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A Quantitative Assessment of Job Rotation for the Upper Extremity

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Abstract

Job rotation has been commonly implemented as an administrative control for ergonomic stress in many manufacturing companies. Yet, limited research has investigated the effectiveness of balancing the ergonomic risk and potential musculoskeletal disorders. This study aimed to determine whether upper extremity risk estimates were related to wrist and elbow discomfort for jobs within job rotation schemes. The DUET (Distal Upper Extremity Tool) ergonomic assessment tool was utilized to quantify the distal upper extremity risk. Nineteen manufacturing workers who worked in four-job rotation schemes were evaluated for upper extremity risk and discomfort. The risk was higher for the entire job rotation scheme than for most of the individual jobs, with wrist discomfort being impacted to a limited extent, as most ratings were mild. Thus, ergonomic redesign may be more effective in reducing the potential for a musculoskeletal disorder than job rotation.

Keywords

Job rotation, manufacturing, musculoskeletal

Introduction

Little is known about the effectiveness of job rotation schemes in balancing ergonomic risk exposures and reducing discomfort and injuries experienced by workers. Researchers (Carnahan et al., 2000; Frazer et al., 2003) have predicted a higher incidence of pain/injury, most oftentimes low back, resulting from job rotation. Based on their review, Padula et al. (2017) concluded that job rotation has not been effective, potentially increasing biomechanical risk for workers. The research paper by Mehdizadeh et al. (2020) demonstrated that rotation could potentially increase injury risk by exposing workers to higher biomechanical loading through a trade-off of "reduced risk" for the high-risk jobs and an "increased risk" for the low-risk jobs. The increase in risk for those individuals more than offsets the decrease in risk for this in originally high-risk jobs, thus necessitating the inclusion of ergonomic engineering controls in many cases. The key is a limited understanding of how balanced or minimized risk is associated with job rotation schemes. However, there is a lack of data assessing the quantitative exposure of work-related musculoskeletal disorder (WMSD) risk factors for jobs within job rotation schemes and a lack of data to indicate a reduction of exposure to these WMSD risk factors because of job rotation.

Methods

A total of 19 workers at an automotive manufacturing company in the Midwest participated in the study. All of the workers had a four-job rotation scheme that rotated every 2 hr. For the portion of the line we observed, there were approximately 60 different jobs. Thus, none of the 19 workers completed the same four-job rotation. Each participant completed a consent form during the initial visit, along with a demographic survey. The research team then evaluated each job for at least 15 min, which included quantifying the number of repetitions of hand and arm movements. Three maximum grip strength measurements were recorded in their dominant hand at the start of the quarter and were used as a reference for the OMNI scores for the wrist/hand exertions. A research member asked the worker for the exertion required to complete the current job relative to the maximum levels during each job. At the end of the quarter, the worker

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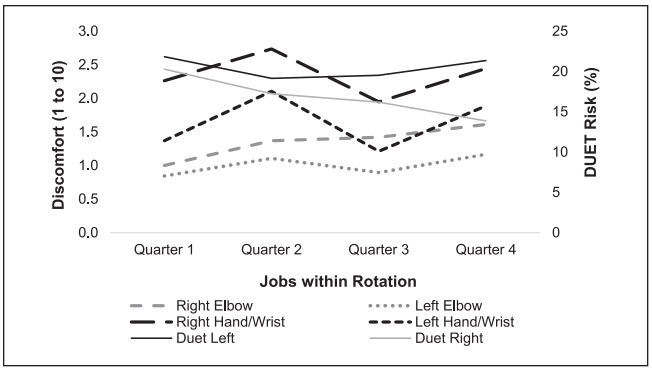

Figure 1. Duet Risk Score (Secondary axis) and Discomfort (Primary Axis) as a function of the jobs.

completed a discomfort survey for multiple body parts, but the current study concentrated on the right and left wrist and elbow discomfort. The individual DUET scores for the right and left hands and the overall job rotation scheme were computed for each job. Overall job rotation DUET scores were calculated by including all the jobs together. Individual job scores for DUET were compared to the discomfort. The overall DUET scores were compared to the discomfort values for the final quarter.

Results

For the four jobs that workers rotated to during the shift, the average right-hand DUET scores ranged between 19 and 22 (need some anchor of what's highest/bad), while the left-hand scores ranged between 14 and 20 (Figure 1). The overall DUET scores for right and left were 36.5 and 32.3, respectively. If you look at the number of individual jobs for low, medium, and high-risk jobs, most jobs were in the low-risk category (Table 1). For the upper extremity, the risk of job rotation schemes appeared to be driven by the worst-case job within each scheme. The discomfort in the left and right elbows and hands/wrists was between 1.0 and 2.7 (mild discomfort).

Conclusion

Initial data indicate that the overall risk for upper extremity disorders was increased for the overall job rotation scheme. Since the risk scores were mostly in the low-risk category, discomfort of the elbows and hands/wrists was not impacted (mild). Based on these preliminary analyses, ergonomic redesign may be more effective in reducing the potential for a WMSD than job rotation. Other considerations, such as productivity, psychosocial factors, and training, must be considered when developing job rotation schemes.

Table 1. Classification of Risk Based on DUET Score.

		Right	Left
Quarter 1	Low	11	13
	Medium	4	2
	High	1	1
Quarter 2	Low	13	12
	Medium	4	5
	High	0	0
Quarter 3	Low	15	15
	Medium	3	3
	High	0	0
Quarter 4	Low	12	15
	Medium	4	1
	High	0	0
Overall	Low	3	5
	Medium	12	11
	High	4	3

Declaration of Conflicting Interests

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