

## Monitoring Sleep, Activity and Function Using Wearable Devices in Post-Surgical Patients: A Pilot Study

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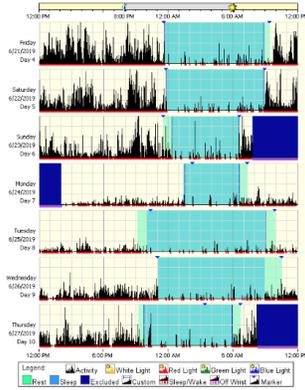
**Background:** The relationship between pain, sleep, activity and functioning are acknowledged as important features of pain treatment<sup>1</sup>, but their interaction is not fully understood. Emerging evidence shows that sleep disturbances are common in children after surgery and poor postoperative sleep is associated with worse postoperative pain control.<sup>2,3</sup> Self-report measures of sleep and activity are frequently used with children and their parents, but are limited by inaccuracies and bias.<sup>4</sup> The goal of this study was to demonstrate feasibility and acceptability of using a wearable actigraphy device to collect sleep and activity data in the pediatric perioperative setting and to compare actigraphy data with information collected in a self-reported sleep diary.

**Methods:** We performed a prospective observational study including nine patients, between the ages of 10 and 21, undergoing various surgical procedures. Patients with a diagnosis of severe cognitive impairment or autism spectrum disorder were excluded. After enrollment, patients were provided a Philips Actiwatch Spectrum Plus at their pre-operative visit and asked to wear it continuously in the days leading up to surgery and to fill out a brief daily sleep diary. The device was then removed during the surgical procedure and reattached in the post anesthesia care unit (PACU). The actigraph was worn continuously during the patient's hospitalization and removed prior to discharge. Data was collected in 30 second epochs. A semi structured interview was completed with the patients and parents at the conclusion of the study to assess acceptability and feasibility of wearing the device. Primary outcomes were collected including total time the wearable was worn, how comfortable the wearable was, how burdensome it was to wear, any adverse reactions to the wearable and the participant's enjoyment of participating in the study. In addition, actigraphy data, including activity counts and sleep time, were analyzed and compared with the patient's sleep diary and postoperative pain scores.

**Results:** All nine patients were highly satisfied with their participation in the study (Mean:  $9.5 \pm 0.76$  out of 10), found the wearable comfortable to wear (Mean:  $8.87 \pm 1.73$  out of 10), and did not find it a burden to wear the device (Mean:  $0.87 \pm 0.83$  out of 10). Eight patients wore the actigraphy units continuously throughout the study except for during surgery, while one patient also removed it for their school prom prior to surgery. The objective sleep data was very similar to the pre-surgical sleep diary data with regard to bed time and waking up time. However, most patients and their parents found it very difficult to fill out the sleep diary in the inpatient settings. Subjects slept significantly more during their postoperative stay then during the baseline period (Mean: 544 Min vs 426 Min,  $p=0.007$ ). The sample was underpowered to assess associations between pain scores and sleep fragmentation.

**Conclusions:** Use of actigraphy is an accepted and feasible method for collecting objective measures of sleep and activity in post-operative settings.

**Figure 1:** Actigraphy data from sample patient. Note decreased activity and increased sleep after surgical procedure on 6/24/19 (first dark blue section).



## References:

1. Smith MT, Haythornthwaite JA. How do sleep disturbance and chronic pain inter-relate? Insights from the longitudinal and cognitive-behavioral clinical trials literature. *Sleep Med Rev.* 2004;8(2):119-132.
2. Kain ZN, Mayes LC, Caldwell-Andrews AA, et al. Sleeping characteristics of children undergoing outpatient elective surgery. *The Journal of the American Society of Anesthesiologists.* 2002;97(5):1093-1101.
3. MacLaren JE, Kain ZN. Prevalence and predictors of significant sleep disturbances in children undergoing ambulatory tonsillectomy and adenoidectomy. *Journal of pediatric psychology.* 2007;33(3):248-257.
4. Lauderdale DS, Knutson KL, Yan LL, Liu K, Rathouz PJ. Self-reported and measured sleep duration: how similar are they? *Epidemiology (Cambridge, Mass).* 2008;19(6):838-84.