CE

1.0 ANCC Contact Hours

Does the Shoe Fit?
Considerations for Proper Shoe Fitting

Marie Mantini Blazer ▼ Laura Beth Jamrog ▼ Lauren Lindsay Schnack

It is important to be properly evaluated for shoes to avoid complications. Ill-fitting shoes can lead to pathologies in different populations. The focus of this article is to review the components and function of a basic athletic-type shoe, general shoe-fitting techniques, and selecting appropriate footwear for various populations including those with diabetes, elderly, and females. Poorly fitting shoes can exacerbate structural foot deformities. Unevenly distributed plantar pressures and wear can lead to ulcerations in diabetic populations. Resources and transportation may impact the elderly population when obtaining new shoes. Esthetics is of superior consideration for females. The Brannock Device measurements are important to ensure a correct fit in guiding shoe selection. The orthopaedic nurse should be able to recognize foot ailments caused by ill-fitting shoe gear. Seeking the advice of a podiatrist should be considered before purchasing shoes.

Introduction

"Shoemaking is a craft. Shoe fitting is a profession" (Rossi, 2013, p. vi). To reach a level of proficiency for shoe fitting, one must have some degree of formal training. The availability of formalized courses on the multifaceted skill of shoe fitting is limited. Currently, expertise is acquired by a "learn as you go" process of on-the-job training. A professional shoe fitter not only has to have an intimate understanding of the shoe product itself but also general knowledge of foot structure and function. At the same time, it is critical to consider current fashion trends and individual style that best serve their client's needs.

Improper shoe fit is prevalent among the general population and is often directly responsible for numerous foot- and ankle-related complaints. According to a survey conducted on behalf of the American Podiatric Medical Association (APMA), 80% of Americans have experienced a foot problem over the course of their lifetime (American Podiatric Medical Association, 2014, March). Frequently, ill-fitting shoes are a contributing factor of foot problems. When shoes do not properly fit, symptoms from preexisting structural deformities such as bunions and hammertoes may be magnified. Ill-fitting shoes can lead to unwanted dermatological manifestations such as ingrown toenails, blisters, and corns/calluses.

Special populations such as those with diabetes, the elderly, and females are at an increased risk of developing shoe-induced ailments due to complications from neuropathy, age-related alterations in foot function, and high heel use, respectively. In many cases, these conditions can be prevented with proper shoe sizing and assessment of adequate fit.

The orthopaedic nurses, due to their frequent contact with these special populations, may be the first line in recognition of a patient's ill-fitting shoe gear. As a result of the nursing staff being so involved with patient care, day to day they are able to observe the consequences of foot ailments that may not be reported to the physician. Our article hopes to provide the basic proper shoe-fitting education so that nurses in the long-term care setting, home healthcare, or in the office of a family practitioner may be able to address patient ailments. If a patient cannot be helped at the time of the nursing visit/encounter, a referral can be made to the podiatrist for additional intervention.

Components and Function of a Basic Athletic-Type Shoe

To properly size and assess overall shoe fit, one must have an understanding of the basic components and functions of the shoe. In this section, the focus will be on the athletic-type shoe because it is the most basic model of a shoe. There are four basic components of the athletic shoe: outsole, midsole, insole, and the upper (see Figure 1). Variations in these components can potentially alleviate or exacerbate foot pathology. The function of proper footwear will ideally provide comfort and protection, increase functional performance, withstand adequate wear, and improve overall foot health. An additional factor in shoe selection is esthetics, which can be problematic when considering the aforementioned factors (Rossi, 2013).

Marie Mantini Blazer, DPM, Associate Professor, Division of Surgery and Biomechanics, Kent State University College of Podiatric Medicine, Independence, OH.

Laura Beth Jamrog, DPM, Resident, Postgraduate, Genesys Regional Medical Center, Grand Blanc, MI.

Lauren Lindsay Schnack, MS, Podiatric Medical Student, Kent State University College of Podiatric Medicine, Independence, OH.

The authors have no conflicts of interest.

DOI: 10.1097/NOR.0000000000000447

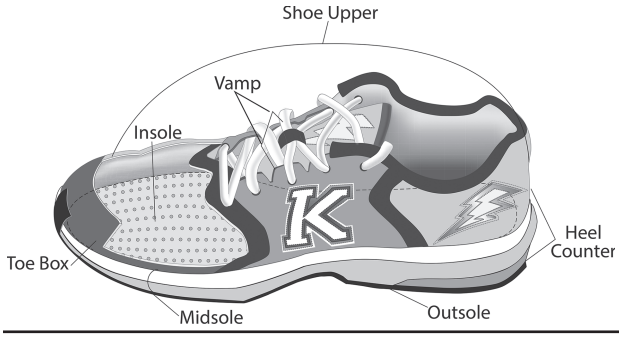

Figure 1. Components of an athletic shoe.

Outsole

The outsole is the portion of the shoe that contacts the ground. It provides traction and protects against frictional forces. Outsoles should be durable to resist excessive wear, yet provide some flexibility to allow shock absorption. The outsole can provide important information about balance and shoe fit. According to the Professional Shoe Fitting manual by the National Retailers Shoe Association (Rossi, 2013), analyzing outsole wear patterns does not diagnose foot problems but rather help the clinician recognize problems with shoe fit and associated foot pathology. The tread wear patterns of the outsole can identify how the foot reacts to the shoe and how the shoe fits (see Figure 2). Outsoles that have an even wear pattern can indicate adequate foot balance, whereas an uneven wear pattern can indicate areas of increased pressure. Areas of increased pressure may lead to hot spots, calluses, or in severe cases, ulceration. Consider shoe replacement if there is greater than a 4-mm difference from one shoe to the other, or if the midsole is visible through the outsole (Furman, n.d.).

Midsole

The midsole of the shoe is an added layer of material located in-between the outsole and insole of a shoe (see Figure 3). The purpose of the midsole is to provide cushion, absorb shock, and provide shoe stability (Rossi, 2013). Most midsoles are made from varying densities

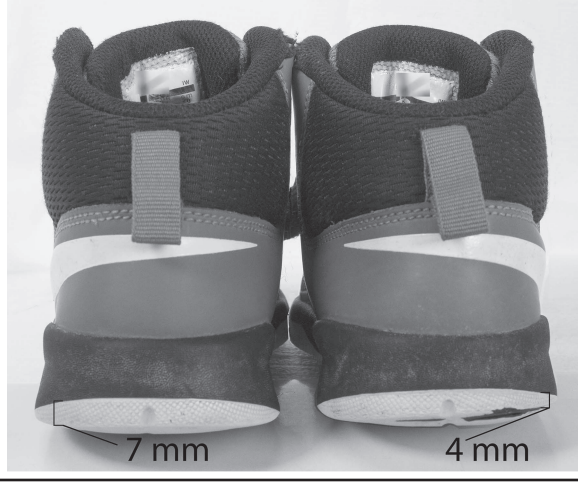

Figure 2. Lateral wear on the heel of an athletic shoe.

Figure 3. High-density gray material makes up the midsole of this shoe.

of a foam material, which are measured in durometers. A higher durometer material provides less cushion but more support to an individual. A lower arch foot may need a shoe that counteracts overpronation by adding higher durometer materials to the medial arch for support. Low durometer materials provide cushion and more flexibility to help offset deficient shock absorption that may be seen in a higher arch foot. Shoes should be replaced when the midsole compresses unevenly or displays noticeable creasing indicating that the shoe is worn and has lost the ability to provide adequate shock absorption and stability.

Insole

The insole of a shoe is also known as the sock liner (see Figure 1). To assess proper shoe fit using the insole, remove it and compare it with the foot as a template. A foot that "spills" over the insole may indicate a shoe that is too small. Ethylene vinyl acetate is the standard insole material and may be replaced with an over-the-counter insole based on an individual's needs (Werd & Knight, 2010). Spenco, a neoprene rubber, reduces friction to slow the progression of callus formation. Sorbothane gel can alleviate symptoms of plantar fat pad atrophy. In addition, custom functional foot orthotic devices can replace a shoe insole and correct a variety of foot pathologies (Scherer, Kirby, Choate, Huppin, & Walters, 2011).

Custom functional orthotics are commonly used to offload areas of pressure and improve symptomatology from structural pathology such as flat feet, metatarsalgia (pain under the ball of the foot), or bunion deformity (Scherer et al., 2011). By obtaining impressions of the patient's foot, custom functional foot orthotic devices can be fabricated by a podiatrist or pedorthist with a physician's prescription. According to the APMA, 29% of Americans admit to using store-bought insoles in their footwear, whereas only 10% admit to using doctor-prescribed orthotics (American Podiatric Medical Association, 2014, March). Over-the-counter insoles may not have optimal results due to the inability to address specific biomechanical issues of an individual. It is best to consult a podiatrist when having foot challenges before purchasing footwear.

Upper

The upper of a shoe is the region covering the dorsum (top) of the foot (see Figure 1). It is a complex area of the shoe consisting of numerous parts: heel counter, vamp, and toe box (Rossi, 2013). The heel counter is the stiff posterior backing of the shoe that stabilizes heel motion, which helps support the shape of the posterior aspect with increasing wear, while keeping the foot striding in a forward direction. The vamp is at the forefront

of the upper component of the shoe that may consist of several pieces and designs. The toe box is the roof covering the toes inside the shoe, which acts to maintain the shape of the anterior shoe and allows adequate room for toes. Common upper materials include nylon, nylon mesh, full stretch material, and leather. Patients with contracted digits, such as hammertoes, should especially consider nylon mesh or full stretch material uppers (Cheskin, 2013; Rossi, 2013). These materials provide stretch and decrease friction, which can reduce irritation and decrease the risk of ulceration of skin over boney prominences.

General Shoe-Fitting Techniques

There are various factors that need to be considered when selecting a shoe. These considerations can help individuals find that "right fit" (see Table 1). Each time when trying on footwear, the individual should have both feet professionally measured, preferably in the latter part of the day when feet are the largest due to swelling (Cheskin, 2013). This ensures that there will be enough room in the shoe to accommodate your feet as they swell throughout the day. One should have his or her feet professionally measured periodically throughout his or her lifetime because factors such as weight gain, pregnancy, and age can also cause a change in foot size. Foot size and shape often fluctuate, so previous shoe sizes may not provide an adequate fit (American Orthopaedic Foot & Ankle Society, 2017). The size that individuals wore during their teens may not be the same size that is continued to be worn in late adulthood.

When planning to try on shoes, it is beneficial to take to the shoe retailer the socks and orthotics that you plan to wear so these can be worn in conjunction with the shoes during fitting. It is preferable to purchase your shoes at a specialty retailer that will measure your feet and stock quality good-fitting shoes rather than going to a typical chain store. Footwear should feel comfortable right away, "breaking in" the shoes is not an option (American Podiatric Medical Association, 2016). It should not be assumed that new shoes will stretch over a period of time and become more comfortable (American Orthopaedic Foot & Ankle Society, 2017). A common and trusted method of determining proper shoe size is to use a shoe-measuring device, such as the Brannock Device, which was designed in 1927 (The Brannock Device Company, 2016). The Brannock Device measures three separate measurements to ensure a correct fit: heel-to-toe (see Figure 4), heel-to-ball/arch length (see Figure 5), and foot width (see Figure 6). A common mistake is to take foot measurements while the person is sitting. This can result in an inaccurate measurement of foot size. It is important to have the person stand with equal weight on both feet to ensure maximum elongation and splay size (The Brannock Device Company, 2016).

Table 1. Basic Shoe Selection Guidelines

Purchase footwear at the end of the day due to swelling.
Obtain a professional foot measurement with a Brannock Device.
Size your shoe length to the largest toe.
Fit the shoes to the larger of the two feet.
Keep heel heights <2 in.
Those with diabetes, or those with forefoot pathology, should wear shoes with a large toe box and extra depth.

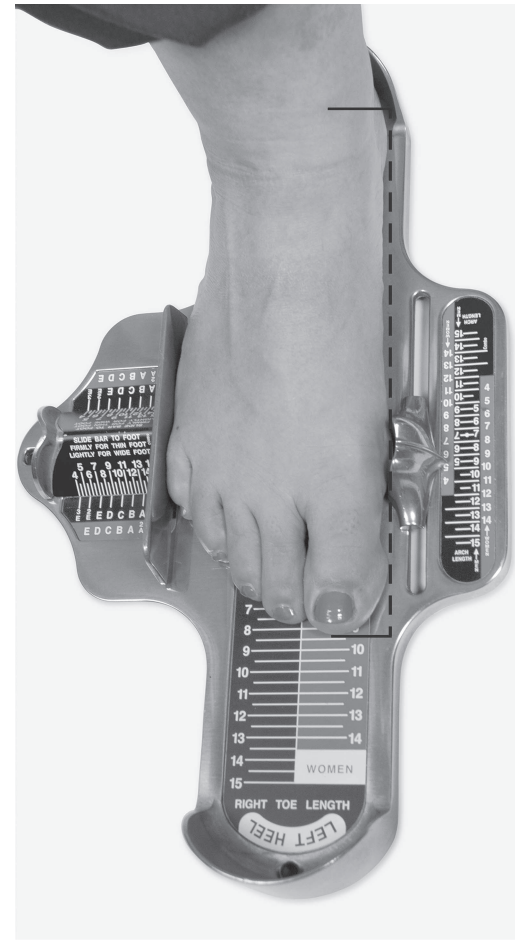

Figure 4. Heel-to-toe measurement.

The heel-to-toe measurement (see Figure 4) is most commonly used to identify shoe size. This measurement is taken from the posterior heel to the end of the longest toe. In many cases, the second toe is the longest toe, not the hallux (McPoil, 1988). Ideally, there should be three-eighths inch or one-half inch, or about the width of a finger, between the longest toe and the end of the shoe (American Orthopaedic Foot & Ankle Society, 2017).

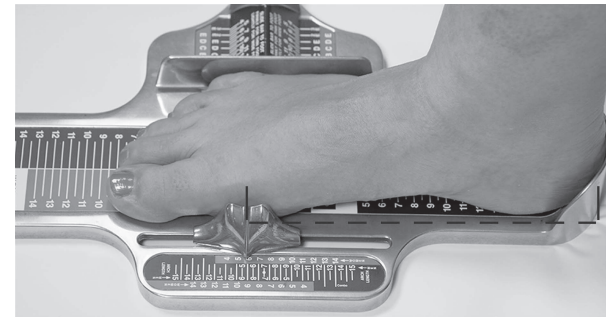

Figure 5. Heel-to-ball measurement.

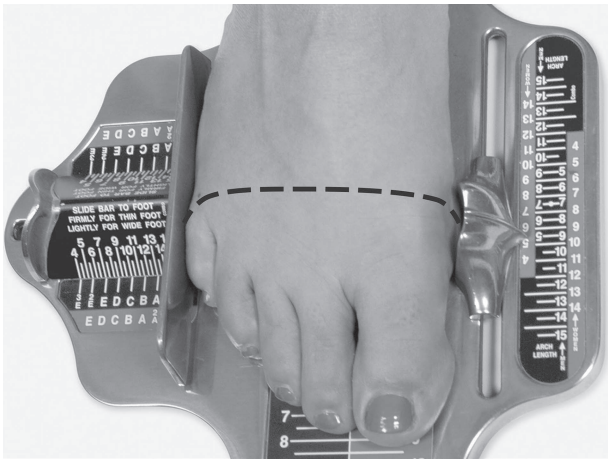

Figure 6. Corresponding width measurement.

The heel-to-ball/arch length measurement (see Figure 5) is taken from the posterior heel to the first metatarsophalangeal joint, also known as the ball of the foot. This measurement takes into account a foot with long versus short toes and is important because the hinge point of the shoe should correlate with the anatomic position of the patient's first metatarsophalangeal joint. For example, two patients may have the same heel-to-toe measurement but may require different size shoes due to a difference in their heel-to-ball/arch length measurement. The heel-to-toe and heel-to-ball/arch lengths are compared to determine the appropriate shoe size. A larger heel-to-ball/arch length may indicate a need to consider the addition of a half-size increase from the heel-to-toe measurement.

Foot width can also be determined by the Brannock Device. If the shoe size is between two widths, use the wider measured width for a thicker foot type and the narrower width for a thinner foot type (The Brannock Device Company, 2016). Structural deformities such as bunions can also necessitate the need for an increase in shoe width.

It is important to measure *both* feet because it is not uncommon to have variations in length and width. If there is a discrepancy in the sizing between the patient's two feet, fit to the larger of the two. Unfortunately, shoe sizes are not uniform among different brands and vendors. Because of variations between manufacturers, foot measurements should serve as an indication of shoe size, not a determinate of the precise shoe size required of an individual (Rossi, 2013). While in the shoe retailer, be sure to take the shoes for a "test drive." Take the time to walk around the store to determine potential areas of rubbing, irritation, or discomfort. Comfortable fitting shoes and good judgment should take precedence over exact foot measurements. These general guidelines, as discussed previously, can be utilized when addressing proper shoe fit for special subpopulations including those with diabetes, elderly, and females.

Proper Shoe Fit for Those With Diabetes

Diabetic patients, as well as patients with other systemic diseases, often require regular foot care from a podiatrist (Department of Health and Human Services, 2011). A proper podiatric examination is required to ensure that diabetic shoes meet the needs of the individual. Most diabetic patients are eligible through their insurance to obtain extra depth diabetic shoes and multidensity Plastazote diabetic inserts. In addition to using the Brannock Device measurements, podiatrists use a Harris Mat and foam box impression. For example, a Harris Mat is used to obtain a general outline of the patient's foot as well as areas of increased plantar pressure. Foam boxes are used to capture foot impressions. Diabetic shoes are required to have extra depth to accommodate structural foot deformities. Diabetic inserts help decrease friction and pressure to prevent preulcerative lesions or offload (reduce pressure to the bottom of the foot) existing plantar foot pathology. It is important that patients with diabetic shoes and inserts work closely with their podiatrist to ensure continued offloading and adequate fit as they tend to need replacement every 12–18 months depending on insurance coverage.

In diabetic populations with peripheral neuropathy, foot ulceration due to improper shoe fit is a major concern. A study conducted by Harrison, Cochrane, Abboud, and Leese (2007) that evaluated 100 diabetic patients in a diabetic clinic showed that 66% of this diabetic population wore ill-fitting shoes, 33% wore shoes of inadequate length, and 45% wore shoes inadequate in width. Diabetic foot ulcerations are likely to be exacerbated by repetitive pressure from gait patterns and improper shoe wear in addition to peripheral neuropathy. Understanding the proper shoe sizing methods and assessing proper shoe fit in those with diabetes can help reduce risk of ulceration and amputation, which can improve overall quality of life.

Proper Shoe Fit for the Elderly

Falls among senior citizens are a major concern that often leads to morbidity and mortality. Shoe products that are not firmly attached to the foot can lead to slips and falls (Moore, 2014). According to one study, almost one-third of senior citizens who suffered a fall say that their shoes were the main reason for the fall (Frey & Kubasak, 1998). Other problems such as inefficient gait, slipping, and tripping were also implicated as the primary causes of falls. Assessing elderly individuals for proper shoe fit and type may help prevent a potential fall and its associated complications. Proper footwear can help improve balance, especially in older people who may struggle with their mobility (American Podiatric Medical Association, 2016).

A study by Burns, Leese, and McMurdo (2002) evaluated shoe sizes in 65 consecutive rehabilitation admissions and found that 72% were wearing poorly fitted shoes. Of those patients, more than half wore shoes that were too big, which contributed to patients having foot pain and an increase in ulceration (Burns et al., 2002). Shoes that are too small can also cause foot ailments. Ill-fitting narrow shoes are significantly associated with pain, corns, calluses, and bunions in older people (Menz & Morris, 2005). A survey conducted by Borland, Hollins Martin, and Locke (2013) indicates that approximately 85% of nursing home residents' footwear is purchased

by family members. The nursing staff may be the first line of recognition that their patients may be at risk for falls due to their ill-fitting shoe gear. Early intervention can result in prevention of other musculoskeletal accidents such as a fractured bone. Socioeconomic factors may also play a role with the elderly when purchasing quality, supportive shoes (Ikpeze, Omar, & Elfar, 2015). Three principles recommended by the American Podiatric Medical Association (2016) when purchasing footwear to improve gait and balance are to make sure the heel area is supportive by pressing on both sides, bending the front of the shoe to select footwear with toe flexibility, and selecting footwear that does not twist in the middle. Focusing on community awareness through foot screenings to assess proper shoe fit may increase quality of life for the elderly population.

Proper Shoe Fit for Females

There has been an increasing trend in attempting to fit the foot to the shoe, rather than properly fitting the shoe to the foot (Rossi, 2013). According to a study by Borchgrevink, Viset, Witsø, Schei, and Foss (2016), women who wore high-heeled shoes (>5 cm) between the ages of 40 and 66 years suffered from more pain and increased callus formation (Borchgrevink et al., 2016). It has been suggested that shoes for the female population are better for fashion and not for fit and function. A study by Branthwaite, Chockalingam, Grogan, and Jones (2013) found that young women did not consider obtaining their foot measurement as a high priority when purchasing shoe gear. In their study, 98% of young female participants did not have their feet measured before purchasing their shoes. Minimizing the time spent in high-heeled shoes reduces the potential for foot problems such as painful bunions (boney prominence at the base of the great toe), hammertoes (contracted digits), and neuromas (painful nerve irritation). These forefoot pathologies are associated with the increased forefoot pressure secondary to the increased heel height. As shoe heel height increases, so does pressure on the forefoot. A study conducted by Kim, Fell, Cha, You, and Kim (2012) found that peak plantar pressures of the dominant lower limb, while the foot was in contact with the ground, increased in the lesser toes and heel regions while 5-cm heels were worn but were considerably lower when 3-cm heels were worn. Higher heel heights can significantly impact the forefoot and may later contribute to pathology. For those who need to wear high heels, a shoe with a heel height of 2 in. or less is recommended because a small heel or wedge can promote arch support (American Podiatric Medical Association, 2014, May).

Padding at the front of the footwear and an abundant toe box area can also help in foot pain prevention (American Podiatric Medical Association, 2014, May). The shape of the toe box may also affect the health of the foot. The shape of a shoe's toe box has a significant impact on dorsal and plantar pressures of the foot (Branthwaite, Chockalingam, & Greenhalgh, 2013).

A tracing of the patient's foot may be beneficial when comparing it with the actual shoe. Observing this will show the patient that his or her shoes may be narrower than the actual width of his or her foot. Show the patient the difference in size, especially in the forefoot area. Differences in size can be directly evaluated by having the patient step onto the foot tracing itself. As healthcare providers, we need to educate our patients that shoe selection can be a complicated process because there is no standardization in sizing among brands and different types of shoe gear (Cheskin, 2013).

In general, increased forefoot pressure from increasing heel heights along with compression of the forefoot due to a narrow toe box often causes pain to existing deformities. In females who suffer from contracted or overlapped toes, shoes with a large toe box may be able to accommodate for their pedal deformities (Werd & Knight, 2010). Spot stretching can be performed at a local shoe repair shop and may help alleviate pain over already present structural deformities. Although 71% of women report that their high heel shoes hurt their feet, following the aforementioned simple rules may improve the fit and comfort of their shoes (American Podiatric Medical Association, 2014, May).

Conclusion

Ill-fitting shoes can and will affect mobility. All footwear, if not properly fitted, can and will cause pain. Fit and function on the foot, when selecting all footwear, should be the main priority for this external covering. Special populations, such as those with diabetes, the elderly, and females, are susceptible and at risk for other ailments of the body caused by improper footwear such as an irritation of structural deformities. When having foot challenges, it may be in the best interest of the patient to consult a podiatrist before shopping for footwear. Fashion trends and esthetics along with individual style best serving the patient's needs may be incorporated with the podiatrist's advice. Footwear should not only fit well but look and feel good. Considerations for proper shoe fitting are necessary for this to reach full fruition. Orthopaedic nurses play a vital role in recognition of potential health concerns caused by ill-fitting shoe gear and as a result, making the referral to podiatry as appropriate.

Acknowledgments

Special thanks to Joan Lannoch for her photography and illustrations and Donna Perzeski, MLIS, for all her assistance on this article.

References

American Orthopaedic Foot & Ankle Society. (2017). 10 points of proper shoe fit. Retrieved from http://www.aofas.org/footcaremd/how-to/footwear/Pages/10-Points-of-Proper-Shoefit.aspx?PF=1

American Podiatric Medical Association. (2014, March). Public opinion research on foot health and care. Retrieved from https://www.apma.org/files/APMA2014TodaysPodiatristSurveyAllFindings.pdf

American Podiatric Medical Association. (2014, May). Well-heeled. Retrieved from http://apma.files.cms-plus.com/ProductPDFs/APMATodaysPodiatristInfographic_web_May2014.pdf

American Podiatric Medical Association. (2016). Balance-boosting footwear tips for older people. Retrieved

from http://www.apma.org/Learn/HealthyFeetTips.cfm?ItemNumber=10050
Borchgrevink, G. E., Viset, A. T., Witsø, E., Schei, B., & Foss, O. A. (2016). Does the use of high-heeled shoes lead to fore-foot pathology? A controlled cohort study comprising 197 women. *Foot and Ankle Surgery*, *22*(4), 239–243.
Borland, A., Hollins Martin, C., & Locke, J. (2013). Nurses' understandings of suitable footwear for older people. *International Journal of Health Care Quality Assurance*, *26*(7), 653–665.
Branthwaite, H., Chockalingam, N., & Greenhalgh, A. (2013). The effect of shoe toe box shape and volume on forefoot interdigital and plantar pressures in healthy females. *Journal of Foot and Ankle Research*, *6*(1), 28.
Branthwaite, H., Chockalingam, N., Grogan, S., & Jones, M. (2013). Footwear choices made by young women and their potential impact on foot health. *Journal of Health Psychology*, *18*(11), 1422–1431.
Burns, S. L., Leese, G. P., & McMurdo, M. E. T. (2002). Older people and ill fitting shoes. *Postgraduate Medical Journal*, *78*(920), 344–346.
Cheskin, M. (2013). Sizing up footwear. *Podiatry Management*, *32*(8), 109–118.
Frey, C. C., & Kubasak, M. (1998). Faulty footwear contributes to why seniors fall. *Biomechanics*, *5*, 45–47.
Furman, A. (n.d.). *How do I know when it is time to replace my athletic shoes?* Retrieved from http://www.aapsm.org/replace_shoes.html
Harrison, S. J., Cochrane, L., Abboud, R. J., & Leese, G. P. (2007). Do patients with diabetes wear shoes of the correct size?. *International Journal of Clinical Practice*, *61*(11), 1900–1904.
Ikpeze, T. C., Omar, A., & Elfar, J. H. (2015). Evaluating problems with footwear in the geriatric population. *Geriatric Orthopaedic Surgery & Rehabilitation*, *6*(4), 338–340.
Kim, J. S., Fell, D. W., Cha, Y. J., You, J. E., & Kim, K. (2012). Effects of different heel heights on plantar foot pressure distribution of older women during walking. *Journal of Physical Therapy Science*, *24*(11), 1091–1094.
McPoil, T. G., Jr. (1988). Footwear. *Physical Therapy*, *68*(12), 1857–1865.
Menz, H. B., & Morris, M. E. (2005). Footwear characteristics and foot problems in older people. *Gerontology*, *51*(5), 346–351.
Moore, J. (2014). How shoes play a role in balance in older adults. *Podiatry Management*, *38*(8), 101–111.
Rossi, W. A. (2013). *Professional shoe fitting*. Tucson, AZ: National Shoe Retailers Association.
Scherer, P. R., Kirby, K. A., Choate, C., Huppin, L. Z., & Walters, L. L. (2011). *Recent advances in orthotic therapy: improving clinical outcomes with a pathology-specific approach*. Albany, NY: Lower Extremity Review LLC.
The Brannock Device Company. (2016). *Instructions & fitting tips*. Retrieved from https://brannock.com/pages/instructions-fitting-tips
U.S. Department of Health and Human Services. (2011). *Medicare podiatry services: Information for Medicare fee-for-service health care professionals* (pp. 1–5). Medicare Learning Network. Retrieved October 2011, from https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/downloads/medicarepodiatryservice-sse_factsheet.pdf
Werd, M. B., & Knight, E. L. (2010). *Athletic footwear and orthoses in sports medicine* (pp. 8–11). New York, NY: Springer.

For additional continuing nursing education activities on orthopaedic topics, go to nursingcenter.com/ce.