COMPARISON OF ANTI-VIBRATION INTERVENTIONS FOR USE WITH FASTENING TOOLS IN METAL

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Introduction

Tool manufacturers continue to incorporate new designs to the internal mechanism of tools in order to decrease the vibration that is delivered to the hand during operation. Modification of some tools to minimize tool vibration is not easily resolved through internal tool design. For this reason, vibration damping materials applied between the tool and the hand are a simple alternative. The damping materials may be applied to the area of the tool directly contacted by the operator or in a glove containing a vibration absorbing pad. These interventions are developed specifically to damp vibration but are not necessarily produced and tested under the same work conditions that a company may expose their workers. Therefore, it is important to test the value of the proposed interventions for the specific applications. This study evaluates the effectiveness of anti-vibration interventions currently in use at a local manufacturing company.

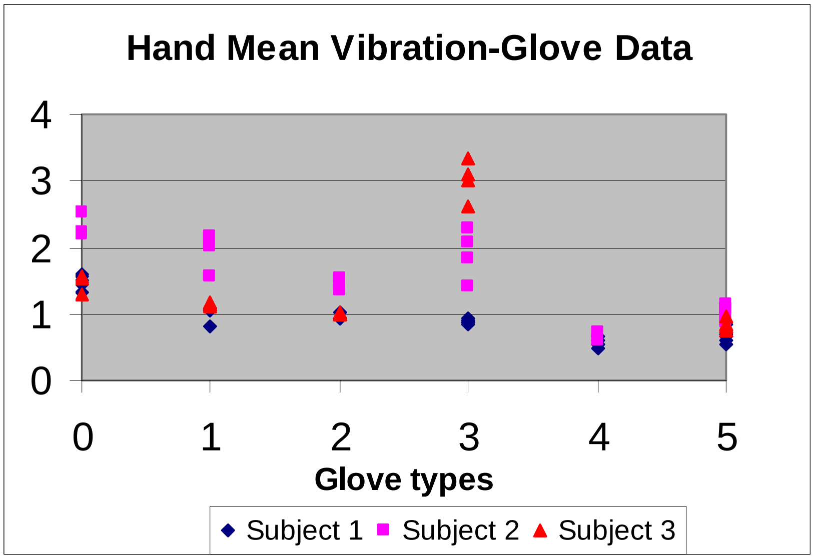
Methods

The design of this study evaluates the vibration energy produced at the tool handle and from the back of the operator's hand. Each operator performed a series of fastener installations in metal using several interventions and one series with no intervention as a control. Four of the interventions were gloves containing anti-vibration material and the fifth intervention was an anti-vibration material wrapped around the tool handle. The protocol for wrapping the tool handle was developed and is part of the equipment procedure at this manufacturing company. Test conditions mimicked production work conditions including similar materials, fasteners and technique for installation. Vibration values were collected using 3 tri-axial accelerometers with one firmly glued to the tool handle close the hand grip as recommended by ISO 5349. A second accelerometer was placed on the top of the pistol shaped tool. The third accelerometer was attached to the back of the hand close to the third knuckle using double sided tape.

Results

Preliminary results for 3 volunteers show a difference between the vibration values of the control condition (mean hand vibration on bare hand = 1.77 Gs) compared to all of the interventions (p=.0001 using Mixed Procedure, Tests of Fixed Effects).

The graph below shows individual trials for each subject for each condition. Glove 3 with the air bladder insert shows large variability between subjects (Range = 0.84-3.33 Gs). The other interventions show much less variability both within subjects and between subjects indicating consistent response with use of the intervention.



Glove Types
0 = bare hand
1 = mesh
2 = wrist support
3 = air bladder
4 = foam
5 = wrapped handle

Discussion

All interventions showed less vibration energy produced at the level of the hand compared to the control condition. Thus providing an interface between the operators hand and vibration source decreased the energy directed to the operator. Three of the gloves produced a beneficial response with minimal variation. Intervention glove 3 containing the air bladder provided less consistent beneficial effects due to the large variability in response. This device requires the operator to manually pump the air bladder to the desired level. The manufacturer recommends pumping the air bladder 50 repetitions prior to the initial use and a few additional pumps each day the glove is used. The amount of air delivered to the glove for this pilot was determined by the personal preference of the subjects and resulted in large variability in vibration output.

Intervention 5 consists of a Viscolas™ material wrapped over a tool handle, and held in place with shrink wrap. The manufacturing company developed this method to provide protection to the workers with a durable wrap that was cosmetically pleasing. The lowered vibration values for the Viscolas™ wrapped handle compared to the control indicates the method of wrapping the handle is protective to the operator.

Since both the gloves and the Viscolas™ wrap on the handle of the tool measured lower vibration values, work conditions and behaviors of the workers should be considered to determine the recommended intervention. Use of gloves to minimize vibration exposures requires the operator's consistent use of the glove during all tool use. Wrapping the handle of a tool to protect a worker from vibration exposures does not depend upon a worker's behavior for effectiveness. Assuming all areas of the tool encountered by the hand are covered with the Viscolas™ material, every time the worker grasps the tool, the hand is protected. Since three of the gloves in the study are fingerless, the anti-vibration material will not protect the exposed skin. Operators cannot manipulate small fasteners with full fingered gloves. Recommendations for anti-vibration materials for use in a work force should consider the work methods and behaviors of the operators. In determining a recommended intervention for a particular manufacturing process, it is important to test the real physical conditions as well as the typical behaviors of the workers.