



Contents lists available at ScienceDirect

## Journal of Orthopaedic Science

journal homepage: <http://www.elsevier.com/locate/jos>

## Original Article

## Radiographic evaluation of the normal ankle joint in children and adolescent

Ki Hyuk Sung <sup>a,1</sup>, Soon-Sun Kwon <sup>b,1</sup>, Seung Jun Moon <sup>c</sup>, Seung Yeol Lee <sup>d,\*</sup><sup>a</sup> Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, Kyungki, South Korea<sup>b</sup> Department of Mathematis, College of Natural Sciences, Ajou University, Kyungki, South Korea<sup>c</sup> Department of Orthopaedic Surgery, COMWEL Ansan Hospital, Kyungki, South Korea<sup>d</sup> Department of Orthopaedic Surgery, Ewha Womans University Mokdong Hospital, Seoul, South Korea

## ARTICLE INFO

## Article history:

Received 31 August 2017

Received in revised form

21 February 2018

Accepted 7 March 2018

Available online xxx

## ABSTRACT

**Background:** The purpose of this study was to determine the reliability of numerous radiographic measurements of the skeletally immature ankle joint, timing of ossification of medial malleolus and appearance of tibial incisura and differences in the values of radiographic measurements based on age and sex.

**Methods:** This study included 590 subjects (0–15 years), who underwent ankle AP, lateral and mortise radiographs. Presence of the medial malleolus and incisura fibularis were recorded. Tibiofibular overlap, tibiofibular clear space, medial clear space, talar tilt, talocrural angle, relative fibular width and fibular position were measured.

**Results:** All radiographic measurements showed good to excellent intraobserver and interobserver reliability (ICCs, 0.603 to 0.949). The timing of ossification of medial malleolus and appearance of tibial incisura between boys and girls were not different. Tibiofibular clear space on mortise views, and medial clear space on AP and mortise view significantly decreased by age. Tibiofibular overlap on AP and mortise views, relative fibular width on AP view significantly increased by age. Talocrural angle, tibiofibular overlap on AP view, tibiofibular clear space on AP and mortise views, medial clear space on AP and mortise views and fibular position were significantly larger in boys than in girls. The difference in tibiofibular overlap, tibiofibular clear space and medial clear space on AP view of both sides was <50% in 97.1%, 93.1%, and 97.2% of patients, respectively. The difference in tibiofibular overlap, tibiofibular clear space and medial clear space on mortise view of both sides was <50% in 98.0%, 96.5%, and 100% of patients, respectively.

**Conclusions:** For skeletally immature patients, the criteria for absolute radiographic values used in adults to assess distal tibiofibular syndesmosis or deltoid ligament injury cannot be applied, but comparison of both sides of ankle joint could help physicians to predict the need for additional evaluations.

© 2018 Published by Elsevier B.V. on behalf of The Japanese Orthopaedic Association.

## 1. Introduction

Injuries to the distal tibiofibular syndesmosis with fracture or with soft tissue injuries alone are relatively common in adults [1–3]. Disruption of the syndesmosis without fracture has been reported to occur in approximately 1–10% of all ankle sprains in adults [4–6]. In pediatric patients, although ligamentous ankle

injuries are less common than fractures involving the physeal plate, they do occur. A previous study reported 2 patients who had deltoid ligament tears and syndesmotom disruptions associated with triplane ankle fractures [7].

Harper and Keller described the “normal” radiographic relationships of the distal tibiofibular syndesmosis in adults [8]. The criteria included [1] tibiofibular clear space on the AP and mortise views of <6 mm [2], tibiofibular overlap on the AP view of >6 mm or 42% of the fibular width, and [3] tibiofibular overlap on the mortise view of >1 mm. Previous studies reported that medial clear space of >4 mm or 5 mm on mortise view indicated deltoid ligament injury [9–13].

However, because of incomplete ossification of the medial malleolus and appearance of tibial incisura, measurement values

\* Corresponding author. Department of Orthopaedic Surgery, Ewha Womans University Mokdong Hospital, 1071 Anyangcheon-ro, Yangcheon-Gu, Seoul, South Korea. Fax: +82 2 2642 0349

E-mail address: [kernels00@naver.com](mailto:kernels00@naver.com) (S.Y. Lee).

<sup>1</sup> Ki Hyuk Sung and Soon-Sun Kwon contributed equally to the writing of this article.

for adults do not apply to the skeletally immature patient. Therefore, syndesmosis injury in the skeletally immature patient can be overdiagnosed and overtreated. Although comparison to radiographic standards for ankle joint is critical for evaluation of syndesmosis injuries, such standards are not well defined for children and adolescents. A previous study concluded that the criteria used to evaluate the integrity of the distal tibiofibular syndesmosis in adults do not apply to children [14]. Nevertheless, to our knowledge, there are few studies regarding determination of the normal configuration of the ankle joint on radiographs in skeletally immature patients. Understanding the normal configuration of the ankle joint including distal tibiofibular syndesmosis is essential to diagnosing abnormalities in children and adolescents.

We therefore sought to determine [1] the reliability of numerous radiographic measurements of the skeletally immature ankle joint, including the tibiofibular clear space, tibiofibular overlap space and medial clear space [2]; the timing of ossification of medial malleolus and appearance of tibial incisura in males and females; and [3] the differences in the values of these radiographic measurements based on age and sex.

## 2. Materials and methods

This retrospective study was approved by the institutional review board of our hospital, and informed consent was waived owing to the retrospective nature of the study.

We evaluated the radiographs of consecutive subjects to determine their suitability for inclusion in this study. We considered the images of all patients between the ages of 0 and 15 years who had ankle anteroposterior (AP), lateral and mortise radiographs obtained at our hospital between 2012 and June 2016. The exclusion criteria were [1]: fracture around the ankle joint: medial malleolus, lateral malleolus, and distal tibia; and [2] inadequate ankle radiographs for measurement. We retrieved ankle radiographs of 605 children and adolescents with 0–15 years old. After implementation of inclusion and exclusion criteria, a total of 590 subjects were included to assess normal configuration around the ankle joint (Table 1) and 419 subjects were evaluated for comparison between both sides (Fig. 1). Patient diagnosis included contusion, sprain, benign tumor, such as ganglion and non-ossifying fibroma, growing pain, and laceration. The mean age was  $9.7 \pm 3.6$  (range, 0 to 15) years. There were 353 males (59.8%) and 237 females (40.2%). The mean male age was  $10.4 \pm 3.6$  years and the mean female age was  $9.7 \pm 3.6$  years.

Ankle radiographs were obtained using a UT 2000 x-ray machine (Philips Research, Eindhoven, The Netherlands) at a source-to-image distance of approximately 100 cm. Settings for the radiographs depended on the patient's body size: 58 kVp and 6.3–8 mAs for smaller patients and 60 kVp and 10 mAs for larger patients. All evaluated radiographs were AP, lateral and mortise views of the ankle. Mortise radiographs were taken in approximately 15 degrees of internal rotation. All conventional radiographic images were acquired digitally, and measurements subsequently were made using a picture archiving and communication system (PACS; Infinitt, Seoul, Korea).

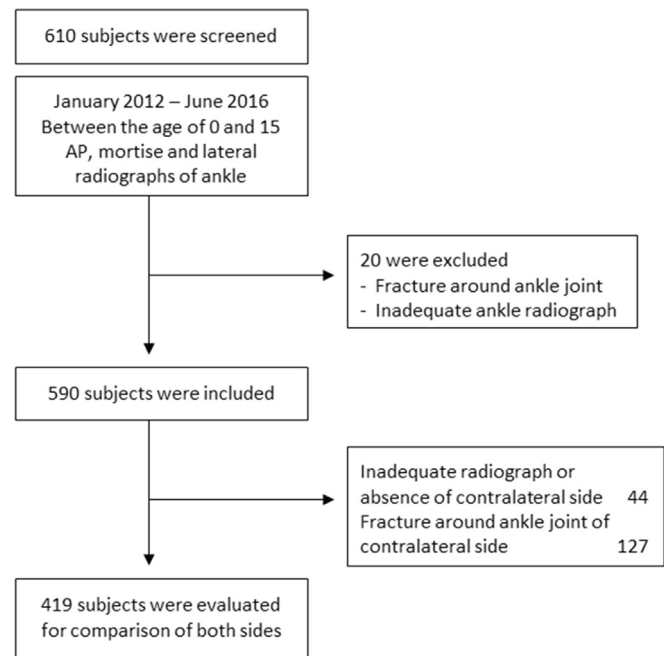


Fig. 1. The flow chart shows the process for subject selection.

### 2.1. Consensus-building session

A consensus building session to select and define the radiographic indices was held by 3 orthopedic surgeons (KHS, SYL, SJM), with orthopedic experiences of 13, 12 and 5 years. Previous studies that assessed measurement values around an ankle joint on conventional radiographs were chosen [8,14–16], and one of the authors (KHS) selected the items that he believed would be relevant to measure the syndesmosis injury. This literature suggested the tibiofibular overlap, tibiofibular clear and medial clear space as appropriate measurement methods for use on the ankle AP and mortise view. Three orthopedic surgeons (KHS, SYL, SJM) held a consensus building session before measuring the radiographs. The talar tilt and talocrural angle on AP radiograph, and fibular position on lateral radiographs was added by the panel. Additionally, 1 radiographic index was developed to evaluate the relative fibular width. Finally, 7 items such as, tibiofibular overlap, tibiofibular clear space, medial clear space and relative fibular width on AP and mortise ankle radiographs, talar tilt and talocrural angle on AP ankle radiograph, and fibular position on lateral ankle radiographs were selected for the radiographic measurements by panel consensus. During the consensus building, the landmarks were clarified and the methods for radiographic measurements were defined.

Evaluation of ossification of medial malleolus and presence or absence of tibial incisura were performed. Ossification of medial malleolus is defined as the secondary ossification center fused with the distal tibia (Fig. 2).

Table 1  
Demographic data.

Sex	Age group (years)																Total
	0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	
Male	0	5	36	30	42	30	36	31	11	5	7	9	21	31	26	33	353
Female	1	4	17	27	20	18	10	21	8	3	7	16	15	22	22	26	237
Total	1	9	53	57	62	48	46	52	19	8	14	25	36	53	48	59	590

Download English Version:

<https://daneshyari.com/en/article/8800153>

Download Persian Version:

<https://daneshyari.com/article/8800153>

[Daneshyari.com](https://daneshyari.com)