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Productive Incident Investigation of Strains, Sprains & Pain

Robert (Bob) Button, M.S.
Director, Safety Results Inc.

Gail House, CSP
Safety & Health Manager
Walt Disney World® Resort

Introduction

Statistics show that strains and sprains are a major cause of lost productivity and Workers Compensation expenditures in all sectors of the U.S. economy. According to the U.S. Bureau of Labor Statistics, in 2006 musculoskeletal disorders (MSDs) caused 32% of all occupational injury and illness lost work days. Strains and sprains alone caused 78% of these MSD lost work days. This computes to strains and sprains causing 25% of all lost work days.

The primary symptom of strains and sprains is pain intense enough to impair physical mobility and performance of daily tasks. So clearly, these incidents also hurt quality of life as well as productivity.

However, one of the primary tools in the safety professional's tool box – Incident Investigation – often goes unused or results in prevention recommendations of questionable value.

For example, here are some facts uncovered in a recent review of sprain and strain incidents at a remote worksite averaging between 800 to 1000 employees and contractors performing administrative, hospitality, transportation, mechanical craft and construction tasks:

1. In the year 2005, there were 397 reports of pain and injury requiring medical advice. Most of these reports did not ultimately qualify as OSHA recordables.
2. 157 (40%) of the 397 reports were categorized as strains, sprains, pain, or spasm.
3. Only 5 of the 157 reports labeled as strains and sprains were investigated beyond the findings and recommendations on the initial supervisors section of the injury report.

The safety staff initially believed the existence of 152 uninvestigated incidents was reasonable because the incidents did not appear to offer much opportunity for identifying meaningful root causes and productive injury prevention recommendations.

The supervisors' reports often recommended re-training the employee on material handling techniques or offered no recommendations at all. Often, there was only a vague connection between the task associated with the onset of pain and the recommended training. In other words, the recommendations were primarily pro forma and non-specific.

In preparing this article the authors conferred with several other Safety Professionals at other industrial and service sector locations. It appears that pro forma and non-specific recommendations are the rule rather than the exception. The authors believe it is time to try new approaches to investigating sprains and strains.

Therefore, this article will address:

1. How to determine if an OSHA recordable involving musculoskeletal pain is the result of a mechanical incident or the result of a cumulative process.
2. Simple tools to identify specific and correctable work-related hazards and risk factors known to contribute to back pain, shoulder rotator cuff injuries, tendonitis, abdominal hernia and knee injuries.
3. Case study examples that illustrate the current state of vague and pro forma incident investigations versus incident investigation that results in practical recommendations to control or abate existing hazards and risk factors.

The current state of many sprain and strain investigations

Based on our review of the 157 strain and sprain reports and the 5 in depth investigations, we reached the following preliminary conclusions about the current state of sprain and strain investigations.

First, it appears that most strains and sprains are investigated only by the injured employee's supervisor. And, this investigation is usually limited to an interview that asks the employee some combination of the following questions:

1. What hurts?
2. What was the employee doing when the pain occurred?
3. In the employee's opinion, what caused the pain?
4. What does the employee believe might prevent a recurrence of a similar future pain causing incident?

Second, four kinds of strain and sprain incidents are most likely to be investigated more thoroughly:

1. Incidents where it is perceived that high levels of force are applied to the body during a material handling task; e.g. the employee was lifting a heavy object or turning a valve with all their strength.
2. Incidents involving equipment failure or involving conditions that do not meet OSHA compliance.
3. Incidents where there appears to be non-compliance with the organization's policies; e.g. erecting a structure when the wind exceeds the policy for work suspension.

4. Incidents resulting in unacceptable losses; e.g. the incident was both an OSHA recordable and resulted in an unusually high number lost work days.

What kinds of strain and sprain incidents are likely to receive the more cursory supervisor interview and safety department review?

1. Incidents with reported forces that seem minimal. For example, read the case study included in this article about the employee who reports that bending over to pick up a pair of pliers caused the strain.
2. Incidents with forces that are within the norm for the job being done. The word "norm" is very important. For example, if it is normal for loading dock employees to lift 50 lb loads several times each hour, then an incident involving lifting a 40 lb. load is not likely to be investigated.
3. On the other hand if lifting 40 lbs is very unusual (e.g. a software engineer reports pain occurred while lifting a 40 lb. object in his office) then this is more likely to be investigated.
4. Reports of pain where the employee is not sure what caused the pain.

How can investigations of sprains and strains be improved?

Better understanding of risk factors

Improved investigation is often rooted in an improved understanding of the factors that increase or decrease the risk of injury. Here are several quantifiable, task-related risk factors for musculoskeletal injury that are commonly addressed in the literature of ergonomics and sports medicine:

1. **Force**; e.g. weight (the force of gravity), speed (the momentum of a body motion), or extreme static muscle contraction (giving a maximum strength effort). Numerous studies have identified the range of safe lifting forces for various kinds of lifting tasks (Mital et al)
2. **Posture**. Posture has several effects. As a person reaches horizontally away from the body the moment arm of any lifting motion is increased which in turn increases the force acting on the musculoskeletal tissues. As the angle of any joint reaches its maximum deviation, muscle efficiency decreases and strain on the connective tissues of the joint increases. This can result in increased muscles exertion and decreased blood circulation during task execution. This in turn can result in muscle tissue inflammation or spasm. And, this in turn can lead to muscle pain, tendonitis or nerve entrapment (Chaffin et al)
3. **Fatigue**. One recognized fatigue factor is repetition of motions to the point of muscle exhaustion and connective tissue inflammation.
   Another fatigue factor is static exertion for a prolonged period; e.g. remaining in a sitting position for hour after hour. (Chaffin et al)

The three risk factors cited above (force, posture and fatigue) are believed to influence both the incidence and severity of strains and sprains. In addition, they are also recognized as risk factors for other MSDs including tendonitis and nerve entrapments.

Force, posture and fatigue are often caused by risk factors such as a hazard in the task/work environment, poor physical fitness, or unsafe work behavior. The inter-relationship between these risk factors is represented in Exhibit 1 below.

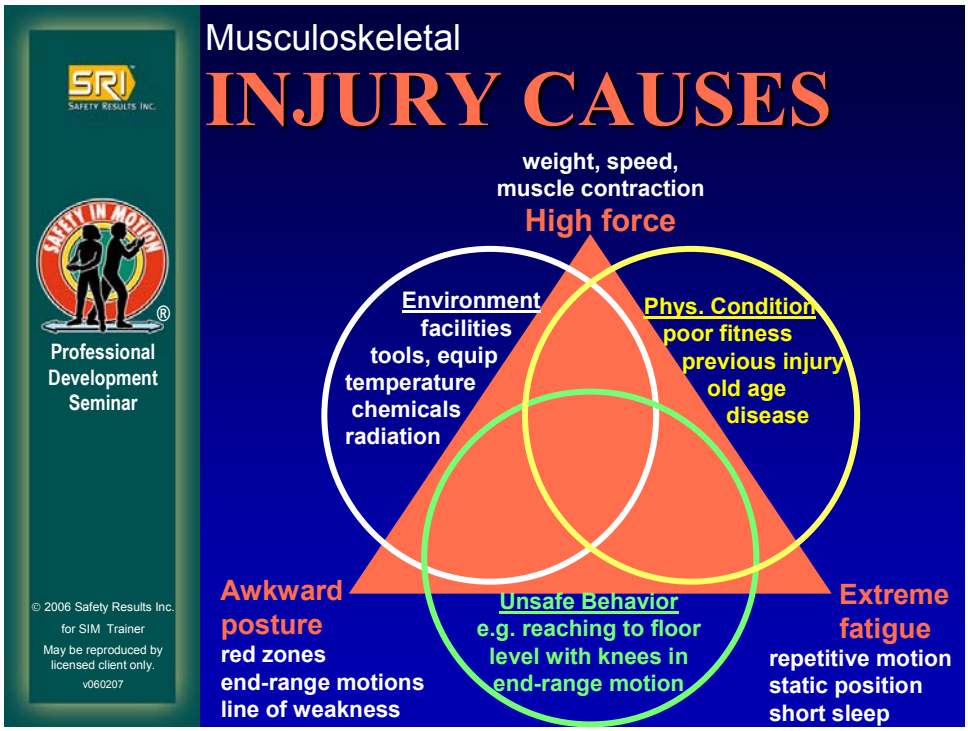

Exhibit 1. The inter-relationship of sprain and strain risk factors (Button 10)

<u>Using available technologies to control and abate risk factors</u>

Both safety and rehabilitation medicine have well accepted technologies for controlling and abating the risk factors cited in Exhibit 1. These include:

1. Industrial ergonomics methods for reducing force, improving work posture and reducing fatigue. These methods include:
   - adjustable work station set up
   - providing material handling equipment
   - providing tools that reduce awkward arm posture and grip force
   - providing task appropriate chairs for seated or sit-stand tasks
2. Proven body mechanics techniques to reduce the strain on specific joints and muscles. For example, material handling techniques that Position Elbows Closer to the side of the torso. This technique reduces the moment arm of all reaching, pushing, pulling carrying and lifting motions thereby reducing strain and fatigue on the arms, shoulders, neck and lumbar spine.
3. Physical fitness testing and training. This includes:
   - muscle balance testing and exercise prescription
   - exercise systems designed to increase core strength and soft tissue mobility; e.g. Pilates.
4. Injury rehabilitation through work hardening.
   Work hardening usually involves quantifying the forces involved in specific job work tasks and creating physical therapy treatments to develop sufficient strength and range of motion to accommodate the tasks.

5. Behavior based safety processes.
   Behavior based safety processes simplify and focus hazard recognition. In addition, excellent behavior based processes educate and engage employees in recognizing hazards coupled with coaching on behavioral techniques for controlling or abating the hazard.

These safety and rehabilitation technologies for preventing strains and sprains are illustrated in Exhibit 2 below.

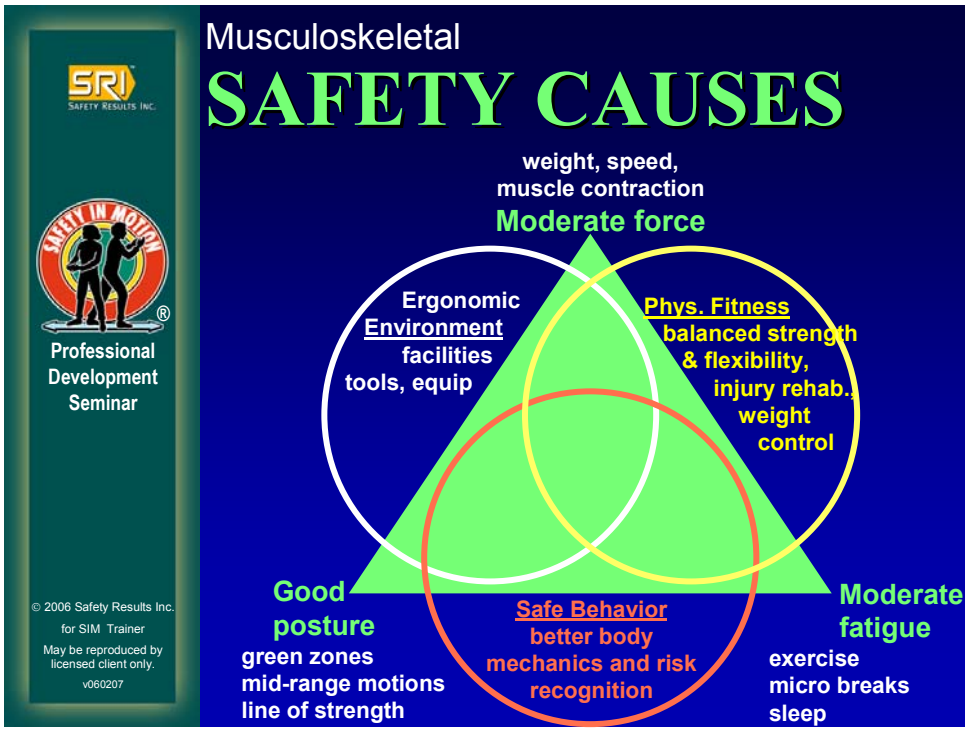

Exhibit 2. The inter-relationship of sprain and strain risk factor controls (Button 14)

Determining if a strain or sprain was acute or cumulative

Sprain and strain incidents that clearly resulted from an event involving high levels of force applied to muscles or connective tissues are often termed 'acute injuries'. For example, a warehouse employee was off loading totes that usually weight 10 to 30 lbs. This employee was surprised by unexpectedly pulling and supporting a tote weighing 75 lbs. Pain in the shoulder was immediate and severe.

Current incident investigation tools and methods are usually well suited to determining the mechanical causes (e.g. excessive weight coupled with an extended reach) and root causes (e.g. no warning label or computerized weight allocation system) and control measures appropriate to preventing recurrence of similar future acute injuries.

However, many if not most strain and sprain incidents are not associated with a clearly remembered, high-force incident. This lack of association can have at least three reasons that are often referred to as 'cumulative':

1. The level of force for a set of tasks involved many high-force exertions such that the person who is injured did not notice which exertion or task caused the pain.
   This frequently happens to athletes engaged in an extended vigorous competition such as a tennis match. It also happens to industrial athletes who are engaged in an 8 to 12 hour event such as delivering packaged beverages to restaurants.
2. The cause was not a single high force incident. Instead the pain was caused by a repetitive or sustained task involving lower levels of force, end-range posture and fatigue that eventually lead to inflammation or spasm.
   - Example A – the housekeeper servicing her 18th room who is twisting and reaching down for the 36th pile of sheets or towels; or lifting and cornering the 72nd mattress corner; etc.
   - Example B – the welder inside a vessel who is bent over welding seams for two hours at a time.
3. The primary cause was not the force, posture and fatigue of work tasks. Instead it was caused by physical fitness deficits such as:
   - muscle weakness
   - muscle strength imbalance
   - chronic strain on muscles and connective tissue caused by morbid obesity.

One way to determine if a strain-sprain-pain incident is acute or cumulative is to ask a few open-ended questions:

1. "When did you first notice the pain?" This question does not bias the injured employee by asserting that a single task should be associated with the pain. An employee who is asked this question might respond:
   - "Right after I pulled on the heavy tote box" (suggests acute causation)
   - "I'm not sure" or "It's been coming on for a while but it became too much when I was unloading the truck" (suggests cumulative causation).
2. "Did the pain develop slowly or suddenly?"
   - If the answer is "suddenly" then this suggests a possible acute incident.
   - If the answer implies onset over time, this suggests cumulative causation.
   - If the answer is "I don't know" this suggests cumulative causation.
3. "What tasks required the most physical strength during the days before you noticed the pain?" This question helps identify a single high force task or multiple high force tasks.
   - If there is only one high force task it may be a candidate for investigation as a potential acute cause of injury.
   - If there are multiple high force tasks identified then the investigation can consider cumulative high force causation and might do best to look at material handling or tool ergonomics as well as body mechanics and fitness.
   - Sometimes this question reveals that off the job events such as soft ball games or taking a motor cycle off a trailer may have contributed.
   - If no high-strength tasks are identified, or the tasks identified do not involve high forces, this suggests cumulative causation and the investigation might best consider work station ergonomics, body mechanics and re-energizing breaks.

4. "How much or your day is spent sitting or standing in one spot" If the answer can be translated as "most of the work day" then the investigation may want to concentrate on cumulative causation and include physical fitness testing and workstation adjustment evaluation.

Develop simple tools to identify specific hazards and corresponding corrective action options

Some extreme postures are associated with strain and sprain causation. These include:

1. Reaching forward so that the elbow is more than 6 inches distant from the torso and the torso is flexed forward. The authors refer to this posture as the Far Red Zone.
2. Reaching up so that the elbows are above the shoulders. We refer to this as the High Red Zone.
3. Reaching down so that the elbows are below the waist or below the knees. We refer to this as the Low Red Zone.
4. End-range flexion or extension of the wrist. We refer to this as End-range Wrist Motion.
5. End-range forward flexion of the spine. We refer to this as a C-curve.

The authors have recently developed Action Option Checklists which help quantify the combination of force, posture and fatigue associated with one of the specific extreme five postures listed above. These checklists also offer relevant ergonomic, material handling techniques, daily task techniques and fitness improvement action options for injury prevention.

Sample checklists are too large to embed in this article. However, we will share sample checklists during our presentation at the 2006 ASSE PDC in Seattle.

Case study examples

As mentioned above, it is very common and often incorrect to associate a strain and sprain with the most immediate activity the employee was performing when the injury occurred. Sprains and strains more often then not are cumulative in nature. The same relatively minor, virtually undetectable injury repeating itself time after time while the injury gets progressively worse suddenly resulting in debilitating pain.

Here are a couple of examples of injury cases where the injury would typically be associated with the task when the injury occurred. After reviewing some of the findings that are based on a brief interview with the injured employee how would you categorize the injuries – acute or cumulative? Also ask yourself what facts gave you the best insight about the complexities and prevention of this type injury?

Case 1

Sprain interview information

Incident description:

On 1/3/06 an employee dropped a pair of pliers. When the employee bent over to pick the pliers up he felt a pop in his lower back and severe pain. The employee went down to his left knee and reached with his right hand to pick up the pliers. He felt the pain as he stood up.

Treatment:
The employee was taken to the on site medical clinic. He was diagnosed with low back pain with spasm. The employee was treated with OTC anti-inflammatory, ice and bed rest for the remainder of that shift.

General work description:
The employee is an insulator. His job entails work in a shop laying out insulation blankets on a work bench and then sewing the blankets. Once the blankets are finished the employee installs the blanket on the pipeline valve. The work environment is ergonomically designed in the shop and is equally divided between layout of blankets, sewing, and installation.

Findings during interview:
- The work group participates in a mandatory 10 minute stretching program daily.
- The employee has attended body mechanics training
- Employee is 58 years old
- The work just prior to the injury was installing a blanket.
- The work was outside. The temperature –28 F.
- The work was at about chest level and the duration about 10 minutes.
- Force required during installation is considered to be in the normal range.
- The work and hours for the previous days was considered normal.
- The activity during the employee's time off was considered normal
- The injury happened on the 6th hour of a 12 hour shift.
- The employee stated he has never experienced any back problems
- Employee had no indication he was about to have a back episode
- The employee stated he does not take any anti-inflammatory medicines on a regular basis.
- The employee has lost ~ 60 pounds in the last 3 months by taking medication prescribed by his doctor.
- The employee is a smoker.
- The employee does not participate in a regular exercise program at home but does play basketball and golf during his time off.
- Employee does not exercise at work. Said "if you can work out after working you haven't done a days work".
- The employee considers the injury non-serious.
- The employee stated that the stretching program is worthless.
- The employee stated that he does not feel any difference from stretching.
- The employee stated that seeing a Physical Therapist would be a waste of money.
- The Physicians Assistant was going to provide a muscle relaxer but the injured employee asked if this treatment would make the injury an OSHA recordable. When the PA responded that the treatment would make the injury recordable the employee said he only wanted the anti-inflammatory.

The information contained on the report under **Supervisors Initial Findings s**tates "employee dropped his pliers and bent over to pick them up, when he stood up his lower back had pain in it.

Under **Immediate Corrective Action** the statement written is " To be determined after talking further with the employee".

There was not a formal Incident Investigation conducted on this case.

Case 2

Incident description:
On 1/10/06 the employee was checking bulk soda containers. This did not require lifting or an awkward posture. The employee bent forward slightly to shake the containers level and his back "locked up".

The employee went down to his knees. He managed to get up and sit down for a while. The employee stayed at work the rest of the night and did not report the injury. He thought that with rest and Advil he would feel better the next day.

The injury was not much better the next day so the employee informed his supervisor and sought medical attention at the clinic on 1/11/06.

Treatment:
Exam, Heat, anti-inflammatory and Ice.

General Work Description:
The employee is a Janitor. Work includes sweeping, mopping, emptying trash, stocking bathrooms, etc.

Findings during interview:
- The employee has had body mechanics training and seemed to have a good grasp of the material
- The employee is 47 years old
- The day of the injury was a normal shift
- The force required at the time of the injury is considered light
- There were not any awkward body postures at the time of the event
- There were not any extended awkward postures on the previous day
- The day before the injury was also a normal work load
- Nothing happened at home to aggravate the employees back
- Employee had no indication that he was about to have a back episode
- The employee likes the janitor work in the plants because there is less work to do than in the office areas
- Employee does not have a regular exercise program at work or at home
- Employee has a pre-existing back condition from a car accident in 2002
- Wakes up with a stiff back in the morning
- Employee takes a couple of Advil every day to combat the pain and stiffness
- Employee believes that exercise could help his situation
- Employee does not think that he drinks enough water and does drink too much coffee
- Employee does smoke
- Employee thinks the use of a Physical Therapist might help
- Employer does not have a stretching program
- Employee was open and at ease during the interview

The information contained on the report under **Supervisors Initial Findings s**tates "employee was checking soda bibs, and felt pain in lower back. Employee did not lift any heavy objects".

Under **Immediate Corrective Action** the statement written is "The employee has been through body mechanics training. There is no real cause for the incident at this time."
There was not a formal Incident Investigation conducted on this case.

All of the findings listed for both cases were from interviews with the injured employees. The interviews only took about half an hour.

Some of the things to consider during the investigation to determine if the injury is acute or the result of a chronic condition:

- Force required to perform the work
- Would this amount of force be expected to result in an injury
- Posture required during the task
- Duration of the task and posture
- Frequency of the task
- Employee fatigue
- History strains/sprains/spasms of same body part
- Employee's general physical condition
- History of employee's activities both on the job and off the job for the day of the injury and the previous week
- Frequency and dose at which the employee takes anti-inflammatory medications
- Employees perception of their level of strength & flexibility
- History of sprain/strain in the employees' work group
- How soon after the event did the employee report the injury and/or seek treatment

References

1. Mital, A., Nicholson, A.S. and Ayoub, M.M. *A Guide to Manual Materials Handling*, Taylor & Francis,1993.

2. Chaffin, Don. B. and Andersson, Gunnar B.J. *Occupational Mechanics (second edition)* Wiley-Interscience, 1991.

3. Button, Robert. "Action Options for Preventing Musculoskeletal Disorders" Proceedings of the Safety In Motion® Users Conference, Phoenix: 2006.