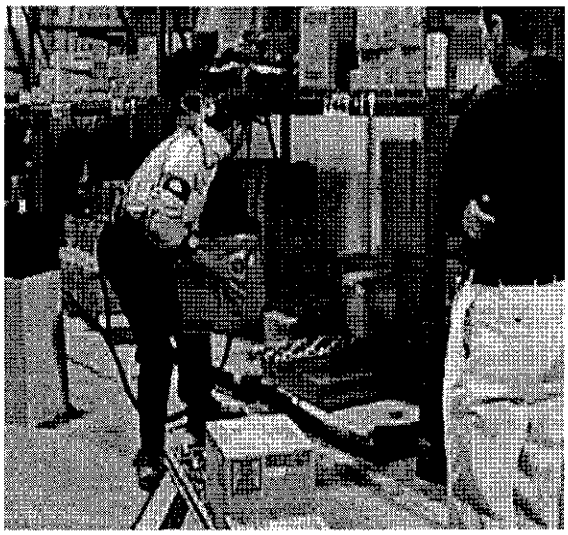
A Test of the *LiftTrainer*: An Aggressive Approach for Preventing Back Injuries Through Training

Steven A. Lavender, Ph.D., CPE
Department of Orthopedic Surgery
Rush Presbyterian St. Luke's Medical Center
1653 West Congress Parkway
Chicago, IL 60612
slavende@rush.edu
312-942-5000 X29724

Most jobs in warehousing and distribution require a considerable amount of manual material handling. Many studies have shown that the way an individual lifts and handles objects can have a substantial impact on the resulting spine loads (Buseck, Schipplein, Andersson, & Andriacchi, 1988; de Looze, Toussaint, van Dieen, & Kemper, 1993; Dolan, Mannion, & Adams, 1994; Leskinen, Stalhammar, Kuorinka, & Troup, 1983; Toussaint, van Baar, van Langen, de Looze, & van Dieen, 1992; van Dieen, Hoozemans, & Toussaint, 1999). This suggests that training on manual material handling (lifting) techniques potentially plays a critical role in the prevention of work related low back disorders. The purpose of this study was to quantify the effectiveness of a new behavior-based approach for training workers on lifting techniques.

In this new training approach, employees are coached through a series of 5 one-on-one sessions. At the beginning of each session the trainee is instrumented with sensors from an electromagnetic motion measurement system called the ***LiftTrainer***^{TM}. The sensors provide the kinematic data necessary for a 3 dimensional dynamic model of the upper body. The model is comprised of two lower arms, two upper arms, a head, and a rigid torso segment. Static hand forces are determined by having the trainees' lift and place objects from one scale to another. The dynamic components of the hand loads are computed based on the acceleration of the lifted object. The motion data, collected at 103 Hz, are combined with the hand loads in the model to compute the moments and forces through the kinetic chain, starting at the hands, and terminating at the base of the spine (L5/S1). The magnitude of this three-dimensional moment vector is computed in real time and used to control the pitch of the "biofeedback" tone. Quite simply, the larger the moment vector, the higher the pitch of the tone heard by the trainee. Data showing the peak forward bending, twisting, and side bending moments at the spine are displayed graphically for the trainee in between sets of lifts.

Once the participant has been "wired-up", he or she is asked by the coach to perform a lifting task. The parameters of the task vary from training site to training site, depending on the nature of the work performed. For warehouse workers, the task requires boxes be "picked" from a specified location ("slot") and placed approximately 1 meter away. Although, the distance may be adjusted by the trainee if they indicate that their normal approach would differ from the initial layout. The task is comprised of a set of lifts, usually between 3 and 6 depending on the configuration. The first time through the task serves as baseline data for each individual trainee. The peak moments in



each plane (forward bending, twisting, and side-bending) are then presented graphically and explained to the trainee. Following the explanation the "biofeedback" tone is turned on and the trainee is instructed in how to interpret the feedback. The session then enters the coaching phase during which the trainee is coached on how to improve his or her lifting techniques based on the audio feedback and the charted data. As the thirty minute session draws to a close, the tone is turned off and the trainee is asked to perform the lifting sets without the feedback. The final set is then compared with the initial set to determine the degree of improvement that was achieved over the course of the session.

To date seven facilities are participating in the study. Over 293 individuals have received between 1 and 5 sessions, depending upon how far along each company is in its participation. Most of the trainees work in warehouses where their primary responsibilities consist of picking and palletizing cases for shipment. The remainder work in delivery jobs (beverage or food products). Table 1 shows the average improvements seen in the first session for the companies participating in the training study.

Clearly, the biggest percentage gains tend to be in the side bending and twisting moments. The magnitude of the forward bending moment is largely dependent upon the degree of trunk flexion. Instructing employees in strategies to maintain a more upright torso has been only marginally successful. Most are unwilling to shift toward more leg intensive strategies. However, small reductions in the forward bending moment can be achieved by addressing the smoothness of the lift. The side bending and twisting moments on the spine are largely affected by the box trajectory and the movement of the feet. These become key areas of focus during the coaching process.

Table 1. The percent change in the forward bending, twisting, and side bending moments between the averaged first and last sets of the initial training session.

Company	N	%Change Forward Bending Moment	% Change Twisting Moment	% Change Side Bending Moment
A	70	4.6%	19.9%	24.0%
B	80	5.1%	11.7%	34.2%
C	25	2.6%	21.5%	32%
D	22	9.0%	18.6%	0.5%
E	34	2.9%	-11.2	11.4%
F	34	5.0%	-1.3%	9.2%
G	28	6.9%	21.6%	35.6%

In general, most of the participants have indicated that they feel this approach to training has been beneficial. When asked about what they like most about the training, most point to the value of having objective data to indicate whether the modifications to their box handling techniques are beneficial. Ultimately, this training needs to change the lifting behaviors these people elect to use every day on the job. The belief that the learned techniques are truly beneficial is critical in encouraging these employees, many who have been doing these material handling jobs for over 10 years, to incorporate the learned techniques into their regular behavioral repertoire. Obviously, this is required for training to actually reduce injuries.

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