Foot and Ankle Surgery 22 (2016) 200–204

Contents lists available at ScienceDirect

Foot and Ankle Surgery

journal homepage: www.elsevier.com/locate/fas

Talolisthesis in end stage ankle arthrosis

Jeffrey C. Christensen [a], John M. Schuberth [b,*], Eric G. Powell [c]

[a] Attending Surgeon, Department of Orthopedics Swedish Medical Center, Seattle, WA. 3131 Nassau Street, Suite 101, Everett WA 98201
[b] Chief of Foot & Ankle Service, Kaiser Permanente, San Francisco, CA. Department of Orthopedic Surgery, 450 6th Avenue, San Francisco, CA 94118
[c] Attending Staff, Minor and James Medical Clinic 515 Minor Avenue, Suite 24 Seattle, WA 98122

ARTICLE INFO

Article history:
Received 10 July 2015
Received in revised form 6 September 2015
Accepted 10 September 2015

Keywords:
Ankle arthrosis
Ankle arthritis
Talolisthesis
Sagittal displacement

ABSTRACT

Background: Sagittal displacement in patients with end stage ankle arthritis has been described as the tibiotalar ratio (TTR). Yet the incidence, distribution and predictive factors of talolisthesis are unknown.
Methods: The radiographs of 470 cases of ankle arthritis were compared with a control group of 49 normal ankles. The TTR was measured for both groups. Additional co-variables included the anterior and lateral distal tibial angles, and talar tilt.
Results: The mean TTR in the arthritis cohort was 34.8 + 9.12 compared to the normal group of 34.1 + 2.62. Twenty-eight percent of the ankles had anterior displacement and twenty-eight percent had posterior talolisthesis, while forty-four percent had normal tibiotalar alignment.

Multivariate linear regression revealed significant predictors of anterior distal tibial angle ($p < 0.0001$) and talar tilt ($p = 0.0007$) for abnormal TTR.
Conclusion: Sagittal displacement is common in end stage ankle arthritis and is affected by ligamentous laxity and joint morphology.

1. Introduction

Talolisthesis is a pathological anterior or posterior transposition of the talus relative to the tibial anatomical axis. It is an under-appreciated deformity that is often associated with end-stage ankle arthritis [1]. Surprisingly none of the modern classification schemes for ankle arthritis include any description of talar transitional malalignment. Yet, sagittal plane tibio-talar alignment has been cited as an important radiographic parameter in total ankle survival and function after ankle fusion [2–12].

A variety of traumatic mechanisms can distort the normal anatomy that gives rise to variable complex radiographic disease patterns. However, it is not clear if there are any mechanisms or structural variables that predispose the development of talolisthesis. Pre-existing or evolving changes in joint angles, tibio-talar congruency, morphology and arthritis etiology may be factors associated with anterior or posterior talolisthesis.

In the normal ankle, the sagittal tibio-talar axis alignment is easy to determine and varies over a narrow range. However, in situations of end-stage ankle arthrosis, the joint line and natural anatomic features become distorted which precludes accurate determination of this relationship. Alternative methods have been developed to evaluate the distorted ankle and the most accurate technique has been defined as the tibiotalar ratio (TTR) [8,9]. The TTR uses the intersection of the longitudinal axis of the talus and the midtibial axis (Fig. 1). To correct for radiographic magnification, the position of the intersection is quantified into a percentage along the talar axis, measured from posterior to anterior. By convention, smaller percentage values reflect larger anterior talar displacements. The mean TTR in normal patients has not been clearly established; however, values ranging from 34.8 to 40 percent have been reported [9,10].

The incidence and clinical significance of talolisthesis in patients with end-stage ankle arthritis is not known. A greater understanding is necessary to optimize patient selection and treatment of end-stage ankle arthritis with pathological talar displacement. The purpose of this paper is to analyze a large group of patients with end-stage arthritis in order to determine the incidence, associated pathology, and disease patterns of talolisthesis.

2. Patients and methods

Over an eleven-year period, four hundred and seventy-seven patients were treated with the diagnosis of end-stage ankle

* Corresponding author. Tel.: +1 4152461510; fax: +1 4154358542.
E-mail addresses: jccdpm@gmail.com (J.C. Christensen), jmfoot@aol.com (J.M. Schuberth), eric.egp@gmail.com (E.G. Powell).

http://dx.doi.org/10.1016/j.fas.2015.09.002
1268-7731/

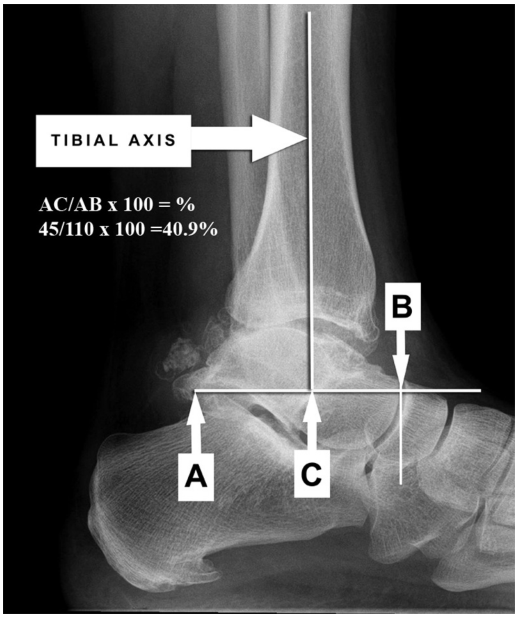

Fig. 1. Lateral radiograph showing the method of determination of TTR. (A) Posterior extent of talus. (B) Anterior extent of talus. (C) Tibial axis.

arthritis in a dedicated specialty clinic (xxx). Standard (3 views) weight bearing radiographs of the ankle of each of these patients were prospectively collected and retrospectively analyzed. Inclusion criteria required radiographic images with a minimum of 10 cm of the distal tibia and a ground plane that was easily visualized on the images. Exclusion criteria included: (1) any operative procedure, previous injury, or error in radiographic positioning that prevented accurate determination of the tibial axis; (2) History of previous hindfoot arthrodesis or injury that obliterated adjacent talar joint surfaces; (3) History of injury or deformity of the proximal tibia; (4) Bilateral ankle arthrosis (only one side per individual was accepted for study to avoid the potential of skewing the data).

Fifty-one radiographic controls were collected from clinic patients with no history of: ankle arthritis, fracture, repetitive trauma, congenital deformity or ankle surgery. The control group served to provide a TTR normal range based on histogram analysis. All radiographs for both groups were evaluated by a single reviewer (XXX) and TTR was calculated according to the Tochigi method [8].

The distribution of TTR in the control group of 49 patients was 29.2 to 39.8 with a mean of 34.1 $\pm$ 2.62. There were two obvious outliers with TTR values of 43.4 and 47.0. We therefore excluded the two outliers and deemed the range of 29.2 to 39.8 to represent the normal range of the TTR. We classified those ankles in our study group that were below, within, and above this range as having low (anterior talolisthesis), normal or high (posterior talolisthesis) TTR, respectively.

In order to determine the factors that may influence the direction of sagittal subluxation, additional radiographic variables were measured. These included the anterior distal tibial angle (ADTA), lateral distal tibial angle (LDTA), talar tilt angle (Fig. 2), [13,14] frontal joint congruency [15], sagittal joint congruency [15], anterior lip containment [16], fibular position [17], syndesmotic alignment, plafond morphology and arch height (Table 1). Where applicable, radiographic measurements were made on digital images with Image J (National Institute of Health) software. Otherwise the variable parameters were assigned according to arbitrary criteria as described in Table 1.

Demographic data, chief complaint, and the etiology of the end stage arthritis were also recorded (study group only). Etiologies were assigned into one of five categories: posttraumatic, inflammatory, idiopathic, instability and other (congenital deformity, neuromuscular disease or focal avascular necrosis) [18]. Statistical analysis involving descriptive and multivariate linear regression was performed using R Statistics Program (open source).

2.1. Source of funding

No financial relationships exist for any of the authors related to this investigation, and no external funding source was provided for this study.

3. Results

3.1. Descriptive statistics

Of the 477 pathological ankles evaluated, 90 were excluded leaving 387 ankles for study. The mean age was 59.71 $\pm$ 11.29 (range 19–90) years with 204 males and 183 females. The mean age of the control group was 41.7 $\pm$ 16.3) (range 18–80) years with 20 males and 29 females.

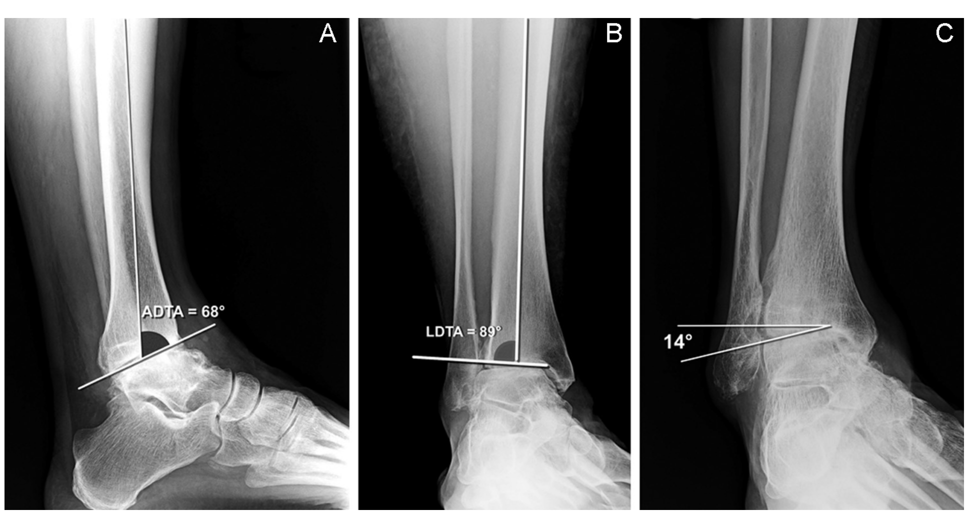

Fig. 2. Radiographic examples of (A) Anterior distal tibial angle; (lateral projection). (B) Lateral distal tibial angle; (anterior–posterior projection). (C) Talar tilt angle; (anterior-posterior projection).