The Value of Axial Loading 3D CT as a Substitute for Full Weightbearing 3D CT: Comparison of Reproducibility According to Degree of Load

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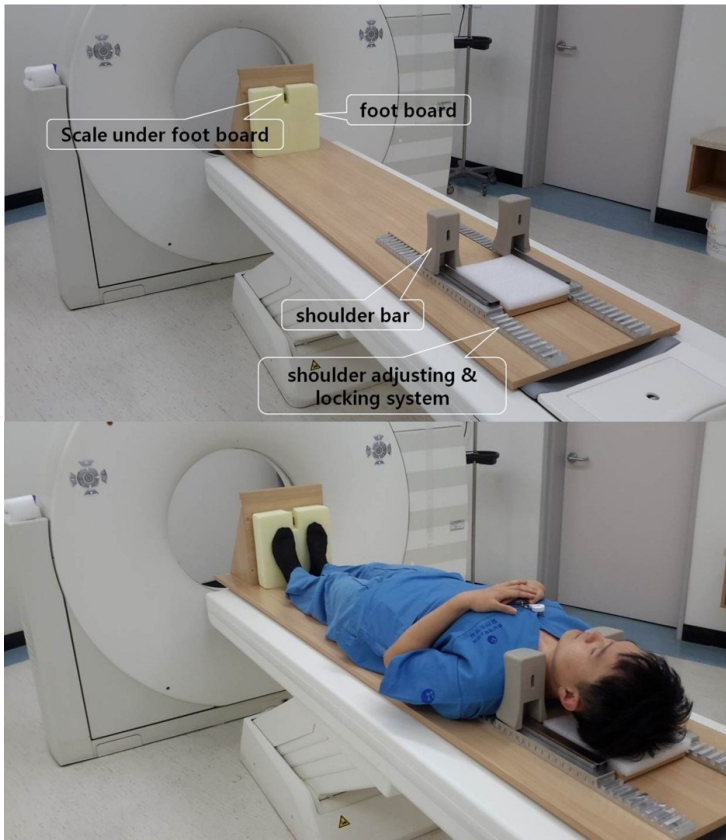
Category: Other

Keywords: Foot, Ankle, Standing radiography, Weightbearing CT, Axial loading CT

Introduction/Purpose: Full weightbearing(WB) three dimensional computed tomography(3D CT) is an excellent imaging tool. However, due to its high cost, it is only used in a few hospitals. We evaluated the usefulness and cost-effectiveness of axial loading(AL) 3D CT by comparing bony alignments with standing radiographs, and assessed reproducibility according to the degree of AL.

Methods: Eighty patients(156 feet), who underwent standing radiographs and 3D CT with an AL device from January 2016 to May 2017, were investigated. According to the degree of AL(AL force×100/body weight), the patients were randomly assigned to three groups: Group A(30-50%; n=21, 40 feet), Group B(50-70%; n=32, 63 feet), and Group C(70-100%; n=27, 53 feet). The following angles were measured three times by two orthopedists: hallux valgus(HVA), 1st-2nd intermetatarsal(IMA1-2), and talo-navicular coverage(TNCA), calcaneal pitch(CPA), talo-1st metatarsal(T1MA), and talo-calcaneal angle(TCA). Agreements between the two imaging methods were analyzed and compared according to the degree of axial loading in each group.

Results: Intra- and interobserver reliability was excellent (>0.75). In Group A(30-50% AL), all of the angles except HVA and IMA1-2 differed (p<.05). In Group B(50-70%), TNCA (p= .023), T1MA (p= .017), and TCA (p=.035) differed. In Group C(70-100%), none of the angles differed between the two imaging methods (p> .05). Higher agreement between the two imaging methods was realized when 70% or more(>70%) AL was applied.

Conclusion: AL 3D CT with >70% axial load has full WB effects and can be substituted for expensive full WB 3D CT.

Group A (30-50% axial load)					
Parameter	Radiographs		Axial loading CT		P value
	Mean	STD	Mean	STD	
HVA	16.3	7.56	16.3	7.49	>0.05 (0.927)
IMA1–2	9.1	2.11	8.9	2.11	>0.05 (0.124)
TNCA	21.8	7.15	17.7	7.34	<0.05 (0.001)
CPA	17.6	4.74	20.0	4.67	<0.05 (0.002)
T1MA	8.7	5.23	6.4	4.64	<0.05 (0.006)
TCA	44.6	5.97	43.2	5.83	<0.05 (0.010)

Group B (50-70% axial load)					
Parameter	Radiographs		Axial loading CT		P value
	Mean	STD	Mean	STD	
HVA	16.3	11.4	16.1	11.4	>0.05 (0.846)
IMA1–2	9.8	3.53	9.7	3.58	>0.05 (0.952)
TNCA	22.1	6.58	19.8	6.62	<0.05 (0.002)
CPA	18.3	4.87	19.2	4.78	>0.05 (0.252)
T1MA	7.8	4.97	6.2	4.89	<0.05 (0.001)
TCA	45.5	5.23	45.2	7.59	<0.05 (0.035)

Group C (70-100% axial load)					
Parameter	Radiographs		Axial loading CT		P value
	Mean	STD	Mean	STD	
HVA	20.0	11.0	19.9	11.0	>0.05 (0.219)
IMA1–2	11.0	3.57	10.9	3.61	>0.05 (0.176)
TNCA	20.0	7.62	19.6	7.52	>0.05 (0.135)
CPA	19.0	4.31	19.3	4.16	>0.05 (0.206)
T1MA	7.2	4.56	6.9	4.49	>0.05 (0.613)
TCA	45.7	5.52	46.0	5.64	>0.05 (0.345)