous large-scale anatomical studies of the classification of the PIML, the present results provide very important basic data.

Moreover, it became clear from the present research results that the PIML adheres to various tissues. These complex relationships with the surrounding ligaments and tissues may be among the factors that make interpretation of imaging findings difficult. Therefore, it was thought that these results are useful for elucidating the mechanism of the posterior impingement syndrome.

But, there is limitation to this study. This study did not consider about morphology of intermalleolar joint and morphology of the fibula and general curve. In the future, biomechanical studies using these research results as basic information are now needed.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The methods were carried out in accordance with the 1964 Declaration of Helsinki, and the cadavers were legally donated for the research by the Nippon Dental University of Life Dentistry at Niigata in Japan.

Informed consent Informed consent was obtained from the families of all subjects.

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