

# Repetitive Strain Injury on Automobile Assembly Process and Alexander Technique

김 대 식 \*  
Kim Dae Sig

## Abstract

In the trim line of an automobile assembly process, 52.9% of the subjects complained the shoulder and low back pain simultaneously. The Alexander Technique is an educational method which shows people how they are misusing their bodies and how their daily habits of work can be harmful. It also teaches people how to avoid work habits which create excessive amounts of static work and how to reduce the amount of unnecessary muscular force they are applying to their bodies. The purpose of this paper is to investigate the importance of repetitive strain injury on automobile assembly line process and contribute reducing the repetitive strain injury through Alexander Technique.

**Keyword** : repetitive strain injury, automobile assembly process, Alexander Technique

## 1. Introduction

According to the Bureau of Labor Statistics (BLS), the incidences of repetitive strain injury(RSIs) have jumped from 18% of all occupational illnesses in 1981 up to 66% today. However, even this dramatic growth underestimates the scope of the problem. Many cases of RSIs go unreported as workers try to "work through the pain" in order to keep their jobs, others are not reported by employers, and BLS data does not include self-employed workers or federal, state, and local government employees. The BLS put the RSI rate at 332,000 in 1994, but the American Public Health Association estimates that more than 775,000 workers suffered from RSIs in 1995. In the automobile assembly process, average 30.87% of employees complained in 1988. (Lee)

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\* Dept. of Industrial Engineering, Ansan College of Technology

## 2. Repetitive Strain Injury

RSI is a term that musculoskeletal symptoms affect work and daily activities caused by physical and/or psychological stresses on the body, beyond it's ability to adapt. RSI is really a blanket name that is used to describe many different types of soft tissue injury including carpal tunnel syndrome and tendinitis. It is usually caused by a mixture of bad ergonomics, poor posture, stress, and repetitive motion.

### 2.1 Risk Factors

RSI continues to be the subject of many research studies and recent studies have demonstrated the importance of psychological factors in the development of RSI. The followings are risk factors cause the rsi.

#### 2.1.1 Repetitive actions

Jobs requiring highly repetitive motions with short cycles require greater muscular effort and consequently more time for the muscles to recover. Jobs that are paced by machine, for example those on an assembly line, put workers at increased risk of RSI.

Payment by results and similar bonus schemes that put workers under pressure to work even faster will mean that they are working their muscles and tendons even harder and are at even greater risk. They are also under greater mental stress.

#### 2.1.2 Forceful movements

Tasks which place a high load or pressure on the muscles will put greater strain on the muscles and tendons which will become fatigued much more quickly. In addition, poor design of the tool, workplace or task will mean that the worker has to exert excessive force to overcome resistance. If force is applied with the body in a static or awkward posture, the risk will be even greater.

#### 2.1.3 Static or awkward postures

Posture plays a significant role in the development of RSI. Where workers have

to adopt a static or awkward posture for long periods, the joints and muscles are put under severe pressure. Awkward postures include those which overload the muscles and tendons in an uneven way and those where a static posture is being held at the extreme of the range of movement for example, with the arms outstretched or above the head, or with wrists bent to the maximum angle, or where the worker has to reach behind their shoulder repeatedly.

#### **2.2.4 Gripping and twisting**

Forceful gripping, pinching and clothes-wringing actions can increase the risk of RSI. And constant gripping or pressure on a particular part of the hand, for example a tool pressed against the palm of the hand, can lead to problems in that area.

#### **2.2.5 Poor work organization, including payment systems**

A number of organizational factors are involved in the development of RSI. For example, production lines where workers have a low level of control over the work rate etc., piece rate payment systems or payment by results systems which make earnings dependent on workers achieving excessive work rates, bonus systems which make people overwork themselves, insufficient breaks for rest and recovery, jobs with little variety, and lack of information, instruction and training. Organizational deficiencies which place additional stress on workers such as poor work relationships, lack of consultation, no worker participation in decisions which affect them, job insecurity, and an authoritarian management style can all increase the risk of RSI.

#### **2.2.6 Stress**

Although the role of stress is not fully understood, it plays an important part in the development of RSI. It is quite clear that workers under stress are more tense and excessive tension in the muscles is a risk factor for RSI. However, it is important to note that the fact that mental stress may be involved does not mean that RSI is all in the mind as some people try to insist.

#### **2.2.7 Cold**

Working in a cold environment or handling cold products such as chilled or frozen

foods is an additional risk factor in the development of RSI. Wearing gloves increases the amount of effort needed by the muscles to perform certain tasks such as gripping and can therefore be an added risk factor for RSI.

### **2.2.8 Vibration**

Exposure to vibration is a further risk factor. For example, the use of vibrating tools, particularly where they are used for repetitive and forceful tasks, is known to be associated with carpal tunnel syndrome.

## **2.2 Stages of Risk Identification, Risk Assessment, and Risk Control and Treatment**

There are three key stages in the process of reducing injuries arising from tasks undertaken in the workplace which involve :

1. repetitive of forceful movement or both; and/or
2. maintenance of constrained or awkward postures.

### **2.2.1 Risk identification**

The first stage is to identify manual handling tasks which are likely to be a risk to health and safety.

- (1) Analysis of workplace injury and incident records
- (2) Consultation with employees
- (3) Direct observation

### **2.2.2 Risk assessment**

The second stage is to conduct assessment of particular risk factors.

- (1) Workplace and workstation layout
- (2) Working posture
- (3) Duration and Frequency of activity
- (4) Force applied
- (5) Work organization
- (6) Skills and experience
- (7) Individual factors

### 2.2.3 Risk control

The third stage is to consider and implement control measures to eliminate or reduce risks.

- (1) Job design and redesign
- (2) Modify workplace layout
- (3) Modify object or equipment
- (4) Maintenance
- (5) Task-specific(particular) training

## 3. Automobile Assembly Process and RSI

### 3.1 Automobile Assembly Process

Automobile Assembly Process is the final process which equips in or outdoor parts like indoor decoration, dash board, seats, and glasses to painted body, assemblies units like engine, transmission, and axle, and works for electric parts, wires and pipes as a completed manufactures.

The automobile assembly line is labor-centered and very important process in logistics management.



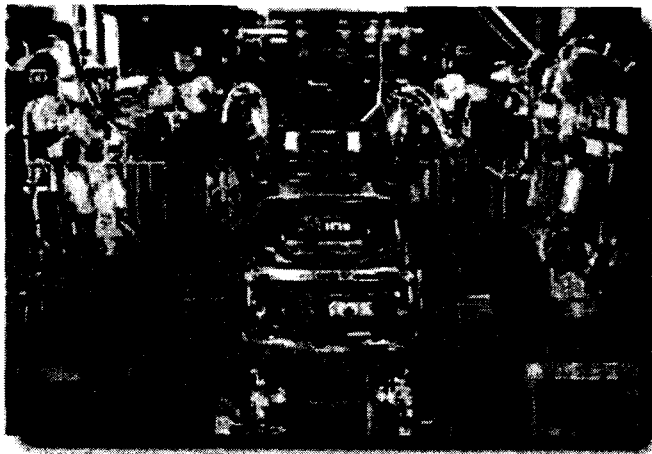
< Figure 1 > Automobile Assembly Process

On < Figure 1 > automobile assembly process the other hand, the assembly line is related to parts makers closely, is needed quality certification of the whole parts, and is needed few exclusive equipment. The assembly line, also, does not need drastic equipment change and the ratio of automation in model change compared with other process.

All kinds of works are operated on conveyor in this assembly line. The assembly line is composed of main and sub lines. The detailed processes are followings.

### 3.1.1 Body Assembly Process

The different panels, made by press, are assembled and The body assembly process is to assemble and weld panels by press operation. In the process of the body assembling, the preciseness is needed. Therefore, assembly operators feel great of fatigue.



< Figure 2 > body assembly line

The assembly equipment is composed of main line and several sub-line and automatic equipment like robot welding, automatic seal spread equipment, and automatic conveyor system. The assembly works are composed of welding, sealing, metal finishing, soldering, volts working and hemming. There are three welding works: spot, CO<sub>2</sub>, and blazing welding. Among them, the spot welding is the most popular method in the process of body assembly line. The importance of body assembling line is to have automobile shape and safety.

The assembly line is composed of the followings:

- 1) main process on the floor for the body
- 2) process for the side of the body, side major parts

- 3) main body process , equips side roof, rear panel to the basis floor
- 4) main subprocess, assembles middle parts to the main process
- 5) metal line process, equips door and hood to the main body
- 6) metal subprocess, assembles parts of doors and hoods for the metal line

### **3.1.2 PBS equipment**

The bodies in the PBS are input to the assembly line with optimal input order by computerized manufacturing schedule. There are two transferring methods : over head conveyor with hanger and floor conveyor with giant swing.

### **3.1.3 TRIM LINE**

In this trim line, wiring, ceiling and equipping of dashboard and parts in the engine room are assembled.

### **3.1.4 CHASSIS LINE**

In this chassis line, engine and axle, center of automobile, muffler and other suspension systems are equipped.

### **3.1.5 FINAL LINE**

In this final line, almost complete shape of automobile is provided. Tires, glasses, interior trim, and ramps are equipped. After finishing of all assembling, brake oil, coolant, engine oil, and gasoline are infused into the tank.

## **3.2 RSI**

Lee, yoon-keun(1988) evaluated ergonomic risk factors and injured body parts for RSI in the national auto manufacturer with ANSI Z-365 Quick checklist(ANSI, 1996) The results of the evaluation shows that 78.3% of the works are evaluated as dangerous jobs.

In the automobile body assembly process, 43.1% of the subjects complained the leg pain. In the process of PBS, 45.9% of the operators complained pains of hand/wrist. The rest of the processes, most of workers complained pains for shoulder and low back< Table 1 >.

< Table 1 > The ratio of Cumulative Trauma Disorders complain in automobile assembly line

body part	auto body parts	PBS	trim	chassis	final	other	total	p-value
No. of subjects	144	37	51	42	40	166	480	
neck	25.7	24.3	39.2	31.0	35.0	25.9	28.3	0.385
shoulder	35.4	29.7	52.9	40.5	37.5	32.5	36.5	0.146
arm/ elbow	29.2	13.5	31.4	26.2	15.0	19.9	13.5	0.096
hand/ wrist	37.5	45.9	45.1	35.7	35.0	26.5	34.8	0.077
low back	35.4	29.7	52.9	40.5	37.5	32.5	36.5	0.146
leg	43.1	24.3	49.0	31.0	27.5	30.7	35.6	0.025

#### 4. Alexander Technique

Alexander Technique, developed by F M Alexander (1869-1955), has been enjoying a resurgence in the last few years. It is well known among musicians and performers; indeed Alexander was an actor himself. Early in his career Alexander found that when he was giving recitals his voice began to deteriorate. This was something that did not occur during normal everyday speaking, and was clearly very damaging for his career. He set out to analyse what he was doing differently during a performance to see if this problem could be overcome.

The AT is an educational method which shows people how they are misusing their bodies and how their everyday habits of work can be harmful. It also teaches people how to avoid work habits which create excessive amounts of static work and how to reduce the amount of unnecessary muscular force they are applying to their bodies.

The structural basis of the AT is composed of followings : The head sits at the top of the spine and weighs 10-14 lbs in the average adult. The spine is curved in an S-shape, with a limited amount of flexibility. Because of the curvature, the



spine has the ability to absorb shocks, and allow fluid, balanced movement. The spine is the anchor point for the muscle attachments of the arms and legs, as well as the origin of the nerves to the limbs. In case of losing the optimal length of the spine, all body functions are compromised. All actions are dependent for their efficiency on the optimal relationship of the head and the spine.

The AT focuses on this head, neck, back relationship, so is applicable to any movement. The benefits for sufferers of RSI are obvious - when sitting at a desk, actions with good functioning can be still performed. A great deal of attention is now being paid to the office environment, and well balanced seating, and yet it is still possible to slump on a good chair, and therefore restrict movements and breathing, and more specifically, the nerve supply to arms. Sitting is a complex and difficult activity and much harder on the body than standing. Good chairs and a well designed work station are an important step. The most important factor, however, is to look at how people sit and use their desks. An excellent form of seating is a saddle chair, yet anyone can still slump on it. Many companies have invested in new split, curved keyboards, but frequently staff don't know how to get the maximum benefit from them. It is through Alexander lessons that we can learn the widening of the shoulders and arms, and then truly benefit from this better designed technology.

The body is at its optimal balance in upright movement and any activity that takes away from this for prolonged periods is a challenge. Any occupation that requires extensive periods of standing can lead to the hips and knees becoming stiff, and the muscles of the legs and back braced. Twisting the body routinely is probably the most damaging activity, and yet many work stations are set up in such a way that the user is twisted for much of the day. For any occupation, the body needs to be constantly moving, in major or subtle ways.

#### **4.1 Application of AT on Automobile Assembly line.**

There are three stage approach to prevent RSI on the automobile assembly line.

##### **4.1.1 Bio-Ergonomics Analysis**

- observes workers at work station. Together they explore individual movement patterns and evaluate the efficiency of these patterns. Help employees to make the best of existing work conditions

### 4.1.2 Retraining Work Habits

- teach workers efficient ways of sitting and standing, walking, bending, using arms and hands, etc. Develop good coordination in all workplace activities, Alter postural behaviors which predispose us to a wide range of repetitive stress injuries, e.g. back, neck, and shoulder pain, wrist and hand pain,

### 4.1.3 Application to Specific Workplace Activities

- let workers practice improved coordination while at their jobs : bending, lifting, carrying, working with tools. Build strength and correct body mechanics for sitting, standing, and moving efficiently all day long

According to the < Table 1 >, workers in line of trim, chassis, final and other complained shoulder and low back pain. In auto body parts line and PBS, employees answered on the survey as hand and leg pain. In practice the most basic things to attend to are allowing muscles in your neck and back to be released from inappropriate tensions and your spine consequently to be nicely lengthened, with your head in a lightly balanced state on top.

This exercise might be helpful the automobile assembly line workers to reduce the RSI on break time.

- 1) Find a chair with good back support, and move your hips to the back of the seat. Try improving your chair design by placing a pillow on the chair back just above the waist to bring you forward and provide thoracic support.
- 2) Place feet flat on the floor or use a footrest.
- 3) Without slumping, allow the back of the chair to support you.
- 4) Without stiffening, lean into the chair back and envision your back lengthening and widening.
- 5) Pay attention to neck and jaw tension. Allow the neck to be free, head poised easily.
- 6) Notice your breathing. Allow it to expand to the back and sides of your ribs.
- 7) Sit at a comfortable distance from your work surface.
- 8) When you look down to read or write, allow your eyes to lower while maintaining the ease of the neck and the poise of the head.
- 9) Allow lengthening and widening of the torso. Allow the breath to flow.

## 4.2. Expected Effects

Excess tension in the body can cause a variety of unpleasant symptoms and it can interfere with your ability to perform activities well. Therefore, it is not surprising that most people come to the AT because they are in pain of backaches, sore necks and shoulders, carpal tunnel syndrome etc. Apart from the immediate physical benefits of minimizing, eliminating or preventing various painful symptoms, and all body movements becoming increasingly light and effortless in feel, there is the fact that wear on joints becomes greatly reduced, so your active life is likely to be considerably extended.

The expected effects of the AT on the automobile assembly line are followings : a simple method of moving while protecting joints, improved posture with a subjective feeling of support and lightness, more freedom of movement without exceeding the margins of joint safety, and confidence in one's ability to move with greater ease.

## 5. Conclusions

The AT will increase productivity and employees' morale by minimizing of loss of time, production and property and cost of temporary staff, compensation, allowances and fines. Many RSI sufferers have received enormous benefit from the AT, both in promoting recovery and preventing relapse. In the automobile assembly process, most of injuries come from awkward posture. Therefore, rsi should prevent and reduce through AT. By the A.T., insurance premiums and care and recovery: for staff suffering from pre-existing injury or illness will lower. In conclusion, the AT will treat and rehabilitate pre-existing injury and illness and reduce permanent injury or disablement.

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## 저 자 소 개

김 대 식 : 현 안산공과대학 공업경영학과 교수

관심분야는 Low Back Injuries, Workstation Design, Safety in Virtual Reality, Human Sensibility Ergonomics 이다.