Rapid Upper Limb Assessment (RULA) Technique for Posture Correction in Worker Reducing Musculoskeletal Disorders and Enhancing Work Efficiency

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Abstract

Work-related musculoskeletal disorders in industrial workers are the leading cause of morbidity in employees leading to detrimental influence on the company's overall productivity and profit. Long working hours in unsuitable posture can result in musculoskeletal disorders. If not treated these can progress to chronic illnesses in employees ultimately decreasing work efficiency and admonishing company output. Static and dynamic postures can cause severe musculoskeletal disorders and can harm permanently if immediate action is not taken. Using a technique called Rapid Upper Limb Assessment (RULA), it is possible to correct an employee's posture to an acceptable level. It also helps in reducing the severity of the problem by improving the working posture of employees and enhancing the productivity of the company. The posture correction process in time time-consuming since the adaptability of the new posture differs from person to person because of their varied anthropometric data. **Reducing** the severity of musculoskeletal disorders and optimizing working hours are possible when an employee's posture is improved. The workers who adopt the suggested posture have a higher task completion rate in the prescribed time. This was because the number of complaints connected to inappropriate posture during working hours was significantly lower.

RULA utilizes a photographic memory technique that allows the expert to quickly improve an employee's posture without the need for expensive equipment, allowing for increased productivity during working hours. The need for ergonomic intervention for worker safety and willingness to adapt suggested posture when needed with immediate effect.

Keywords:

Rapid Upper Limb Assessment (RULA), musculoskeletal disorders, productivity, photographic memory, and posture correction.

1. Introduction:

1.1. Importance of training and skill enhancement in the industries

Since many unskilled and semi-skilled workers in India take on menial employment to make enough money to survive, there is a large market for industrial education in this country(Anon n.d.-d; Yassierli 2017). The necessity for skill-enhancing programs in any profession where active upskilling, reskilling, and cross-skilling are necessary to prepare individuals for the advanced technologies for the company's requirements and demands in the current scenario is the primary motive(Alam, Ogawa, and Islam 2022; Burke and Hutchins 2007; Griffin and Mary 2020; Johnson, Blackman, and Buick 2018; Kumar, Mandava, and Gopanapalli 2019; MUCHIRI 2022). With improved abilities, the trainee obtains enough knowledge to meet the requirements of the job description and can perform well enough to increase productive hours over untrained time. Trained professionals frequently avert the possibility of accidents during working hours, saving individual lives and reducing unproductive time as well(Luger et al. 2019; Nath and Behzadan 2017; WSH Council 2014).

A shift worker is required to work for 8 hours and the majority of the time their duties are recurrent and sedentary, which increases the worker's risk of developing musculoskeletal ailments. Working long hours might lead workers to lose enthusiasm, and there is a potential that their working ability will decline. Because of decreasing motivation, the worker's posture will shift, increasing the risk of musculoskeletal problems. If the worker's posture is not adjusted, he may permanently harm his body by remaining in an unfavourable position(Marin et al. 2017; Street, Lacey, and Somoray 2019; Valirad et al. 2015).

1.2. Impact of posture correction on productivity and musculoskeletal disorders.

Working in a standing posture which is improper and uncomfortable can lead to musculoskeletal disorders in the employees. This decreases work efficiency and output, resulting in a loss of revenue to the organization or the hiring company(Anon n.d.-c; Babu, Birru, and Dey 2023; Dey and Sharma 2013; Helander 2005; Kittusamy 2002). Work stress and after-work life should be balanced because they are inseparable and frequently affect the social life balance in most people because the origin of stress is unclear to many. If the after-work life is unbalanced, it will have an impact on the working hours and may result in accidents and cuts while working(Sen and Das 2000; Shanahan et al. 2022; Sivapuram et al. n.d.; Tripathy and Ala 2018) .

1.3. Overview of rapid upper limb assessment techniques

To significantly decrease the risk of musculoskeletal problems, standing in proper posture or in a stance with minimal postural stress is imperative. Rapid Upper Limb Assessment (RULA) is one such scale utilized to obtain an ergonomic assessment, where a score of 1 to 7 is given for the lowest and highest values while analysing the postural analysis under the instruction of an expert(Guide n.d.; Kong et al. 2018; Lynn and Corlett 1993; Plantard et al. 2017; Tirgar et al. 2015).

The Rapid Upper Limb Assessment (RULA) tool is regarded as a physical ergonomics tool that uses a methodical process to evaluate the necessary body position, force, and repetition for the labour task under consideration. On a single worksheet page, it is possible to evaluate the required or desirable body posture, the frequency of muscle activation, and the intensity of an effort.

Use of the RULA method 1) To present a method for assessing working individuals' exposure to high risk for upper extremity conditions related to their field of work. 2) To recognize the potential for muscular exhaustion caused by the physical strain associated with particular working positions and high pressures applied during prolonged or static activity. 3) To provide a simple scoring system that determines an indicator of urgency and yields an outcome at the level of action. 4) To provide a straightforward evaluation technique that requires little equipment, time, or work(Anon n.d.-a; Guide n.d.; Lynn and Corlett 1993).

Three steps are used to describe the RULA process. The assessment begins with the selection of a posture or postures, followed by the scoring of those postures using scoring software, body part, diagrams, and tables, and the conversion of the scores into one of the action levels.

Table 1. RULA Action level, score and interpretation of the posture and its need of correction

Action level	RULA score	Posture description	Requirement of Investigation	Need of Action
1	1-2	Correct posture	Not needed	No action
2	3-4	Risk of injury	Investigation needed	Change posture
3	5-6	Poor posture	Investigation needed fast	Posture correction needed soon
4	7	Awkward posture	Immediate intervention to suggest good posture	Change posture immediately

Depending on the action levels required for posture correction, the professional proposal must be taken into account without fail. Because if the worker does not adjust his posture, the severity of the musculoskeletal disorders will worsen swiftly and he will have to stop working till he recovers, causing irreversible damage to his survival.

2. Methodology and approach:

2.1. Significance of proper posture in the workplace

Maintaining proper posture when standing or sitting involves keeping our body straight against the pull of gravity. However, body posture changes constantly in response to employment requirements, and the forces felt while working can result in problems with the musculoskeletal system(Anon n.d.-b; Bhaskaran et al. 2022; BHUSHAN MANDAL et al. 2018; Dey and Sharma 2013; Kong et al. 2018; Lin 2016; Montuori et al. 2023; WSH Council 2014; Yassierli 2017). The spine, neck, upper arms, lower arms, wrists, and palms are the main parts of the human body that are stressed. Furthermore, the worker will experience emotional distress as a result of uncompleted assignments(ÅStrand et al. 1960; Bailey et al. 2019; Van Der Feltz-Cornelis et al. 2020; Shanahan et al. 2022).

2.2. The impact of disorders on productivity and employee well-being

The worker's excitement decreases significantly and he loses the drive to do the prescribed activity within the allotted time when they experience musculoskeletal diseases. The employee's productivity is below what is needed. Less output causes the company to lose jobs and increases the likelihood that employees may lose their jobs, which can cause psychological stress for those affected(Chung 2018; Mohan 2018; Valirad et al. 2015).

3. Data collection:

The information is gathered through pictures and videos of trainee students in awkward positions where extreme physical strains (RULA scores of 5 to 7) are developed in their bodies. These positions are not allowed to be taken while working because the worker's productivity is very low and he takes longer than necessary to finish the task.

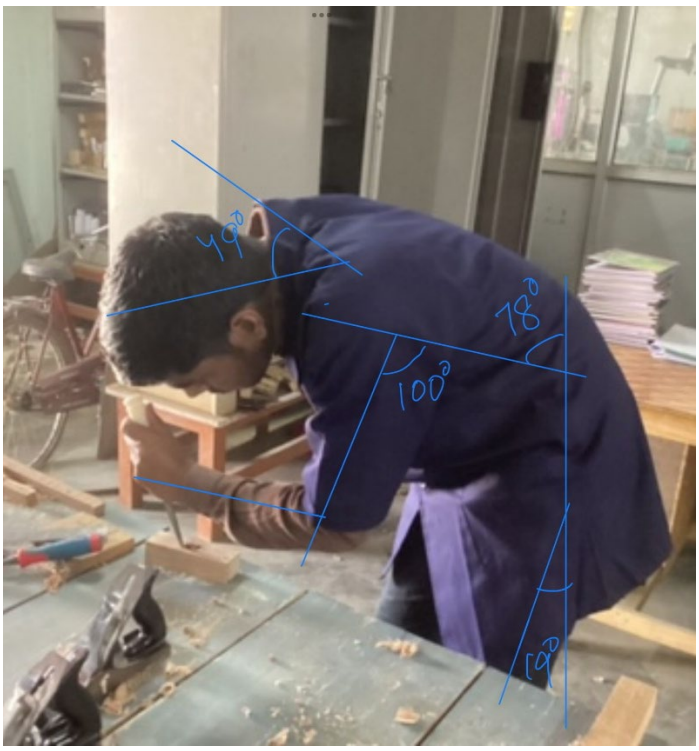

Figure 1. Improper posture of a trainee student having a RULA score of 7

Figure 1 illustrates the trainee student's forward lean, with the upper arm forming a 100° angle with the body's trunk and the spine forming a 78° angle with the vertical. The right hand is continuously applying pressure of more than 10 kg, and the neck is forming a 49° angle with the body. This results in a RULA score of 7, indicating that the worker's efficiency will be lowered in this stance, and he will eventually discontinue working with greater frequency.

In this position the arm and wrist analysis the upper limbs are making an angle more than 90° with the shoulder raised and abducted and the lower arm is making more than 20° from the neutral position and the arms are twisted and applied a force more than 10 kg also the trunk and neck bent forward and force applied both on the upper part of the body and lower part of the body giving the highest score for the complete upper limbs which will give stress to the body and RULA score 7 ensuring there is a need for the complete change in posture and the immediate action is needed. The analysis of the body posture, and the assessment work sheet are shown in the figures 11 and 12. From this we can conclude that the action level need for the posture correction should be done immediately. The learner finds it challenging to comprehend posture correction at first, but after experiencing physiological pressures, he is able to alter his posture to lessen the severity of the long-term harm.

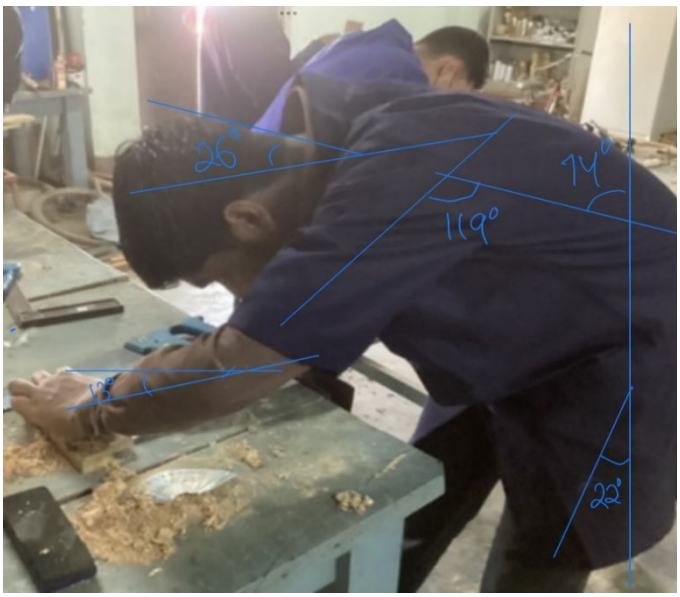

Figure 2. Improper posture of a trainee student having a RULA score of 7

The trainee in Figure 2 is shown to be leaning forward in a neutral position, with his spine at a 74° angle with the vertical, his upper arm at a 119° angle with the trunk, and his neck at a 26° angle with the vertical. He also repeatedly applied force exceeding 10 kg while maintaining this position for more than 10 minutes, which resulted in an RULA score of 7, indicating that immediate action is required to improve the posture.

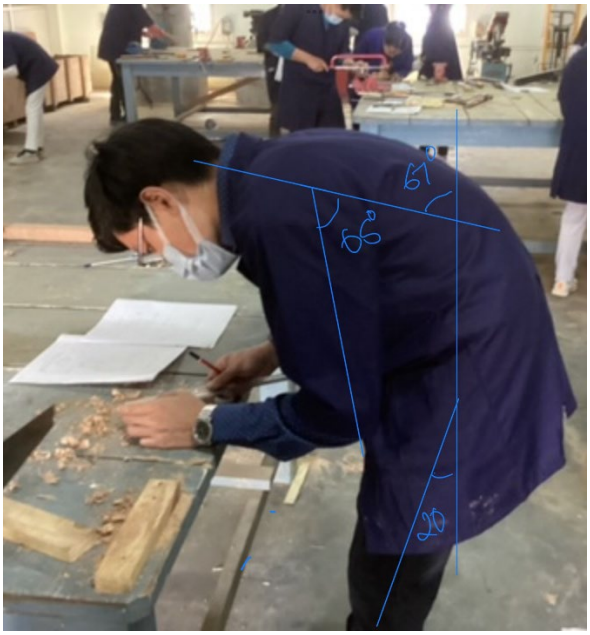

Figure 3. Improper posture of a trainee student having a RULA score of 7

The trainee student is positioned in Figure 3 leaning forward, with his arms supported and his neck constantly shifting position as he marks. His arms are at an angle of 65° with the trunk, and his spine is angled at 67° with the vertical neutral position. His RULA Score ranges from 6 to 7, indicating that he needs to correct his posture immediately.

Figure 4. Improper posture of a trainee student having a RULA score of 6

The student in Figure 4 is standing with his arms extended from his trunk, his upper and lower arms bent 50° to the neutral position, his neck leaned forward at a 50° angle, and he is applying force repeatedly. This posture results in an RULA score of 6, meaning that the student needs to take action to correct it.

Figure 5. Improper posture of a trainee student having a RULA score of 6

In Figure 5, the subject is positioned at a 45° angle, his upper limbs are at a 64° angle in the neutral position, his forearm is at a 16° angle, his right arm is constantly moving and exerting pressure greater than 10 kg, and his

trunk is slightly bent. This results in an RULA score of 6, indicating the need for the accountable to correct their posture.

Figure-6.Improper posture of a trainee student having a RULA score of 5

Figure 6 depicts the trainee bent forward with a spinal angle of 29°, a right upper arm angle of 29°, and a left upper arm angle of 55°, and he is repeatedly applying a force greater than 5 kg. His neck also forms a 43° angle with the vertical, giving him a RULA score of 5, indicating that improvement in posture requires action.

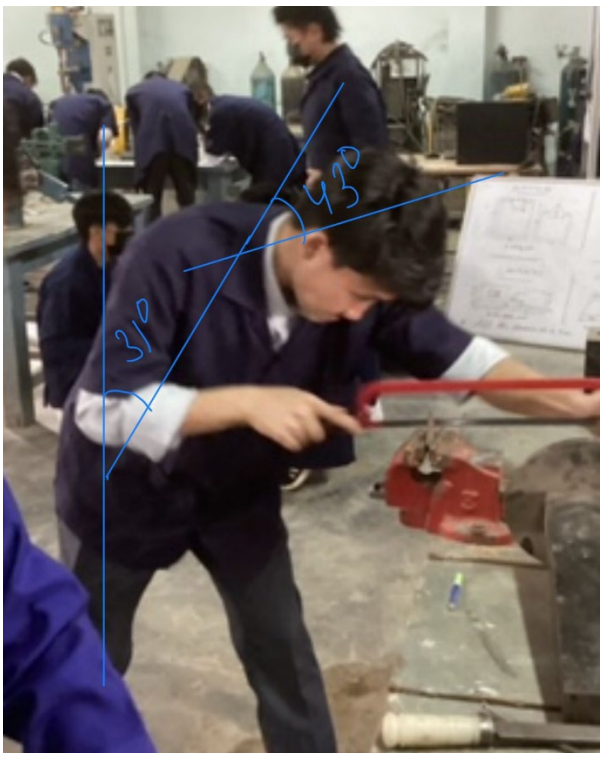

Figure 7. Improper posture of a trainee student having a RULA score of 4

Figure 7 shows the training student leaned forward with a 31° trunk angle, a 43° neck angle, and a force of more than 5 kg while continuously shifting his arm placements, giving him a RULA score of 4, which indicates that better posture requires intervention.

Figure 8. Posture of a trainee student having a RULA score of 3

In the figure 8, the trainee student bends forward at an angle of 36° with the vertical, her neck makes a continuous angle change from 20° to 70°, and her forearm repeatedly applies a force of 3–4 kg, resulting in an RULA score of 3, indicating that action is required for good posture.

Figure-9. Posture of a trainee student having a RULA score of 2

Figure 9 shows the trainee bent forward at an angle of 13° to the vertical, with the neck forming a 70° angle and the shoulder raised. This posture is acceptable but still requires correction because the neck is inflamed in this position, necessitating correction of the neck posture.

Figure10. Posture of a trainee student having a RULA score of 1

The trainee in figure 10 is standing vertically with his neck at a 20° angle to the vertical, his arms in various positions, and his left arm resting while holding a tool. A force of 2–5 kg is applied. This position is OK, but if force is applied repeatedly, it may lead to musculoskeletal issues. The RULA score for this assignment is 1, which is acceptable.

4. Results and discussions:

When the worker is in an awkward position, the completion time is three to ten times longer than the time required to complete the duties. When the RULA score exceeds 4, the chances of job completion are reduced compared to persons with good posture with values 1 to 2 in RULA analysis. As the RULA score rises, so do the possibilities of developing musculoskeletal disorders in various body areas where the posture surpasses the limiting vales. The suggested postures for the RULA scores are depicted in figures 21 and 23, where the arms, wrists, neck, trunk, and legs are in neutral positions with minimal strain on the body components and the corresponding assigned scores and minimum resulting in RULA scores 1 and 2. When the arm flexion exceeds 45°, the discomfort begins to build gradually, and when it approaches 90°, the upper arms encounter considerable stress, and the worker is unable to sustain the static tension induced by the increased flexion of the arm. If the lower arm moves 20° on either side of neutral, it experiences less stress; if it surpasses that, the tension created is greater, and he experiences higher static and dynamic loads each time he wants to do a specific activity. Wrist flexion and abduction, as well as pronation and supination, all put a strain on the muscle tissues. When the neck bends up to 20°, the stress created is smaller, and if it surpasses this amount, it can cause serious damage to the spine, resulting in spinal injury and potentially fatal injury to the worker. If the trunk bends too far, the risks of stress on the lumber region increase, resulting in spinal cord injury.

The body posture scores and analysis of each RULA score are displayed separately in the diagrams from figures 11 to 24, ranging from a maximum RULA score of 7 to a minimum RULA score of 1. The scores were assigned using the RULA program, analysed, and relevant suggestions for posture adjustment were made to each subject utilizing the photographic memory technique. The trainee students were initially resistive to the new position, but

the situation improved after a proper demonstration and explanation of the psychosocial impact of posture and how it will affect their after-work life using real-world examples.

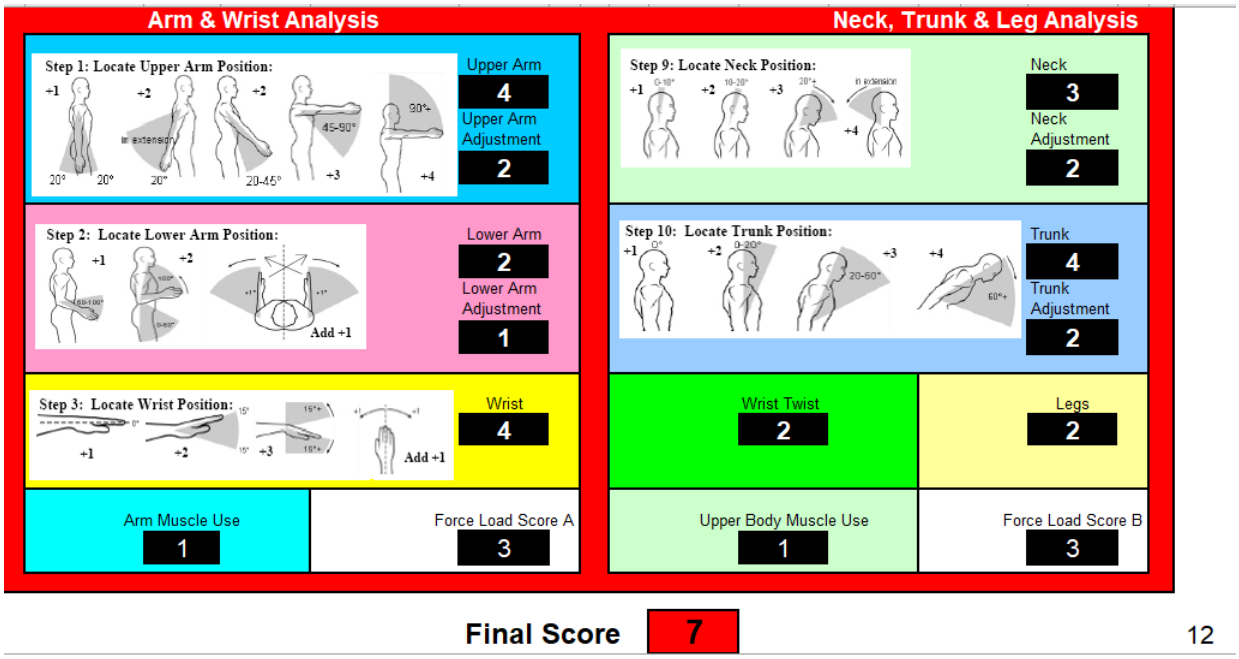

Figure 11. Arm, wrist, neck, trunk and leg analysis showing RULA score 7

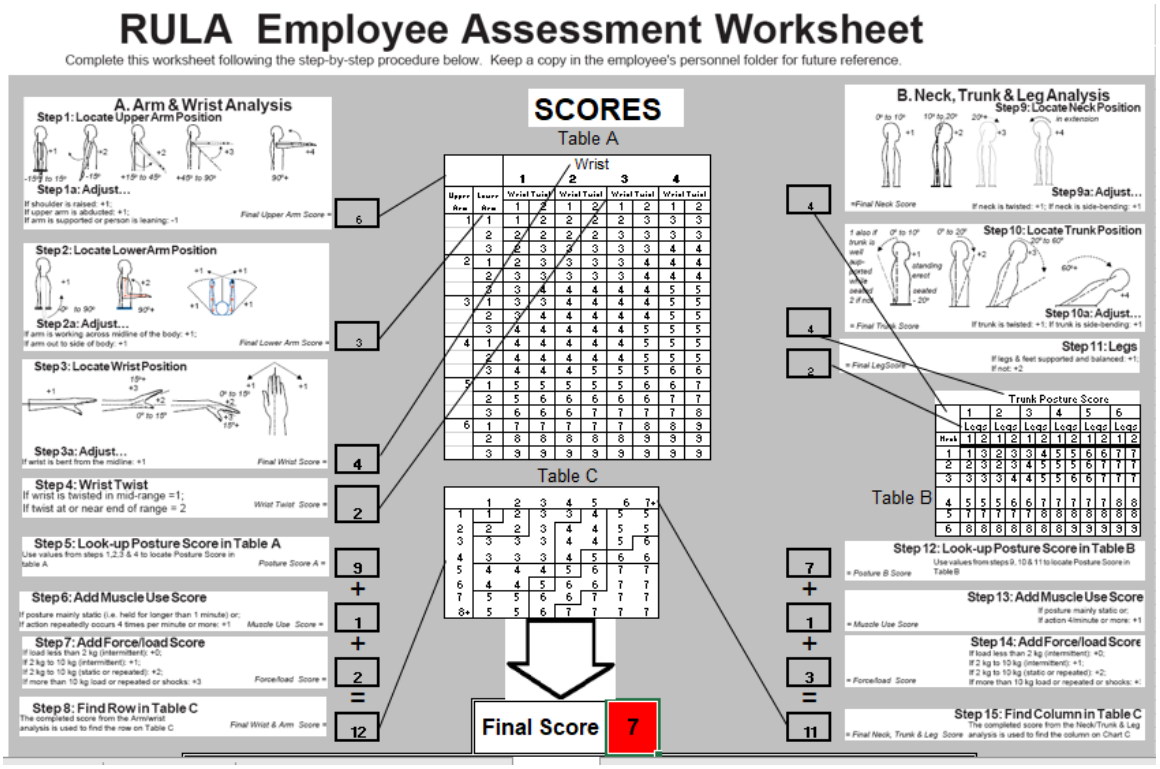

Figure 12. RULA employee assessment worksheet with maximum score of 7

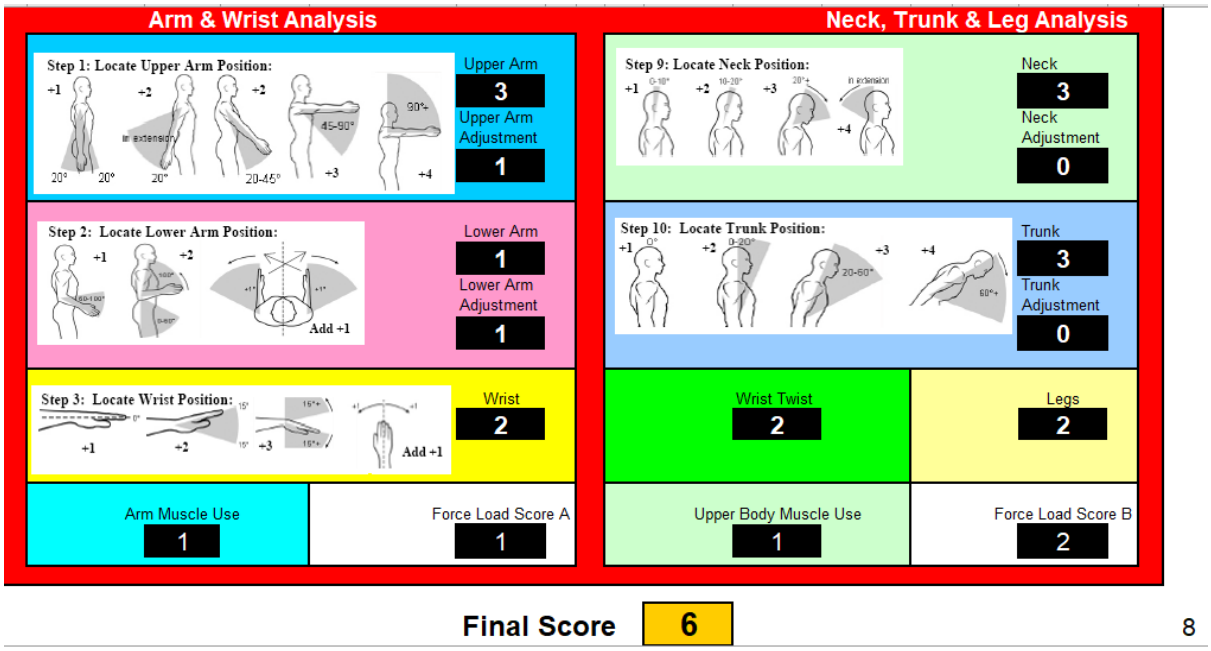

Figure 13. Arm, wrist, neck, trunk and leg analysis showing RULA score 6

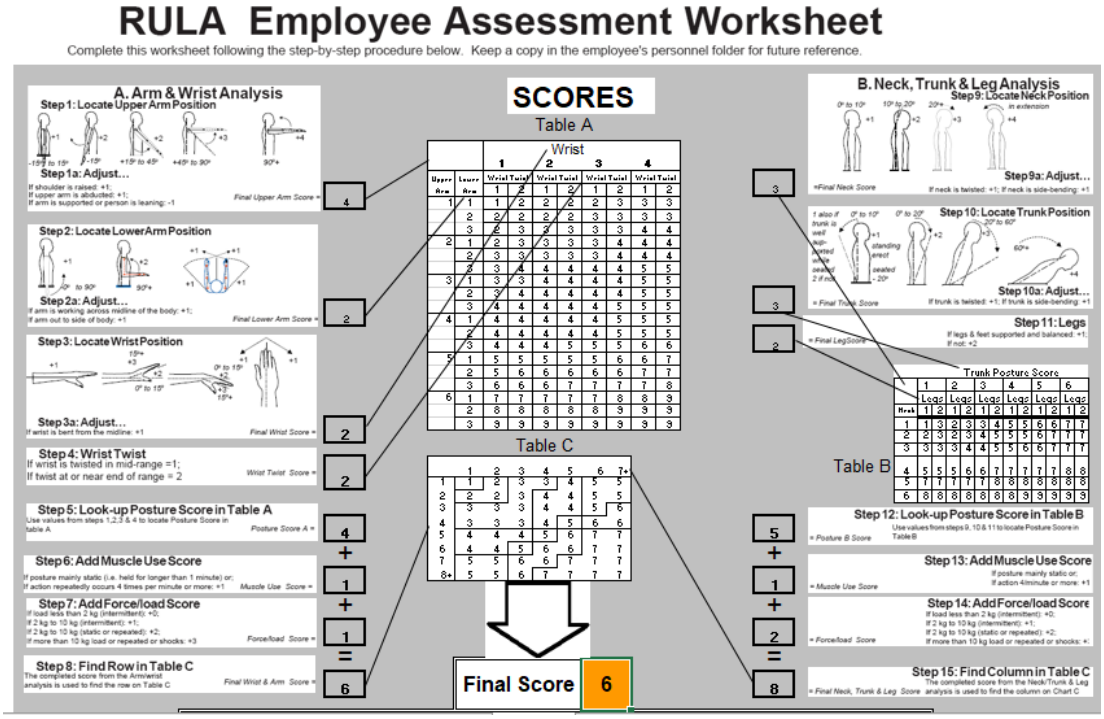

Figure-14. RULA employee assessment worksheet with score of 6

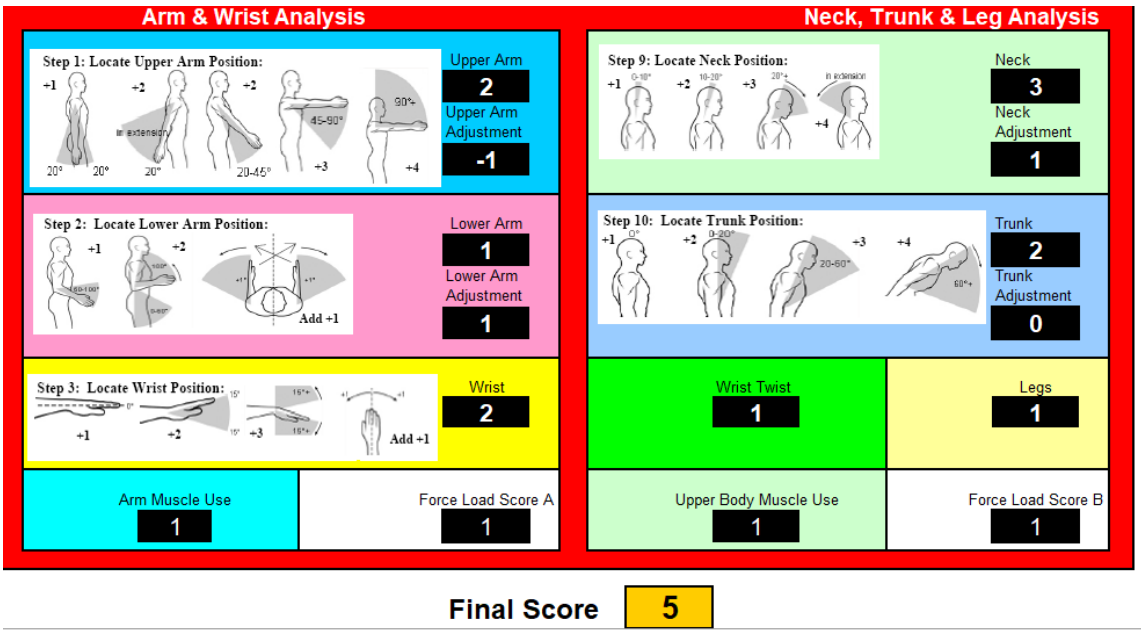

Figure 15. Arm, wrist, neck, trunk and leg analysis showing RULA score 5

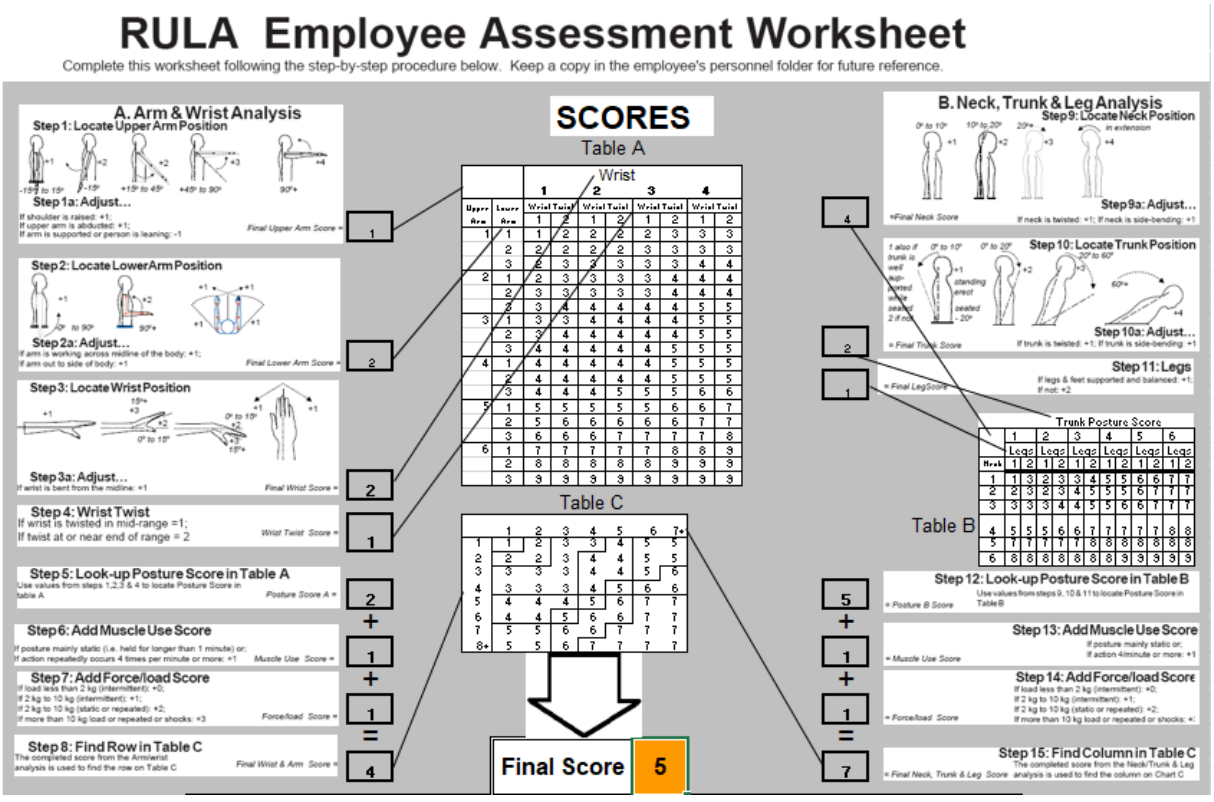

Figure-16. RULA employee assessment worksheet with score of 5

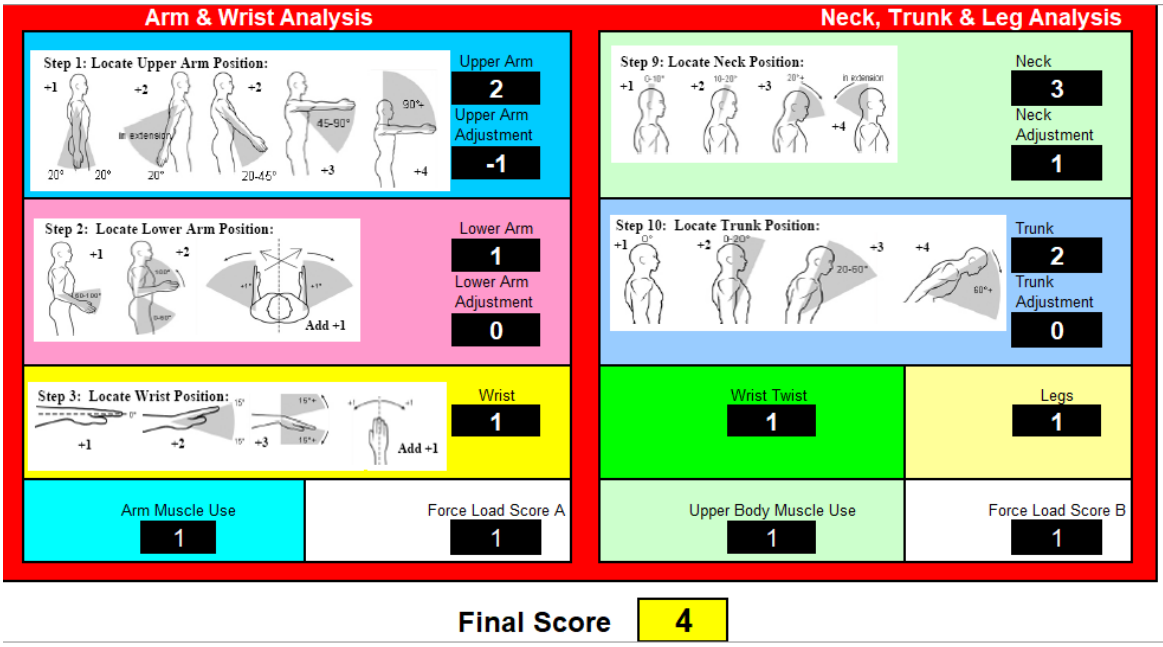

Figure-17: Arm, wrist, neck, trunk and leg analysis showing RULA score 4

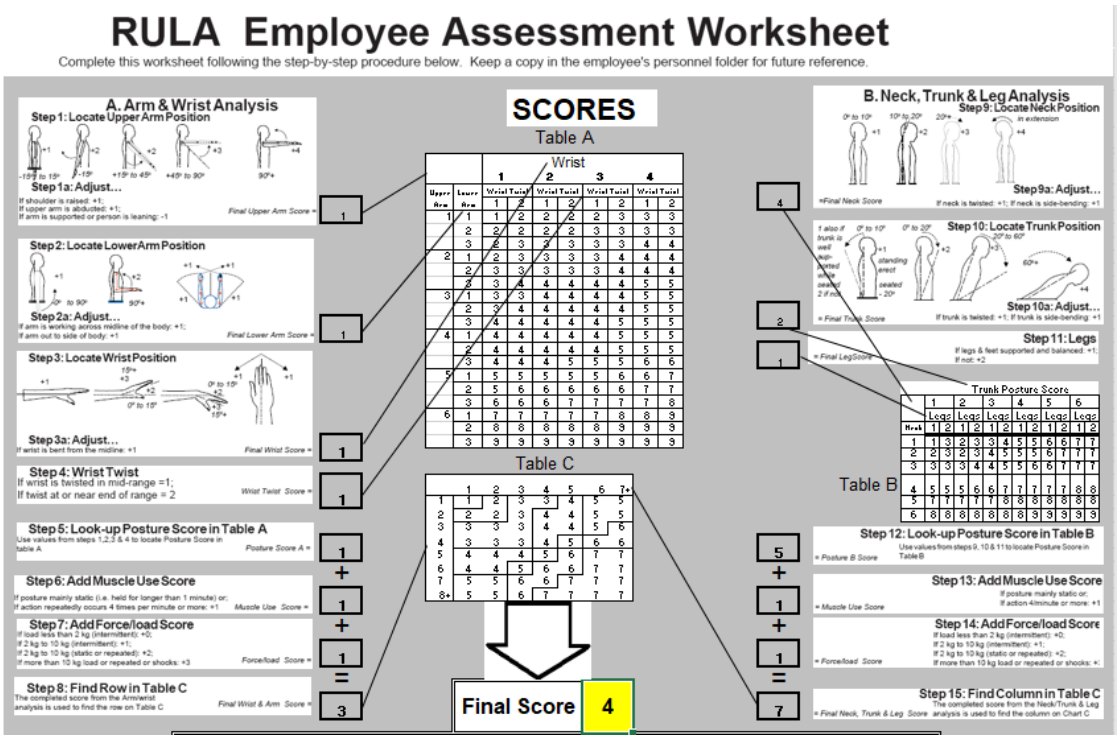

Figure 18. RULA employee assessment worksheet with score of 4

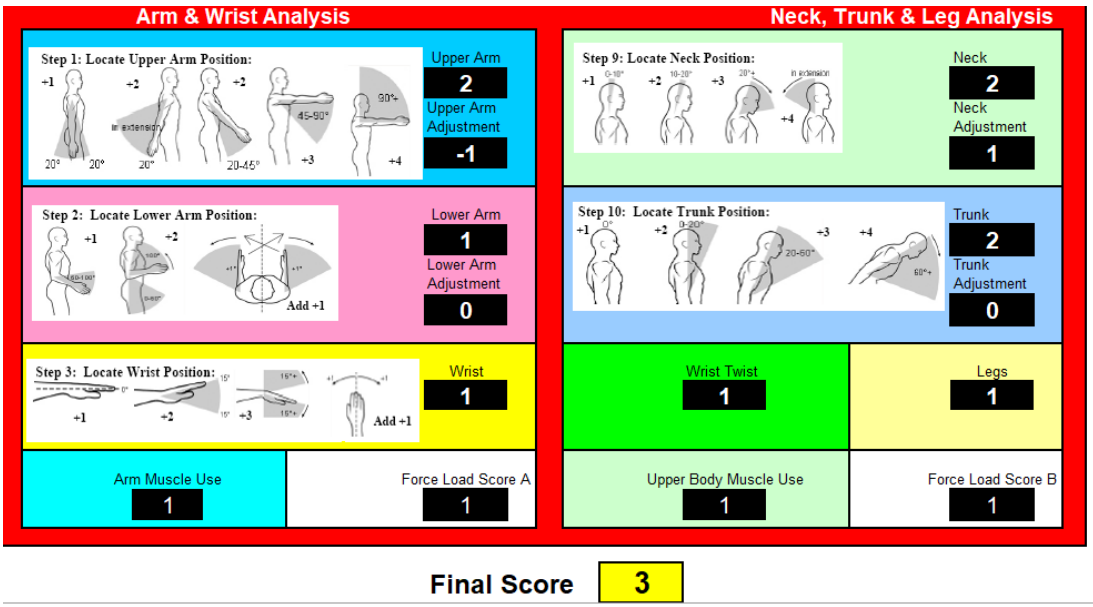

Figure 19. Arm, wrist, neck, trunk and leg analysis showing RULA score 3

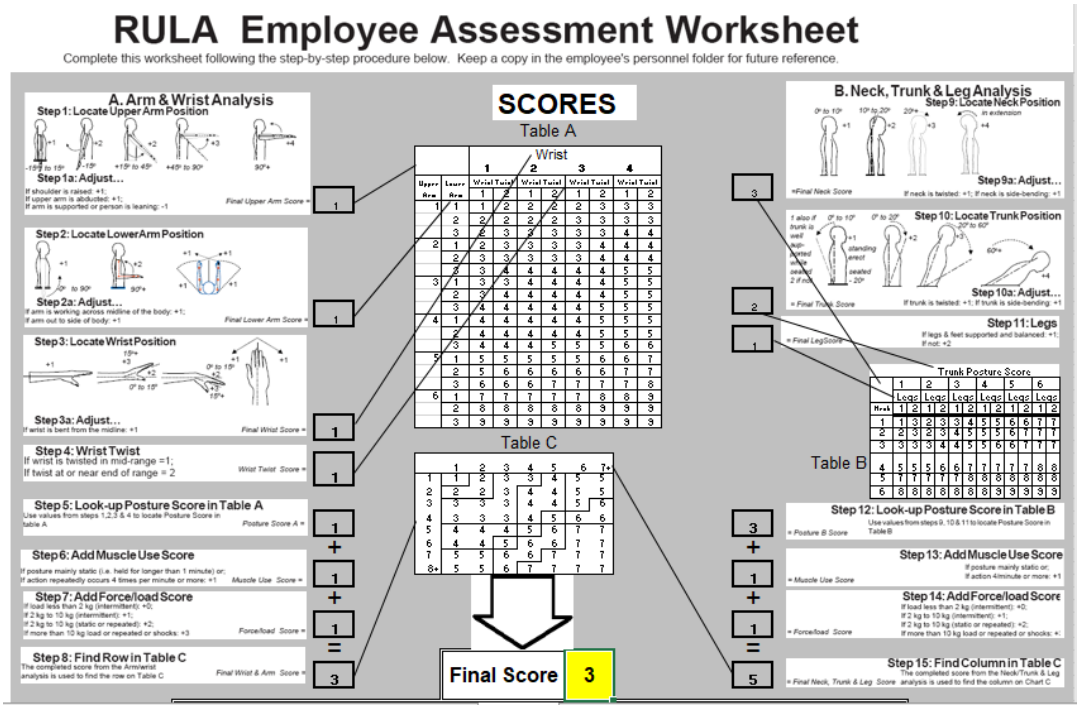

Figure-20. RULA employee assessment worksheet with score of 3

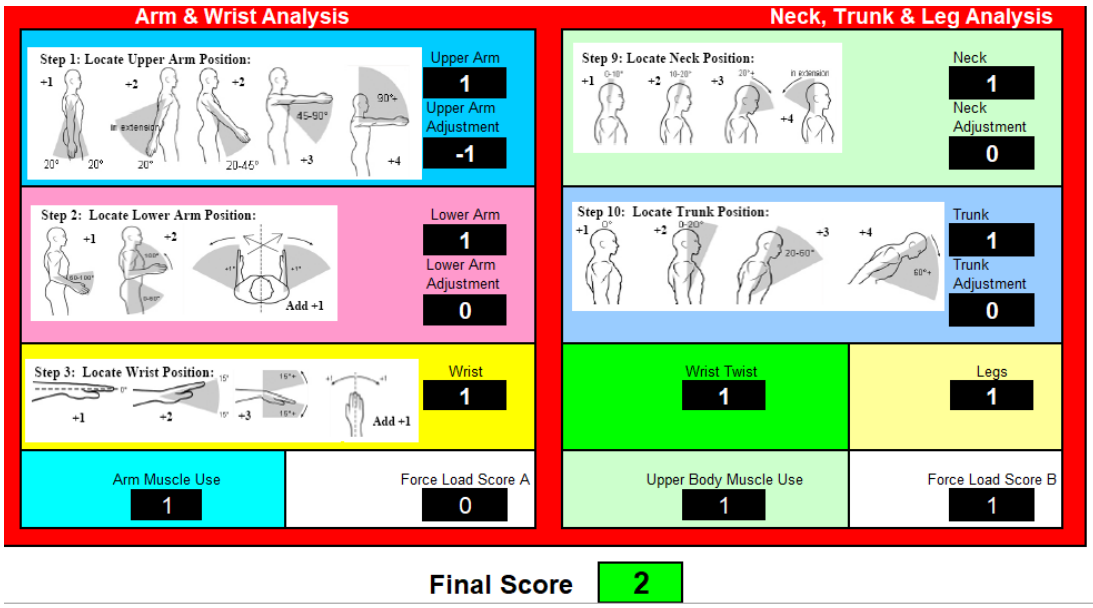

Figure-21. Arm, wrist, neck, trunk and leg analysis showing RULA score 2

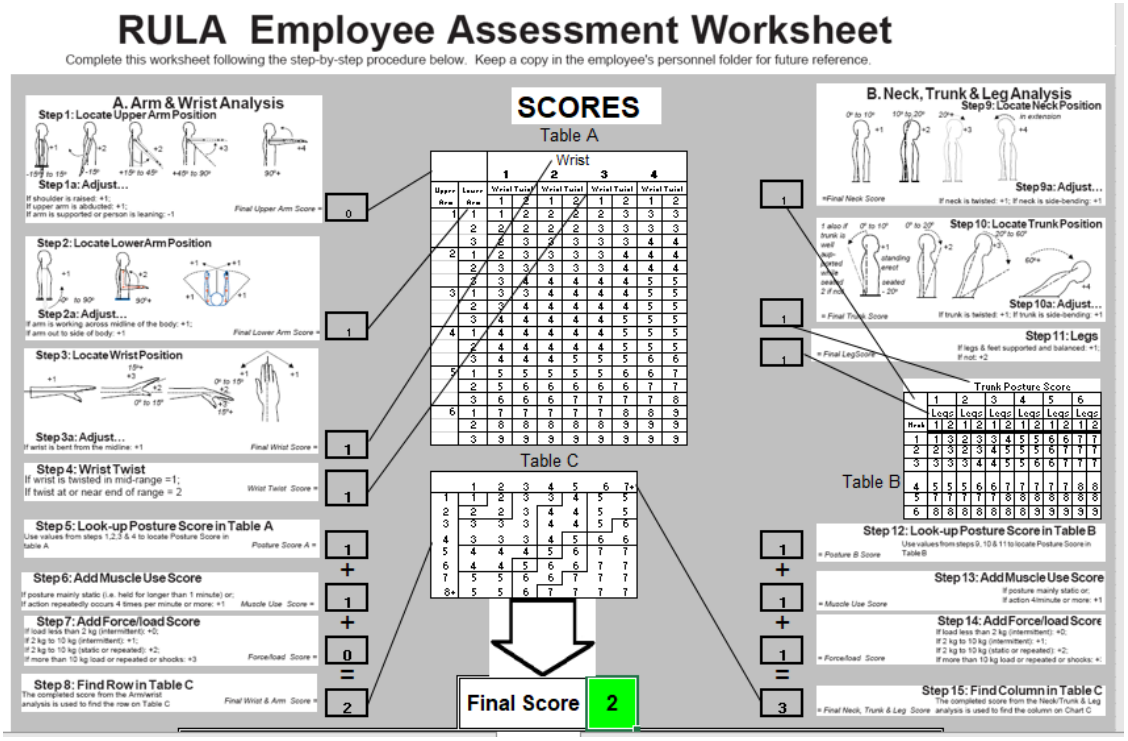

Figure-22. RULA employee assessment worksheet with score of 2

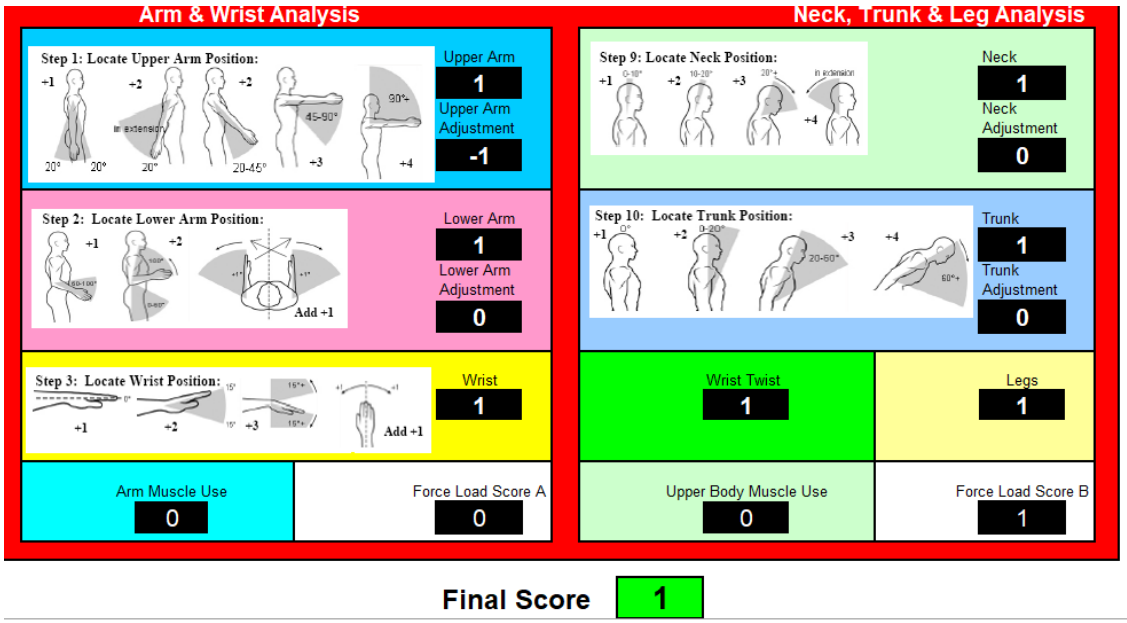

Figure-23. Arm, wrist, neck, trunk and leg analysis showing RULA score 1

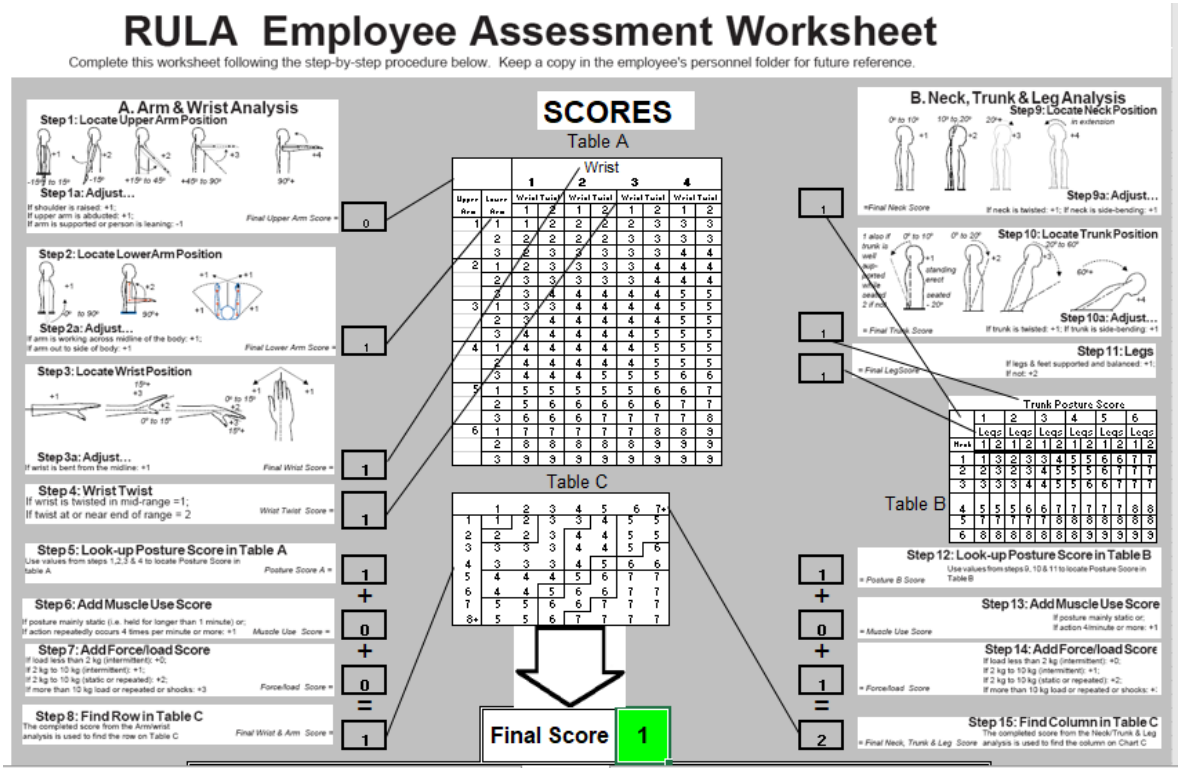

Figure-24. RULA employee assessment worksheet with minimum score of 1

5. Conclusions:

Posture correction is one of the most common interventions used to treat musculoskeletal disorders in the workplace, as absenteeism due to musculoskeletal disorders, particularly in the spine, arms, wrist, and neck, can lead to morbidity if the problem is not addressed early on.

Awkward posture while working reduced productivity to almost zero.

Awkward posture is generating a change in behaviour because improper tool handling resulted in acute pain in various sections of the body.
Early stage posture adjustment reduces muscle damage and stress caused by posture
The RULA posture correction tool eliminated the need to purchase equipment.
Improved posture aided the trainee in completing the assignment in the allotted time, and production increased several folds when he was in good posture.

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Dr. Amandeep Kaur is currently working as Assistant Professor in the Department of Oral Health Sciences Centre, PGIMER Sangrur. She completed her Bachelor's degree from the Government Dental College and Hospital, Shimla (Himachal Pradesh). She pursued her Master's degree from the prestigious All India Institute of Medical Sciences, New Delhi. After her specialization, she continued as a senior resident at AIIMS, New Delhi for three years and three years as Assistant Professor in RIMS, Imphal, Manipur. She has a keen interest in Academics and research particularly in the fields of dental trauma, geriatric dental care and biomedical engineering. She completed the fellowship programme for faculty from the Indian Institute of technology, New Delhi. She has started an awareness programme about dental trauma in schools of Imphal. She has given key note lectures in various national conferences. She has presented research papers and chaired scientific sessions in various national and international conferences and has publications in high impact national and international journals. She has contributed to two book chapters and is currently the principal/ co- investigator for various funded projects. She has been a part of the organizing committee/ scientific committee for various conferences and symposia.

She is the executive committee member of the Indian Society of Dental Traumatology and executive committee member of the Indian Dental Association, Manipur State Branch. She is the Associate editor of the official newsletter of Indian Society of Dental Traumatology "Trauma Thoughts" and co-chair of the CDE and symposium committee of ISDT. She is the assistant clinical director for Special Olympics Bharat. She is also a fellow of the Pierre Fauchard Academy, India section.