

Anterior Tibial Artery Danger Zone in Anterolateral Plate Fixation of the Distal Tibia: A 3D CT Angiogram Modeling Study

Brendan O'Leary, Sean Thomas, Brendon Mitchell¹, Brady K Huang², Keenan Onodera³, William Kent⁴

¹Univeristy of California San Diego, ²UCSD Medical Center, ³UCSD Health, ⁴Department of Orthopaedic Surgery UC San Diego Hea

INTRODUCTION: The anterolateral approach in the treatment of pilon fractures has gained popularity in the past decade as it provides enhanced visualization of the tibial plafond during reduction and fixation. Often, the more proximal fixation of anterolateral plating is done through a minimally invasive technique with percutaneous screw placement. However, due to the lack of direct visualization, this technique puts the anterior tibial artery (ATA) and associated neurovascular structures at risk of injury. This study aims to use a novel 3D CT angiogram (CTA) modeling technique to establish the danger zone where the anterior tibial artery is at risk during anterolateral plating of the distal tibia.

METHODS: The initial study population included lower extremity CTAs performed between 04/2020 and 04/2022 in patients 18 years of age and older. Patients with lower extremity trauma, evidence of a previously healed tibia fracture, or poor visualization of the ATA were excluded. Thirty-five patients (56 lower extremities) were modeled with a 3.5mm LCP anterolateral distal tibia plate using Sectra ID7 software. The ATA was identified and the levels at which the artery began to intersect the plate, putting the artery at risk, were marked both proximally and distally. The distance of the ATA from the distal most aspects of the fibula, lateral tibial plafond, and central tibial plafond were measured perpendicular to the previously marked tibial levels (Figures 1 and 2). In addition, the specific plate hole numbers at which the ATA was at risk for injury by screw placement were recorded. The data was analyzed with IBM SPSS Statistics, Version 28 (SPSS, Chicago, IL).

RESULTS: Proximally, the ATA coursed anteriorly and intersected the plate at a mean of distance of 126 mm (CI 121 - 133) from the distal fibula, 103 mm (CI 97 - 109) from the lateral plafond, and 105mm (CI 99 - 111) from the central plafond. Distally, the ATA intersected the plate at a mean distance of 72mm (CI 66 - 77) from the distal fibula, 48mm (CI 43 - 52) from the lateral plafond, and 49mm (CI 44 - 53) from the central plafond. The ATA was at risk for injury with screw placement as distally as hole number 1 and as proximally as hole 13 of the anterolateral distal tibia plate. The potential risk for damage to the ATA for specific plate holes is shown in Table 1. There was no correlation found between tibia length and danger zone distance from the tibial plafond or any distal bony landmarks (Table 2).

DISCUSSION AND CONCLUSION:

The ATA is at risk when percutaneously placing proximal screws in an anterolateral distal tibia plate. The danger zone for the ATA can be as close as 49mm and as far as 105mm proximal to the tibial plafond. Surgeons should take caution when placing screws in this region.

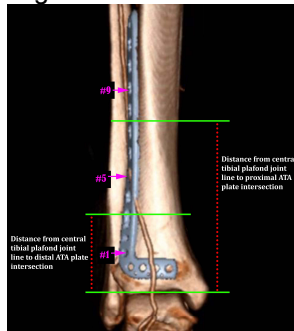
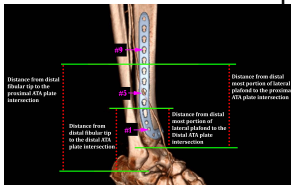


Table 1. Frequency of ATA overlap with plate holes on a 3.5mm LCP anterolateral distal tibial plate

Plate Hole #	Frequency of ATA Overlap
1	3/56 (5%)
2	15/56 (27%)
3	33/56 (59%)
4	47/56 (84%)
5	53/56 (95%)
6	47/56 (84%)
7	35/56 (63%)
8	22/56 (39%)
9	7/56 (13%)
10	6/56 (11%)
11	3/56 (5%)
12	1/56 (2%)
13	1/56 (2%)
14	0/56 (0%)

Table 2. Distance from distal bony landmark to danger zone compared to tibia length

Distal Bony Landmark	r ² Value
Distal Fibular tip to proximal ATA plate intersection	.019
Distal Fibular tip to distal ATA plate intersection	.052
Lateral tibial plafond to proximal ATA plate intersection	.011
Lateral tibial plafond to distal ATA plate intersection	.056
Central Tibial Plafond to proximal ATA plate intersection	.015
Central Tibial Plafond to distal ATA plate intersection	.075