

# Effect of Working Posture and Hand Grip for Carpal Tunnel Syndrome among Aerospace Workers

Seri Rahayu Kamat., Norhidayah H., Isa Halim, and Hui Hui C.  
*Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka,  
 Durian Tunggal, 76100 Melaka, Malaysia  
 Phone: +606-3316447, Fax: +606-3316411*

**Abstract** — Manufacturing process often related to continues process to produce better quality and profitable product. Continues process is often linked with unstopable process where workers done their job repetitively ever day. Repetitive motion of the workers may cause them have carpal tunnel syndrome (CTS) and this condition occur for workers in aero space industry. Therefore, investigate needs to be done on working posture and hand grip force to prevent CTS. The method is using the questionnaire on psychology working experience and equipment using vibration force and hand grip strength. The result shows the relationship between four factors; working experience, working posture, hand grip strength and exposure time. The suggestion is given such as hand massage, suitable vibration glove; reduce exposure time and regular exercise hands frequently to improve circulation for help CTS workers.

**Index Terms**—Working Posture, Hand Grip Strength, Working Experience, Exposure Time, Carpal Tunnel Syndrome (CTS)

## I. INTRODUCTION

In the industry, power hand tool is one of the common tools that have been used by the worker almost every day. For the workers that handled the power hand tool such as hammer, hand grinder and hand drill in their daily job, they will confront the physical stress such as hand-arm vibration. Vibration that produced by the vibration power hand tool enters the body of the user from the organ in contact with vibrating equipment [1],[2] and [3]. Hand-Arm Vibration Syndrome, it is usually caused by the frequent use of vibrating hand tools that have the frequency range between 8 Hz and 1500 Hz with the most hazardous frequencies are from 100 Hz to 150 Hz [4]. The persons with this syndrome will have common symptoms such as tingling, numbness, loss of feeling and pain in the fingers or hands. They may experience a gradual decrease in their grip strength, reduced dexterity, and both their hand and arm muscles tire easily. They also may have a cold feeling of the fingers and possibly whitening of the fingers beginning at the tips [5] and [6]. These symptoms are initially intermittent but later become continuous if exposure continues. Since of this workers health condition, therefore this study wants to describe a research, observation on the vibrating hand tool and working posture. The objectives of this study is want to investigate workers working posture, measure and compare the grip strength before and after the workers do their tasks. The data has been taken about two months using same workers. Also we used the analysis working posture using the Rapid Upper Lim Assessment

(RULA) to further investigate the cause to Carpal tunnel syndrome (CTS).

## II. METHODOLOGY

Ten male respondents which involved who had been identified working with hand tool vibration (router gun, drill gun, flat sander, and angle grinder). These workers involved the vibration task 8 hours per day and have two shifts (morning and evening). Volunteers with age are between 18 to 58 years. In this study, the questionnaire on psychology and physical test has been used to collecting the data. The dynamometer was used to measure the hand grip force of the workers while undertaken the tasks using vibrating hand tool. The hand grip test was conducted before and after the industrial workers do their job using the vibrating hand tool. While doing the test, the responses were asked to grab the dynamometer with a neutral grip and take a deep breath. The experiment took about 20 minutes to finish. After finish the experiment the respondents should answer the psychology questionnaire. The questionnaire have 2 sections: first section is about demography information and section 2 is more about their present jobs, discomfort experience on the hand (finger, wrist and shoulder), tools usually used and the syndrome after and before they doing the job.

## III. RESULT

The graph in Fig. 1. shows the different of hand grip force before and after undertaking the vibration task. From the analysis, we can clearly see that there is a huge different in the strength of the workers before and after doing their trimming task. The graph shows the hand grip strength is higher before using the vibration hand tool compared to after using the vibration hand tool. From the observation, while the worker undergoing the experiment, their hand feel tingling (shaking nonstop). This could be a dangerous situation where the worker might suffer from Carpal Tunnel Syndrome. The percentage different of the grip is about 68.42%. The strength of the worker reduced after undergoing vibration task.

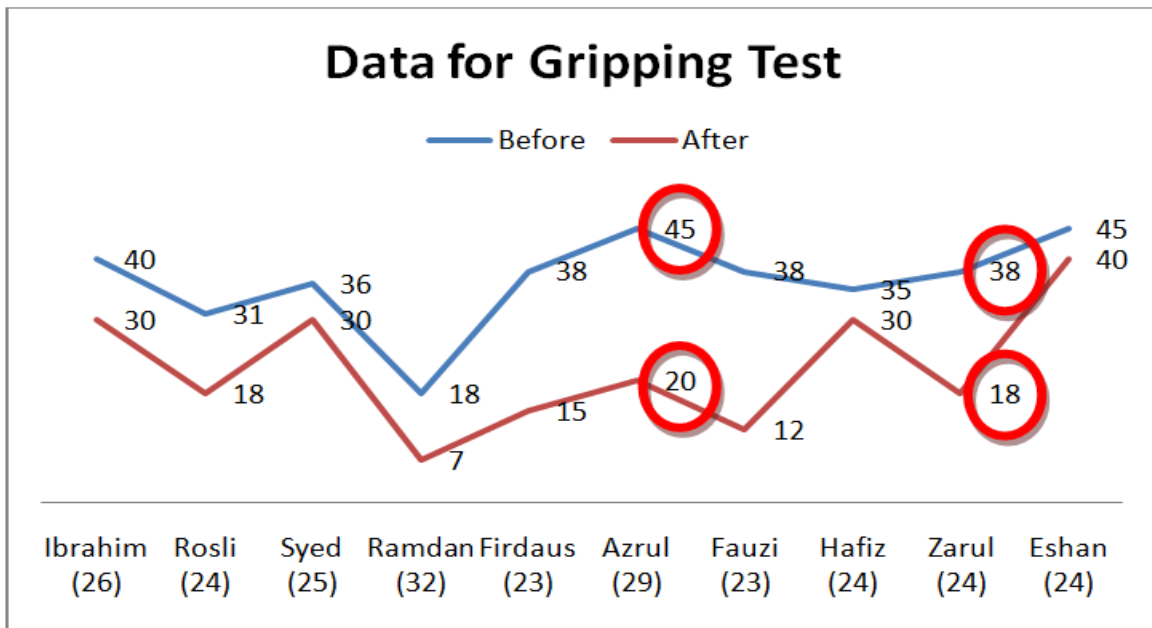


Fig. 1. Graph for data Gripping Test

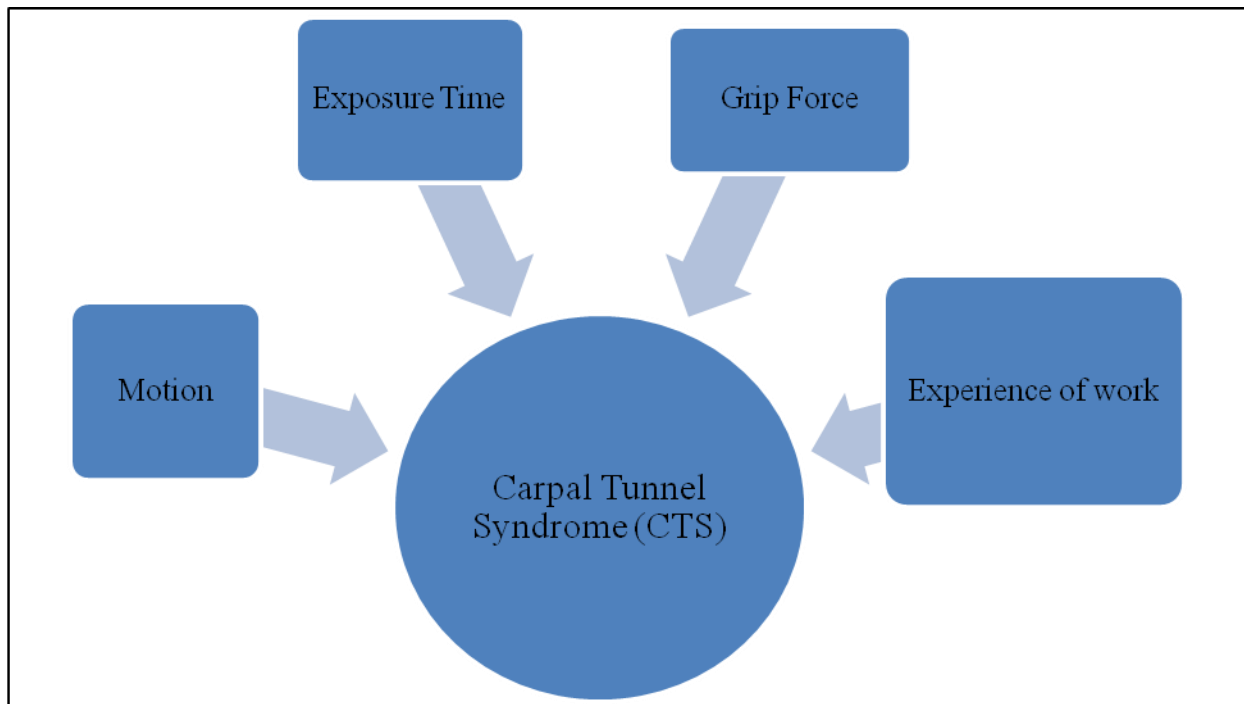


Fig. 2. Correlation of CTS

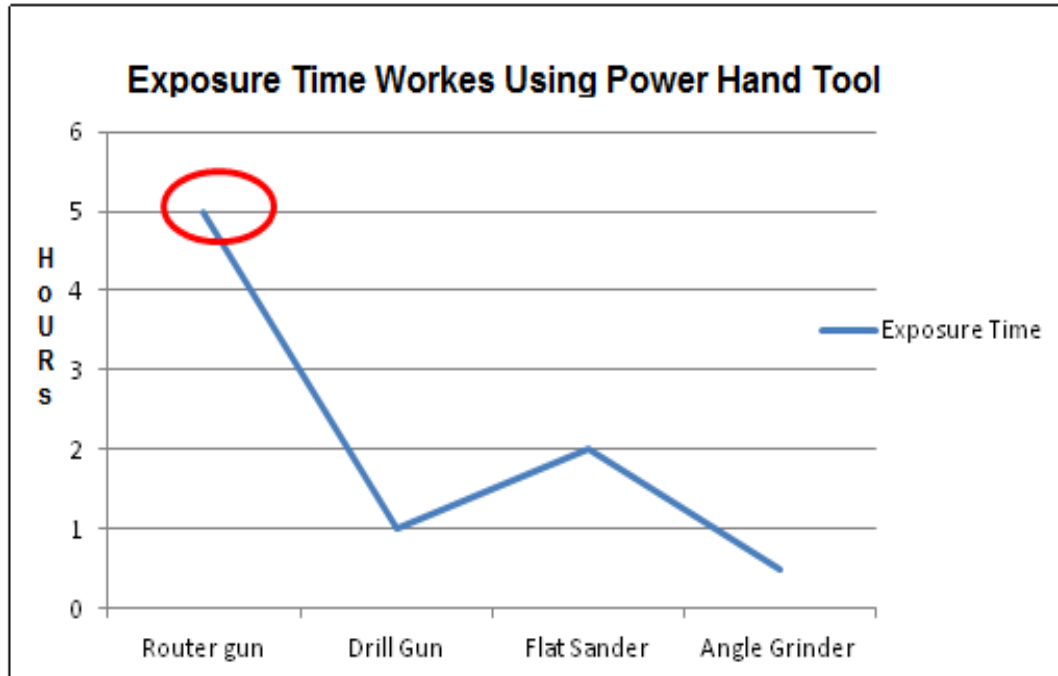


Fig. 3. Exposure time for each hand tools

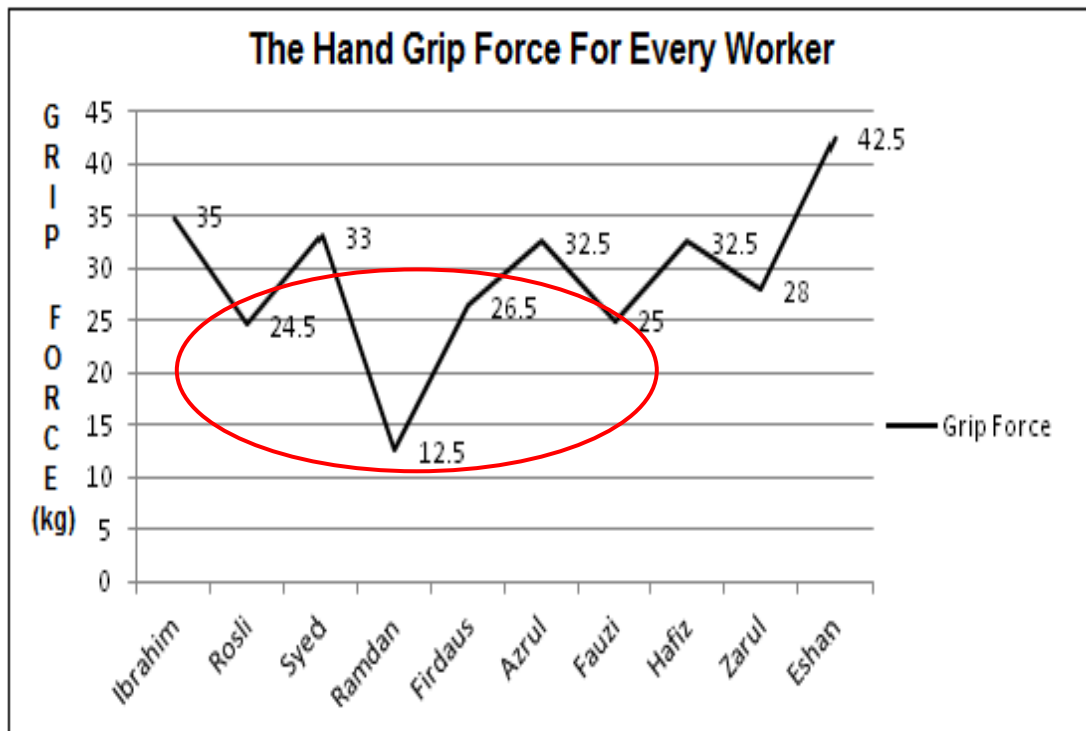


Fig. 4. Results of grip force for two months

Fig. 2. shows the correlation of Carpal Tunnel Syndrome (CTS) ∝ Exposure vibration ∝ Motion ∝ Grip force ∝ Experience of work. The exposure vibration, motion, grip, and experience of work to determine which workers in CTRM already suffer from CTS. As shown in Fig. 3., the exposure time for the router gun is 5 hours per day where the router gun have the highest vibration points exceed 466m/s<sup>2</sup>.The vibration may cause the workers to feels numbness, tingling and painful burning in the thumb. For prolonged period of time handling this vibration tools may cause the worker to suffer from CTS. The worker is having serious carpal tunnel syndrome (CTS) which they feel difficulty in moving hands and fingers, and also losing their grip force as shown in Fig. 4.

When they losing their grip force, they also don't have feeling towards their arm, loss sensation in gripping experiment. CTS could occur based on age, gender [7], acute trauma, chronic disease, use of birth control pills, circumstances of pregnancy and breast-feeding, medication or therapy, menopause, repetitive movements, excessive force applications, static muscle load, body posture, mechanical stress, vibration and cold [8]. In relevance to this, one of the workers Ramdan is 32 years old which is the oldest among the CTRM workers, grip force is reducing day by day, experiencing tingling while doing experiment, exposure to vibration hazards five hours a day and often bending or twisting his body postures to trim the panel. Besides that, the working experience also influenced the grip force as shown in

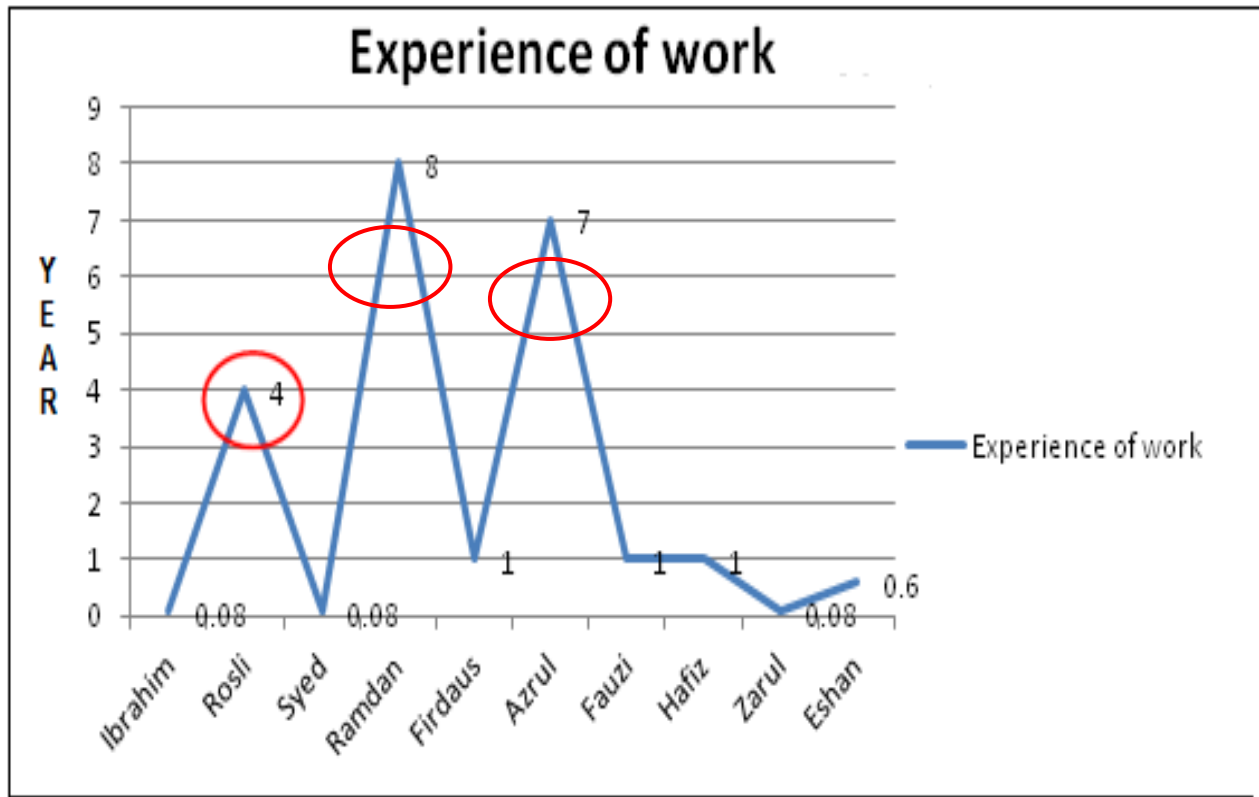


Fig. 5. Working experience for each worker

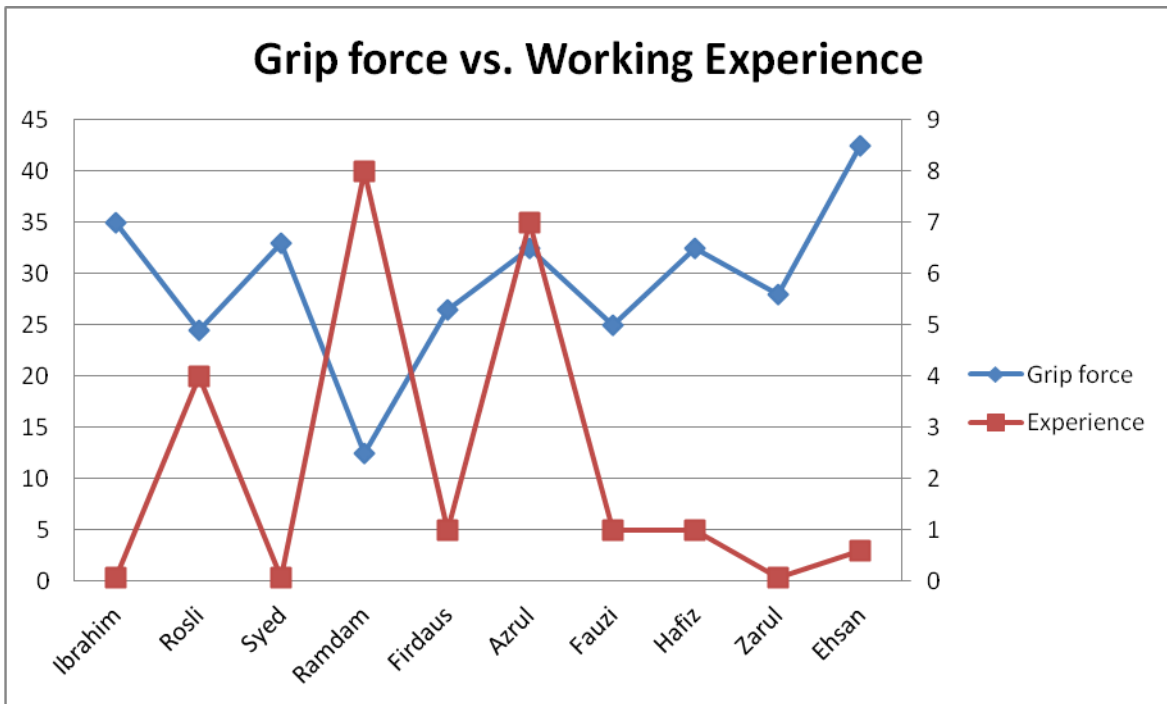


Fig. 6. Correlation of grip force and working experience

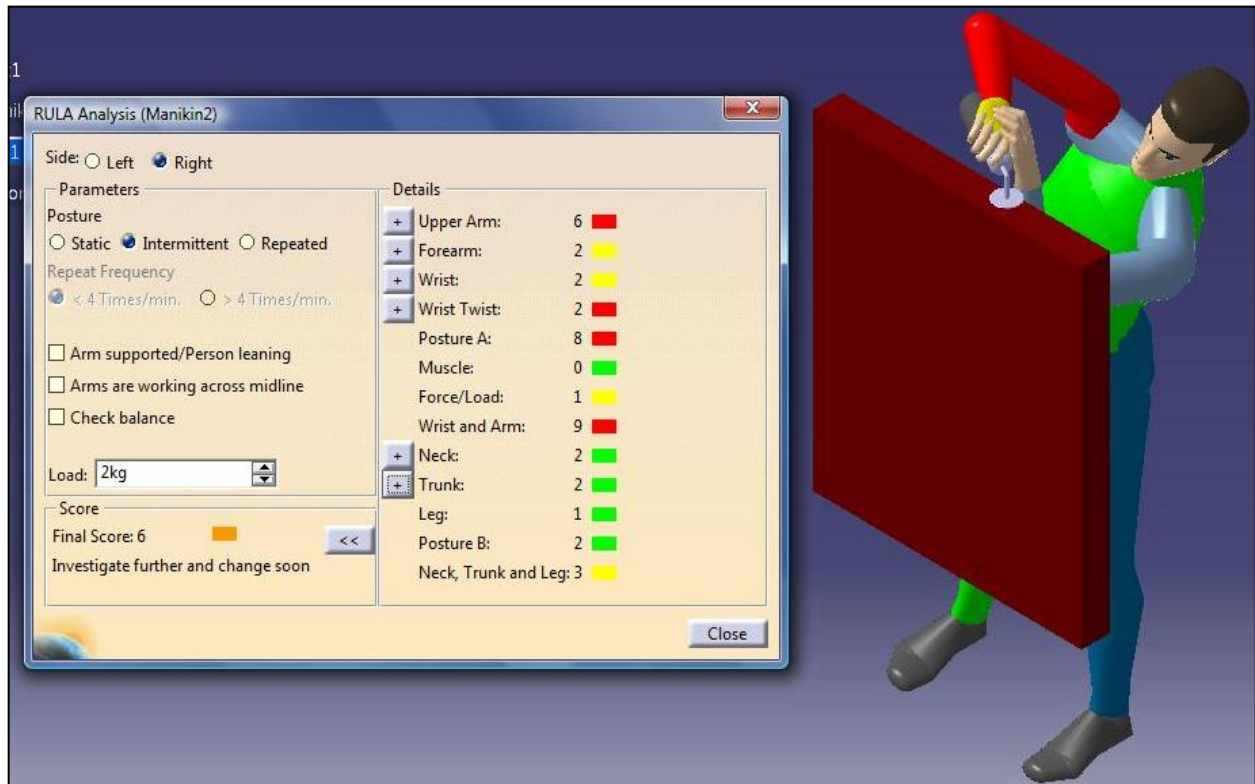


Fig. 7. CATIA analysis for right side of worker's body

Fig. 7. show one of the worst worker working posture while doing trimming task using vibration tool. From the analysis of the CATIA Software for the right side of the body, the postures of the worker is categorized as score of 6 indicates very high risks action and the postures need to be changed immediately. The right arm is usually in dangerous discomfort as it is used to hold and give force to trim the hard panel. From the analysis of the CATIA Software for the left side of the body, the postures is categorized as score of 4 where it indicates low risk postures and change of the postures may be needed. Left arm is less risk than right arm because it is supported by the panel.

#### IV. CONCLUSION

CTS is very dangerous diseases as it may cause the human to suffer from physical ailments of the wrist, arm and shoulder, caused by the cumulative effect of repeated mechanical stress. The four factors which are exposure vibration, motion, grip force and experience of work give effect of the CTS. Therefore to prevention techniques also need to be done to reduce or avoid the CTS to occur. A few recommendations can be taken such as hands massage (one in two weeks). From the interview, one of the worker suggest that the company can provide hand massage for them every two weeks to reduce the pain and tingling at their hand after manual handling tasks. The company should provide suitable anti vibration glove to the workers as suitable anti vibration glove can reduce the vibration by 50%. As the previous vibration glove provided is very tight and is painful to the hand while they handling the manual tasks. Reduce the exposure time, the worker should use three hours only done the task. The workers in the trimming department should have an experience in trimming the product together with the correct skills to avoid any defects occur and minimize the vibration of the tool while handling task.

#### ACKNOWLEDGMENT

The authors would like to acknowledge the Ministry of Higher Education of Malaysia, the Universiti Teknikal Malaysia Melaka (UTeM), and the Centre of Research, Innovation & Management (CRIM) UTeM for funding this research under Research Grant PJP/2012/FKP (6D) S1125. Special thank also goes to Composites Technology Research Malaysia (CTRM) Sdn. Bhd. for the permission and opportunity to facilitate a fruitful research.

#### REFERENCES

- [1] Alaska Department of Labor and Workforce Development, 2011. Physical Agent Data Sheet: Hand-Arm Vibration. [Online]. Available at: [www.labor.alaska.gov/lss/pads/hand-arm.html](http://www.labor.alaska.gov/lss/pads/hand-arm.html) [Accessed on 8 October 2011]
- [2] Canadian Centre for Occupational Health and Safety (CCOHS), 2008. Vibration-Introduction. [Online]. Available at [www.ccohs.ca/oshanswers/phys\\_agents/vibration/vibration\\_intro.html](http://www.ccohs.ca/oshanswers/phys_agents/vibration/vibration_intro.html) [Accessed on 8 October 2011]
- [3] Occupational Health Clinics for Ontario Workers Inc., 1990. Hand-Arm Vibration Syndrome (HAVS).
- [4] Construction Solution, 2011. Hand-Arm Vibration: Hazard Analysis.

- [Online]. Available at: [www.cpwconstructionolutions.org/masonry/hazard/128/vibrate-and-compact-concrete-or-grouthand-arm-vibration.html](http://www.cpwconstructionolutions.org/masonry/hazard/128/vibrate-and-compact-concrete-or-grouthand-arm-vibration.html) [Accessed on 7 October 2011]
- [6] Janet,T.K., et al., 2009. Ergonomics: Risk Factor-Vibration. [Online]. Available at: [www.ima-na.org/IMA-NA-files-ccLibraryFiles-Filename-00000000427-5RiskFactorsVibration.pdf](http://www.ima-na.org/IMA-NA-files-ccLibraryFiles-Filename-00000000427-5RiskFactorsVibration.pdf) [Accessed on 21 October 2011]
  - [7] Nicola, M.W., et al., 2011. Hand Grip Strength: age and gender stratified normative data in a population-based study.
  - [8] Alvin Luttmann et al. (2003). "Preventing Musculoskeletal Disorders in the Workplace." India: Protecting Workers' Health Series No 5, pp 21-30.