Second-Toe Length and Forefoot Disorders in Ballet and Folk Dancers

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Background: Although there is no ideal foot type for classical dancers, second-toe length seems to be a factor in the etiology of foot disorders in ballet dancers.

Methods: We investigated the relationship between second-toe length and foot disorders in 30 ballet dance students and 25 folk dance students. Second-toe length in relation to the hallux (longer or equal/shorter), hallux deformities, first metatarsophalangeal joint inflammation, number of callosities, and daily pain scores were recorded in both groups and compared.

Results: There was no statistically significant difference in toe length between the two groups ($P > .05$). Ballet dancers with equal-length or shorter second toes had lower pain scores, less first metatarsophalangeal joint inflammation, and fewer callosities in their feet compared with dancers with longer second toes.

Conclusions: Second-toe length seems to be a factor in the development of forefoot disorders in classical ballet dancers but not folk dancers. Dancers who have equal-length or shorter second toes in relation to the hallux may have fewer forefoot disorders as dance professionals. (J Am Podiatr Med Assoc 97(5): 385-388, 2007)

The physical demands of classical ballet are extreme and often result in foot injuries.[1] Dancing on the toes, exaggerated turnout of the feet, and standing "en pointe" in toe shoes seem to be major etiologic factors (Fig. 1). In ballet dancers, the length of the second toe compared with the hallux affects the distribution of stresses on the foot, which can cause calluses, injuries, and pain.[1] Callosities are fewer and pain scores are lower in ballet dancers with Egyptian feet (shorter second toe) than in those with Greek feet (longer second toe).[1, 2] The aim of this study was to investigate the relationship between second-toe length and forefoot disorders in ballet dancers and folk dancers.

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Materials and Methods

Two groups of dance students were prospectively enrolled in this study during the 2003–2004 school year. The first group consisted of 30 classical ballet dancers, and the second group consisted of 25 folk dancers.

At the end of the school year, each dancer was interviewed regarding his or her history of foot and ankle problems and treatments. A visual analog scale from 0 to 10 was used to record daily pain. On examination, callosities on all of the toes were counted, and signs of first metatarsophalangeal joint inflammation (hyperemia, swelling, crepitus, and joint stiffness) were noted. Feet were photographed while joints were in the neutral position, and second-toe length in relation to the hallux (shorter, equal, or longer) was recorded (Fig. 2). Toes differing in length by 2 mm or more were considered "longer" or "shorter." No radiologic investigations were performed.

Differences between the two groups were examined using χ^2 analysis. The null hypothesis that no

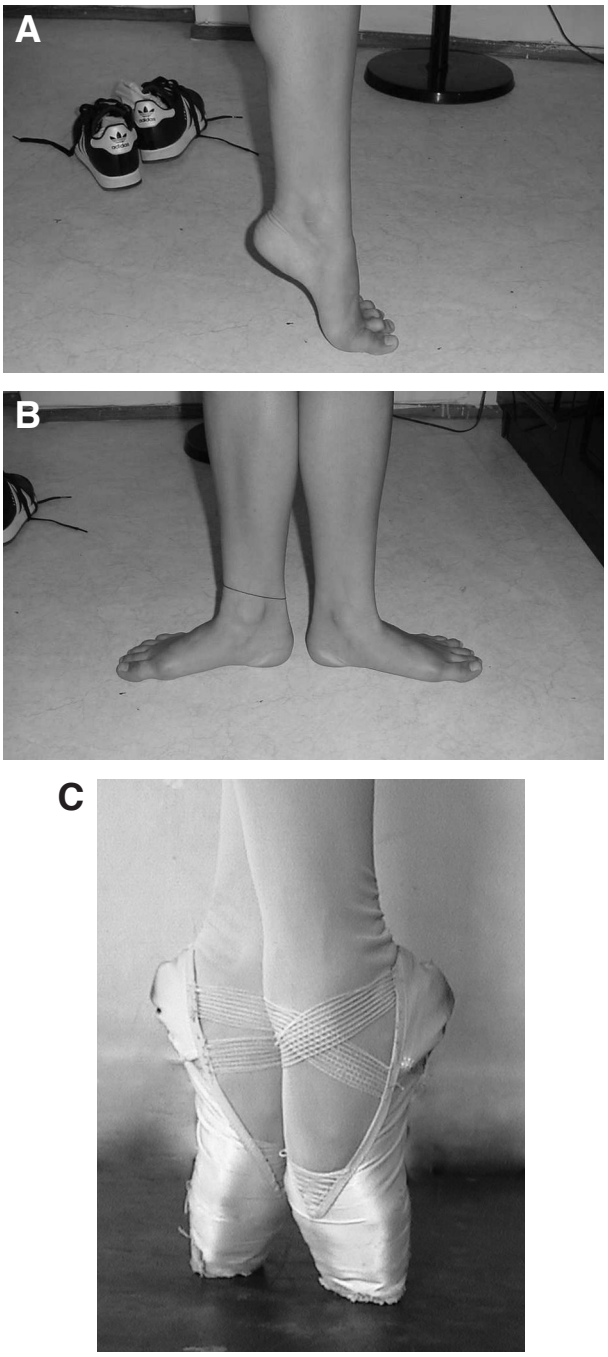


Figure 1. Ballet dancer standing on relevé (A), the first position (B), and pointe (C).

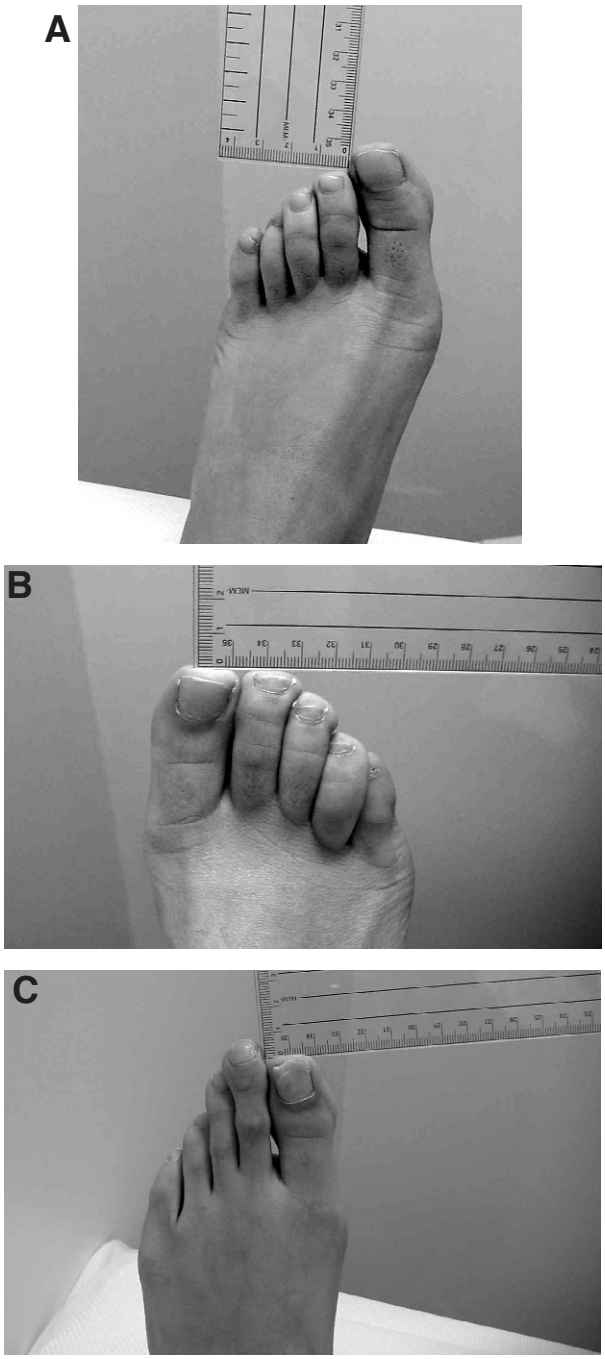


Figure 2. Simple measurement of toe lengths in Egyptian (A), neutral (B), and Greek (C) feet.

difference existed between the groups was rejected at $P < .05$.

Results

The first group of students consisted of 30 classical ballet dancers: 5 boys and 25 girls (mean age, 15.5 years; range, 13–19 years). The second group consisted of 25 folk dancers: 5 boys and 20 girls (mean age, 17.8 years; range, 17–20 years). None of the students had undergone foot or ankle surgery, and no congenital or hallux valgus abnormalities were detected clinically.

Mean visual analog scale scores for daily pain in ballet and folk dance students were 5.6 (range, 2–8)

and 3.6 (range, 1–6), respectively. In ballet students, mean visual analog scale scores were 6.7 (range, 4–8) in those with longer second toes and 4.3 (range, 2–8) in those with equal-length or shorter second toes. In folk dance students, mean visual analog scale scores were 3.7 (range, 1–6) in those with longer second toes and 3.5 (range, 2–6) in those with equal-length or shorter second toes.

The mean number of callosities was 3.5 (range, 1–8) in ballet dancers, and those with longer and equal-length second toes had a mean number of callosities of 4.6 (range, 2–8) and 2.6 (range, 1–6), respectively. In folk dancers, the mean number of callosities was 1.5 (range, 0–4), and those with longer and equal-length second toes had a mean number of callosities of 1.4 (range, 0–3) and 1.5 (range, 0–4), respectively. One or more signs of first metatarsophalangeal joint inflammation were present in nine (30%) of the ballet students: six (67%) with longer second toes and three (33%) with equal-length or shorter second toes. One or more signs of first metatarsophalangeal joint inflammation were present in three (12%) of the folk dance students: one with longer second toes and two with equal-length or shorter second toes.

There was no statistically significant difference in number of students with longer or equal-length second toes between the two groups ($P > .05$). Nor was there a statistically significant difference in daily pain, as recorded on the visual analog scale, between the two groups ($P = .058$). Callosities were more common in ballet dancers ($P = .002$), and callosity count was correlated with the presence of inflammatory signs in the first metatarsophalangeal joint ($P = .028$). In ballet students with longer second toes, callosities were more numerous, visual analog scale pain scores were higher, and signs of metatarsophalangeal joint inflammation were more frequent. There was no statistically significant difference in callosities and second-toe length between the two groups ($P = .515$). However, ballet dancers with longer second toes had more callosities than ballet dancers with equal-length or shorter second toes ($P = .003$).

Discussion

Ballet students had more callosities and clinical signs of first metatarsophalangeal joint inflammation than folk dance students (Figs. 3 and 4). As Ogilvie-Harris et al[1] found, ballet dancers with shorter or equal-length second toes had fewer calluses and less daily foot pain than ballet dancers with longer second toes. Those with a longer second toe had a higher rate of first metatarsophalangeal joint inflammation and higher visual analog scale pain scores.



Figure 3. Inflammation in the first metatarsophalangeal joint of a ballet dancer.

The length of the second toe seems to be more important for formation of callosities in ballet dancers than in folk dancers ($P > .05$), although this difference did not reach statistical significance (Fig. 4). This difference is probably due to ballet dancers' tight shoes and intensity of daily exercises. Folk dancers generally wear more comfortable shoes (Fig. 5) during daily practice, which was reflected in their lower mean pain scores, although this difference did not reach statistical significance.

Ballet dancing has a detrimental effect on the hallux joint. Rigidus deformity despite valgus angulation of the first metacarpophalangeal joint is frequently observed in ballet dancers.[3-5] Although some researchers believe that ballet dancing induces hallux



Figure 4. Callosities in a ballet dancer's foot.

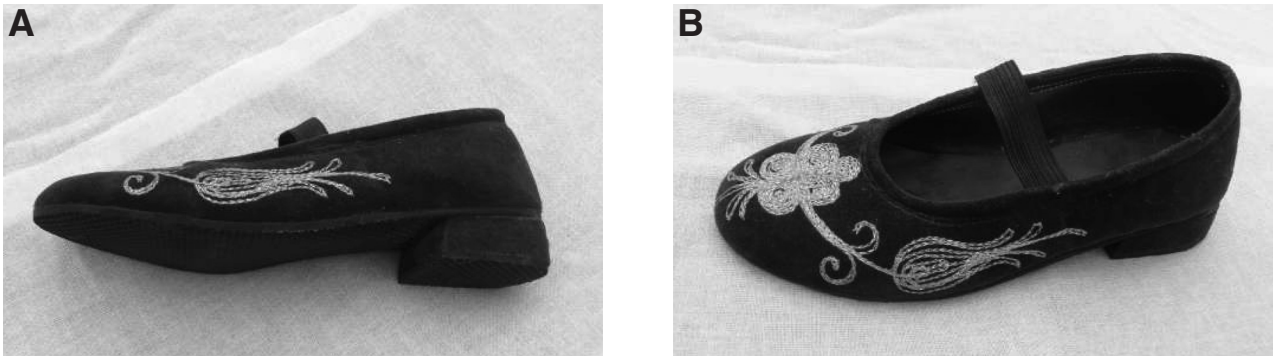


Figure 5. Two views of actual footwear of a female folk dancer.

valgus, we detected none in these ballet students, and radiographs of 63 active and 38 retired ballet dancers of both sexes showed no increase in the valgus angulation of the hallux compared with that of nondancers.[3] Radiographs of the feet of classical ballet dancers typically exhibit bone cortex hypertrophy of the second metatarsal and squaring of the distal phalanx of the second digit, which are related to the weightbearing stresses of dancing "en pointe."[5] According to the literature,[1-7] there is no ideal foot type for the ballet dancer. Many believe, however, that the Greek foot[2] is not biomechanically suited to pointe positions[1] and that squared or Egyptian feet allow a larger surface area to support body weight.[1, 2, 8]

The incidence of first metatarsophalangeal joint osteoarthritis is high in ballet dancers.[1] In this study, however, we observed more inflammatory and impingement problems of the first metatarsophalangeal joint than hallux rigidus or osteoarthritis in ballet dancers. This may be related to the young population of the groups studied. Students with metatarsophalangeal joint inflammation also reported higher pain scores. Despite a previous report[1] that found no relation between second-toe length and relative pressure on the hallux, we found a higher incidence of metatarsophalangeal joint inflammation (n = 6 in 14 long second toes) in ballet students with longer second toes. We did not analyze clinical findings by sex because of the small number of boys (n = 5 in each group), which is a limitation of this study compared with that of Ogilvie-Harris et al.[1] Relatively few boys train as professional dancers in Turkey, where this study was conducted.

Conclusion

The results of this study show that longer second-toe length is associated with a higher incidence of forefoot deformities in students of classical ballet but not of folk dance. Longer-term studies are needed to determine whether ballet dancers with an equal-length or shorter second toe in relation to the hallux have a lower incidence of forefoot problems during their dance careers.

Financial Disclosures: None reported.
Conflict of Interest: None reported.

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