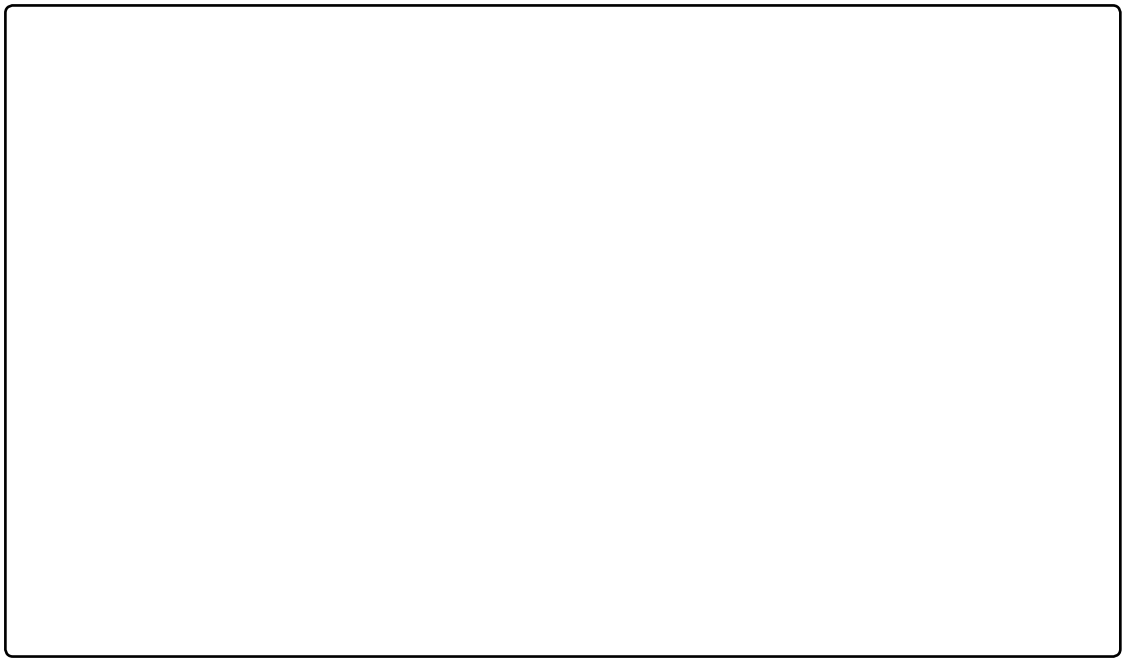
xhibited excessive subtalar joint pronation. This could explain the rational for a subset
ve to typical treatments aimed at healing the diseased fascial tissue, without address
joint instability. Patients who develop recalcitrant PF should be evaluated for subtala
realign and stabilize the subtalar joint should be incorporated as part of the treatment



Ke ords: Plantar fasciitis; Plantar fasciopathy; Plantar fasciosis; Subtalar joint instability; Hyperpronation; Peri-talar subluxation talotarsal joint displacement

Introduction

Plantar Fasciopathy (PF) is a rather common, painful condition that alters the quality of life of patients. Symptoms are generally most prevalent with the rst steps upon waking in the morning and then subside shortly therea er, only to return a er prolonged periods of non-weight bearing. e underlying factors that contribute to the development of PF have been debated and include anatomical, biomechanical, and environmental factors [1]. Knowledge of the contributing factors is important in determining the most e ective treatment options to alleviate symptoms and prevent recurrence.

Several studies have claimed that mechanical control of the foot provides the best outcomes [1-6]. is would seem to support the theory that biomechanical factors play a signi cant role in the development of PF. Abnormal biomechanics, especially excessive subtalar joint pronation, places excessive stress and tension on the medial band of the plantar fascia [7-13]. e plantar fascia is a somewhat rigid band that does not stretch therefore, the end result of these abnormal stresses is localized tissue damage near the origin of insertion into the medial tubercle of the calcaneus. Since this occurs with all weight bearing activities, the healing process is prevented due to repetitive weight bearing activities [14]. is might help explain why athletes and runners seem particularly prone to the development of PF [15,16]. It has been suggested that there is a link between the amount of tension placed on the plantar fascia and the development of plantar fasciopathy [14].

e purpose of this retrospective study is to evaluate the possible magnitude of the di erence of subtalar joint stability in PF patients with normal and non-normal levels of subtalar joint alignment. e presence of higher than accepted normal relaxed stance weight bearing Talar-second Metatarsal (T2M) and/or Talar Declination (TD) angles in patients diagnosed with PF can be considered an indication of the underlying abnormal subtalar joint biomechanics. Such evaluation would help emphasize the importance of addressing excessive subtalar joint pronation in addition to amelioration of the associated symptoms of PF.

Patients and Methods

A cohort of 108 patients were considered for this study. ese patients represented the number of patients that were diagnosed with recalcitrant PF, unresponsive to conservative treatment for 6 months, by the physicians at the Louis Stokes Cleveland VA Medical Center (Cleveland, OH) who ultimately required plantar fasciotomy, partial or full, within a calendar year. e diagnosis of excessive subtalar joint pronation was determined retrospectively through examination of pre-operative relaxed stance weight bearing radiographs. No examinations of the postoperative radiographs were performed. is study received institution review board approval.

Patient selection procedures

A diagnosis code search was performed for a calendar year period of all patients who required surgical intervention due to recalcitrant PF was performed. Patients who received a minimum of 6 months of conservative care were considered. Typical symptoms, such as post-static dyskinesia and pain to palpation of the medial band of the PF, were experienced by all patients. Furthermore, all patients had standard weight bearing radiographs performed to rule out fractures, tumors, or other atypical ndings rather than PF. Patients were only included if they had not previously undergone any osseous ankle or foot surgery, as this may in uence the radiographic measurements. e radiographs for these selected patients were then evaluated to ensure they met the inclusion criteria.

e patient selection criteria did not explore the number of patients with bilateral PF and the radiographs of the contra-lateral limb were not routinely taken, unless the patient also complained of symptomatology of that limb. is study was concerned only with the foot that required surgical transection of the PF. Finally, only the pre-operative radiographs were used for analysis.

Data collection

e data collected from patients was in the form of dorsoplantar (DP) and lateral view Relaxed Stance weight bearing (RSP) radiographs of the foot/feet presenting with medial heel pain. All patients were radiographed using standard angle and base of gait technique.

Determination of radiographic angles

Subtalar joint alignment was objectively assed using the Talar Declination (TD) angle (sagittal plane) and Talar-Second Metatarsal (T2M) angle (transverse plane) [17-22] (Figures 1 and 2). e DP T2M angle has been considered a reliable measurement to evaluate the osseous alignment between the forefoot and the hind foot [17]. e T2M angle is measured between the longitudinal bisection of the second metatarsal and the talus [18]. e second metatarsal is a more reliable reference point over the rst metatarsal since many patients can also present with a deviated rst metatarsal bone, i.e. increased rst intermetatarsal angle. omas et al. reported T2M angular values in normal populations as 16° in the bipedal stance position [23].

e TD angle can be used as a direct measure of the inclination of the talus with respect to the ground surface. During pronation, the head and neck of the talus undergo plantar exion leading to an increase in the TD angle values, while during supination; they undergo dorsi exion leading to a decrease in the TD values. us, pathologic TD values would indicate the occurrence of abnormal subtalar joint alignment. e TD angle can be measured between the longitudinal axis of the talus and the plane of support [23-25]. e accepted normal TD angle is 21° [26,27].

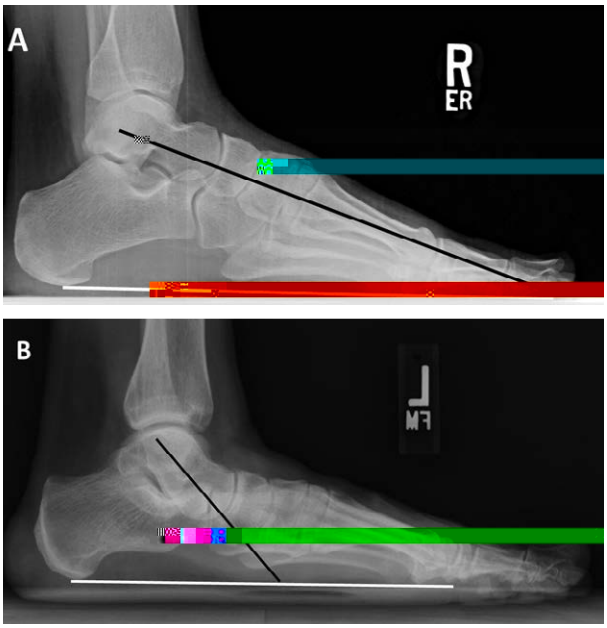


Figure 1: Weightbearing lateral radiographs. (A) Talar declination angle ≤ 21 degrees. (B) Talar declination angle >21 degrees.

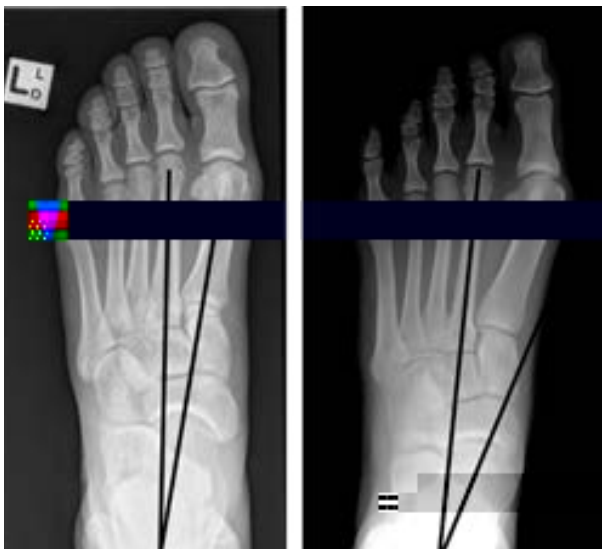


Figure 2: Weightbearing dorsoplantar radiographs. (A) Talar second metatarsal angle ≤ 16. (B) Talar second metatarsal angle >16.

A T2M angle of 16° or less and TD angle of 21° or less were considered normal values and used as the reference to compare the T2M and TD angles measured in the feet of the patients. Both radiographic

e percentage of occurrence of values higher than the normal values in at least one view (DP or lateral) was calculated. is result indicates the frequency of presence of subtalar joint instability.

Once a total percentage was calculated, the presence of the deformity was further analyzed with respect to the plane of dominance, if any. Higher values of T2M angles indicate deformity in the transverse plane while higher values of TD angles indicate deformity in the sagittal plane. Transverse plane dominance was identi ed when the radiographs for a single patient showed a higher than normal T2M angle and a TD angle within the normal range. Alternatively, sagittal plane dominance was identi ed with only a higher TD angle coupled with a normal T2M angle. Higher T2M and TD angles together indicate deformity in both planes.

Statistical analysis

For each of the angular measurements, TD_a and $T2M_a$, we labeled each angle value as either normal or non-normal, creating two binary variables, TD_c and $T2M_c$. e distributions of angular measurements, TD_a and $T2M_a$, from the 108 radiographs of feet were examined visually and labeled by their normal/non-normal group assignment, TD_c and $T2M_c$. e frequency and relative frequency of patients who had normal and non-normal TD angles were calculated. e frequencies and relative frequencies of patients who had normal TD and T2M angles, only normal TD angles, only normal T2M angles, and both angles non-normal were calculated. Based on the resulting contingency table, a χ^2 te2 χ

Discussion

PF is one of the most common foot and ankle pathologies [29]. It is commonly accepted that repetitive strain on the plantar fascia due to excessive tensile forces at its origin (calcaneal attachment) is the most common cause of this condition [30-32]. Some researchers believe PF is caused by biomechanical overuse from extended standing or running which results in microtears at the calcaneal enthesis [33]. Other research suggests this condition is a result of an underlying mechanical abnormality [8,9,29,34]. However, this is still debated as there has not been any signi cant evidence to support this conclusion [35].

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