

# Rebar-tying machines reduce musculoskeletal injuries



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## Injuries

Rodworkers in Ontario have a higher lost-time injury (LTI) rate than the construction-industry average. This is due to a high rate of non-traumatic musculoskeletal injury.

“Rodwork” refers to the handling, storage, transportation, and installation of the reinforcing steel or “rebar” used in concrete construction.

Reducing the physical load experienced by rodworkers would reduce musculoskeletal injury. Recent research suggests that interventions should focus on reducing the frequency of awkward trunk postures. Workers often adopt awkward postures when tying rebar manually with pliers.

One way workers can reduce the frequency of these postures is to use an automatic rebar-tying machine. The machine eliminates the need for stooping when a worker ties rebar on a horizontal platform.



A rebar-tying machine



Tying rebar: Using a machine with an extension arm (left) or pliers (right).

## Study

The Construction Safety Association of Ontario and the Ironworkers' Local 721 undertook a study to evaluate whether using a rebar tying machine with an extension arm would lead to a reduced risk of musculoskeletal disorders.

The study took place in the field and examined ground-level rebar tying. Eleven rodworkers participated. Variables such as trunk postures and rebar-tying cycle were quantified and measured in workers for both manual and machine tying.

Researchers used a before-and-after approach. First, they measured workers tying rebar manually. Three months later, they measured the same workers tying rebar with the machine.

After each phase (manual tying and machine tying), researchers asked participants to complete a questionnaire concerning the work method they just used.

## Results

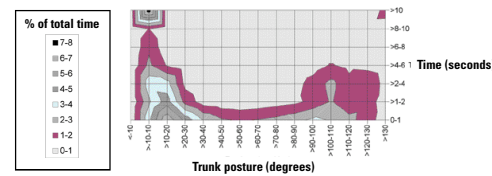
Average rebar-tying time was different for the two methods. Average tying time using the manual method was 8.9 seconds. Average tying time using the machine was 4.2 seconds—52% less than the manual method.

The workers' trunk postures differed according to the method used. During manual tying, workers spent by far the most time in neutral (<20°) and extremely awkward (>60°) trunk postures. During machine tying, the magnitude, frequency, and duration of trunk postures was concentrated between angles of >-10° and <50°.

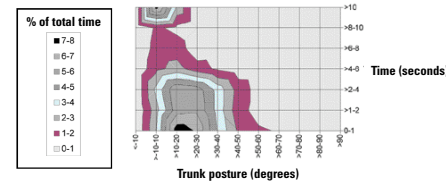
The amplitude of the median and peak trunk-posture level was significantly ( $P < 0.05$ ) higher when participants tied rebar manually.

The participant questionnaires indicated that generally workers preferred working with the machine for ground-level rebar tying.

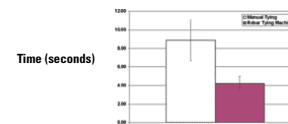
## Trunk posture, manual tying



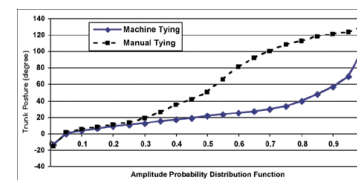
## Trunk posture, machine tying



## Tying time compared



## Trunk posture amplitude



Average amplitude probability distribution function of trunk posture.

## Recommendations

Based on the findings of the study and the experience gained in carrying it out, the research team recommends that the following issues be considered when introducing or using the rebar-tying machine in the workplace.

1. Productivity can be substantial when the machine is used in a crew of **4-5 workers**. One worker uses the machine to tie rebar, two workers handle and place the rods, and a fourth directs the work.
2. Workers with low-back or hand injuries will suffer less stress using the machine instead of manual tying. The machine can be used in a **return-to-work** program.
3. You can use the machine for **more than rodwork**. You can use it to tie electrical conduit and radiant heat tubes. This can lower the risk of musculoskeletal injuries among electricians and heating-tube installers. The productivity benefits of the machine are even more dramatic for these trades than for rodworkers. Manual tying is a much slower process for electricians and heating-tube installers than for rodworkers, so the productivity benefits of the machine are greater.
4. Choose a machine that allows tying rebar at a comfortable back posture. An **adjustable** extension arm helps to ensure that rodworkers of different heights can tie rebar in a neutral trunk posture.
5. Select a machine that can tie **various sizes** of rebar.
6. Select a vendor that will provide **ongoing support** and regular maintenance for the machine.
7. If you use the machine to tie slab-on-grade rebar, you will need to use a lightweight **steel hook** to lift the rebar off the ground (see photo at right).
8. Many machines require **warm-up** in cold conditions. You will need to adjust the tying tension of the machine in the cold.
9. On hot summer days, allow the machine to **cool** in a shady area during break times.



## Acknowledgements

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