

WORKPLACE SOLUTIONS

From the National Institute for Occupational Safety and Health

Reducing Work-Related Musculoskeletal Disorders among Rodbusters

Summary

NIOSH evaluated reinforcing ironworkers' (rodbusters) exposures to risk factors for developing low-back and hand disorders when tying together reinforcing steel bars (rebar) on a freeway bridge. Rodbusters used three techniques to tie rebar together—a pliers and a tie wire wheel, a battery operated power tier (PT), and a PT with an extension handle (PTE). NIOSH found that using the PT and PTE reduced the rodbusters' exposures to risk factors for work-related low-back and hand-wrist disorders. In addition, power tying was twice as fast as than pliers tying.

Description of Exposure

Reinforcing ironworkers have reported high prevalence rates for work-related musculoskeletal disorders (WMSD) symptoms affecting the low-back (80.2%) and wrists/hands (48.4%) [Cook et al 1996]. Boston-area rodbusters reported high

prevalence rates for self-reported symptoms of the low-back (52.2%) and hands/wrists/fingers (47.8%) and high prevalence rates of doctor-diagnosed WMSDs, including ruptured spinal discs (14%) and carpal tunnel syndrome (16%) [Forde et al. 2005].

Traditionally, *pliers and a tie wire wheel* have been used to pull, wrap, twist, and cut the 'tie' wire around two or more concrete reinforcing bars. This requires using both hands and making rapid and repetitive hand, wrist, and forearm movements while gripping the pliers. In recent years, *power tiers* have become available. The PT is a battery-powered and trigger-operated wire tier that automatically wraps, cuts, and ties the wire around the rebar. Tying rebar at ground level using either the pliers or the PT requires working in a stooped posture. A height-adjustable extension handle (PTE) is commercially available for one type of hand-held PT enabling the worker to tie the rebar while standing.

Evaluation

A concrete reinforcing contractor requested that NIOSH evaluate workers' exposures to WMSD risk factors

during rebar tying on a freeway bridge deck construction project that required making more than 2 million "ties." The contractor's workers used both pliers and PTs to tie rebar. NIOSH introduced the PTE as a third technique to be investigated in the study. Although rodbusters perform other job activities that require "maximum muscle force to lift, push, pull, or carry objects" [ONET 2008], NIOSH analyzed only rebar tying during this study because of the nature of the request and time constraints.

The three rebar tying methods were studied with relation to (1) hand, wrist, and forearm position and movements and (2) trunk (or back) position.

Results

Hand/Wrist

- *Pliers* tying involved the most hand, wrist, and forearm motions and the highest risk for developing a WMSD of the hand-wrist (see Figure 1).
- *PT* and *PTE* tying involved fewer hand, wrist, and forearm motions and less risk for developing a WMSD of the hand-wrist.



Figure 1. Rebar tying using pliers. Note the bent posture and awkward hand position.

- Workers rated hand-wrist effort highest for *pliers* and the *PTE*, and least for *PT* tying.

Low-back

- *Pliers* tying at ground level involved the most risk for low-back problems.
- *PT* tying at ground-level allowed workers to support the weight of their trunk with one hand.
- *PTE* tying could be done standing-up with the least strain on the low-back.
- Workers said they had the most low-back discomfort using *pliers* and the least using the *PTE* and the *PT*.

NIOSH found that the frequency and duration of the hand and wrist motions are associated with increased risk of a hand-wrist WMSDs [NIOSH 2005]. The similar effort ratings for tying with pliers and the PTE conflict with the results of other studies in which workers having experience using the extension handle reported much less effort [Vi 2003]. Workers did not have time to use the extension handle before this study began. Consequently, workers were observed holding the PTE far from the body, which would increase the stress on the shoulder, elbow, and wrist.

Workers reported less low-back effort using the PT than the pliers, although both required frequent and prolonged stooping (see Figure 2). During the study, NIOSH observed all workers using the free hand/arm—the one not holding the PT—to support their body when stooping. This posture likely reduced the stress to the low back and the report of less low-back effort, which is consistent with other reports [Gallagher et al 1988; Ferguson 2002; Kingma 2004].

Tying rebar using the PT and PTE was faster than using the pliers. Workers were able to complete twice as many ties during the study period with the PT as compared with the pliers. Vi [2005] reported that PTE tying by experienced workers was twice as fast as pliers tying. Contractors and workers have reported difficulties with power tier use that can affect actual productivity levels, including tool malfunction, wire jams, and short battery life [ORISE 2007]. Power tiers can make one type of tie and are not appropriate for all applications.

Recommendations

Contractors and workers should take the following steps to reduce the risk of developing MSDs when tying rebar on freeway bridge decks and other construction



Figure 2. Rebar tying using a MAX-USA RB-392 power tool. Note the bent posture.



Figure 3. Rebar tying using a MAX-USA RB-392 power tool with adjustable extension.

projects requiring frequent and prolonged rebar tying. [Albers and Hudock 2007; NIOSH 2005]:

- Use PTs instead of pliers to reduce harmful hand-wrist movements.
- Use a PTE when tying ground level rebar.
- When using a PTE, hold it close to the body to avoid unnecessary stress and strain on the wrist, arm, and shoulder (see Figure 3).
- When using a PTE extension, adjust the height of the hand-grip so that it can be firmly held with your arm hanging relaxed to minimize stress on the upper extremities and low back.
- Report low-back or upper-limb aches, stiffness, or pain that may be due to your work to your health care provider.

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NIOSH [2007]. Simple solutions: ergonomics for construction workers. By Albers J and Estill C. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2007-122 [<http://www.cdc.gov/niosh/docs/2007-122/>].

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