

Angel Estrada. Foot Stool Options to Reduce Lower Back Pain. April 8th, 2008

Foot Stool Options to Reduce Lower Back Pain in Office Workers.

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Abstract

Office workers spend a considerable amount of their day sitting at their desks in front of a computer. This paper provides some ideas on how foot stools provide back pain relief and reduce strain on the worker's back and also improving circulation and posture. Several companies have available solutions that provide different methods to relieve and reduce pain. These solutions are analyzed in detail and a recommendation provided for the office worker's personal use.

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Foot Stool Options to Reduce Lower Back Pain for Office Workers.

Introduction & Problem Statement

Back pain is one of the most reported incidents in office environments. According to a study by A. D. Bayeh and M. Smith (1999), in those office workers surveyed to understand how the workstation layout, accessories, and chair cause pain, “100% of the respondents with usable data reported neck pain and 84% back pain” (p. 10). This paper describes how unsupported feet cause back pain and provides an analysis of the commercially available solutions to reduce lower back pain in office workers sitting for long periods of time. Kroemer, Kroemer and Kroemer-Elbert (2001) argue that a footrest is only needed when the workplace design is deficient (p. 435). However, a good design is not always possible and a footrest is a good countermeasure in many cases in which a complete workplace re-design is not feasible.

Kroemer, Kroemer and Kroemer-Elbert (2001) provide a chart defining the forces affecting the third lumbar disc when sitting on a stool without a backrest (p. 209). In those cases where feet are not supported, these forces could be more than 450 N and could cause “disc and facet joint strain”. Even though a backrest is common in most office chairs, when the employee legs are not supported, the body tends to lean forward and the employee loses the back support creating additional strain. A footrest is a practical solution to maintain a straight posture by pushing the body against the backrest and reducing the intra-disc pressure in the lumbar region by almost 100 N.

As can be seen in Figure 1, the disk is compressed by the vertebra and this compression causes pain in the lower spine.

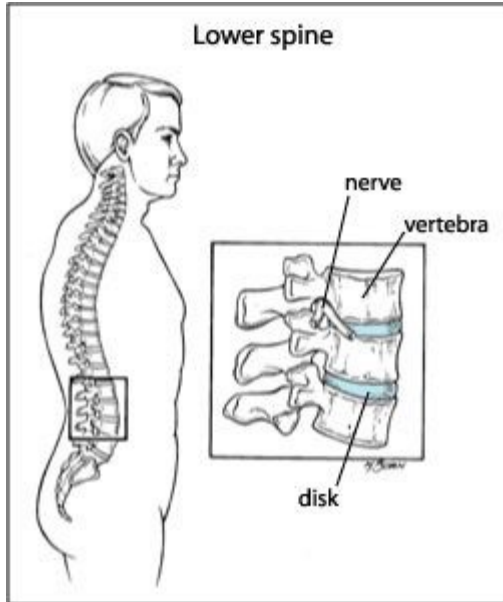


Figure 1

In other situations, the desk or workspace can not be adjusted in height. The appropriate height for the desk is between 60 and 70 cm according to Kroemer et al (2001). This also creates a potential cause for strain in the back because the office worker needs to raise the chair pan for his/her arms to be placed comfortably on the desk. This separates the feet from the floor and again increases the pressure in the lumbar discs.

The issues affecting office workers working long hours in front of their computers have been highlighted in many ways by the media. In an article published in USA Today (Oct, 2002), the author claimed that "sitting in a slumped or awkward position puts a strain on the back, shoulders, and neck. The chair should offer adjustment for the seat, back, and height, if raising the height lifts your feet off the floor, add a footrest." (p. 1).

As noticed, there is a consensus that foot rests provide relief for back pain. In the next paragraphs, the discussion will focus on the different injuries that could occur due to the lack of leg support and their impact on the office worker.

Finally, footrests provide additional benefits to the worker besides reducing back pain. These include improvement of circulation in legs consequently reducing leg fatigue and also reducing neck pain by improving sitting posture.

Background

According to some experts (Goldsborough, 2000), “posture counts” and if it is not possible to sit up straight with the feet on the floor, the office worker should use a footrest (p. 5). However, there is not perfect solution for extended sitting periods and it is always recommended to take breaks every so often to prevent back problems.

Back pain as it was mentioned in the previous paragraphs, is one of the most reported issues in the office environment and has multiple causes. In the majority of cases, the back pain is caused by a previous injury during a straining exercise. Most people do not know the cause of their back pain but one of the main reasons is twisting the back while lifting an object. However, repetitive sedentary positions with poor posture could also cause back pain. In those cases where office workers must sit in front of a computer, the sitting position is critical in the prevention of lower back injuries and in providing relief when a previous injury has occurred.

Lower back pain is one of the most documented reasons for doctor’s office consultations. According to Jenssen, Brant-Zawadzki and Obuchowski (1994), “thirty-one million Americans have low back pain at any given time” (p. 1) and sooner or later they seek some type of relief. This relief comes at a great cost to the employee and the

company. Phillips (2004) estimates that “the cost of back pain in the US is conservatively estimated to be upwards of 90 billion dollars” (p. 1). This number does not take into consideration the loss in productivity because of this issue which could increase this cost even more. Lower Back Pain (BP) is not a simple issue to resolve and by applying ergonomic interventions, the practitioner could help relief some of the symptoms as well as prevent injuries cause by the poor sitting environment of the office worker.

Historical issues around lower back pain and solutions implemented in the past.

In the past, when an office worker did not have a comfortable sitting position because his/her legs were too short or the chair or desk were not height adjustable, a simple solution was to place some books on the floor and to put the feet over them. This would raise the knees to a comfortable position parallel to the floor and relief strain on the lower back. This solution obviously provided an opportunity for the occasional joke and it was not based on scientific fundamentals but just provided a more comfortable sitting position. However, during the last twenty years several devices have been designed to provide some type of relief for the office worker based on scientific data. At the beginning the first foot stools were just no more than a wooden box. Later, these boxes were covered with softer materials like wool or different padded fabrics.

Lately some models are available with built-in heaters to improve comfort and circulation in the legs. Overtime, engineers developed complex devices that could adjust in height to accommodate different people’s legs lengths as well as tilting mechanisms to maintain a straight posture while sitting by forcing the subject to has his/her back in touch with the seat back. Other devices offered a rocking movement to

provide exercise to the legs and many had wider panels made of different materials to provide comfort (i.e. mesh, wood, rubber and steel). Finally other features were added such as rollers to provide an extra massage for the feet and vibration to improve also circulation and reduce stress. A solution offered by 3M Ergonomics has an anti-slip surface to prevent the feet from losing traction while on the footrest.

Potential Issues

In an effort to understand the potential hazards that could be counter measured with the use of a footrest, the following hazards analysis has been created (table 1):

Hazard	Cause	Criticality	Countermeasure
Spinal Disc Compression	Unsupported feet while sitting	High	Height Adjustable Foot Rest
Low Back Pain (LBP)	Unsupported feet while sitting	Medium	Height Adjustable Foot Rest
	Degenerative Disc Disease	High	Tilting Foot rest
	Spondylolisthesis	High	Height and tilting Foot Rest
	Previous Injury	High	Height and tilting Foot Rest
	Congenital Anomalies	High	Height and tilting Foot Rest
Back Injury	Unsupported feet while sitting	High	Height Adjustable Foot Rest

Table 1

Several factors could cause back pain and also major injuries to the back. In those cases where employees already suffer from back problems, the foot rest option could provide some relief and countermeasure any further deterioration of the injury.

However, the highest benefit of the device is in the ability to prevent injuries from occurring and to reduce the sensation of pain in the back.

The hazards analysis has been focused only on the causes of back pain and how the footrest can help alleviate and/or mitigate the effects. The practitioner also understands that the foot rest alone can not provide a solution for all back pain problems, but it is a component of the system that needs to be in placed to eliminate potential sources of injuries and pain. These other components would include desks, chairs, monitors, keyboards, etc. all working as a system to prevent injuries an strain to the office worker.

Foot Rest Requirements

Based on our hazards analysis, we can determine how to mitigate some of the effects and causes of back pain that are related to the positioning of the feet while sitting as well as reduce the pain due to other previous injuries or deceases. However, many other sources of pain will not be addressed by our application of the foot rest in this case.

The major requirements for the device are:

- Height adjustment: The foot rest must be able to adjust for longer or shorter legs.
- Tilting: The foot rest must be able to tilt to adjust to the position of the operator.
- Support Surface: The foot rest must have a support surface wide enough and long enough to fit both feet comfortably.
- Non-Slip: The foot rest should prevent feet from slipping on the surface.
- Softness: The foot rest should be strong enough to last but soft enough to provide adequate support without flexing.
- Durability: The foot rest should last at least 5 years of normal use.
- Safety: The foot rest should not create a safety issue for the user and must meet all safety standards.

- Certification: The foot stool should be certifiable for use in most countries.
- Dimensions: The foot stool should fit under a standard size desk comfortably.

Some of the desired requirements for the foot rest that are not mandatory for use are:

- Temperature management: The foot rest may have a temperature control feature for additional comfort.
- RollerBalls: The foot rest may have roller balls to add a massage option for circulatory help.
- Luxury materials: The foot rest may have premium wood as optional components to add luxury feel to the device.

Based on these requirements, the following steps are to evaluate the commercially available options and decide on the best options to select for the office worker application.

Potential Solutions

A search has been performed in the Internet to look for available footrests for office use. Even though not all possible models have been evaluated, there is a significant number of options available commercially that could provide the relief and benefits sought after.

D. Bayeh and M. Smith (1999), defended in their study that “some people appreciated the footrest as a source of support when the work surface could not be adjusted in height” and that the “biggest improvements were noted for the back (80% of change showed improved condition)” with the use of foot rest devices (p. 10).

The models analyzed have a price range from \$28 to \$130 and come in different sizes and made of different materials. The cheapest ones are simply a plastic stool with

molded rollers and do not provide height adjustment. The most expensive one has a heater feature, tilting capability, height adjustment and built in rollers.

Table 2 provides a summary of the different models, features and dimensions:

Device Name	Company	Price	Dimensions	Features
Foot Trampoline	Levenger	\$28	23 ¾"W x 15 ¾"D x 7 ¼"H	Tilt, Mesh, Rollerballs
Adjustable Foot rest	3M	\$35	22"W x 15" D X 4.75 H	Tilt, Height, Slip Resistant
FootRester	Workrite	\$45	23" W x 11 1/4" D X16" H	Tilt, Extra Height
FM300B	Humanscale	\$95	16" W x 11.875" D x 6.75" H	Tilt, Rollers
FM500	Humanscale	\$130	16.75" W x 12.25" D x 4.5" H	Tilt, Rollers, Rocking
Comfort Tread	HealthyBack	\$30	13" W x 17.5" D x 3" H	Rollers
Toasty Toes	Comfort Store	\$90	18" W x 12" D x 5" H	Heated, Rollers, Tilt

Table 2

Foot Trampoline (Picture 1)

This device is manufactured by Levenger and at \$28 provides a great value. It has a mesh that provides a softer support than traditional harder surfaces but also is constructed of solid wood to provide strength. The stool can tilt to provide better support and has three built-in rollerballs to provide an additional massage during long hours at the desk. The support surface is 23" wide so it would not fit underneath some desks.

The aesthetics are superior to all the other models.

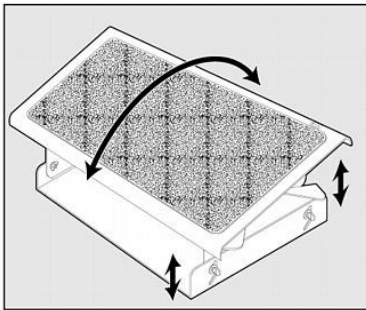


Picture 1

3M Ergonomics. Adjustable Foot Rest (Picture 2)

According to 3Ms product literature:

“The Adjustable Foot Rest by 3M Office Ergonomics has been designed to help align the entire body, reducing strain and fatigue on your legs, back and neck. The height and angle adjustments are independent, maximizing proper body alignment. It has an extra wide 22" platform allowing for more foot and leg movement. The Adjustable Foot Rest is made of sturdy, heavy gauge steel and has 3M Safty-Walk Slip Resistant Material on the platform to keep your feet from slipping.”



*Tilt and height adjustable
for a perfect fit.*

Picture 2

This device has the anti-slip surface which provides an added benefit compared to other footrests options. The construction is metal and can both tilt and adjust in height. It is not as eye appealing as the Levenger one, but it has more adjustments and has better grip. However, the surface is solid versus the mesh in the previous one making it less suitable for use without shoes. Also, it does not provide rollerballs for extra massage.

FootRester 215 by Workrite Ergonomics (Picture 3)

Product Literature:

“Complementary products like footresters are designed to enhance your workstation environment and help you to achieve a proper ergonomic position while sitting at the computer. The sturdy steel frame and aluminum platform combine strength and versatility. The platform's fluid, rocking motion automatically adjusts to changes in body position.

Features:

- Contemporary charcoal finish
- Easy height adjustment locks into place automatically
- Platform measures 23" W x 11 1/4" D and is adjustable in 1" increments from 4" to a maximum height of 16" from the floor
- Extra-wide platform
- Constructed with a sturdy steel gauge frame and 3/8" thick composite plastic
- Comes with 5-year manufacturer's limited warranty.”



Picture 3

Humanscale FM 300B Foot Machine Footrest (Picture 4)

Product Literature:

“Research studies have shown that 70% of all women and 40% of all men have health issues such as blood clots, varicose veins and pressure on the Achilles tendon due to pooling of fluids in the lower limbs — the result of prolonged, inactive sitting. The Humanscale FM 300B foot machine, with its ball-bearing, roller design encourages gentle rocking of the feet in the same way a rocking chair encourages movement. This rocking motion uses most of the lower leg muscles and increases healthful circulation. The Humanscale FM 300B Foot Machine also performs as a standard foot rest, providing support for the legs and relieving pressure on the lower back

The Humanscale FM 300B, with its ball bearing rollers, encourage gentle rocking of the feet in the same way a rocking chair encourages movement. This rocking motion uses most of the lower leg muscles to increase healthy circulation. The FM300B offers built-in massage balls to rejuvenate tired feet. In addition, the FM 300B offers you height adjustment for custom positioning.”



Picture 4

The FM300B has also the rollers and the ability to tilt. However the height adjustment is very limited so it is not suitable for very small or very tall people. This

footrest has a good size surface and it is simple in design. The combination of wood and metal is also appealing aesthetically.

Humanscale FM 300B Foot Machine Footrest (Picture 5)

The product literature for this device is very similar to the FM300B from the same company. However, this unit provides a rocking mechanism to encourage movement. Even though these benefits are great, the unit would tend to slip while rocking and could create a misalignment between the legs position and the torso that creates strain on the back.



Picture 5

AliMed ComfortTread Plus Footrest (Picture 6)

Product Literature:

“**ComfortTread™ Plus Footrest** smoothly tilts and rocks 15° forward and back for comfortable support and lower limb exercise. Three height adjustments (4", 5 ½", 6 ½") for perfect positioning. Textured surface prevents slipping. 4" to 6"H x 14 ¼"D x 18 1/8"W. Gray.”



Picture 6

This footrest both tilts and rocks at the same time. This added benefit makes it superior to other footrests in the table. It has the texture surface with small balls to prevent slipping of the feet and the provide soothing and comfort for long sitting periods.

Toasty Toes Heated Foot Rest (Picture 7)

Product Literature:

“Soothe tired and cold feet with Toasty Toes Heated Footrest. Toasty Toes personal heated footrest allows you to warm and rest your cold, tired feet in your office or at home, while also stimulating circulation. The footrest provides gentle radiant heat and is a safe and energy efficient alternative to a space heater. The two position adjustments let you angle the footrest to help improve posture while sitting.

Features & Benefits of Toasty Toes Heated Footrest:

Direct heat promotes circulation and blood flow to your feet.

Ergonomic design encourages proper seated posture.

Two position settings allow use as a footrest or a flat heating panel.

Built-in thermostat maintains optimal heat output on any setting.

Low wattage footrest is energy efficient for low use cost.

Specifications of the Toasty Toes Heated Footrest:

Material Content: ABS plastic casing.

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Care: Unplug unit and wipe clean with a damp cloth. Allow to dry completely before plugging in to reuse.

ETL listed.

Cord Length: 6 feet.

Measurements: 12" x 18" x 5".

Weight: 5 lbs.”

Undoubtedly, this device has a clear advantage over all the others in the way that provides heat as well as all the other features available in the most popular models. This device replaces the need to have an extra heater to warm the feet in the winter by acting as a thermal blanket.



Picture 7

Selection Process

With so many options available, the selection process is difficult. However, by comparing the requirements with the features offered by the different manufacturers, the worker can make an informed decision.

The following table provides this comparison:

Device Name	Quality	Evaluation	Link
Foot Trampoline	H	H	http://www.levenger.com
Adjustable Foot rest	H	H	http://www.3m.com/product/information/Adjustable-Foot-Rest.html
FootRester	H	H	http://www.ergoware.com/model-215-footrester-p-387.html
FM300B	H	M	http://www.ergodirect.com/product_info.php?products_id=13620
FM500	H	H	http://www.ergodirect.com/product_info.php?products_id=14080
Comfort Tread	L	L	http://www.sitincomfort.com/hefototohead.html
Toasty Toes	H	H	http://www.lifewithease.com/toastytoes.html

Table 3

Basically most of the devices available provide the mandatory requirements needed to prevent injuries and relief back pain. Some of them are most expensive and provide additional desire features that help relief other medical conditions and prevent other injuries.

Based on this and the price of the devices, the user can make an informed decision and select the device that better fit his/her budget or the company budget. The health and safety engineer should be able to use this information to provide an informed decision to those employees at risk due to the nature of their job.

Conclusion

Foot stools are a good option to reduce back pain when used in combination with other tools available to the office worker. The possibility of adjusting the height to make sure the feet rest comfortably and legs are square to the floor is critical to reduce back pain and prevent permanent injuries to the spinal discs. However, the user has to perform the due diligence necessary to understand the features that add value to his/her specific setting. Several devices have plenty of features that the average worker would not use, but will pay for it when purchasing it. Understanding the needs of the user goes along way in defining the device that will provide the highest benefit over time.

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