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Original Research

Pedobarographic and Radiological Analysis After Treating a Talus Neck Fracture

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ABSTRACT

Misalignment of the talar neck after surgical repair can redistribute the load among the posterior, middle, and anterior facets of the subtalar joints, which can change the joint biomechanics, cause arthritis, and impair function. However, we found no studies analyzing the plantar pressures after treatment of talus neck fracture. We determined the dynamic plantar pedobarographic and radiographic characteristics and ankle range of motion, function, and pain among patients after surgical repair of talar neck fractures. A total of 19 patients completed the assessments. The median follow-up period was 29 (range 12 to 113) months. At the last visit, the mean pain score was 3.3 on a 10-cm visual analog scale. The mean American Orthopaedic Foot and Ankle Society function scale score was fair (73.5), and the mean range of motion was restricted in 4 planes. The mean maximum force was lower in the hindfoot ($p = .002$) and midfoot ($p = .03$) of the injured foot than in the noninjured foot. The mean peak pressure was lower in the hindfoot ($p = .05$) but higher in the forefoot ($p = .03$). Radiographic measurements revealed differences between the feet in the talo–first metatarsal angle ($p = .002$), Meary's angle ($p = .001$), and the medial cuneiform–fifth metatarsal angle ($p = .002$). Radiographic and pedobarographic analysis showed an elevated arch in the injured foot. Thus, talar injury and immobilization can affect the stance and the gait cycle in these patients. Pain, range of motion, function, and the weight transfer pattern should be evaluated carefully during the follow-up period to provide the best postoperative results.

Most fractures of the talus occur in the neck. Talar neck fractures comprise <1% of ankle–foot fractures (1–3) and are generally seen in young males as the result of high-energy trauma, such as a fall, motor vehicle accident, or direct trauma (3–5).

The talus is the most superiorly located bone in the foot and is important in maintaining the normal ankle range of motion (ROM) and function (6). With serious injuries, all foot and ankle movements will be affected. Osteonecrosis, malunion, nonunion, post-traumatic arthrosis, skin necrosis, and infection are possible complications after treatment (5–8). Deformity as a consequence of post-traumatic misalignment of the talus leads to painful functional impairment (6,9,10). The most common deformity after malunion (47%) of a talar fracture is varus misalignment of the hindfoot, which markedly decreases subtalar and midtarsal motion. This misalignment is particularly common after closed reduction of Hawkins type 2 talar neck fractures (7,11–13).

Varus misalignment of the talar neck can shorten the medial column considerably, which locks the hindfoot in varus and internal rotation (13). The degree of varus misalignment is also associated with changes in foot position and the degree of subtalar motion (13). Even 2 mm of misalignment at the talar neck can redistribute the load among the posterior, middle, and anterior facets of the subtalar joints, changing the joint biomechanics and resulting in arthritis (13,14). This possible varus and internal rotation of the talus neck also disrupts the normal relationship between the midfoot and hindfoot and reduces the mobility of the midtarsal joint (13). The decreased ROM in the subtalar and midtarsal joints often causes a painful, rigid, and cavovarus foot. An increase in the lateral load transfer in the foot results in callus formation (15).

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Table 1
Characteristics and long-term outcomes of 19 patients with surgically treated fractures of the talus neck or talus neck and body

Characteristic	Value
Male gender (n)	15
Age (yr)	
Mean ± SD	33.3 ± 11.1
Median	34
Range	15 to 55
Injured foot (n)	
Right	13
Left	6
Injury type (n)	
Fall from a height	13 (68.4)
Crushing	1 (5.2)
Motor vehicle accident	5 (26.3)
Hawkins classification (n)	
1	4 (21.1)
2	10 (52.6)
3	4 (21.1)
4	1 (5.2)
Interval from injury to surgery (n)	
Within 24 hr	13 (68.4)
24 to 48 hr	1 (5.2)
5 days, after leaving ICU	2 (10.5)
10 days, after leaving ICU	1 (5.2)
Cast immobilization	2 (10.5)
Immobilization period (days)	
Mean ± SD	64.2 ± 35.2
Median	60
Range	30 to 160
Pain score	
Mean ± SD	3.3 ± 2.1
Median	3
Range	0 to 7
AOFAS scale score	
Mean ± SD	73.5 ± 1.1
Median	76
Range	50 to 100
Excellent (n)	3 (15.8)
Good (n)	6 (31.6)
Fair (n)	6 (31.6)
Poor (n)	4 (21.1)
Subtalar arthritis (n)	16 (84.2)
Tibiotalar arthritis (n)	14 (73.7)

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; ICU, intensive care unit; SD, standard deviation.
Data in parentheses are percentages.

Table 2
Ankle range of motion and structural angles at a mean follow-up point of 45 months

Outcome	Injured Foot (n = 19)	Noninjured Foot (n = 19)	*p* Value
Ankle dorsiflexion ROM (°)			<.001
Mean ± SD	12.4 ± 5.8	19.4 ± 2.1	
Median	10	18	
Range	5.0 to 25.0	18.0 to 25.0	
Ankle plantarflexion ROM (°)			<.001
Mean ± SD	25.0 ± 10.9	41.8 ± 2.8	
Median	30	42	
Range	5.0 to 45.0	37.0 to 50.0	
Ankle inversion ROM (°)			<.001
Mean ± SD	9.4 ± 7.1	24.5 ± 2.6	
Median	8	25	
Range	0 to 25.0	20.0 to 30.0	
Ankle eversion ROM (°)			.001
Mean ± SD	7.1 ± 5.6	14.7 ± 1.7	
Median	5	15	
Range	0 to 20.0	12.0 to 20.0	
Kite's angle (°)			.29
Mean ± SD	25.2 ± 6.7	26.1 ± 5.6	
Median	24	25	
Range	13 to 38	20 to 39	
Talo–first metatarsal angle (°)			.002
Mean ± SD	6.7 ± 9.9	−0.25 ± 6.7	
Median	5	1	
Range	−11 to 34	−13 to 15	
Meary's angle (°)			<.001
Mean ± SD	7.8 ± 7.9	1.1 ± 7.0	
Median	7.5	3	
Range	−4 to 26	−14 to 12	
Hibbs' angle (°)			.06
Mean ± SD	134.0 ± 7.1	136.3 ± 7.3	
Median	135	135	
Range	120 to 147	124 to 149	
Calcaneal pitch angle (°)			.05
Mean ± SD	21.0 ± 5.7	18.6 ± 4.7	
Median	20	20	
Range	14 to 36	11 to 25	
Medial cuneiform–fifth metatarsal angle (°)			.002
Mean ± SD	17.2 ± 8.2	10.2 ± 7.1	
Median	20	10	
Range	1 to 28	0 to 25	
Talonavicular coverage angle (°)			.116
Mean ± SD	5.7 ± 6.5	8.0 ± 7.9	
Median	5	7	
Range	−5 to 22	−10 to 26	

Abbreviations: ROM, range of motion; SD, standard deviation.

All these changes have negative effects on plantar pressures. However, we found no studies of the plantar pressure after talus neck fracture. Pedobarographic pressure analysis shows biomechanical alterations and can objectively evaluate the foot after different orthopedic foot and ankle problems, injuries, and surgeries (16–18). Therefore, we sought to determine the dynamic plantar pressure and radiographic characteristics of patients who had undergone surgery or cast immobilization for a talar neck fracture.

Patients and Methods

The ethics committees of our institutions approved the present study. All the patients provided written informed consent. We enrolled patients presenting with a fracture of the talar neck (International Classification of Diseases code S92.11) or of the talar body (International Classification of Diseases code S92.12) and talar neck who presented to the Dr Lütfi Kırdar Kartal Education and Research Hospital from December 2005 to January 2014.

The exclusion criteria were the presence of a concomitant injury in the ipsilateral or contralateral lower extremity, the use of arthrodesis or amputation of a lower extremity, a congenital deformity or neurologic problem, previous surgery of the spine or lower extremity, poor balance, the use of medications that could affect balance, an open wound on the foot, and any mental problems or any situation that might interfere with the patient walking barefoot.

Patients with a fracture of the talar neck or of the talar body and talar neck treated at our institution during the study period were identified from the computerized hospital records. Patients who met the inclusion criteria were interviewed by telephone and invited to participate in the present study. All patients underwent a comprehensive physical examination of the injured foot and radiographic and pedobarographic evaluations. The ankle ROM, function, and pain were measured in all patients at the follow-up visits. Data on age, sex, the mechanism of trauma, the interval from injury to surgery, and the duration of the immobilization period were also recorded.

Pain was assessed using a 10-cm visual analog scale (VAS), with 0 representing no pain and 10, the worst pain imaginable (19). The American Orthopaedic Foot and Ankle Society (AOFAS) ankle hindfoot scale consists of 9 questions related to pain, activity and functional limitations, walking distance, difficulty with different terrains, gait