Rheumatoid Flat Foot and Deformity of the First Ray

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ABSTRACT. ***Objective.*** To study the relationship between flat foot and forefoot deformities in rheumatoid arthritis (RA) in order to improve understanding of the progression of deformity and thus provide more appropriate treatment.

Methods. Anteroposterior and lateral weight-bearing radiographs were obtained of 308 feet of patients with RA and 202 feet of patients with neck pain (control feet).

Results. In women with RA, we observed with disease duration an increased frequency of flat foot that was correlated with first ray deformity (chiefly metatarsus primus adductus) and severe stages of disability. Flat foot increased very markedly after 3–4 years of disease duration. In control women, flat feet were more frequent after the age of 50 years.

Conclusion. In RA the inflammatory and mechanical factors leading to foot deformity must receive early medical treatment to avoid progressive hindfoot deformities that lead to disability. (J Rheumatol 2002;29:903–5)

Key Indexing Terms:
FOOT FLAT FOOT RHEUMATOID ARTHRITIS
TARSITIS TENOSYNOVITIS

In rheumatoid arthritis (RA), forefoot deformities are possibly related to flat foot, which is chiefly marked by decrease of the longitudinal arch and valgus hindfoot. These are difficult to observe clinically, particularly while the patient is walking. Radiographically, the positioning of the foot modifies the measurements of flattening, but comparisons can be made in a series of feet observed under identical conditions[1]. In RA, flattening of the midfoot is easily measured by the medial arch angle (MAA) (Figure 1)[2,3], and this gives the same results as talar pitch[4] or the angle between the axes of the first metatarsal and the talus[5].

MATERIALS AND METHODS

We radiologically examined 308 feet of 154 consecutive patients with RA, defined according to the American College of Rheumatology criteria[6] (RF group). The average age of patients was 55.6 years (range 19–79) and average duration of disease was 7.10 years (range 1–43). The RF group comprised 118 women (76.6%) and 36 men (23.4%). The mean age of the women was 55.1 years (range 19–79) and of the men 57.3 years (34–78). Mean duration of disease was 8 years (range 1–43, median 5) in the women and 4.1 years (1–34, median 2) in the men. Functional capacity was assessed according to Steinbrocker classification[7]: class I, 2.6% ; class II, 53.2%; class III, 36.4%; class IV, 7.8%.

The control feet (CF group) comprised 202 feet of 101 consecutive patients with simple neck pain, 75 women (74.3%) and 26 men (25.7%). These patients were free from inflammatory rheumatism or any known systemic disorder and none had undergone surgery on the foot or ankle.

The RF and CF groups were homogeneous for sex, age, and side of the affected foot.

Anteroposterior and lateral weight-bearing radiographs of the foot were obtained with the patient standing and bearing weight equally on both feet in muscular relaxation. During the lateral radiograph the film was in contact with the medial border of the foot and parallel with it.

Angles (Figure 1) were measured by 2 experienced readers, who reached a consensus if measurements differed. The medial arch angle is formed by the intersection of 2 lines: the first joins the inferior pole of the medial sesamoid and the lowest point of the talonavicular joint; the second is formed by joining this last point and the lowest point of the calcaneus. If this angle is equal to or exceeds 130° the foot is flat[2-4].

The intermetatarsal angle, M1/2, is defined by bisection of the first and second metatarsals and an angle of more than 10° indicates metatarsus primus varus. The angle between the first metatarsal and the first phalanx of the hallux (M1/P1 ≥ 20°) was also calculated. Results of quality control tests were excellent, since the percentage of reproductibility and repeatability (R & R) value was 13.93% for MAA and 15.18% for M1/P1. Results of quality control tests were marginal for M1/M2 since the percentage R & R value was 22.48%, but reproductibility was excellent, with a variance equal to zero.

Statistical analysis. SPSS software was used. The RF and the CF groups were compared using Fisher's exact test for 2×2 tables for qualitative data and the chi-square of likelihood ratio when the number of items was greater than 2. Student's t test and analysis of variance were used for quantitative data. Logistic regression was carried out to analyze the incidence of flat foot according to group, age, and sex.

RESULTS

The increased frequency of flat feet in RF was correlated with disease duration and was greatest between 3 and 4 years of disease duration (Table 1).

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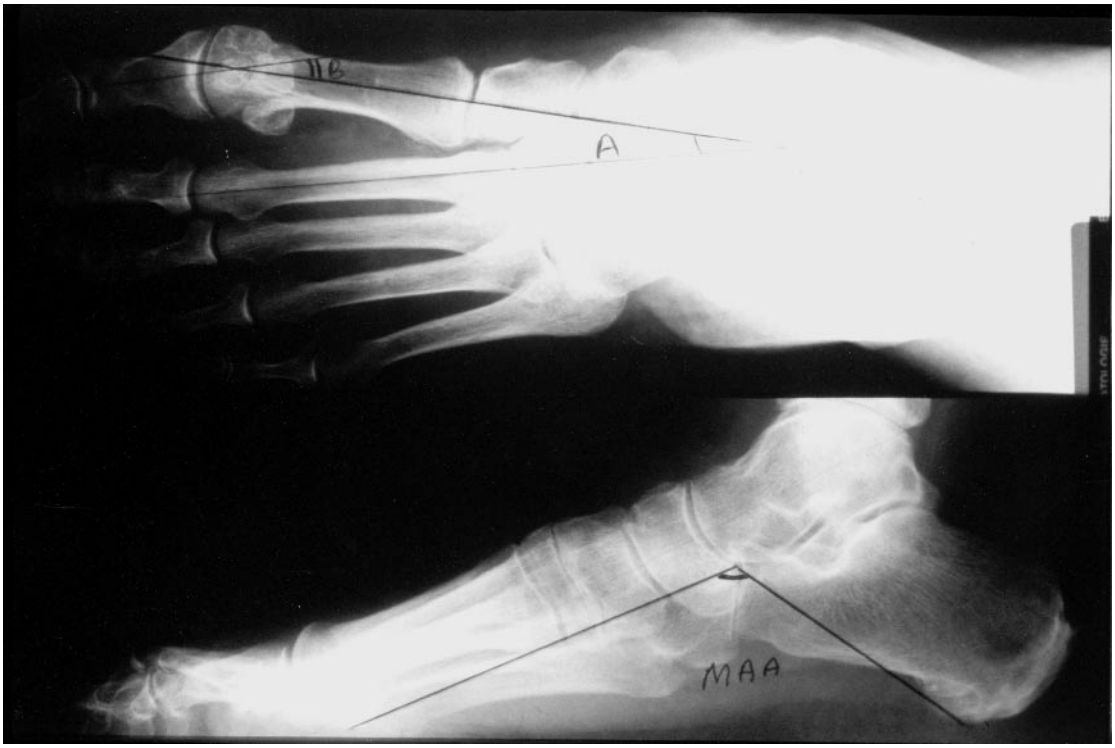

Figure 1. MAA: medial arch angle; A: M1/M2 angle; B: M1/P1 angle.

Table 1. Flat foot was more frequent in the rheumatoid group (RF) than in the control group (CF) as a whole, as well as before and after the age of 50 in women. Flat foot was more frequent after age 50 in CF.

Valgus Flat Foot Group	Overall Frequency Between Groups	Intragroup Age ≥ 50 yrs	Intragroup Women Only, ≥ 50 yrs	Intergroup, Women Only, < 50 yrs	Intergroup, Women Only, > 50 yrs
RF	+ p < 0.0005	+ p = 0.015	+ p = 0.063	+ p = 0.005	+ p = 0.002
CF	—	+ p = 0.023	+ p = 0.023	—	—

There was a close correlation between M1/2 ≥ 10° and MAA ≥ 130° in the RF group, which did not depend on the duration of disease (Table 2); the correlation with M1/P1 angle ≥ 20° (p = 0.005) was less significant. No correlation appeared between flat feet and forefoot angles in the CF group. Flat foot was correlated with severe stage of Steinbrocker classification, but M1/M2 ≥ 10° was not correlated.

DISCUSSION

Two principal factors influence the deformities observed. Hyperpronation is the main mechanical factor[8], with internal rotation of the tibia that is maximal during heel strike and the early part of the stance phase. Consequently, the dynamic supporters of the medial arch contract for a longer period of time in an attempt to stabilize or decrease the degree of pes planus deformity during the stance phase; this can lead to muscle fatigue, stretching of the midfoot, and subsequent stresses[9]. The second factor in flattening of the medial longitudinal arch in RA is degenerative change of the subtalar joint complex (STJC)[4,10] (particularly tarsal sinus

Table 2. In the rheumatoid group (RF) M1/2 angle ≥ 10° was correlated with flat feet in both men and women. There was no correlation with disease duration or with control feet (CF).

	M1/2 ≥ 10°	
	Male Feet	Female Feet
Flat feet		
RF	p = 0.043	p < 0.0005
CF	NS	NS
Disease duration	NS	NS

lesions leading to laxity of the STJC[10]) and change of the posterior tibial tendon (PTT), which undergoes stretching[10–12]. There are very few ligaments providing support between the first and second metatarsi: it is debatable whether the first metatarsal bone adducts simply because the weakening of this ligamentous support has been further compromised by RA (with the same process causing laxity of the hindfoot) or whether it is related to the onset of the flat foot deformity.

Shi, *et al*[13] found no correlation between flat foot and angles of the first ray, but the angles used were different and 100 rheumatoid feet were studied, compared with 308 (154 patients) in our series. Probably the relationship does not appear in the men because of the smaller number of men's feet and their shorter disease duration. Among the control women, flat feet were more frequent after age 50. PTT degenerative insufficiency may explain this observation[14].

Medical treatment cannot eliminate an established deformity in RA. It aims only to prevent progression and therefore maintain satisfactory functional capacity. It must be initiated as soon as there is inflammatory involvement of the foot. This implies control of synovitis and relief from weight-bearing during inflammatory episodes. The use of shoes with a firm counter helps maintain the axis of the hindfoot and firm plantar orthoses support the medial longitudinal arch[8,15].

REFERENCES

1. Hlavac HF. Differences in x-ray findings with varied positioning of the foot. J Am Podiatr Assoc 1967;57:465-71.
2. Djian A, Annonier CL, Denis A, Baudoin P. Radiopodométrie (principes et resultats). J Radiol Electrol 1968;49:769-72.
3. Montagne J. Atlas of foot radiology. New York: Masson Publishing Inc.; 1981:40-74.
4. Bouysset M, Bonvoisin B, Lejeune E, Bouvier M. Flattening of the rheumatoid foot in tarsal arthritis on x-ray. Scand J Rheumatol 1987;16:127-33.
5. Bouysset M. Empreinte plantaire encrée et profil radiologique du pied dans la polyarthrite rhumatoïde. Lyon Médical 1984; 251:497-501.
6. Arnett FC, Edworthy SM, Bloch DA, et al. The American Rheumatism Association 1987 revised criteria for rheumatoid arthritis. Arthritis Rheum 1988;31:315-24.
7. Steinbrocker O, Traeger CH, Batterman RC. Therapeutic criteria in rheumatoid arthritis. JAMA 1949;140:659-62.
8. Tillmann K. The rheumatoid foot. Stuttgart: G. Thieme; 1979:44-56.
9. Mann RA. Biomechanics of running. In: Mack RP, editor. Symposium on the foot and leg in running sports. American Academy of Orthopaedic Surgeons. St. Louis: Mosby; 1982:1-29.
10. Jernberg ET, Simkin P, Kravette M, Lowe P, Gardner G. The posterior tibial tendon and the tarsal sinus in rheumatoid flat foot: magnetic resonance imaging of 40 feet. J Rheumatol 1999; 26:289-93.
11. Rosenberg ZS, Cheung Y, Jahss MH, Noto AM, Norman A, Leeds NE. Rupture of posterior tibial tendon: CT and MRI imaging with surgical correlation. Radiology 1999;169:229-35.
12. Michelson J, Easley M, Wigley FM, Hellmann D. Posterior tibial tendon dysfunction in rheumatoid arthritis. Foot Ankle Int 1995;16:156-61.
13. Shi K, Tomita T, Hayashida K, Owaki H, Ochi T. Foot deformities in rheumatoid arthritis and relevance of disease severity. J Rheumatol 2000;27:84-9.
14. Pomeroy GC, Pike HR, Beals TC, Manoli A. Acquired flat foot in adults due to dysfunction of the posterior tibial tendon. J Bone Joint Surg Am 1999;81:1173-82.
15. Budiman-Mak K, Conrad K, Roach J, et al. Can foot orthoses prevent deformity in rheumatoid arthritis? A randomized controlled trial [abstract]. J Clin Rheumatol 1995;1:313.