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# Sit-Stand Unit Integration: A Method of Evaluation

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**Abstract:** A case study involving 7 participants was completed to enhance and evaluate their transition from full time seated office workstations to sit-stand unit workstations. All participants were given ergonomic training and orientation of the sit-stand units. Participants were given a two-week period to use a sit-stand workstation during their regular job requirements. Throughout the study participants completed regular discomfort surveys and sit/stand schedule journals. Ergonomic coaching and training was available to all participants throughout the trial. All participants demonstrated either improved overall comfort or same level discomfort at the conclusion of the trial. Participants who completed the most adjustments and spent the least time standing showed the largest improvement in comfort.

*Keywords:* office discomfort, sit-stand units, sit-stand frequency, sit-stand duration

## 1. Introduction Sit-Stand Unit Integration: A Method of Evaluation

Office sit-stand workstation awareness and implementation is a growing trend in the ergonomic field. While previous research has provided information on many of the potential health benefits (1,2) there is variability in the beliefs and practices to optimize their use. To effectively support the evolution of office ergonomics it is imperative that office sit-stand integration is successful. Through effective evaluation techniques and integration strategies this case study provides a method for optimizing the implementation of sit-stand units to improve overall comfort.

A qualitative feedback and ergonomic based approach was used to aid in the transition of workers from a static seated workstation to a dynamic sit/stand workstation. The strategies and ergonomic systems used to successfully complete this transition included ergonomic training, ergonomic coaching, discomfort monitoring and participative feedback. The information obtained throughout the study also contributed to valuable findings surrounding the ideal use of sit-stand workstations for improved comfort.

The primary objective of this study was to ensure the implementation of the sit-stand workstations improved the comfort and well being of all participants in their work environments. Ergonomic training, coaching, evaluation and monitoring was used to enhance the transition from a static seated workstation to a dynamic sit-stand workstation. All participants were provided with sit-stand units that could be implemented into their current workstation area. An initial ergonomic training session was performed by on-site Ergonomists for all participants prior to the installation of the sit-stand units. All participants were provided with the background knowledge of proper working postures in both seated and standing positions. This included (but was not limited to) basic anatomy, proper working zones, neutral joint postures, and basic ergonomic force, posture, and repetition principles. A workstation review was also completed for each subject in which the Ergonomist investigated any subject discomfort and ergonomic concerns with their initial seated workstation.

Participant discomfort was monitored throughout the study and the on-site Ergonomist collected discomfort information regularly. Ergonomic job coaching and reviews were available to all participants during the course of the study. These sessions included supporting initial installation of the sit-stand units, as well as providing interim support to aid in addressing increased discomfort levels experienced by some participants.

The secondary objective of this study was to gain information on the frequency of sit-stand transitions and duration of standing time that corresponded to the highest comfort level of the participants. This was accomplished through participative journal logging. Instructions given in the pre-installation ergo training outlined the minimal expectations for sit-stand adjustments. An adjustment was identified by a transition from either sitting position to standing or standing position to sitting. Participants recorded their daily sit-stand activity in a sit-stand transition journal/log. Information from this log was used to determine both their frequency of adjustments as well as the duration spent in both seated and standing positions.

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## 2. Methods

### 2.1 Subject Selection Criteria

Participants selected for this study were individuals whose full time working schedule involved greater than 80% of their daily tasks performed at their desk. This case study involved 7 subjects monitored over a two-week period (Ten 8hr working days). Subject inclusion criteria did not require previous experience utilizing alternating seated/standing positions when performing office work tasks.

### 2.2 Ergonomic Training

An ergonomic sit-stand classroom based workshop was presented to all participants involved in the trial. The workshop covered ideal ergonomic postures with both seated and standing working positions. Instruction on ideal working zones, equipment placement and task locations was provided. Participants were also instructed on proper sit-stand adjustment techniques, specifically involving force application to unit when adjusting from seated to standing positions. Information on effects of footwear and standing alignment was also communicated.

### 2.3 Comfort Monitoring

Subjective discomfort experienced was captured using a numerical comfort rating scale (NCRS). The NCRS ranged from 0 to 5 with 0 representing no discomfort and 5 representing maximum discomfort. Overall discomfort was assessed using the NCRS in addition to individual body part discomfort rating, using the same NCRS levels.

All participants were assessed for their baseline comfort levels prior to commencing the trial. Comfort monitoring was evaluated through paper-based subjective discomfort surveys in which participants were free to identify any body parts in discomfort and the level of discomfort experienced. After the baseline comfort assessment subjects completed comfort surveys at the conclusion of days 1,3,5,6, 8 and 10 for a total of 7 discomfort surveys for each participant.

### 2.4 Sit-Stand Adjustment Schedule

It was required that all participants complete a daily sit-stand transition “journal” which captured the number of adjustments throughout the day. The duration of time spent in both seated and standing posture was also recorded by participants.

The client requested a minimum requirement of 2 adjustments per quarter of the regular daily working schedule. This translated to 2 adjustments per 2 hour working time slot of an 8 hour working day. Subjects were free to make their preferred number of transitions between sitting and standing positions, provided the minimum of 2 adjustments per quarter (2 hours) of their day.

### 2.5 Ergonomist Intervention

During the two-week period the on-site ergonomists were available to provide job coaching and positioning feedback to the subjects involved when requested. In addition, ergonomists responded to any requests for discomfort review and also regularly monitored participant discomfort from incoming discomfort surveys.

Any increases in discomfort were reviewed through completion of an ergonomic workstation assessment to identify and correct areas of concern. This included evaluations of primary equipment use including chair, monitor, keyboard and mouse, and sit-stand unit. Workstation audits were also completed to review each participant’s job specific tasks and secondary equipment use (i.e. telephone, document holders, calculator, footwear etc.).

### 2.6 Statistical Analysis

Participant results were divided into two groups based on overall discomfort changes; participants who reported a reduction in overall discomfort and those who reported the same level of overall discomfort from baseline to the end of the study. A two-tailed T-test was performed to assess the statistical differences between groups for the number of adjustments and the percentage of the working day spent standing. An alpha level of 0.05 was used to determine statistically significant differences between discomfort groups.

## 3. Results

All participants discomfort surveys and sit-stand journals were reviewed for their combined average number of daily adjustments, combined average percent of day spent standing and corresponding overall discomfort level changes.

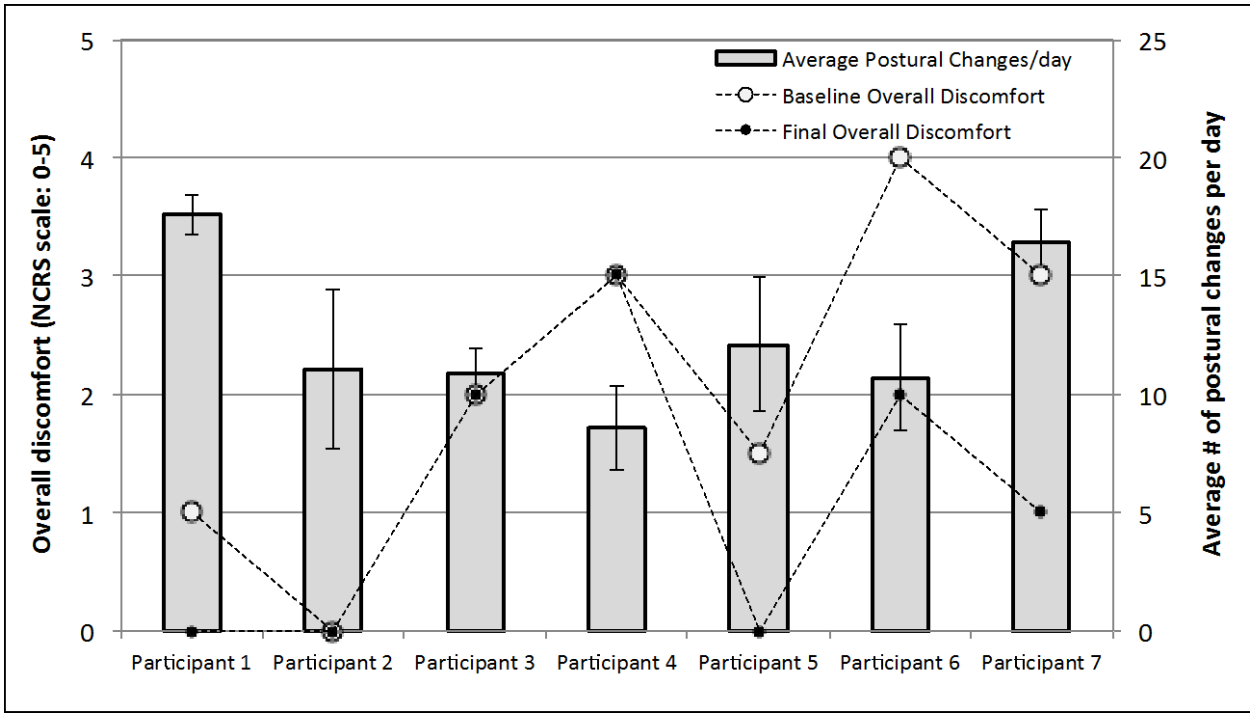


Figure 1. Overall discomfort and average number of postural changes per day.

At the conclusion of the trial period, all participants either reported a decrease in their overall discomfort or a same level of overall discomfort rating compared to baseline. The four participants that demonstrated overall discomfort reduction were participants 1,5, 6 and 7 with overall discomfort reductions of 1, 1.5, 2 and 2 NCRS levels, respectively (Figure 1). These participants performed a combined average of 14.2 postural changes within the workday (1.8 adjustments/hour) for the course of the trial. The subjects who did not show any change in level of discomfort performed a combined average of 10.1 postural changes within the workday (1.3 adjustments/hour) for the course of the trial.

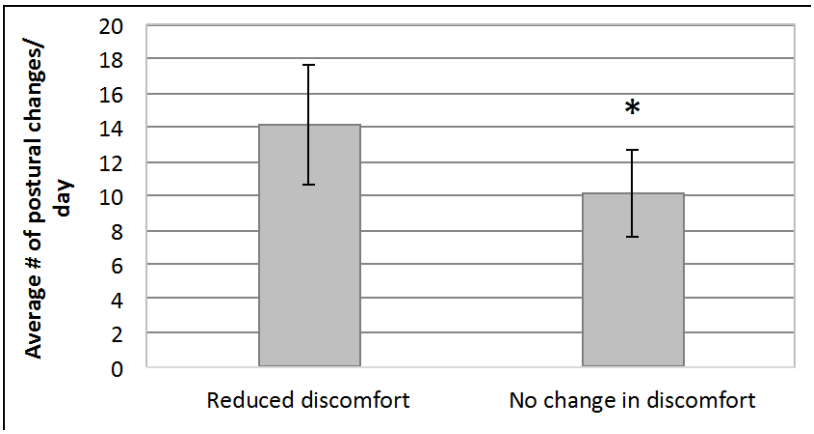


Figure 2. Average number of postural changes per day and differences between discomfort groups.

The average frequency of posture changes between a seated and standing posture was significantly different between participant groups ($P < 0.01$). Significant differences between discomfort groups are denoted (*).

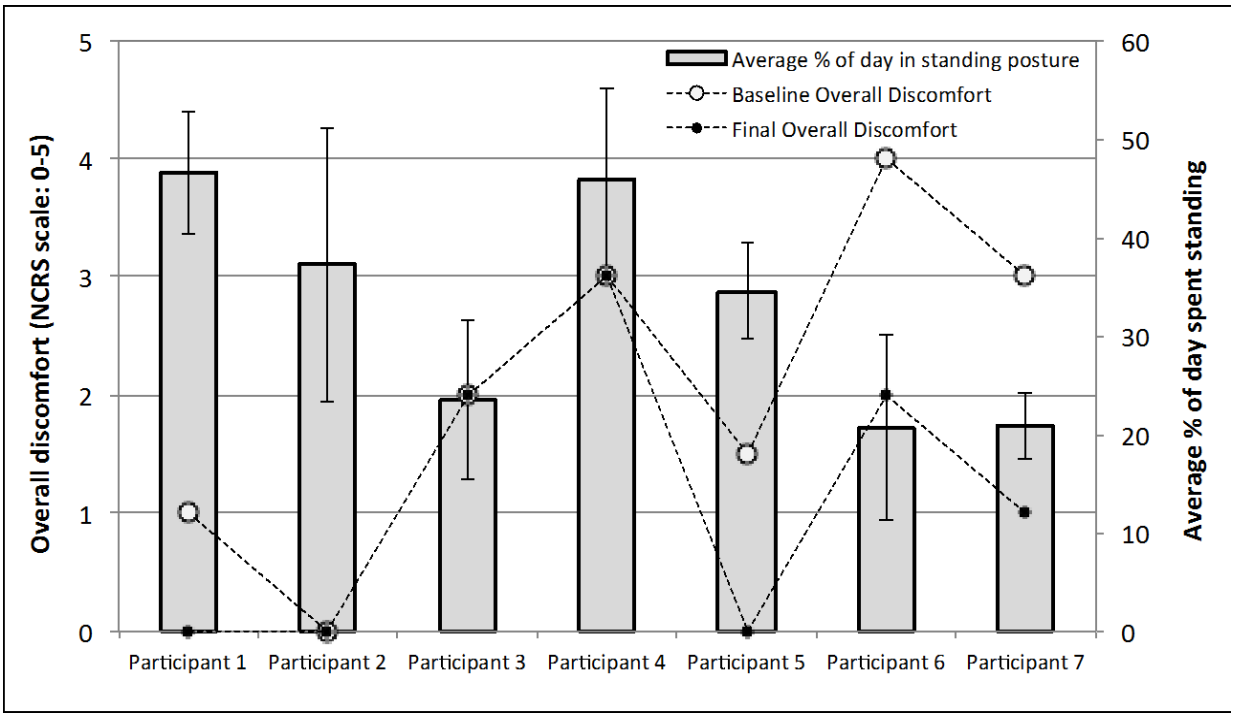


Figure 3. Overall discomfort and percentage of the day spent in a standing posture

Participants who reported a reduction in discomfort over the duration of the trial spent a combined average of 30.6% of the day in a standing posture. Participants who reported no change in discomfort spent a combined average of 35.5% of the day in a standing position. Statistically significant differences between discomfort groups were not identified for percentage of the day spent standing.

Analysis of individual participants revealed that the largest reductions in discomfort (2 NCRS points) were identified with those participants that stood for 21% of their daily schedule. Opposite to these findings, for the 3 participants who spent the largest percent standing of their day, only one individual had a lowered level of discomfort and 2 of the individuals did not show any improvement in overall discomfort.

## 4. Discussion

The major finding of this study was shown through changes in overall discomfort and the relationship between the frequency of adjustments throughout the participants' day. The participant group that showed overall discomfort reduction also had a lower combined average percentage of time spent standing than the participants who showed no change in overall discomfort.

The strategies and methods used for the integration of the office sit-stand units were successful in decreasing overall discomfort of a portion of the participants. Onsets of discomfort resulting from transition to the workstation were resolved through close discomfort feedback monitoring and ergonomic audits/coaching.

### 4.1 Frequency of Standing and Level of Discomfort

The information gathered from the sit/stand journals indicated a relationship between the combined average number of transitions per day and overall discomfort improvements. The improved overall discomfort group demonstrated a higher combined average number of adjustments per day in comparison to the maintained level of overall discomfort group.

All subjects that demonstrated a decrease in overall discomfort completed a combined average of 1.8 adjustments/hour in their 8 hour working day while the maintained overall discomfort comfort group completed a combined average of 1.3 adjustments per hour.

### 4.2 Daily Standing Percentage and Level of Discomfort

The comparison of the improved overall discomfort group and the maintained overall discomfort group did not show a statistically significant difference in percentage of day spent standing. The combined average of daily percentage spent standing for participants with decreased overall discomfort was lower than the combined average of daily percentage spent standing for participants with no overall discomfort change.

### 4.3 Ergonomic Strategy to Implementing Sit/Stand Workstations

The procedure that resulted in an effective implementation of the sit/stand station into the office environment included the following stages: i) equipment screening, ii) core group training, iii) comfort/feedback monitoring and iv) ergonomic technique auditing and coaching.

Ergonomic equipment screening was used to determining the ideal unit that would be used to meet the needs of the current office workers at their workstations. Due to the current client set up there was a requirement for the units to be integrated onto the desk surfaces. The temporary trial units were screened to meet office ergonomic guidelines in combination with meeting client and worker needs. One unit out of five reviewed was selected based on its ability to meet proper working ranges and the equipment needs of the workers (ie. Dual monitors, laptop docks, document holders etc.).

The ergonomic core group training provided to the participants allowed them an independent ability to transition into the ideal positioning for neutral joint function in both sitting and standing positions. Training was delivered in a classroom environment with those participating present. Sample equipment was used as a demonstration and for hands-on review of the equipment in advance of installation. Empowering participants with an independent ability to adjust the unit for use of ideal seated and standing positions allowed them the freedom to make adjustments according to their personal preference. This freedom and ability was imperative to the study in order to obtain standing percentages and adjustment frequencies that corresponded to varying levels of discomfort.

Comfort/feedback monitoring assisted in determining what body part/areas of discomfort were present, and changed, during the course of the trial. Auditing and coaching completed by the on-site Ergonomist helped to determine any workstation modifications or daily work habits that may have been contributing to an onset of discomfort from the transition to the sit-stand unit. Focused one-on-one interaction between the ergonomist and participant allowed for an opportunity to correct postures and working habits. Workstation auditing also allowed for collection of participant specific information on their specific job tasks and related equipment used at the desk (i.e. phone, document holders, calculator, footwear etc.) which could contribute to their working ergonomics and technique.

### 4.4 Discomfort Resolution

Ergonomic management and support of the sit-stand unit integrations aided in the resolution of new discomforts that developed from the transition of participants to the sit/stand unit. After initial implementation of the unit there were five participants that had an onset of discomfort in a new body part(s) that was previously rated 0 (NCRS) at the baseline evaluation. This discomfort was recognized by the on-site ergonomist through discomfort survey feedback as well as through the ergonomic auditing process. Modifications to standing working posture in addition to changes to equipment arrangements were implemented as a result of the one-on-one ergonomic consulting with the participants.

Of the 5 participants that reported an onset of discomfort for a body part, which was rated 0 for baseline NCRS, four subjects returned to a level of 0 for the body part(s) at the conclusion of the study. The single subject that did not return to 0 for the onset of discomfort indicated a previous condition that had fluctuating (non-work related) levels of discomfort that was not aggravated at the time of the baseline evaluation. The rating of overall discomfort from this participant did not increase at the conclusion of the study.

Contributing factors to the onset of discomfort were non-compliance to proper work positioning in both seated and standing postures, high frequency secondary equipment uses outside of neutral zones (i.e. phone, document holders, calculator) and unsuitable footwear (i.e. high heels). The ergonomic coaching resolved these factors through additional posture coaching, equipment use recognition (i.e. phone headset) and footwear recommendations. The procedure for discomfort feedback monitoring and ergonomic audit/coaching was shown to be successful in resolving the onset of new discomfort in four of the five participants.

## 5. Conclusion

The primary objective for this study was met by decreasing the overall discomfort levels of 4 out of 7 participants and maintaining same level of comfort for the other 3 participants through the sit-stand workstation integration. Continued wellness and ergonomic monitoring of participants throughout implementation also successfully reduced any onset of discomfort as a result of the transition to a sit-stand workstation. Proactive strategies including ergonomic knowledge training and practical equipment use preparation allowed participants to understand and utilize ideal working positions. Reactive strategies including ergonomic job coaching, discomfort monitoring, and ergonomic audits contributed to decreasing and resolving discomfort.

The secondary objective for this study was met through obtaining useful information for determining relationships between participant's comfort level and the frequency and duration of time spent standing during work tasks. Participant ability to freely use the sit-stand workstations was critical to obtaining the information contributing to the results of this study. The largest reductions in discomfort were seen in the 2 participants who spent the lowest percentage of their daily schedule standing. The results indicate that in this core group the most successful comfort results were shown by participants who, on average, adjusted sitting and standing positions more frequently. The increased overall comfort group performed an average of 1.8 adjustments/hour while the maintained level of overall comfort group performed 1.3 adjustments/hour. This relationship is important to consider when determining recommended adjustments rates for daily sit-stand workstation schedules.

As shown through the follow up support, interim coaching/modifications required, and support provided prior to the implementation of the sit-stand units, it is imperative that initial and ongoing ergonomic expertise be included in any program. Initially, any new sit-stand workstation user should receive education on ideal workstation configuration for both seated and standing work and have an ergonomic assessment completed to ensure that they are working in ideal positions. Additionally, a follow-up assessment/adjustment of the standing workstation is recommended to ensure that the user is adopting ideal postures during its use.

## 6. References

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