Foot and Ankle Problems in Thai Monks

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Background: *Foot and ankle problems in Thai monks have not been explored. This is an unshod population, and its members have a unique lifestyle living among others in our modern era. Beginning at their ordainment, they follow strict rules about barefoot walking, the amount of daily walking, and their sitting position, practices that theoretically can increase their risk of developing foot and ankle problems.*
Objective: *To evaluate the prevalence of common foot and ankle problems in Thai monks.*
Material and Method: *A cross-sectional survey was conducted in combination with foot and ankle examinations of monks living in northern Thailand. Foot morphology was examined using a Harris mat footprint. Results of the interviews and the foot and ankle examinations were evaluated.*
Results: *Two hundred and nine monks from 28 temples were included in this study. Common foot and ankle problems found included callosity (70.8%), toe deformities (18.2%), plantar fasciitis (13.4%), metatarsalgia (3.8%), and numbness (2.9%). Callosity and toe deformities were associated with prolonged barefoot walking over extended periods since ordainment ($p<0.05$). The callosity was found on the forefoot (47.3%), lateral malleolus (40.7%), and heel (12%). Arch types were considered normal in 66.4% of cases, high in 21.6%, and low in 12%. No association was found between arch type and foot and ankle problems.*
Conclusion: *Callosity and toe deformity were the most common foot and ankle problems found in Thai monks, especially those with prolonged period of barefoot walking and long-term duration of ordainment. The unique pattern of walking and sitting of Thai monks may have contributed to the development of those feet and ankle problems.*

Keywords: *Foot ankle, Monk, Prevalence, Problem, Unshod, Callosity*

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Thai monks are a unique group of individuals who practice Buddhist asceticism. A monk's life includes taking care of the temple compound, praying, studying, and teaching Buddhism. A subset of the monk population in Thailand lives in rural areas or inforest temples where they follow the Buddha's way of life; others live in urban areas[1]. Shoe wearing is generally proscribed and monks must walk and do their other activities barefoot. Monks go on daily morning alms rounds receiving donations of food, walking at least three to five kilometers each day in forests, on concrete or dirt roads, or in rice fields. The rest of the day they pray, teach, and study Buddhism in a temple building containing the main Buddha image. They always sit in the tailor's seat or lotus position on a raised platform during those activities[2] (Fig. 1).

Common foot and ankle problems have been explored in many groups of human populations, including both shod and unshod individuals. Diabetic patients represent a shod population with a high risk of foot callosity and ulcers[3]. In the diabetic population, 77.2% have a history of ulceration, and the prevalence

Fig. 1 Unique activities of monks, cross-leg sitting and barefoot walking.

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of foot ulcer is 1.9 to 8%. Diabetics' risk of foot amputation is five times that of non-diabetics[4,5]. The unshod population usually has fewer problems with their feet than the shod population[6,7]. It has been generally accepted that natural adaptation of the osseous and soft tissue in the feet and the lack of influence from shoes accounts for this protective effect. Thai monks are a unique unshod population in that they had been wearing shoes all their lives prior to their ordainment. The strict rule of barefoot walking, the amount of daily walking, and the sitting position can theoretically increase their risk of developing foot and ankle problems. The aim of this study was to analyze the common foot and ankle problems and associated factors in Thai monks.

Material and Method

After having received approval from the Institutional Review Board of Chiang Mai University, 209 monks from the northern part of Thailand were included in the study which was conducted over a period of 12 months (January 2012 to December 2012). Monks under the age of 10, those who had lower limb gait abnormalities such as poliomyelitis, cerebral palsy and those who had a previous foot or ankle surgery were excluded. All subjects underwent an interview, a physical exam by a fellowship-trained orthopaedic surgeon, and a Harris mat imprint study.

A questionnaire was used to obtain information on the monk's age, body weight, height, duration of ordainment, and daily barefoot walking time. Data were collected at temples in the northern part of Thailand. Interviews were conducted in person by orthopaedic residents and medical students to ensure that all questions were fully completed. The purpose of the interview was explained and a consent form was signed.

An examiner (TV), a fellowship-trained orthopaedic surgeon, conducted the foot and ankle examinations of all the Thai monks in the present study. Data on skin abnormalities including callosity, ulceration, and infection were recorded. Deformities of toes, mid foot, hind foot, and ankle were evaluated. Passive ankle motion was measured with the monk sitting and recorded using a goniometer. Ankle motion was assessed by passive ankle dorsiflexion with the knee flexed to 90 degrees and fully extended. The goniometer was placed on the lateral aspect of the foot and ankle with the proximal arm aligned along the axis of the fibula and the distal arm aligned along the plantar axis of the foot[8]. Presence of gastrocnemius contracture was defined as limitation of passive ankle dorsiflexion to less than 10 degrees[8,9].

Foot morphology such as pes planus or cavus was analyzed using a Harris mat imprint study. Two Harris mats were used to gather accurate data on both feet. Monks were requested to stand about 18 inches behind the Harris mat. Subjects walked forward, placing both feet on the center of the Harris mats. They then continued walking forward beyond the mats, leaving imprints of their feet[10]. The footprint measurements, Chippaux-Smirak index (CSI), and the midline foot axis (MFA) were evaluated. CSI was calculated as the ratio of the maximum width of the metatarsals to the minimum width of the arch[11,12]. The MFA, measured as the distance from the medial edge of the mid foot imprint to the point that bisects a line drawn from the middle of the second toe imprint to the middle of the heel imprint, was used to identify foot deformity[10] (Fig. 2).

The CSI data classified feet as normal (CSI ≤29.9%), mild flatfoot (CSI = 30-39.9%), moderate flatfoot (CSI = 40-44.9%), or severe flatfoot (CSI ≥45%)[12]. A MFA scores of less than -2 was classified as a high arch, -1 to +1 as a neutral arch, and more than +2 as low arch[10]. The CSI and MFA were calculated by computerized measurement model with a reliability of 0.8 compared to manual measurement.

All information collected was stored on Microsoft excel spreadsheet and SPSS database for analysis. Chi-square was used for the analysis of

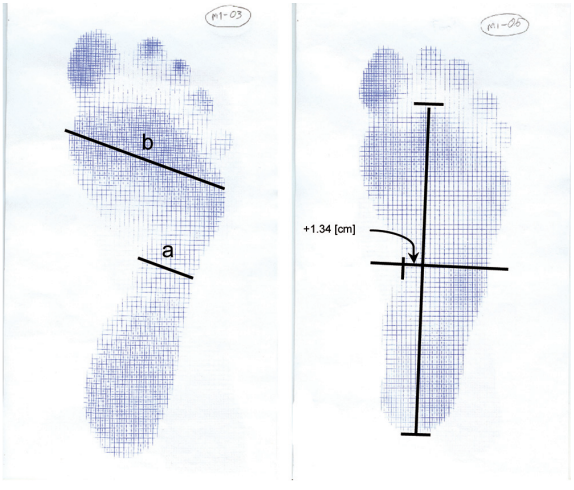

Fig. 2 Foot prints showing measurement of the Chippaux-Smirak index (CSI) (a/b) and the mid foot axis (MFA).

the associated factors in unshod Thai monks. The analyses were considered statistically significant when *p*-value were less than 0.05.

Results

Demographic data

Two hundred and nine Thai monks from 28 temples in the northern part of Thailand were included in the present study. Their average age was 30.9 years (range, 10 to 83 years); their mean body mass index was 22.4 kg/m^2 (range,13.9 to 43.3 kg/m^2). Fifty-five monks (26.3%) had been ordained for less than 1 year, 62 monks (29.7%) for 1 to 5 years, 45 monks (21.5%) for 6 to 10 years, and 47 monks (22.5%) for more than 10 years.

Fifty-two monks (24.8%) had at least one underlying general medical condition. In terms of daily barefoot walking time,124 monks (59.3%) walked less than 10 hours per day and 85 (40.1%) walked more than 10 hours per day. Forty-five percent of the monks had a history of foot or ankle problems appearing after ordination with symptoms including pain (35.4%), ulceration (8.2%), and numbness (2.4%).

Foot and ankle examination

Five common foot and ankle problems found in Thai monks included callosity (70.8%), toe deformities (18.2%), plantar fasciitis (13.4%), metatarsalgia (3.8%), and numbness (2.9%). In addition, gastrocnemius contracture was present in 30.2% of the Thai monks, Achilles tendinopathy was present in 2.4%, and foot ulceration was present in 1.43%.

The callosity was mostly present on the forefoot (47.3%), followed by the lateral malleolus (40.7%) and the heel (12%). It was present bilaterally in 81.9% of Thai monks, whereas 28.7% presented with multiple callosities on one foot. The most common presentation of multiple callosities was a combination of forefoot and lateral malleolus (19.6%). The callosity was significantly more common in Thai monks who had been ordained for more than five years than those ordained five years or less (p = 0.0022). Moreover, callosity was significantly more common in Thai monks who walked barefoot more than ten hours per day than in monks who walked barefoot less than 10 hours per day (p = 0.04). However, there was no association between callosity or gastrocnemius contracture and duration of ordainment (Fig. 3).

Toe deformities commonly found included hallux valgus and claw toes. Hallux valgus was found in 14.4% of Thai monks and claw toes in 4.3%. Toe deformities were significantly more common in Thai monks who had been ordained more than five years and those who walked barefoot daily for more than 10 hours, with p-value of 0.0212 and 0.036, respectively (Fig. 4).

For the problems of plantar fasciitis, metatarsalgia, and numbness, there were no statistically significant associations with duration of ordainment and daily barefoot walking period. Obesity and age were not associated with any foot or ankle problems.

Harris mat imprint studies

The mean MFA score was -0.25 (range, -2.0 to 4.1). Among the Thai monks, 66.4% had normal arch, 21.6% had high arch, and 12% had low arch. The mean CSI was 0.35 (range, 0.09 to 0.82). Frequencies of mild, moderate, and severe flatfoot were 41.9%, 11%, and 11%, respectively. There were no statistically significant associations between foot shape and duration of ordainment, daily barefoot walking period, or gastrocnemius contracture.

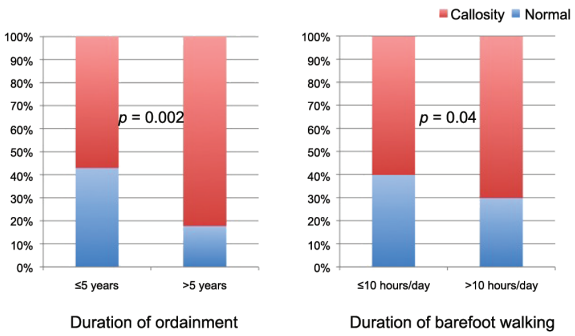

Fig. 3 Association between callosity with duration of ordainment and with barefoot walking.

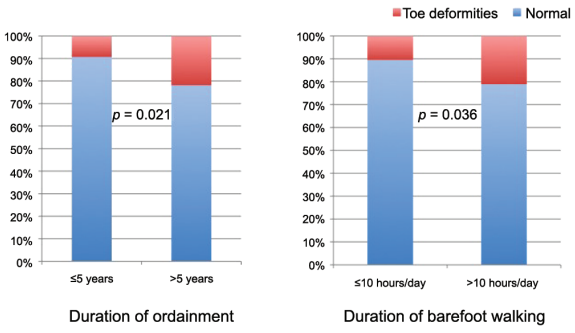

Fig. 4 Association between toe deformities with duration of ordainment and with barefoot walking.

Discussion

A high prevalence of foot and ankle problems was found in Thai monks from the northern part of the country. The most common problems were callosity, followed by toe deformities, plantar fasciitis, metatarsalgia, and numbness. They were commonly symptomatic with complaints of pain, numbness, and discomfort. Prolonged periods of barefoot walking and long duration of ordination might have increased the risk of developing foot problems, especially callosity and toe deformities. The effect of gastrocnemius contracture was, surprisingly, not associated with foot and ankle problems.

The callosity of feet and ankles in Thai monks in this study was higher than other general populations, especially those in Western countries[13,14]. The prevalence of foot and ankle callosity of 70.8% is the highest the authors have seen reported[13,15]. The location of presented callosities - forefoot (47.3%), lateral malleolus (40.7%) and heel (12%) - might be explained in two ways. Firstly, Thai monks usually walk without wearing shoes for long periods of time each day, causing increased pressure on the plantar surface of the foot; significant association was found between duration of barefoot walking and callosity. Most Thai monks walk without shoes during the daytime, and only some of them wear shoes for limited periods. The push off and heel strike phases during barefoot walking create high pressure on the forefoot and heel, respectively. Secondly, Thai monks who live in rural areas walk either in areas that do not have smooth surfaces or on concrete or dirt roads. This may be a cause of high contact pressure on the plantar aspect of the foot resulting in callosity. Thai monks cease wearing shoes when they are ordained. Prior to that, their feet usually have not been accustomed to barefoot walking, unlike other groups which habitually walk unshod and whose bone structure has adapted[6].

Callosity on the lateral malleolus was a common location (presenting bilaterally) in Thai monks. This may be explained by their unique lifestyle that requires regular and prolonged cross-leg sitting in the lotus (tailor) position. The lateral malleoli are in contact with the floor for long periods during those activities. That callosity can cause symptoms of pain and wound breakdown[13,15,16]. The wound can become infected and cause osteomyelitis, especially in the monks who have underlying diseases such as diabetes. In this study, foot and ankle active ulceration was present in only 1.43% of Thai monks, but 8.2% had a history of previous ulceration.

The high prevalence of toe deformities in Thai monks was associated with prolonged periods of barefoot walking and long-term ordainment. Lesser toe deformities were common and associated with those same factors, but the incidence was less than that present in other general populations[13,14,17]. This might be explained by the lack of prolonged compression effect from shoes[13,14,17,18]. The prevalence of hallux valgus deformity in Thai monks was not different from that of the general population. This favors the genetic theory of hallux valgus development rather that effects from shoes or activities. The influence of barefoot walking may have been reduced in the subjects as they had regularly worn shoes prior to their ordainment.

No association between foot and ankle problems and prolonged periods of barefoot walking, long-term ordainment, or gastrocnemius contracture were found. This might be due to the lack of compression effect from shoes or to the small number of Thai monks included in the present study. No high risk factors, including obesity or older age, were found in the present study group. Few Thai monks are overweight because they regularly eat only once a day, in the morning[19,20]. In addition, the mean age of Thai monks in this study was relatively young, in contrast to most studies reporting common conditions causing foot pain, e.g., plantar fasciitis or metatarsalgia, where the average age is older, into the fourth or fifth decades[21-24].

The main results from this study suggest important potential preventive strategies. Although ulceration was not found to bea major problem for the Thai monks in this study, the prevalence of callosity indicated mechanical overload of the forefoot and the lateral malleolus. Thai monks who have a high risk of ulceration, e.g., diabetic neuropathy or vasculopathy, may need to modify their activities, e.g., change their position of sitting, reduce the amount of sitting and walking, or temporarily wear shoes. They would also benefit from regular stretching exercises for the gastrocnemius muscles to reduce foot and ankle pain. The stretching may also decrease abnormal foot pressure distribution and callosity formation[25,26].

The present study included only monks from northern Thailand due to the logistical problems of recruiting monks from a larger area which introduced a potential sampling bias. Former monks who might have presented with different types and numbers of foot and ankle problems were not examined. In addition, radiographic study was not utilized to confirm bony abnormalities.

Conclusion

A high prevalence of callosity and toe deformities was found in Thai monks. Prolonged periods of barefoot walking and long-term ordainment were risk factors for developing these problems.

What is already known on this topic?

There were no previous studies of prevalence in foot ankle in unshod monk. There was a study of foot and ankle injury in Taekwondo and some contact sport. The interesting is to understand and process to prevention in next study.

What this study adds?

Adding new knowledge that are the problem of callosity, ulcers and tight heel cord lead us to study more about how to prevent and treating problems for avoiding chronic foot ankle problems in the monks.

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Potential conflicts of interest

None.

References

1. Yiengprugsawan V, Seubsman SA, Sleigh AC. Health, well-being, and social indicators among monks, prisoners, and other adult members of an Open University Cohort in Thailand. J Relig Health 2012; 51: 925-33.
2. Tangtrakulwanich B, Geater AF, Chongsuvivatwong V. Prevalence, patterns, and risk factors of knee osteoarthritis in Thai monks. J Orthop Sci 2006; 11: 439-45.
3. Evans SL, Nixon BP, Lee I, Yee D, Mooradian AD. The prevalence and nature of podiatric problems in elderly diabetic patients. J Am Geriatr Soc 1991; 39: 241-5.
4. Tapp RJ, Shaw JE, de Courten MP, Dunstan DW, Welborn TA, Zimmet PZ. Foot complications in Type 2 diabetes: an Australian population-based study. Diabet Med 2003; 20: 105-13.
5. Davis WA, Norman PE, Bruce DG, Davis TM. Predictors, consequences and costs of diabetes-related lower extremity amputation complicating type 2 diabetes: the Fremantle Diabetes Study. Diabetologia 2006; 49: 2634-41.
6. Sim-Fook L, Hodgson AR. A comparison of foot forms among the non-shoe and shoe-wearing Chinese population. J Bone Joint Surg Am 1958; 40-A: 1058-62.
7. Engle ET, Morton DJ. Notes on foot disorders among natives of the belgian congo. J Bone Joint Surg Am 1931; 13: 311-8.
8. Coughlin MJ, Jones CP. Hallux valgus and first ray mobility. A prospective study. J Bone Joint Surg Am 2007; 89: 1887-98.
9. DiGiovanni CW, Kuo R, Tejwani N, Price R, Hansen ST Jr, Czierneckі J, et al. Isolated gastrocnemius tightness. J Bone Joint Surg Am 2002; 84-A: 962-70.
10. Coughlin MJ, Kaz A. Correlation of Harris mats, physical exam, pictures, and radiographic measurements in adult flatfoot deformity. Foot Ankle Int 2009; 30: 604-12.
11. Chen KC, Yeh CJ, Kuo JF, Hsieh CL, Yang SF, Wang CH. Footprint analysis of flatfoot in preschool-aged children. Eur J Pediatr 2011; 170: 611-7.
12. Forriol F, Pascual J. Footprint analysis between three and seventeen years of age. Foot Ankle 1990; 11: 101-4.
13. Formosa C, Gatt A, Chockalingam N. The importance of clinical biomechanical assessment of foot deformity and joint mobility in people living with type-2 diabetes within a primary care setting. Prim Care Diabetes 2013; 7: 45-50.
14. Shapiro J, Rhee CS. Podiatry screening project for children in the District of Columbia. Public Health Rep 1970; 85: 803-8.
15. Lazaro-Martínez JL, Aragon-Sanchez FJ, Beneit-Montesinos JV, Gonzalez-Jurado MA, Garcia Morales E, Martinez Hernandez D. Foot biomechanics in patients with diabetes mellitus: doubts regarding the relationship between neuropathy, foot motion, and deformities. J Am Podiatr Med Assoc 2011; 101: 208-14.
16. Driver VR, Goodman RA, Fabbi M, French MA, Andersen CA. The impact of a podiatric lead limb preservation team on disease outcomes and risk prediction in the diabetic lower extremity: a retrospective cohort study. J Am Podiatr Med Assoc 2010; 100: 235-41.
17. Hung LK, Ho YF, Leung PC. Survey of foot deformities among 166 geriatric inpatients. Foot Ankle 1985; 5: 156-64.
18. Menz HB, Morris ME. Footwear characteristics

and foot problems in older people. Gerontology 2005; 51: 346-51.
19. Coughlin MJ, Jones CP. Hallux valgus: demographics, etiology, and radiographic assessment. Foot Ankle Int 2007; 28: 759-77.
20. Jimenez-Ormeno E, Aguado X, Delgado-Abellan L, Mecerreyes L, Alegre LM. Foot morphology in normal-weight, overweight, and obese school-children. Eur J Pediatr 2013; 172: 645-52.
21. Sobhani S, Dekker R, Postema K, Dijkstra PU. Epidemiology of ankle and foot overuse injuries in sports: A systematic review. Scand J Med Sci Sports 2013; 23: 669-86.
22. Goff JD, Crawford R. Diagnosis and treatment of plantar fasciitis. Am Fam Physician 2011; 84: 676-82.
23. Smith BW, Coughlin MJ. Disorders of the lesser toes. Sports Med Arthrosc 2009; 17: 167-74.
24. Hartemann A, Attal N, Bouhassira D, Dumont I, Gin H, Jeanne S, et al. Painful diabetic neuropathy: diagnosis and management. Diabetes Metab 2011; 37: 377-88.
25. Hastings MK, Mueller MJ, Sinacore DR, Strube MJ, Crowner BE, Johnson JE, et al. Botulinum toxin effects on gasatrocnemius strength and plantar pressure in diabetics with peripheral neuropathy and forefoot ulceration. Foot Ankle Int 2012; 33: 363-70.
26. Chen WM, Park J, Park SB, Shim VP, Lee T. Role of gastrocnemius-soleus muscle in forefoot force transmission at heel rise-A 3D finite element analysis. J Biomech 2012; 45: 1783-9.

ปัญหาเท้าและข้อเท้าของพระไทย

ธนวัฒน์ วะสีนนท์, ปิยะพงศ์ อินทรสมพันธ์, ทองเอก วัฒนโรจนาพร, ศันสนีย์ เอื้อพันธ์วิริยะกุล, นิพนธ์ ธีรอำพน, พินิจ พิสิษฐ์กุล

ภูมิหลัง: *ปัญหาเท้าและข้อเท้าพบได้บ่อยในบุคคลที่ไม่สวมรองเท้า วิถีชีวิตของพระส่วนใหญ่ไม่สวมรองเท้าต้องเดิน ต้องนั่ง และปฏิบัติธรรมทุกวัน โดยปราศจากการสวมใส่รองเท้า*

วัตถุประสงค์: *เพื่อศึกษาความชุกของปัญหาเท้าและข้อเท้าที่พบบ่อยในพระ*

วัสดุและวิธีการ: *เป็นการศึกษาสำรวจโดยการสัมภาษณ์ ตรวจร่างกาย พิมพ์เท้า เพื่อหาความผิดปกติของเท้าในพระทั่วภาคเหนือของประเทศไทย*

ผลการศึกษา: *พระ 209 รูป จาก 28 วัด ปัญหาเท้าที่พบบ่อย คือ ผิวหนังแข็ง 70.8 เปอร์เซ็นต์ นิ้วเท้าผิดรูป 18.2 เปอร์เซ็นต์ พังผืดใต้ฝ่าเท้าอักเสบ 13.4 เปอร์เซ็นต์ ปวดจมูกเท้า 3.8 เปอร์เซ็นต์ ชา 2.9 เปอร์เซ็นต์ ผิวหนังแข็งและนิ้วเท้าผิดรูปสัมพันธ์กับระยะเวลาการเดินโดยไม่สวมรองเท้าและการทำวัตรเป็นระยะเวลายาวนานอย่างมีนัยสำคัญ ผิวหนังแข็งพบบ่อยใต้ฝ่าเท้าส่วนปลาย 47.3 เปอร์เซ็นต์ ตาตุ่มด้านนอก 40.7 เปอร์เซ็นต์ และส้นเท้า 12 เปอร์เซ็นต์ พบรูปเท้าปกติ 66.4 เปอร์เซ็นต์ เท้าโก่ง 21.6 เปอร์เซ็นต์ และเท้าแบน 12 เปอร์เซ็นต์ ไม่พบความสัมพันธ์ระหว่างรูปเท้ากับปัญหาเท้าและข้อเท้า*

สรุป: *ผิวหนังแข็งและเท้าผิดรูปพบได้บ่อยในพระ โดยเฉพาะอย่างยิ่งพระที่เดินเท้าเปล่าเป็นเวลานาน การนั่งขัดสมาธิ และการเดินโดยไม่สวมรองเท้าเป็นปัจจัยที่สำคัญในการเกิดปัญหาโรคเท้าและข้อเท้า*
