

**Attachment K:
Details of Interventions**

Tool Support (TS) Intervention

TMMK has pilot tested an articulating tool support device (TS) as an engineering control to reduce muscular loading as a countermeasure for the problem of overhead work and its contribution to shoulder-related MSD symptoms. The TS includes an articulated arm with multiple spring-tensioned joints originating from a dolly mounted base that can be moved with the assembly line. The device enables workers to maneuver tools as if they are weightless, but without loss of range of motion. The TS unloads the mass of the tool from the employee, potentially saving the employee from 48 minutes of supporting a 4.5 lb load above shoulder height over the course of a two-hour work period. The TS device is not *believed* to change working posture or the duration of time the employee's arm is held elevated (a hypothesis that will be tested in study phase I). It is, however, expected to reduce scapulohumeral shoulder muscle fatigue accumulated over the work shift. TMMK has found that the intervention is widely accepted by employees on the chassis assembly line and, based on a few anecdotal reports, has reduced shoulder symptoms and discomfort among these employees.

The tool support contains a gimbal mount for a pistol grip nut running torque tool that is suspended at the end of the articulating arm. Adjustment of spring tensions are “tuned” to the mass of the tool supported. See Figure 1.



Figure 1. Tool support intervention.

Exercise Intervention

TMMK has previously pilot tested a “shoulder school” exercise program (E), developed and administered by a physical therapist, to condition the musculature of the employee’s shoulder complex and improve their musculoskeletal responses to overhead work. This program is similar in design to therapeutic exercise programs designed to modify motion and muscle activation abnormalities that are believed to be pervasive amongst those whose occupation requires significant exposure to humeral elevation and overhead work (Wang et al., 1999; Bang and Deyle, 2000; Ludewig and Borstad, 2003). The general strategies of these programs include: (1) strengthening of serratus anterior and the rotator cuff musculature; (2) enhancing normal patterns of scapulohumeral motion that reduce activation of upper trapezius, and (3) stretching to reduce “tightness” (shortness) in pectoralis minor and the posterior capsule of the glenohumeral joint. The “shoulder school” program was evaluated by Toyota in a quasi-experimental pilot test with six employees over a four week time period. Four of the six participants realized appreciable gains in functional capacity in four weeks. During that period study participants reported an 83% reduction in ratings of discomfort and the percentage of work shifts in which these employees reported experiencing no shoulder discomfort or fatigue increased from 53% to 92% (Burton and Jones, unpublished internal report).

Table 1 lists the specific exercises in the shoulder exercise program.

Table 1. Summary of Relevant Exercise Programs for Occupational Shoulder Pain. (Shown with representative studies of preventive exercise programs for shoulder pain/symptoms.)

Target joint, muscle, or movement	L.L. Anderson et al. (2010)	C.H. Anderson et al (2011)	Bang and Deyle (2000)	Ludewig (2003)	Borstad et al (2009)	Camargo et al (2009)	McClure et al (2004)	Burton and Jones Toyota -** Unpublished
Stretch of Posterior capsule			Cross body adduction of humerus; passively increase stretch with opposite arm	Cross body adduction of humerus; passively increase stretch with opposite arm	Cross body adduction of humerus; passively increase stretch with opposite arm	Cross body adduction of humerus; passively increase stretch with opposite arm	Cross body adduction of humerus; passively increase stretch with opposite arm	
Stretch of Pectoralis minor			Forearm on a wall, lean inward	Hand on walls of a corner of a room or doorway, lean inward	Hand on walls of a corner of a room or doorway, lean inward	Hand on walls of a corner of a room or doorway, lean inward		Forearm on a doorframe, lean inward
Stretch of Rotator cuff							Hold towel behind back, use other arm to pull towel up the back	
Stretch of Upper trapezius					Seated, lean head left, drop forward and rotate chin to the right. Increase stretch passively using other hand.	Seated, lean head left, drop forward and rotate chin to the right. Increase stretch passively using other hand.		Standing, lean head left, drop forward and rotate chin to the right. Increase stretch passively using other hand.
Selective Inhibition of Upper trapezius				Relaxation of upper trapezius when elevating humerus overhead				
Strengthening Serratus anterior		Push-up plus (modified)	Elbow push up plus	Lying scapular press with dumbbells	Push-up plus	Seated push up plus with band		Wall push up

Strengthening Rotator cuff (external rotation)			Horizontal extension with external rotation (with bands)	External rotation with bands Upper arm at side and upper arm abducted	External rotation with bands	External rotation with band		External rotation with bands
Strengthening lower and upper trapezius - scapular retraction	Shoulder shrugs (dumbbell)		Standing rowing with band			Standing rowing with bands	Shoulder pull backs with bands	Shoulder pull backs with bands
Strengthening lower trapezius - scapular depression		Seated press-up	Seated press up					Elbows in back pockets
Strengthening Abduction (glenohumeral)	Lateral raises (dumbbell) Reverse flies (dumbbell)		Scaption with band			Abduction with band (scaption)		
Strengthening Flexion (glenohumeral)	Front raises - shoulder flexion (dumbbell)		Shoulder flexion (elevation) with band					

TMMK SHOULDER STRENGTHENING EXERCISE PROGRAM



Chest Stretch

1. Stand with one forearm on the doorframe.
2. Step into the door opening so that you feel a stretch.
3. Hold for 20 seconds.
4. 4 repetitions each arm.



Elbows in Back Pockets

1. Stand with feet shoulder width apart and elbows bent to about 90 degrees.
2. Move your elbows down and in, as if to PUT YOUR ELBOWS INTO YOUR BACK POCKET. You will feel shoulder blades pinch together and your upper trunk arch backwards.
3. Hold for 2 seconds.
4. Repeat 10 reps
5. 2 sets
6. 20 seconds between sets

Note- This is an exercise that you should do frequently all day as a counterstretch.



Arm Raise

1. Stand with back against wall
2. Keep arms against the wall and raise them overhead.
3. DO NOT bring hands together as shown in the picture.
4. 15 reps
5. 2 sets
6. 20 seconds between sets

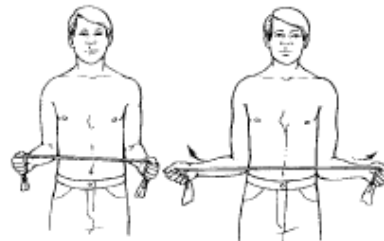
Wall Push Up

1. Stand about 2 feet away from a wall with hands against wall at shoulder height as shown.
2. Place palms against the wall.
3. Keep elbows relatively straight and lean body forward so that shoulder blades come together.
4. Press chest out and away from the wall and round your upper back.
5. 15 reps
6. 2 sets
7. 20 seconds between sets



Shoulder Pull Backs

1. Anchor stretch band to a solid object
2. Stand holding band in both hands with arms in front of body.
3. Pull arms backwards as shown.
4. 15 reps.
5. 2 sets
6. 20 seconds between sets



Shoulder rotation

1. Grasp stretch band in hands as shown.
2. Rotate arms outwards, keeping elbows bent into side.
3. 15 reps
4. 2 sets
5. 20 seconds between sets



Neck Stretch

1. Arm on the side of the neck to be stretched is relaxed at side.
2. Sidebend head away from relaxed arm and rotate face towards the relaxed arm.
3. Increase stretch as needed by depressing head with opposite hand and reaching down toward the floor with relaxed arm.
4. Hold for 20 seconds
5. 2 reps each side

This program has been designed to target the muscles that support and guide the shoulder blades. The benefit of strengthening these muscles is improved tracking of the shoulder joint when raising the arms away from the body and reducing the load on the muscles above the shoulder joint and in the neck.

- Initially the entire program must be completed twice per day for 4 weeks to build up muscle tone.
- After completing 4 weeks frequency may be reduced to 3 times per week to maintain tone.
- Tm's wishing to participate in the program should contact their ESI Team or Safety Specialist for further details.
- Tm's currently undergoing treatment for a shoulder condition are advised to consult their medical provider before commencing these exercises.