ERGONOMIC ASSESSMENT REPORT

Company:
Reach Right
2315 University Drive N, Suite L2
Fargo, ND 58102

Contact: James Pladson, Guy Nelson & Mike Rydell

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Ergonomic Assessment of a Secondary Handle, Reach Right

Reach Right contacted Alter Ergo to evaluate a secondary shovel handle, which is currently in the final stages of being developed. Alter Ergo completed an ergonomic assessment in relation to Reach Right on December 13th, 2022 to identify the benefits and the ergonomic qualities of the handle. An initial ergonomic assessment was completed by Alter Ergo on September 2nd, 2022 to identify risk factors for cumulative trauma and provide recommendations to reduce the risk of injury and musculoskeletal disorders.

Reach Right is a secondary shovel handle that attaches to the shaft of a shovel, using two arms, with one clamp each, that align axially with the shovel handle. The two clamps include T-knobs which are designed to tighten the clamp onto the shaft of the shovel to maintain the position of the handle during forceful lifting, pushing and other shoveling motions.

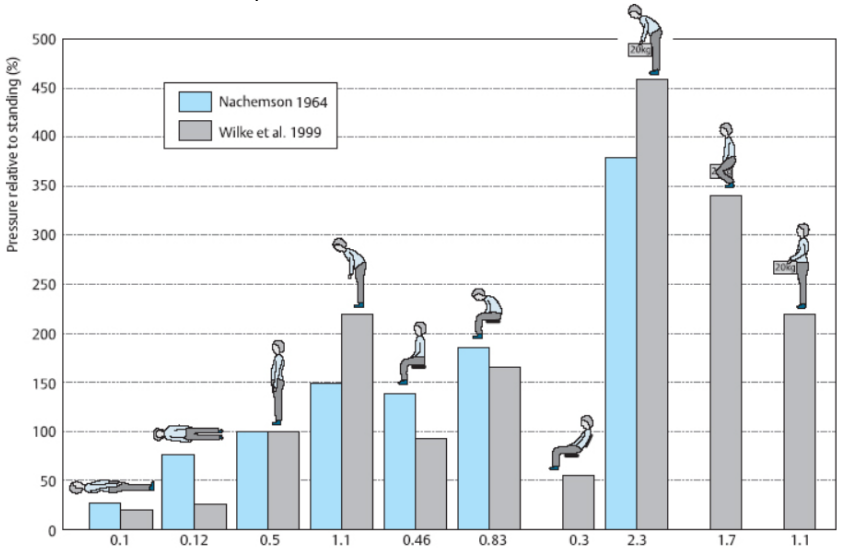
Name: James Pladson, Mike Rydell & Guy Nelson

Job Title: Owner

Job Description and Statistics in Relation to Shoveling

Laborers complete various job tasks which include many physical demands including but not limited to standing, crouching, forward bending, reaching, pushing, pulling and grasping. One of the more common tasks that is completed, and more strenuous tasks is the process of shoveling. Developers of Reach Right have created a solution to improve the ergonomic aspects of shoveling which aim to reduce the risk of injury to workers and reduce the risk of a musculoskeletal disorder.

In the 1970's what has become classic research studies in the investigation of posture influences on in vitro lumbar intervertebral disc pressures were conducted by Alf Nachemson, MD, PhD and colleagues. Results revealed increased discal pressures in out-of-neutral spine configurations. With in-vitro lumbar intervertebral disc pressures normalized to 100% when in a neutral upright standing position, pressures in various postures were measured. For example, a similar position that one may be in when shoveling; a straight-leg/back-bent posture of 30 degrees forward bend resulted in about 225% increase. Lifting about a 30-pound box from a 30-degree flexed forward posture of the low back position results in almost a 500% increase.

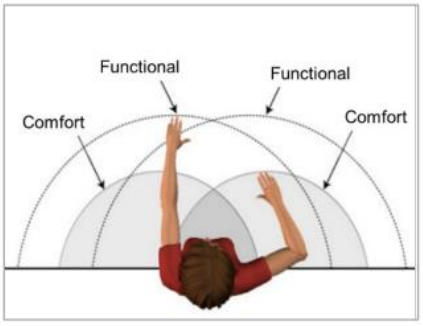


Comparison of disk pressure measurements by Nachemson et al. (1964) with those of Wilke et al. (1992– 2001). The absolute pressure values shown below the bars are from the newer measurements. The relaxed sitting position with reclined backrest, in which part of the weight of the upper body is supported by the backrest, yields a lumbar intradiscal pressure of 0.3 MPa and is thus associated with a significant reduction of stress on the lumbar disks. The low pressure allows fluid uptake into the disk even during sitting (see Chapter 4) (from Wilke 2004).

A thesis was completed by Kelly McAuley, Advisor: Dr. Steven Lavender, titled “Ergonomic Evaluation of Two Alternative Handles for Shovels and Rakes Designed to Prevent Low Back Pain". The study found that both handles significantly reduce twisting moment, twist angle, and flexion angle during the shoveling task. When using the handles during raking task, only flexion was significantly reduced. In conclusion, the products present a possible way to decrease the risk factors associated with raking and shoveling.

Positive ergonomic aspects of Reach Right:

- Improves posture by decreasing forward bend
- Allows worker to keep both upper extremities in the (or closer to the) Power Zone/ Comfort Zone
- Easily adjustable to accommodate for various sizes of workers
- Accommodates for left- or right-hand dominance
- Improves upper extremity positioning by reducing excessive pronation and/or supination
- Current material is lightweight



The following areas were evaluated at the time of the ergonomic assessment. The chart below is divided into two sections which include a concern and an intervention. Each concern that is addressed is provided with an intervention. These interventions help to reduce the risk of a musculoskeletal disorder (chronic injuries to your muscular and skeletal system due to unsafe body mechanics and positioning or repetitive motions). Each concern references a specific point regarding Reach Right. Image below is a reference for each concern.

Ergonomic Design	Ergonomic Information
Smooth, rounded, cylindrical handle	A smooth, rounded handle reduces pressure points to hands and digits. In general, cylindrical handles offer a better grip.
Handle diameter	The diameter of the handle is designed for an optimal grip. In general, the recommended diameter of a handle for an optimal grip is 1.25 - 2 inches. The larger diameter will allow for a maximum torque, while the smaller diameter helps with dexterity and speed.
Handle length with no areas of pressure points	The length of the handle is designed to accommodate a large variety of hand sizes; with and without gloves on.
Extended handle	Having an extended handle improves the overall posture by decreasing forward trunk flexion when in use.
Neutral handle positioning	Avoiding extensive forearm supination and pronation decreases the risk for an injury.
T-knob size	Manipulating the clamps and adjusting the T-knob can be completed with or without gloves on and are designed for all hand sizes while eliminating a lateral pinching position with increased force.

Range Of Motion Comparison of Shoveling With and Without Reach Right

Range of motion **with** Reach Right				
Worker position: Upper extremity on Reach Right (fulcrum) attached to shaft of standard shovel and opposite upper extremity on end shaft of standard shovel				
		Worker height: 6'5"	Worker height: 5'1"	Worker height: 5'9"
Range of motion from pre-shoveling to mid-shoveling	Shoulder flexion:	10-55 degrees	21-37 degrees	12-31 degrees
	Elbow flexion:	130-168 degrees	90-125 degrees	112-132 degrees
	Trunk flexion:	10-30 degrees	10-12 degrees	5-13 degrees
	Hip flexion:	6-55 degrees	6-21 degrees	8-42 degrees

Range of motion **without** Reach Right				
Worker position: Upper extremity on mid-shaft (fulcrum) of standard shovel and opposite upper extremity on end shaft of standard shovel				
		Worker height: 6'5"	Worker height: 5'1"	Worker height: 5'9"
Range of motion from pre-shoveling to mid-shoveling	Shoulder flexion:	43-69 degrees	29-41 degrees	48-63 degrees
	Elbow flexion:	161-168 degrees	156-155 degrees	159-173 degrees
	Trunk flexion:	56-57 degrees	6-31 degrees	46-64 degrees
	Hip flexion:	49-88 degrees	48-51 degrees	80-100 degrees

*Measurements were obtained with a standard goniometer by one evaluator to maintain consistency. The above measurements include a starting range of motion and ending point range of motion for the shoveling process. The starting measurement was obtained when the worker placed the shovel on the ground prior to pushing the shovel forward. The ending point measurement was obtained immediately prior to the worker lifting the shovel upward.

Conclusion of comparison of shoveling with Reach Right and without Reach Right: Based on the small sample of three people, it is noted that using Reach Right can significantly improve posture and decrease extended reaching when shoveling as compared to shoveling without Reach Right.

Positioning Recommendations

In order for the upper extremities to remain in the comfort zone a majority of the time while maintaining a more upright posture, Reach Right should be placed in a position that allows hands to also be placed in a position that is similar in distance to shoulder width. Three participants trialed the use of Reach Right. After education about positioning and comfort zone, the person that is 6'5" found that a comfortable distance between one hand on the end of the shovel shaft and one hand on Reach Right is 19". This same position for the person who is 5'9" is a distance of 17". The person who is 5'1" determined that 15" is a comfortable distance. The distances that were found to be in a comfortable position were all also recommended by this writer and based off of natural body mechanics while considering neutral positions. Therefore, it is recommended that the top section of Reach Right is placed approximately 15 to 19 inches from the end point handle (as noted with an orange line below).

Comparison of Secondary Shovel Handles

Qualities	Handle			
	Reach Right	Radius Garden	The Rah!	The Heft
Improves Posture	✓	✓	✓	✓
Bilateral upper extremities in Comfort Zone majority of time	✓	✓	✓	✓
Easily installed while wearing gloves	✓	X	X	✓
Easily installed without gloves	✓	X	✓	✓
Maintains position on shaft of shovel	✓	✓	X	X
Accommodates for left or right hand dominance	✓	✓	✓	✓
Improves upper extremity positioning	✓	✓	✓	✓
Lightweight	✓	✓	✓	✓
No pressure points	✓	✓	✓	✓
Handle diameter supports power grip	✓	✓	✓	✓
Adequate space for hand when gripping	✓	X	✓	✓
Supportive of upper extremity dynamic positions and movements	✓	X	✓	✓
Attaches to a large variety of tool shaft sizes	✓	X	X	X
*Weight of each handle:	15.4 ounces	17.9 ounces	14.4 ounces	14.4 ounces

Notations related to *Comparison of Shovel Handles* chart

1. The weight of Reach Right of 15.4 ounces was obtained on 9.10.2022. The final weight of Reach Right may be different than what is noted.
2. Comparison of shovel handles is based on the opinion of this writer.
3. Considering all handles that were assessed in the above chart: lifting the shovel to an elevated height may create an awkward posture with increased back extension, such as lifting material into a wheelbarrow.

General Shoveling Recommendations:

- The most efficient shoveling rate is estimated at about 18-21 scoops per minute. However, fatigue builds up over a short time at this rate. Therefore, the recommended rate for continuous shoveling tasks is usually considered to be around 15 scoops per minute.
- Tasks involving continuous shoveling should not be carried on longer than 15 minutes at a time.
- Shoveling rate per minute also depends on how easily the shovel can be inserted into the material being moved, the stability of the material being moved, and the weight of the material

- The rate of rest break depends on many factors. Since most shoveling is done outdoors, consideration for the prevailing conditions is very important. In more extreme conditions such as very hot and humid, or very cold and windy, 15 minutes of shoveling should be followed by 15 minutes of rest.
- The load lifted should be adjusted according to the shoveling rate. For a high rate of shoveling (about 15 scoops per minute) the total weight (weight of shovel plus a shovel load) should not exceed 10 to 15 pounds. For higher weights, a lower rate of scoops per minute is suggested.
- Throw height should not exceed 4 feet. The optimal throw distance is about 3 feet. The load should be reduced if the task requires a longer throw.

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12.13.2022

Date