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EVALUATION OF TECHNOLOGIES AND PRACTICES TO REDUCE OR ELIMINATE LOG LOAD SECUREMENT RELATED INJURIES

PROJECT NUMBER: 301015038

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WorkSafeBC reported 79 overexertion injury claims between 2017 and 2021. Of these claims, shoulder injuries related to throwing wrappers is a major concern. Load securement related injuries have cost WorkSafeBC more than $4.6 million in the last 5 years. These claims costs include injuries caused by throwing, removing, cinching and tightening wrappers as part of the log load securement process. This report identifies tools and practices to mitigate the risk of load securement related injuries and provides log hauling contractors and drivers load securement options to fit their specific operational needs. Project findings are based on controlled tests, scientific data, input for from injury prevention specialists, and driver feedback from in-service trials.

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1 INTRODUCTION

The motion of throwing and securing log load wrappers can cause significant stress on the shoulders of log truck drivers and overexertion-related musculoskeletal injuries are quite common. Shoulder injuries can have a significant impact on drivers including absence from work, increased financial costs, and possible disability (Combs and Heaton 2016). Sections 4.46 to 4.53 of BC's Occupational Health and Safety Regulations outlines the requirements for taking steps to prevent musculoskeletal injuries in the workplace. FPInnovations, in collaboration with the Load Securement Working Group (a subcommittee of the Log Truck Technical Advisory Committee), conducted a literature review (Shetty 2021) and surveyed employers for ideas on how to reduce or eliminate the risk of injury associated with log load securement. These activities led to the identification of both simple and more complex solutions to be investigated to determine their potential for reducing or eliminating injuries related to throwing wrappers while meeting operational requirements of log hauling operations in British Columbia.

2 PROJECT OBJECTIVES

2.1 Work Methods and Tools Assessed

The objectives of the project were:

- To evaluate alternative load securement tools and practices in controlled conditions and actual operations to quantify benefits related to safety, and other human related factors when compared to traditional load securement methods;
- To identify operational considerations, procedures, and costs; and
- To develop key information and resources related to operational implementation in collaboration with the load securement working group, industry, regulators, and injury prevention specialists.

The tools and methods evaluated include:

- Improved/alternative throwing methods
    - Alternative throwing- Method A
    - Alternative throwing - Method B
    - Improved throwing - Method C
- Light weight wrappers
    - 5/16” wrapper
    - Synthetic – 5/8” wrapper
    - Synthetic–1/2” tiedown
- Throw assist tools
    - Jo's Easy Wrap (light weight lead rope thrown over the load)
    - JB Cable Slinger (a special pole used to flick wrappers over the load)
    - RotatorSaver
- Elevated Platform
    - A raised platform which elevates drivers to the same height as the load.

2.2 Loader Assist Tools

The objective was to evaluate different loader-assist systems to assess their operational feasibility and time requirements compared to traditional loader-assist methods. The systems evaluated were:

- ExTe Long Life
- Forest Steel lashing hook
- ANC spring-loaded mechanism

3 METHODOLOGY

3.1 Evaluation of Work Methods and Tools

3.1.1 Controlled Test

Controlled tests were conducted to minimize variability that may affect study results. These tests quantified risk reduction associated with the various alternative tools and methods by comparing the results with those from the traditional load securement method (baseline) under similar test conditions. The traditional load securement method that was used as a baseline was the common manual throwing method which typically includes improper ergonomic postures such as insufficient bend of the knees or use of leg muscles thus relying solely on shoulder muscles to do most of the work (throwing fully coiled 3/8" steel wrapper with one length of chain as a portion of wrapper). Throwing using preferred manual handling postures and techniques such as utilizing an underhand throw and leveraging the stronger lower limb muscles by bending through the knees to gain momentum was considered as an improved throwing method as it reduced the load through the shoulders and back.

Testing description:

- All tests as presented in Table 1 were performed either in the log yard or at a contractor's shop yard.
- Tests were performed at three B.C. locations: Mackenzie, Prince George and Quesnel.
- The required equipment (i.e., truck, trailer and loader) were provided by the participating industry members at each location and six log truck drivers (two drivers (one younger and one older) per location) participated in the study. The second test in Mackenzie included two additional participants that were selected based on their experience with the selected tools.
- The truck drivers were selected from the local area and the same drivers were compared with the baseline and alternative methods/tools tests at each site.
- Baseline and alternative methods/tools comparisons were done concurrently.
- Wrappers that made it over the log load were considered a valid throw and included in the data and resulting analysis.
- The time required to accomplish the tasks was recorded.
- Any adjustments that needed to be made to the tools, methods were noted and incorporated.

Table 1. Summary of testing locations, season and tools/methods used at each location

Spring			Summer
Mackenzie (2 participants)	**Prince George (1 participant) & Quesnel (1 participant)**	**Quesnel (2 participants)**	**Mackenzie (four participants, of which two were experienced users for certain tools)**
• Baseline – 3/8” wrapper • 5/16” wrapper • Synthetic wrapper • Throwing wrappers sidearm from platform	• Baseline – 3/8” wrapper • Jo Easy Wrap • JB Cable Slinger • Alternative throwing method A (Quesnel participant only)	• Baseline – 3/8” wrapper • RotatorSaver • Alternative throwing method B	• Baseline – 3/8” wrapper • Improved throwing method C • JB Cable Slinger • RotatorSaver • Throwing wrappers underhand from platform • Synthetic wrapper • Synthetic tiedown

3.1.2 Injury Risk Measurement

3.1.2.1 Measurement Technology

DorsaVi, an Australian company that specializes in the use of wearable technology for musculoskeletal assessment and injury prevention, was hired on contract for this project. Their ViSafe sensors were used for data collection and their ViSafe software used to analyze an individual's movement patterns and potential risks for injury.

3.1.2.2 Driver selection criteria

At each location, a minimum of one young and one older driver were selected for the tests, with the age of participants ranging between 45 and 65 years. Drivers with previous injuries that might be aggravated were excluded from the trial.

3.1.2.3 Methodology

DorsaVi's testing process involves the use of a wearable sensor called the DorsaVi Movement Sensor, which is worn on the back and shoulder of the participant being tested. These sensors use wireless technology to capture data about the individual's movement patterns, including range of motion, muscle activity, repetitions, and sustained postures.

Sensors were attached to drivers for the complete testing period. Drivers were instructed to conduct six repetitions of the baseline and alternative methods/tools as consistently as possible. Brief training on the alternative methods and tools was conducted and consisted of both a verbal description and physical practice before the actual tests. After testing, the sensors were removed.

Once the data were collected, they were analyzed with DorsaVi's software which generates detailed reports to identify areas of concern and recommendations on how to reduce manual handling injuries based on the results. The reports also provide visual representations of the data, making it easy to communicate findings.

Figure 1 illustrates ViSafe data collection process in which sensor and video data were synchronised in the field and then sent for analysis and graphic representation.

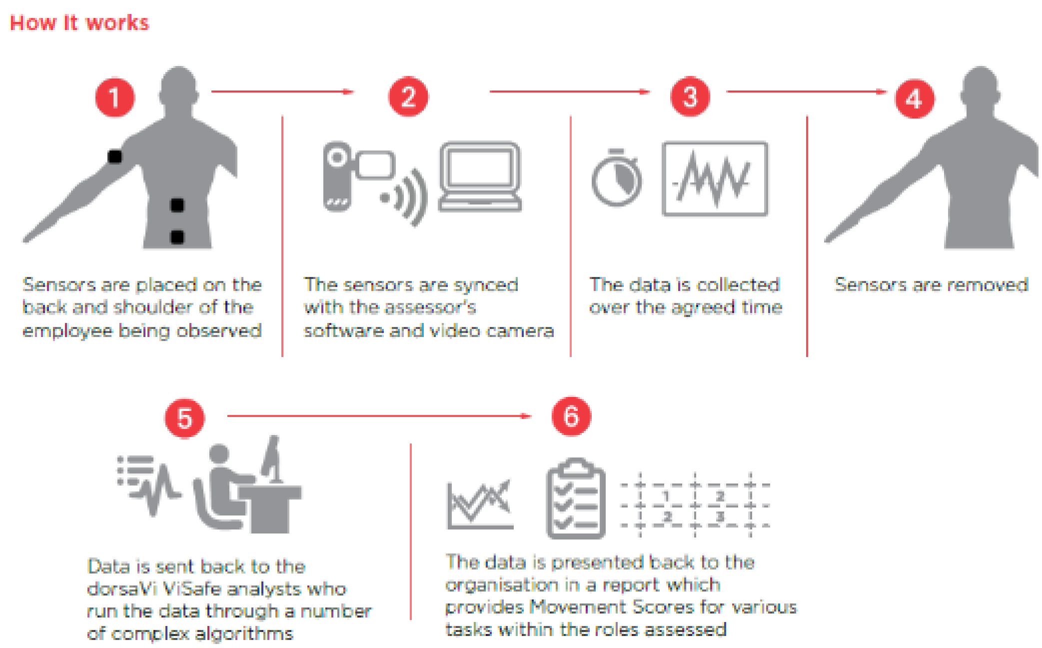

Figure 1. ViSafe data collection process (DorsaVi 2022).

Back sensors measured lumbar flexion, trunk inclination, pelvic angle and electro-muscular activity, whereas shoulder sensors measured upper arm elevations and electro-muscular activity.

Higher electromyography activity is known to increase the risk of repetitive strain injuries or acute injuries. However, high forces can also cause musculoskeletal disorders even if they are not repetitive or sustained. This means that any task involving high force may be a risk, even if it is only done occasionally or for short periods especially when poor manual handling postures are adopted. This damage can occur from a single movement or action that requires the muscles to generate a very high level of force where the tissue stress exceeds their tissue strength or range of motion.

However, highly repetitive shoulder movements are known to be associated with shoulder disorders. Miranda et al (2007) completed a follow-up interval study of 20 years and reported that repetitive shoulder movement was one of the most robust individual risk factor associations with shoulder disorders, increasing the risk of shoulder disorders by 80 – 150%, despite its correlation with other risk factor exposures. The longer and more often force is applied and the higher the force, the greater the injury risk (DorsaVi 2022).

3.1.2.4 Scoring

Movement risk score (MRS) rates the risk level of the activity assessed based on the algorithms developed by dorsaVi as shown in Figure 2.

	Alert	Attention	Preferred
% Time spent outside preferred movement zone	≥ 10% total time in red zone	≥ 20% total time in amber zone	≥ 70% total time in green zone
Repetitions going from preferred movement zone to non preferred zone	≥ 2 reps per minute in red zone	≥ 2 reps per minute in amber or red zone	< 2 reps per minute in amber or red zone
# Sustained Positions # times spending at least 30 seconds outside the preferred movement zone	> 30s position sustained in red zone	> 30s position sustained in amber zone	< 30s positioned sustained in amber or red zone
EMG average muscle activity of a task	$EMG_{AVG} \geq 20\%$ of std. voluntary contraction	$EMG_{AVG} \geq 10\%$ of std. voluntary contraction	$EMG_{AVG} < 10\%$ of std. voluntary contraction

Higher alert values takes precedence over lower values

Figure 2. Risk factors for musculoskeletal injury and risk scoring rules (DorsaVi 2022).

Body MRS and Task MRS are scored on 100 with an associated shade of Orange to indicate the MRS level. The higher the task score and darker the shade of orange, the risker the movement of this task (Figure 3).

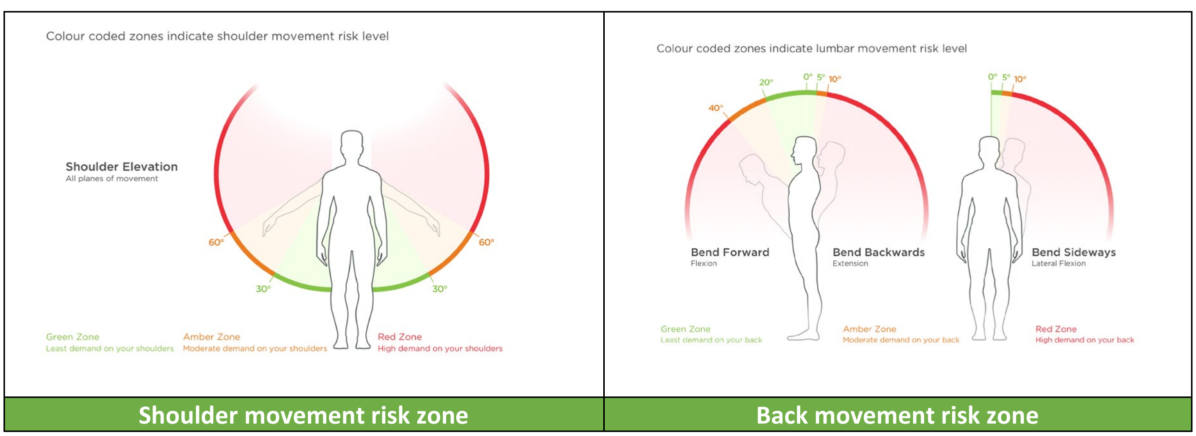

Figure 3. Body movement risk zones (DorsaVi 2022).

Each measurement is combined through complex algorithms to produce a Body Movement Risk Score for back and shoulders, and a Task Movement Risk Score. Figure 4 shows how the algorithm calculates the Task Movement Risk Score. The two Body Movement Risk Scores for back and shoulders are combined to produce the Task Movement Risk Score. Contoured grey lines and orange shaded areas represent the Task Movement Risk Score. As the body movement risk scores become higher and the width between the grey lines (task score) and orange shaded areas become narrower, the higher the back or shoulder score, the higher the weighting towards the Task Score (DorsaVi 2022).

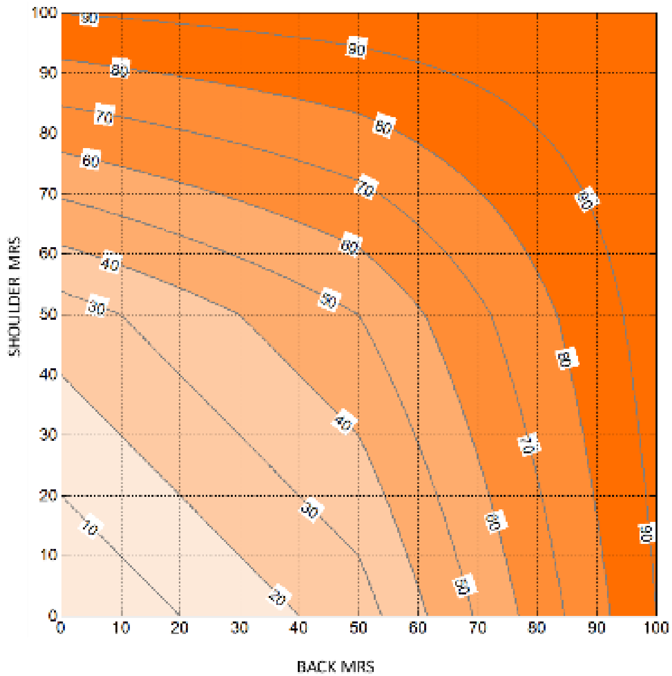

Figure 4. Task Movement Risk Score algorithm (DorsaVi 2022).

Task MRS (Total MRS) values are associated to movement risk levels as shown in Table 2.

Table 2. Task movement risk score level (DorsaVi 2022)

TASK MRS	MOVEMENT RISK LEVEL
0-19	Low
20-39	Moderate
40-59	High
60-79	Very High
80-100	Extreme

3.2 Evaluation of Loader-Assist Tools

3.2.1 Testing

In other regions of the world, loader assist tools are used to minimize the interaction between the loader and the truck drivers. Some of these tools were tested in a log yard to evaluate their efficacy in our operating environment. The loader-assist tools tested were:

- ExTe Long Life is a system designed by ExTe in which two sets of chains connected through a link are hung over steel arms mounted on the inner side of the log bunk crossmember. The arms first need to be moved forward from their rest position and locked at a slight upward angle for hanging the wrappers. Once the loader picks up the wrappers and drapes them over the load, the arm of the Long-Life need to be retrieved back to their original position manually. Use of this tool can be viewed here: https://www.youtube.com/watch?v=QhqQxN_eK1I
- Forest Steel lashing hook system consists of a chain holder and lashing hook. This technique is generally used by self-loading truck operators in Scandinavia. The chain holders are attached to the bunks, and the lashing hook is attached to one end of a chain. The hook rests on a chain holder along with the coiled chain. The loader operator pulls the lashing hook with the grapple and drapes the chain wrapper over the load. Use of this tool can be viewed here: https://www.youtube.com/watch?v=lwFmD_khDBM (watch from 6:50)
- ANC spring-loaded mechanism (SLM) is a tool developed in Australia. The spring-loaded levers are mounted vertically on a set of log bunk stakes, i.e. one lever per stake and two levers per log bunk on a two bunk log trailer. The arms are lowered manually, and two chains connected with a link are suspended on the grooves at the end of the arms. The loader operator retrieves the chains with the grapple and drapes them over the load. Once the chain is lifted off the spring tensioned arms, they automatically return to their original position. Use of this tool can be viewed here: https://www.youtube.com/watch?v=IlUmbIO0igs

The testing process was as follows:

- Pre-planning;
- The loader-assist tools were temporarily attached to the log bunks' components;
- The same loader and operator were used for each test;
- Controlled testing was performed with the loader positioned on both sides of the truck;
- The actions and time required to accomplish the task were recorded;
- Any modification in system design, fixture, or task required for the in-service trial were noted.

In the case of the ExTe Long Life and ANC SLM tool tests, the steps followed were:

1. The driver took two wrappers and laid them on the ground in an extended length position as shown in Figure 5 with near side wrapper’s left end of the chain aligned with bunk A and far side wrapper’s right end of chain aligned with bunk B.

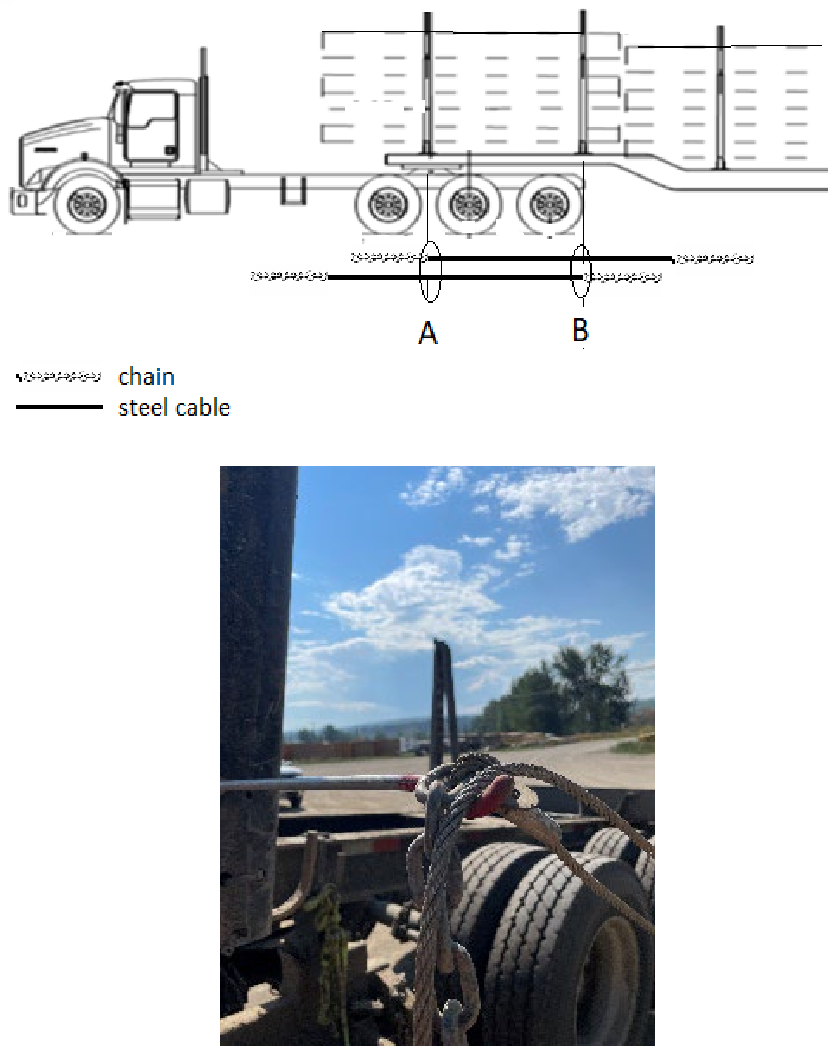

Figure 5. Wrapper layout on the ground and close view of wrapper resting on arm.

2. Driver arranged the wrappers as shown in Figure 6.

Figure 6. Arrangement of wrappers on the arms of the spring-loaded mechanism.

3. After finishing the setup, the driver moved to the safe zone, stayed clear of hazard, made eye contact with the loader operator and gave the go ahead sign.
4. The loader operator grabbed the two wrappers with its grapple as shown in Figure 7 and draped them over the load as shown in Figure 8.

Figure 7. Loader grabbing the wrapper.

Figure 8. Loader draping the wrappers over the load.

5. Once the loader grapple was down, the loader operator communicated with the driver that it was safe to proceed. The driver then temporarily connected the chain ends that were hanging close to the ground to the truck so that the chains did not get caught when the truck moved forward.

3.2.2 In-service Test

An in-service test was conducted to identify operational constraints within regular field operations. The ExTe Long Life and ANC SLM loader-assist systems were shortlisted for the in-service trial and studied with the same contractor that participated in the controlled test.

The in-service testing process was as follows:

- The loader-assist systems were permanently secured to the log bunks for studying the durability of the tools;
- The process and time required to complete the loader-assist task were recorded;
- Feedback from the drivers and loader operators was captured;
- Any observed operational constraint was recorded.

4 STUDY RESULTS

4.1 Traditional Log Wrapper Throw

MRS risk level and movement risk scores for traditional and improved log wrapper throwing methods are summarized in Table 3. The scores are based on the average task score from six drivers. The traditional method using a 3/8“ three quarter coiled wrapper resulted in high risk level because of poor utilization and activation of stronger muscle groups with predominant force coming through the participant's dominant shoulder, environment and equipment setup, including proximity to the load were also contributing factors. The improved wrapper throwing method resulted in a moderate MRS risk level because of improved manual handling techniques including recruitment of lower limb muscles, standing further away from the load to reduce extensive low back extension, and reducing the throw load by only throwing the chain at one end of the wrapper. The total MRS score for the 3/8” wrapper with the traditional method was used as a baseline in this study. There was a 50 % reduction in MRS compared to the baseline when the improved wrapper throwing method was used.

Table 3. Average Movement Risk Score and MRS risk level for baseline 3/8” wrapper by throwing method

Method	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
3/8” Traditional throw	19	54	42	High	Baseline
3/8” Improved throw	21	20	21	Moderate	-50 %

Impact of Age Difference on MRS:

The MRS results between ‘older’ and ‘younger’ workers were not significantly different for the traditional throw method and thus are not presented here separately.

4.2 Lighter Weight Wrappers

4.2.1 5/16” Steel Wrapper

Two other throwing methods used in the industry with lighter 5/16” wrappers were evaluated in this study and are shown in Figure 9. Method A consists of a slight underhand flick motion for getting the wrapper over the load while method B is a traditional overhand throwing method but with only the length of chain at the end of the wrapper used as a throw weight. In addition, a third method “Method C” was evaluated. This is based on a traditional throw but incorporates proper body position i.e. back straight, no major waist twist, bent knees to allow lower limb muscles (specifics includes quads, calves and glutes) to assist with throwing.

Figure 9. Alternative throwing methods using 5/16” steel wrappers.

Table 4 summarizes the MRS and MRS risk level for throwing methods A, B and C. Even with a reduced throw weight, method A was still at a moderate MRS. However, when compared to the baseline, the MRS was reduced by 14%. Method B had the highest score with a high risk, presenting a 21 % MRS increase compared to the baseline score. The improved throwing method C using lighter 5/16” wrappers showed an average reduction of 36 % in MRS over the baseline.

Table 4. Average Movement Risk Score and MRS risk level for 5/16” steel wrappers for the three throwing methods

Throwing Method	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
5/16” Alternative throw - method A	18	52	36	Moderate	-14 %
5/16” Alternative throw - method B	51	44	51	High	+21 %
5/16” Improved throw - method C	13	40	27	Moderate	-36 %

4.2.2 Synthetic Wrappers

Synthetic wrappers and tie downs (with shortened chain length) were also evaluated in this study. Table 5 summarizes the MRS and MRS risk level for different synthetic wrapper types.

The use of synthetic tie downs with the improved throwing methods resulted in an average 67 % reduction in MRS compared to the baseline. Similarly, the MRS was reduced by 48 % with the use of synthetic wrappers and the improved throwing method.

Table 5. Average Movement Risk Score and MRS risk for synthetic wrappers and tie downs

Variation	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
Synthetic – tie down	1	27	14	Low	-67 %
Synthetic - wrappers	1	42	22	Moderate	-48 %

4.3 Throw Assist Tools

4.3.1 Jo's Easy Wrap

Jo's Easy Wrap is designed to act as a lightweight lead rope that can be thrown over the load using an underhand method. Table 6 presents the MRS score and risk level for Jo's easy wrap. The MRS risk reduction when using an underhand throw of the lead rope with proper ergonomic posture resulted in a 76 % reduction compared to the baseline.

Table 6. Average Movement Risk Score and MRS risk for Jo's Easy Wrap

Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
7	13	10	Low	-76 %

4.3.2 JB Cable Slinger

The JB Cable Slinger is a pole designed to hold the chain end of a wrapper and throw above and behind the body and over the log load. During the process the driver used the large muscles of the body and his legs to perform the work. Table 7 presents the MRS risk level and MRS score for the tool with an experienced user, which achieved a 67 % MRS reduction when compared to the baseline.

Table 7. Movement Risk Score and MRS risk level for the JB Cable Slinger and an experienced user

Wrapper Type	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
5/16"	2	27	14	Low	-67 %

4.3.3 RotatorSaver

The RotatorSaver is a new device invented in BC that works like a catapult to throw multiple wrappers over the load with minimal effort. Table 8 summarizes the task MRS and MRS risk level for throwing single and double wrappers. With good manual handling techniques and in accordance to standard operating procedures, i.e. positioning the level of the device at low as possible on the stake to reduce shoulder elevation, standing close to the handle, keeping arms close to the body and using a lunge position while pulling the lever down, the MRS was reduced by 57 % for a single wrapper and 69 % for double wrappers when compared to the baseline.

Table 8. Average Movement Risk Score for RotatorSaver

Variation	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
RotatorSavor – Double 5/16”	0	26	13	Low	-69 %
RotatorSavor – Single 3/8”	5	31	18	Low	-57 %

4.4 Elevated Platform

Elevated platforms can be used to reduce throwing height and therefore directly decrease the physical effort required by the driver to throw a wrapper over a log load when compared to traditional methods. Table 9 presents the average MRS score for this approach using an underhand throwing method. It should be noted that for an underhand throw to be possible, gaps are required along the platform safety railing at intervals determined by the required wrapper locations on the load itself. The maximum gap size should be 8 inches to prevent workers from falling through the railing. For an underhand throw with a single wrapper, the MRS risk level is low showing a 76 % reduction in MRS when compared with the baseline. In the case of an underhand throw using two wrappers, the MRS risk level is again low, and the MRS is reduced by 71 % compared to the baseline.

Table 9. Average Movement Risk Score for elevated platforms

Variation	Back MRS	Shoulder MRS	Total MRS	Risk Level	Diff with Baseline
Underhand Platform - Double 3/8"	0	23	12	Low	-71 %
Underhand Platform - Single 3/8"	0	20	10	Low	-76 %

4.5 Overall Results

Table 10 summarizes average movement risk scores, MRS risk reductions and risk level for all methods and tools tested in this study.

Table 10. Average movement risk scores and associated risk level summary

Variation	Total MRS (Avg)	Average reduction % (best to worst)	MRS Risk Level
3/8" Traditional throw	42	baseline	High
Jo's Easy Wrap	10	76%	Low
Underhand Platform - Single 3/8"	10	76%	
Underhand Platform - Double 3/8"	12	71%	
RotatorSaver - Double 5/16"	13	69%	
Synthetic - tie down	14	67%	
JB Slinger	14	67%	
RotatorSaver - Single 3/8"	18	57%	
3/8" Improved throw	21	50%	Moderate
Synthetic - wrapper	22	48%	
5/16" Improved throw -Method C	27	36%	

4.6 Loader Assist

Loader assistance eliminates the requirement for drivers to throw wrappers over the log load, and therefore significantly reduces the associated MRS risk for this activity. However, some of the barriers to this approach are steep terrain, deep ditches, snow and muddy conditions, narrow roads, driver acceptance (some prefer to throw wrappers), driver interactions with the loader, increased truck cycle time and potentially longer loading times. The conventional loader-assist with driver involvement is a standard practice where the driver throws one to two wrappers into the loader's grapple (Shetty 2013, TAG 2021). The complete process takes around two to three minutes per log bundle, including time to uncoil the wrappers, throw them through the grapple and the loader to place them over the load. However, this process requires loader and driver interactions which can be a safety hazard (TAG 2022) that needs to be addressed. Other considerations include the time required for the loader to complete the process, creating potential delays for other trucks waiting to be loaded.

A risk assessment and safe work procedures for traditional loader assist need to be utilized and can be located here:

SWP's : TAG_Loader-Assist-Safe-Work-Procedure-Final_01-Dec-22.pdf (bcforestsafe.org)

Risk assessment: Risk-Assessment-Tool-MSI-Load-Securement_14-Oct-21_FINAL.pdf (bcforestsafe.org)

During phase 1 (literature review) of the project, three loader-assist tools used in other countries were identified. Figure 10 presents these three tools: the ANC spring loaded mechanism (SLM), the ExTe Long Life and Chain Holder Lashing Hook. These tools help to address some of the challenges associated with traditional loader assist methods, in particular driver and loader interaction.

a) ANC spring-loaded mechanism (SLM)

b) ExTe Long Life

c) Scandinavian chain holder lashing hook

Figure 10. Loader assist tools.

4.6.1 Testing

These three tools were temporarily mounted on bunks and tested in a controlled environment.

4.6.1.1 ANC Spring Loaded Mechanism (SLM)

With this device, two wrappers could be used at the same time. Feedback on this tool from drivers and loader operators at the controlled test site was positive mainly because the tool helped to avoid interactions between driver and loader.

In Australia, full chain wrappers are used in combination with the SLM and the two chains can be coupled to create efficiencies in the process. In this study, standard cable wrappers were used to mirror current industry practices. This created some challenges because the cable wrappers were not sufficiently supported to avoid slipping into a draped position when connected to the SLM. To mitigate this effect, the wrappers were arranged crosswise as shown in Figure 11.

Figure 11. Wrapper layout on the SLM tool.

The process also presented challenges related to the position of the wrapper in relation to the ground and the tractor tires. This draped positioning made it more difficult for the loader operator to consistently grab the wrappers. This problem would be mitigated if chains were used instead of cable wrappers. However, the use of chain wrappers in BC operations remains to be validated. Average time needed to drape the two wrappers over the load was around 50 seconds. This included time to uncoil the wrappers, set up the wrappers on the SLM, and have the loader drape the wrappers over the load. When the loader picks up the wrappers, the arms of the SLM device automatically return to their original position.

The cost of the spring-loaded mechanism set is $250 before shipping from Australia. The total number of sets required per truck will depend on the number of log bundles being hauled, the required wrapper spacing and whether installation on both sides of the load is required or not. The parts are replaceable if they get damaged in the field.

An attempt was made to operate the loader on the opposite side of the SLM mechanism (Figure 12). However, the loader reach was insufficient to grab the wrappers over the load. In addition, the loader operator was working from a blind spot and therefore had insufficient view of the work area on the passenger side of the truck.

Figure 12. Trial of using a loader on opposite side of SLM device.

4.6.1.2 ExTe Long Life

With the Exte Long Life device, the driver needs to pull out the tubular composite arms and place them at an angle to lock them in position. Two wrappers can be handled at the same time and can be arranged in a similar way as for the SLM device. It took approximately a little over a minute to uncoil the wrappers, set them in the device, and place the wrappers over the load. Unlike the SLM, the driver needs to manually return the arms to their original position. Based on the current tool design, it would be challenging to use it in BC conditions because of potential buildup of mud, debris and water. In addition, the mechanism appears susceptible to become inoperable in winter/freezing conditions.

The general impression from the trial with the ExTe tool was that although it certainly removes the interaction between the driver and the loader, it may not be rugged enough for BC conditions.

4.6.1.3 Chain Holder Lashing Hook

Chain holder lashing hooks are primarily used in Scandinavia on self-loading trucks with crossbar grapples. The hook itself is made of polyurethane which is connected to standard chain. During the controlled test, the finger-style grapple used had difficulty retrieving the hook. Therefore, it was concluded that this tool is not suitable for finger-style grapples which are preferred in B.C. As a result of the tool's limitation within the context of BC operations, it was not retained for in-service trials.

4.6.2 In-service Trial Findings

In-service trials were conducted using two sets of ExTe Long Life and two sets of ANC SLM tools mounted on a quad trailer with four bunks. The front two bunks of the trailer had ExTe Long Life mounted on all four stakes and the two rear bunks had ANC SLM tools on all four stakes.

Figure 13 shows a driver setting up the wrappers on the ExTe long life arms (right image) and ANC SLM (left image) at night.

Figure 13. Driver setting up wrappers on the loader-assist tools at nighttime.

4.6.2.1 ExTe Long Life

Figure 14 shows the loader grabbing the wrappers once the driver had completed the set up.

Figure 14. Loader grabbing the wrappers.

Figure 15 shows the draping of the wrappers over the load. In the case of the ExTe Long Life, the driver must return the arms to their original retracted position.

Figure 15. ExTe Long Life arms yet to be retracted to the rested position.

Figure 16 shows how mud contamination on the Exte Long Life could make it difficult to retrieve arms.

Figure 16. ExTe Long Life in operation.

4.6.2.2 ANC SLM

Figure 17 shows a driver setting up the wrappers on the ANC SLM at nighttime (left) and draping of the wrappers over the load (right).

Figure 17. Setting up the wrapper on ANC SLM at nighttime (left) and loader draping the wrapper over the load (right).

With the ANC SLM tool, the arms were installed too low on the stakes (Figure 18), causing concern for the loader operator about the grapple potentially hitting the tire while grabbing the wrappers. Therefore, the appropriate height for the SLM device needs to be carefully planned considering the ability to reach the mechanism for the drivers as well as maintaining enough clearance such that potential grapple contact with the tires is avoided. In addition, the driver suggested a wider groove slot on the SLM arms to ensure the wrapper was sufficiently secured during the process.

Figure 18. ANR SLM installed 2 ft lower than optimal on the stake creating the possibility of grapple hitting the tires.

General in-service trial comments:
The driver felt that the ANC SLM arms are easy to repair in the field compared to the ExTe Long Life. The driver found this tool relatively easy to use; however, less efficient than traditional throwing method due to wrapper set-up time and wrapper chain getting entangled with the arm in some cases.

If chains are used for securing the load via the SLM system, as is done in Australia, then the slack and operational efficiency can be effectively managed for intended use of this tool (Figure 21).

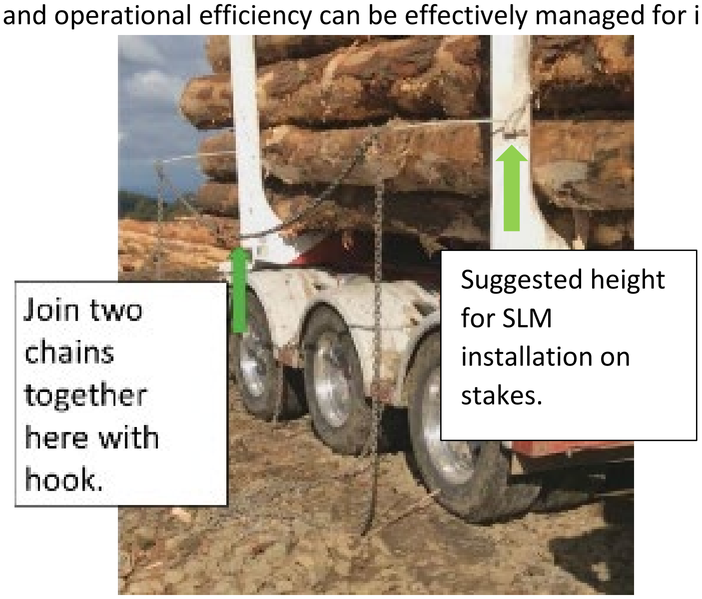

Figure 19. Chain arrangement on the arms of the spring load mechanism used in Australia (image source-ANC Forestry, reproduced with permission).

5 CONTRACTOR TOOLBOXES

Contractor toolboxes are sets of tools and resources that employers and drivers can use to address the risk of injury from load securement activities based on their operational needs and preferences. These toolboxes include descriptions, musculoskeletal injury (MSI) risk reduction measures, time requirements, costs, safe work procedures, risk exposure, risk controls and other implementation resources.

As per WorkSafeBC OHS regulation section 4.46 to 4.53, employers must identify the factors that may expose workers to the risk of MSI in their workplace. Employers can refer to BCFSC's load securement risk assessment tool for risk identification (reg 4.47) and risk assessment (reg 4.48) related to load securement (BCFSC 2021).

It should be noted that the tools or methods identified in the contractor toolboxes reduce but do not eliminate the risk of MSI.

To use the toolboxes effectively, the employers and drivers must:

- Make sure that they become familiar with the tools and resources provided, and understand how to use these tools in their operations;
- Ensure users are trained on safety procedures;
- Be aware of risk exposures and controls;
- Conduct regular safety inspections and stay current with new safety regulations and best practices.

For all toolboxes, there are general risk reduction considerations for drivers that need to be followed:

- Train or refresher training to increase effectiveness and the confidence of workers.
- Remember the importance of stretching throughout the day / during breaks to reset muscles and avoid further strain, targeting especially the shoulders and back before and after load securement activities.
- Consult supervisor or health &safety reps for considering the most appropriate toolbox for drivers with previous injuries, low fitness level or restricted mobility.
- Assess the condition of the load and the work area available on both sides of the truck before using any tool or method.
- Where possible, practice the throwing motion using both dominant and non-dominant hands so that they may alternate and spread the load between both arms throughout the day.
- Avoid throwing multiple wrappers in one throw.

5.1 Toolbox A – Improved Throwing - Method C

Description

This method relies on proper leg work, momentum, and keeping the throw weight as low as possible. The traditional 10 m (30 ft) 9.5 mm (3/8") wrapper (Figure 20) weighs around 4.2 kg and throw weight may vary from 1.6 to 2.94 kg depending on the length of coiled wrapper. Throwing this wrapper over the load from ground level is the common method used in the industry today in the load securement process.

Figure 20. 3/8" steel wrapper.

MRS and MRS Risk Level

Table 3 shows the risk level associated with the use of improved method C and the safe work procedures described below. The method relies on more use of legs and a straight back to create momentum when throwing the wrapper over the load.

Table 11. MRS and MRS risk level for improved throwing method C

Movement Risk Score	Risk Level
21	Moderate

Safe Work Procedure

1. Stay 2.4 to 3.0 m (8 to 10 ft) away from the load (if the ground conditions allow).
2. Keep the weight to be thrown as low as possible. The chain length is generally enough weight to throw the wrapper over the load. (Figure 21). Avoid throwing the fully coiled wrapper.

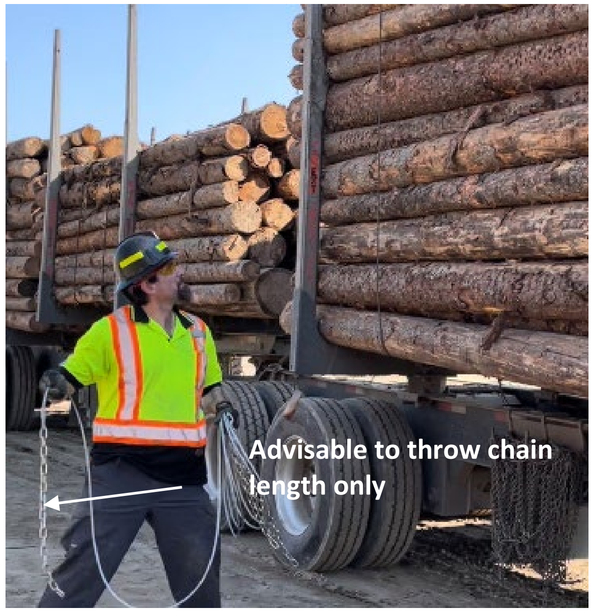

Figure 21. Reducing the throw weight of traditional 3/8” wrappers.

3. Step a foot back with a hand holding the chain behind the body (Figure 22a).
4. Leverage the lower limb muscles by bending the knees before throwing. Avoid twisting the body (Figure 22b). Bend knees and push with the stronger lower limb muscles to generate the force required to throw the wrapper, reducing strain on the lower back and shoulders.
5. Stride forward with the momentum generated (Figure 22c).
6. Release the wrapper prior to the arm extending above the shoulder and follow through (Figure 22d). Avoid twisting the upper body during throw and follow through.

a) **Step back a bit**

b) **Bend knees (leg work) with minimal body twist**

c) **Stride forward with built momentum**

d) **Release and follow through**

Figure 22. Steps for throwing a wrapper while minimizing risk of injury.

<u>Time</u>

5 to 10 seconds per throw. To take less time, do not coil the wrappers, simply hold one end of the chain for throwing.

<u>Cost</u>

Standard 3/8 or 5/16 wrapper - $50/unit

<u>Risk Exposure</u>

When throwing wrappers, drivers are exposed to risk of musculoskeletal related injury (MSI) because of repetitive movement, force required (throwing weight) and non-ideal posture. Other factors such as previous injuries, age, fitness level, throwing multiple wrappers in one throw can also increase risk. Other risks are falling logs, wrappers or debris and slips, trips and falls on uneven and poor ground conditions.

5.2 Toolbox B – Underhand Throw Using Lead Rope

Description

The lead rope (Jo's Easy Wrap) consists of lightweight rope connected to a puck (Figure 23) with a total weight of 3 kg. A triangular hook connects the wrapper to the lead rope. The portion of lead rope used for throwing along with the lightweight puck (weighs around 1 kg) is used to toss over the load using an underhand motion and the wrappers are then pulled over the load from the other side.

Figure 23. Lead rope with puck.

MRS and MRS Risk Level

When using safe work procedures for the lead rope method, the MRS risk is low because of the underhand throwing motion and the light weight of the lead rope itself (Table 12).

Table 12. MRS and MRS risk level for underhand throw using lead rope

Movement Risk Score	Risk Level
10	Low

Safe Work Procedure

The safe work procedures for use of lead ropes are as follows:

1. Stay 10 to 12 feet away from the load.
2. Bend knees and push with the stronger lower limb muscles to generate the force required to throw the lead rope, reducing strain on the lower back and shoulders.
3. Connect the triangular hook of the lead rope to each wrapper required per bundle.
4. Step back two feet with one leg and stand with a wide, stable stance, one foot in front of the other.
5. Hold the rope two to three feet away from the puck.
6. Ensure arms are as close to the body as possible.
7. Adjust the hanging cord length so that the puck does not touch the ground while swinging.
8. Swing the puck like a pendulum a couple of times before throwing. (Figure 24)

Figure 24. Lead rope underhand throw.

9. Use the underhand motion to launch the puck over the log load. Underhand throw reduces overhead movements that cause increased strain on the shoulders.
10. Repeat step 2 to 7 for each bundle.
11. Move to the other side of the load.
12. Take the puck end of the rope and move 5 to 6 feet away from the load.
13. Use both hands to pull the rope and lean slightly backward with one leg forward and hip and knee bent slightly.
14. Use leg and body weight to pull the rope slowly until one end of the wrappers reaches the other side.
15. Disconnect the wrapper from the triangular hook.
16. Coil the lead rope.
17. Repeat step 10 to 14 for each bundle.

Time

The use of this tool will require one to two additional minutes per bundle compared with the traditional throwing method. While conventional wrapping time for three bundle loads is around 3.5 minutes, it might take 6 to 8 minutes with Jo's Easy Wrap. The time for load securement using Jo's Easy Wrap tool could be reduced by using multiple devices.

Cost

The cost of this tool is approximately $200. Several tools may be required depending on the number of bundles per truck.

Risk Exposure

Even with lightweight lead ropes, drivers are exposed to risk of musculoskeletal related injury (MSI) because of factors such as repetition and non-ideal postures. Other factors such as previous injuries, age, fitness level, throwing multiple wrappers in one throw can also increase risk. Other risks are falling logs or debris and slips, trips and falls on uneven or poor ground conditions.

Suppliers

Contact: Jolene Gorrie
Tel: 250 919 0705
E-mail jolenegorrie@gmail.com

A video of Jo's Easy Wrap tool in operation can be found here:
https://www.youtube.com/watch?v=akLOWFWW8NY&t=1s

5.3 Toolbox C – Throw Assist Using a Pole

Description

The J.B Cable Slinger pole weighs around 0.7 kg and is used to help get the wrapper over the load via leverage. This is achieved by attaching one end of the chain to the pole's hook as shown in Figure 25 and using a flicking movement. The throwing process using the pole is repeated for each wrapper.

Figure 25. Throw assist pole.

MRS and MRS Risk Level

Following safe work procedures, the MRS for this method is 14 with a low risk level (Table 13).

Table 13. MRS and MRS risk level when using the JB Cable Slinger

Movement Risk Score	Risk Level
14	Low

Safe Work Procedure

The safe work procedure for the use of the JB Cable Slinger is as follows:

1. Wrapper should be laid on the ground on the side you will be throwing from.
2. With your back facing the load, position yourself 6 feet away when possible or a minimum two feet away with feet hip width distance apart. (Figure 26a).
3. With the pole hook, grab the 2nd link of the chain from collar of one end of the wrapper (Figure 26b).
4. Using an underhand grip, grip the pole with one hand at the end of the pole and the second hand 2 ft from the end. Ensure arms and elbows are as close to the body as possible. (Figure 26c).

5. Position appropriately to avoid twisting the body.
6. Bend knees, bend forward at the hips with a neutral spine (Figure 26d) and push up with the stronger lower limb muscles while throwing the pole behind the body towards/over the top of the load in a controlled manner (Figure 26f).
7. Repeat steps 2 to 8 for each wrapper and log bundle.

a) Stay 2 ft away from the load with the back to the load

b) Position the pole hook onto the second link from the collar of one of the wrapper ends

c) Hold one hand 2 ft from the end of the pole and the other at the end of the pole

d) Bend hips and knees to generate the force required to flick the wrapper over the load

e) Flip the pole toward the load

f) Follow through without the pole touching the load

Figure 26. Use of pole to flip the wrapper over the load.

<u>Time</u>

The time required to use this tool is the same as for the traditional throwing method. The conventional wrapping time for three bundle loads is around 3.5 minutes, so the wrapping time using the JB Cable Slinger tool will be around 3.5 minutes as well.

<u>Cost</u>

The cost of the pole is around $70.

<u>Risk Exposure</u>

Even with this tool, drivers are exposed to risk of musculoskeletal related injury (MSI) because of factors such as repetitive motions and non-ideal posture. Other factors such as previous injuries, age, fitness level, throwing multiple wrappers in one throw can also increase risk. Other risks are falling logs or debris and slips, trips and falls on uneven or poor ground conditions.

<u>Suppliers</u>

JB Cable Slinger
Contacts: John & Linda Guindon
Tel: 705 542-2249
E-mail: johnguidon65@gmail.com

5.4 Toolbox D –RotatorSaver

Descriptions

The RotatorSaver is a tool designed to get the wrapper over the load with minimal effort based on a mechanical advantage principle. The tool weighs around 8.2 kg (18 lbs) and consists of two arms: a primary arm, which measures 6 ft, and a secondary arm, which measures 2 ft. The RotatorSaver mounts on a bracket that is installed on the stake of each bundle. The wrapper is coiled and placed at the end of the arm. The driver pulls the lever to propel the arm in an upward arching motion thereby getting the wrappers over the load effortlessly. The tool is moved from bundle to bundle with the process being repeated.

MRS and MRS Risk Level

When used with recommended safe work procedures, this tool resulted in low MRS risk level with MRS between 13 to 18 (Table 14).

Table 14. MRS and MRS risk level with the use of the RotatorSaver

Movement Risk Score	Risk Level
13-18	Low

Safe Work Procedure

1. Install the RotatorSaver onto the bracket that is mounted on the stake by sliding the hook into the slot (Figure 27) while holding the unit with both hands.

Figure 27. Installing the RotatorSaver onto the bracket mounted on the stake.

2. Coil the wrapper three times around the studs in triangular position as shown in Figure 28. The chain will be coiled on the two bottom studs.

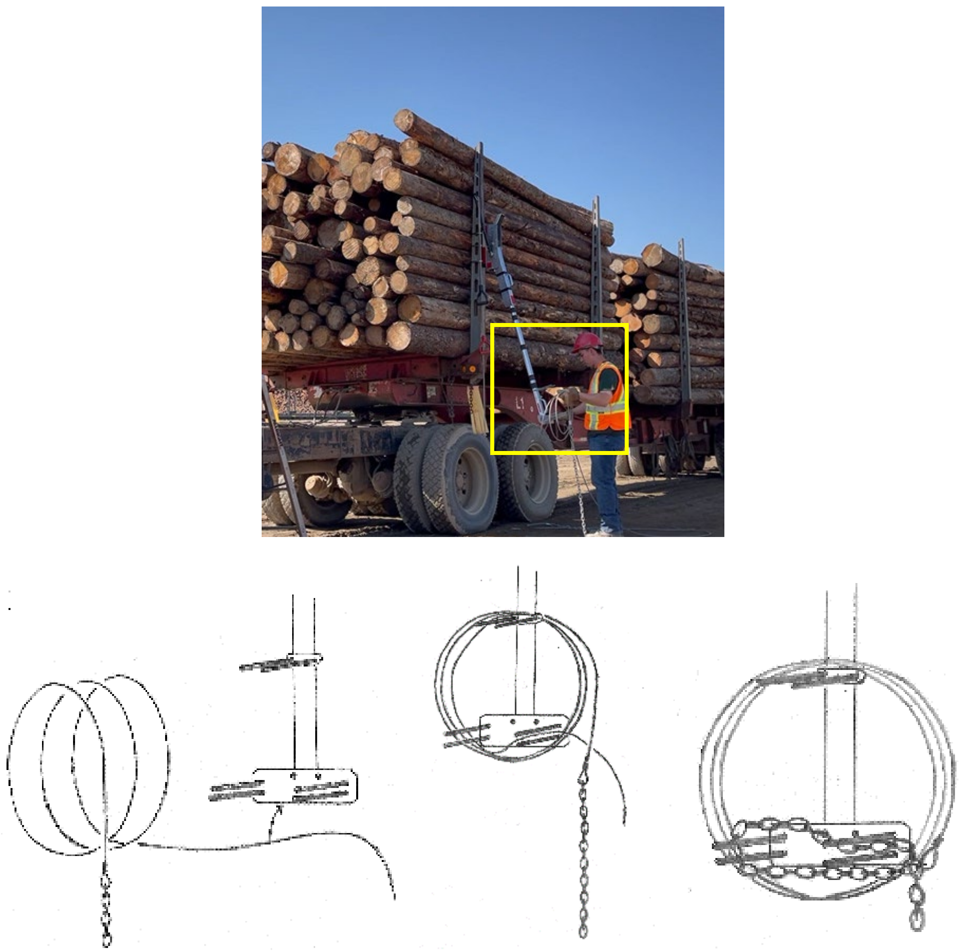

Figure 28. Coiling of wrapper onto RotatorSaver (Source: RotatorSaver, reproduced with permission).

3. Lay the remaining wrapper on right side of the tool on the ground. Take the other end of the chain and rest it on the chassis of truck as shown in Figure 29.

Figure 29. Placement of the other end of wrapper before the slingshot motion.

4. Repeat steps 2 and 3 for installing a second wrapper on the same studs i.e with this tool, two wrappers can be positioned on the arm and tossed over the load at the same time.
5. Face towards the load and grab the red bottom handle of the sling rope and slowly bring towards the mid body position, then grab the second handle (black). Try to keep hands close to the body. Hold the second handle with both hands and bring it closer to lower part of the face. At this position, the longer arm of RotatorSaver will be perpendicular to the stake (Figure 30). Do not raise hands above eye level and avoid facing sideways.

Figure 30. Use of sling rope for preparing for slingshot motion.

6. To create the slingshot action, bring the arm toward the mid body while dropping into a lunge position and maintaining a neutral spine (Figure 31). Use the leg muscles to generate the force. With minimal effort, the wrapper will be propelled over the load.

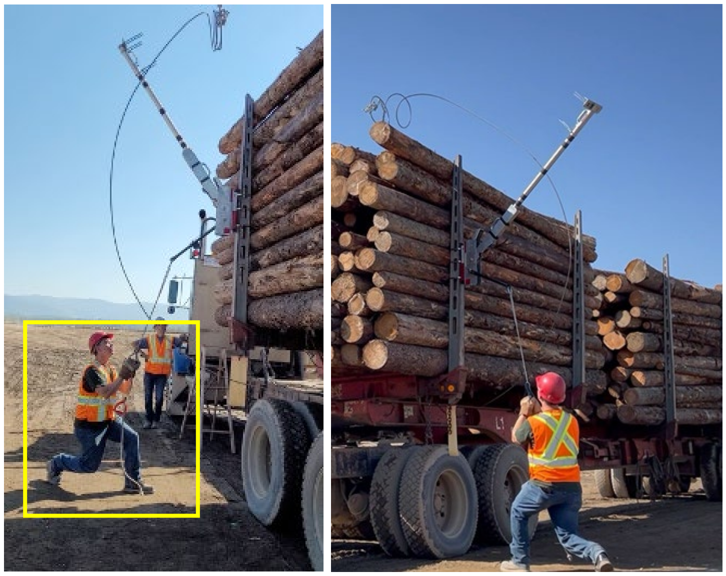

Figure 31. Slingshot motion for getting wrapper over the load.

7. Dismount the RotatorSaver from the bracket on the stake by grabbing and lifting the longer arm slightly upward to unhook the tool from the bracket.
8. Move to another bundle and perform steps 2 to 7 for the remaining bundles.

Time

Conventional wrapping time for three bundle loads is around 3.5 minutes, whereas the wrapping time using the RotatorSaver tool will be around 9.5 minutes as reported by one of the participated fleets.

Cost

The cost of the RotatorSaver including three brackets is around $1,700.

Risk Exposure

Inappropriate use of the tool can expose drivers to risk of musculoskeletal related injury (MSI) because of repetitive motions, improper methods, and non-ideal posture. Previous injuries could also increase risk. Other risks include residual energy of the RotatorSaver, falling logs, wrappers or debris and slips, trips and falls on uneven and poor ground conditions.

Suppliers

RotatorSaver
Contact: Boyd Goodwin (inventor of this tool)
Tel: 250-558-6807
E-mail: blgoodwin416@gmail.com

5.5 Toolbox E – Lightweight Wrappers/ Tiedowns

Descriptions

Synthetic ropes (Figure 32) are much lighter than steel cable for equivalent strength with most of the throw weight coming from the chain portion.

Figure 32. Driver throwing a synthetic wrapper.

Table 15 presents the wrapper portion throw weight for different chain lengths, rope size and wrapper material.

Table 15. Throwing weight for different chain lengths, rope size and wrapper material type

Rope	Weight for the portion of the wrapper being thrown (kg)
Synthetic 5/8" wrapper with short links (3") at both ends	0.5
Synthetic ½" tiedown with 1 ft chain and hook	0.9

Figure 33 shows the throwing length of some of these lightweight wrappers.

Synthetic wrapper

Synthetic tiedown

Figure 33. Lightweight synthetic wrapper/tiedown used for throwing.

MRS and MRS Risk Level

The MRS with safe work procedures for synthetic wrapper/tiedowns is around 14 to 22 (Table 16).

Table 16. MRS and MRS risk level for synthetic wrapper/tiedown

Movement Risk Score	Risk Level
14-22	Low to moderate

Safe Work Procedure

The safe work procedures for the use of lightweight wrappers/tiedowns are as follows:

1. Stand 8 to 10 ft away from the load if the ground conditions allow it.
2. Use an underhand throw to reduce overhead movements that cause increased strain on the shoulders.
3. Use the lightest throw weight. Using the chain itself is generally enough to get the wrapper over the load.
4. Step one foot back and move the hand holding the chain back (Figure 34a)
5. Bend knees and push with the stronger lower leg muscles to generate the force required to throw the wrapper as you return to a standing position, avoiding body twist (Figure 34b).
6. Stride forward with the momentum generated (Figure 34c).
7. Release the wrapper prior to elevating the arm above shoulder level and follow through (Figure 34d).

a) **Step back a bit**

b) **Bending (leg work) with minimal twist**

c) **Stride forward with built momentum**

d) **Release and follow through**

Figure 34. Steps for throwing lightweight wrapper.

Time

The time required for synthetic wrappers is similar to that of the traditional throwing method. Wrapping time using both conventional and lightweight wrappers for a three bundle loads will be around 3.5 minutes.

Cost

Synthetic wrapper or tiedown - $200 to $300, depending on diameter and length.

Risk Exposure

Even with lightweight wrappers, drivers are exposed to risk of musculoskeletal related injury (MSI) because of factors such as repetitive motions and non-ideal posture. Other factors such as previous injuries, age, fitness level, throwing multiple wrappers in one throw can also increase risk. Other risks are falling logs or debris and slips, trips and falls on uneven or poor ground conditions.

5.6 Toolbox F – Elevated Platform

Descriptions

An elevated platform (Figure 35) reduces throwing height and in combination with the use of an underhand throwing method significantly decreases the risk of MSI injury. The platform itself is 4 meters in height and is accessed via two sets of stairs. To facilitate getting the wrappers over the load via an underhand throw, 8-inch gaps are established in the upper guard rails. Two trucks can access the platform simultaneously, one on each side. This platform also has a device to carry multiple wrappers to the top of the platform removing this step for the drivers.

Figure 35. Platform in a reload site for throwing wrappers from an elevated position.

MRS and MRS Risk Level

With an underhand throwing method, the MRS of elevated platforms is 10 to 12 and the risk level is low (Table 17).

Table 17. MRS and MRS risk level when using platforms to throw wrappers

Movement Risk Score	Risk Level
10-12	Low

Safe Work Procedure

The safe work procedures for the use of elevated platforms are as follows:

1. Park trucks close to the platform so that load/bundles are aligned with the railing gaps on top of the platform.

2. Take the required wrappers from the trailers (Figure 36a) and place them in the wrapper belt (Figure 36b). There are two wrapper belts on the platform.
3. Use three-point contact while climbing the stairs (Figure 36c).
4. Rotate the wheel located on the top of the platform using body weight and keeping hands close to the body (Figure 36d) to lift the wrappers to the top. Use only the wheel to turn the wrapper belt.

(a) **(b)**

(c) **(d)**

Figure 36. Steps involved in getting wrappers to top of the platform.

5. Collect and uncoil the wrappers

Figure 37. Underhand throw from platform.

6. Position body in line with the rail gaps. Stand with a wide, stable stance, one foot in front of the other. Avoid twisting of the low back.
7. Ensure elbows are as close to the body as possible.
8. Use an underhand throw. through the railing gaps (Figure 37). Throw wrappers between the gaps only, avoid sidearm throws.
9. Repeat the throw for all bundles.
10. Adjust the truck position if required.

Time

For a three-bundle load, it takes about three minutes to throw six wrappers over the load. This is the same as for the traditional wrapper throwing method.

Cost

Capital cost: approximately $150,000

Risk Exposure

While using the platform, the drivers are still exposed to risk of musculoskeletal related injury (MSI) if non-ideal posture or methods are used. Other risks include slips, trips and falls while climbing stairs.

Railing gaps should be no wider than 8 inches as this provides sufficient space to get wrappers through while preventing workers from falling through the gap.

Suppliers

The platform was fabricated by Monster Industries Ltd, Houston, BC.

Contact number: 250-845-3240

6 DISCUSSION AND CONCLUSION

The objectives of this project were to identify and study tools and methods that could significantly reduce or eliminate MSI risk for drivers throwing log load wrappers. The results of the study indicate there are numerous tools and methods that lower the MSI risk when compared to the traditional load securement methods, specifically throwing wrappers. However, none of the tools or methods eliminate the risk of MSI.

When evaluating alternative tools and methods, the hierarchy of controls (Figure 38) and operational limitations need to be considered. This is particularly important when determining the most appropriate control measures for reducing or eliminating MSI risk in specific operations.

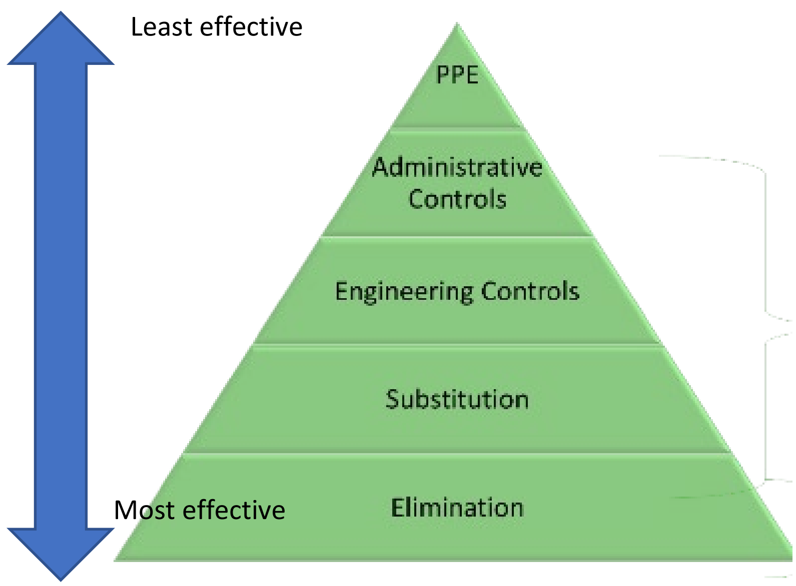

Figure 38. Hierarchy of control.

The options for reducing the MSI risk of throwing wrappers based on the hierarchy of control are:

Substitution

- Loader-assist method.

Engineering Controls

- Reduce throw height with elevated platforms.
- Reduce effort using mechanical advantages (RotatorSaver).

Administrative Controls (equipment)

- Use of throw assist using a pole.

- Use of throw assist using a lead rope.
- Reduce throw weight with lightweight wrappers.
- Throwing wrappers with improved techniques.

Higher-level controls are more effective at reducing the level of risk, however because of task demands, costs, operational limitations and physical work environments, it is not always practical or possible to fully eliminate the MSI risk. In this study, lower-level controls were considered, such as educating drivers on correct work method and best practices to minimize the MSI risk.

Prior to introducing any new method or equipment into operations, it is imperative that training be provided to workers to ensure competency. Unfamiliarity with equipment, process or procedures can lead to workers inadvertently increasing their risk of injury.

7 KEY FINDINGS

Traditional log wrapper throws produce a high risk of MSI and were used as a baseline for the study. Table 18 summarizes the top six alternative methods and tools and ranks them based on MRS reduction and ease of use. As a reminder, MRS scores are derived from an algorithms that combines two Body Movement Risk Scores for back and shoulders that are combined to produce are combined Task Movement Risk Score as previously shown in Figure 4 and Table 2.

Table 18. Ranking of alternative methods & tools

Rank	Tools	MRS reduction (compared to baseline)	Ease of use
1	Platform underhand throw	71-76%	Excellent
2	JB Slinger	67%	Excellent
3	Jo’s easy wrap	76%	Good
4	RotatorSaver	57 - 69%	Good
5	Improved throwing method	50%	Excellent
6	Light weight wrappers	36-67%	Good

8 NEXT STEPS

The next steps in this project are:

- Seek the guidance from TAG, LSWG and other industry members on the implementation of study results;
- Follow up with companies using the tools to identify additional operational considerations, procedures, risks, and mitigation methods;
- Develop training resources;
- Continue to monitor developments in load securement technologies and methods.

9 ADDITIONAL RESOURCES

Other resources on wrapper throwing method, training and injury management that employers and drivers can refer to:

- BC Forest Safety Council: Throwing Wrappers – Method for Reducing Injuries https://www.youtube.com/watch?v=hDD5gzrjFJM
- BC Forest Safety Council: Shoulder Injury Management for Log Truck Drivers https://www.youtube.com/watch?v=emmPSSL3aDE
- BCFSC and Total Physiotherapy (2018) Throwing procedure https://www2.bcforestsafe.org/files/BCFSC_Logging_Poster_Method_Throwing_Wrappers_0.pdf

There are additional resources from BCFSC and FPInnovations that can be used in risk assessments for loader assist methods:

- BC Forest Council: Loader Assist Procedure
    - https://www.bcforestsafe.org/wp-content/uploads/2021/10/Risk-Assessment-Tool-MSI-Load-Securement_14-Oct-21_FINAL.pdf
    - https://www.youtube.com/watch?app=desktop&v=QhORC4T7ABc
- FPInnovations: Reducing Repetitive Strain Injuries Resulting from Installing Log Load Wrappers https://www.youtube.com/watch?v=WX2nWni4FOI

10 REFERENCES

BCFSC (2021). Using the Load Securement Risk Assessment Tool. https://www.bcforestsafe.org/wp-content/uploads/2021/10/Risk-Assessment-Tool-MSI-Load-Securement_14-Oct-21_FINAL.pdf

Combs B. & K. Heaton. (2016). Shoulder Injuries in Commercial Truck Drivers: A Literature Review. Orthopaedic nursing / National Association of Orthopaedic Nurses 35(6):360-374

DorasVi (2022). Throwing wrappers comparative assessment. Internal Report to Load Securement Working Group.

Miranda, H., Heliövaara, M., Viikari-Juntura, E., Knekt, P., & Punnett, L. (2007). Physical work and chronic shoulder disorder. Results of a prospective population-based study. Annals of the Rheumatic Diseases

Shetty M. (2021). Literature Review of Load Securement Technologies and Practices to Reduce or Eliminate Injuries. FPInnovations Technical Report No. 84. https://library.fpinnovations.ca/media/FOP/TR2021N84.PDF

Shetty M. (2013). Overexertion Injuries Resulting from Installing Log Load Wrapper. FPInnovations Contract Report CR-754-WCB.

TAG. (2021). Loader Wrapper/Binder Assist Procedures.

TAG (2022). Loader Assist Injury TAG Safety Alert https://www.bcforestsafe.org/wp-content/uploads/2022/02/TAGSafetyAlert2022Jan28-LoaderAssistInjury.pdf

WorkSafeBC (2021). Amended OHS Regulation Part 26: Forestry Operations and Similar Activities 26.68 Securing log loads.

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