Lower Back Pain and Sleep: Mattresses, Sleep Quality and Daytime Symptoms

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Abstract

Objective: To determine whether sleep architecture is disturbed in patients with severe lower back pain (LBP) and whether a proprietary mattress affects the quality of sleep.
Patients: 8 patients with severe lower back pain.
Methods: Patients had polysomnography (PSG) on conventional spring and test mattresses within a one-week period. They also reported symptoms and quality of life in the month before PSG testing, while sleeping on their conventional spring mattresses, and after PSG testing, while sleeping on the test mattress.
Results: PSG demonstrated reduced REM latency, duration and percent. Slow wave sleep was also markedly reduced (1/4 normal). There were no significant differences in PSG variables between sleep on conventional and test mattresses. One patient had an exacerbation of severe LBP in the month following PSG. In the 7 remaining, reported LBP was significantly less and SF-36-measured physical and mental health scores tended to be better (P = 0.05 and 0.07 respectively) during the month sleeping on the test mattresses.
Conclusions: These preliminary data suggest that sleep architecture is disturbed in patients with LBP and that the specific test mattress may attenuate pain and enhance quality of life. Due to limitations of this small pilot, additional confirmatory studies are required.

Lower back pain (LBP) is among the most common outpatient complaints, and costs the U.S. economy millions of dollars each year.[1,2] There is a paucity of data on the effects of LBP on sleep. Chronic LBP has been reported to affect the self-reported quality of sleep[3] delay initiation of sleep.[3] Few studies have examined the degree to which LBP otherwise disturbs sleep architecture.[4,5] We hypothesize that severe LBP is associated with abnormal sleep architecture i.e. longer sleep latency, REM latency, more frequent arousals, and general fragmentation. While there are many claims regarding the effectiveness of proprietary beds to improve sleep, there are very few published data on this topic. Accordingly, we also hypothesize that a mattress designed to improve sleep mechanics would attenuate sleep abnormalities of patients with LBP (if) noted on conventional mattresses.

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Methods

The Bridgeport Hospital Investigational Review Board approved conduct of this study. Patients were recruited using advertisements posted in Bridgeport Hospital public spaces, and provided informed consent. Volunteers who self-reported severe LBP and frequent (>10/night) "tossing and turning" in bed, were included. Patients with previously diagnosed sleep disorders, anxiety and receiving medications known to impact sleep architecture were excluded.

All patients underwent a screening history and then maintained sleep and pain diaries for a month while sleeping on their conventional mattresses. At the end of this period they completed SF-36 (™), Oswestry Low Back Pain and Disability,[6] and Epworth Sleepiness[7] questionnaires. They then underwent two polysomnograms (PSG), no more than 3 days apart: one on the conventional spring mattress in our Sleep Center and the other on a proprietary orthopedic bed (TempurPedic™). The order of studies (i.e. conventional or test mattress) was determined by random-number generator. Patients were not told whether they slept on conventional or test mattresses (but the test mattress conforms to body shape, so complete blinding could not be assured). PSGs were scored by SleepTech, Inc. technicians and by a Board-certified Sleep physician (FR) who were blinded to mattress allocation. Patients were then given a TempurPedic mattress for their home (to keep). Patients again maintained daily sleep and pain diaries and after one month sleeping on the test mattress, repeated the SF-36, Oswestry Low Back Pain and Disability, and Epworth Sleepiness questionnaires.

Data were extracted from daily sleep diaries. Mean values of reported pain (analogue scale 1–5) and the self-reported number of hours of sleep were compared for the month before and after use of the test mattress by paired Student's t-test. SF36 scores were computed using proprietary software, while Oswestry and Epworth scores were computed using published methodology. SF-36, Oswestry and Epworth scores were also compared by paired Student's t-test. Quantitative data from PSGs were compared (conventional vs. test mattress) by paired Student's t-test for sleep and included: position changes, sleep latency, sleep latency, frequency of arousals, percentages spent in each stage, REM latency and alpha intrusion. A P value of 0.05 signified statistical significance.

Table 1. Polysomnographic Data (mean±SE) of Eight Patients with Severe LBP Sleeping on Conventional Spring and Test (TempurPedic™)Mattresses

Variable	*Spring Mattress PSG*	*TempurPedic™ PSG*	P *Value*
Sleep latency (min)	13.5 ± 5.0	12.9 ± 3.7	0.92
REM latency (min)	161.3 ± 42.6	138.6 ± 30.3	0.38
REM %	9.8 ± 2.5	12.1 ± 3.3	0.26
Stage 1 %	14.5 ± 2.4	12.2 ± 1.7	0.10
Stage 2 %	56.5 ± 2.8	53.3 ± 4.1	0.32
Slow Wave %	5.0 ± 2.2	5.1 ± 2.5	0.91
Sleep Efficiency (%)	82.7 ± 4.0	80.5 ± 5.6	0.63
Wakeful %	14.2 ± 4.0	17.3 ± 5.5	0.51
Arousal index	3.9 ± 2.2	22.5 ± 9.9	0.10
Alpha wave intrusion (n)	2	2	NS

Results

Eight patients, 4 men and 4 women, ranging in age from 25 to 63 and with a mean age of 40 years were studied. Another patient experienced a severe exacerbation of LBP in the month following PSG (while sleeping on the test mattress) and did not complete questionnaires. Five patients were noted to have previously unrecognized obstructive sleep apnea and 2 with periodic leg movements on one or both PSGs.

Polysomnographic Features of Sleep with Severe LBP

PSG hypnograms performed on conventional mattresses are shown in Figure 1 and quantitative data in Table 1. Compared to "normals," patients with severe LBP had markedly reduced REM sleep (10% compared to normal values of 23–28%) and slow wave sleep (5% compared to normal values of 20–25%). Alpha wave intrusion was present in 3 patients. Other sleep parameters were normal or close to normal limits (see Table 1). There were no significant differences in sleep parameters when sleeping on the test mattress (TempurPedic™ versus the conventional spring mattress used in our sleep laboratory.

Quality of Life Data

Patients reported less pain by conventional analogue and Oswestry back pain score when sleeping on the test mattress (Oswestry 32.3 vs. 40.8; P = 0.009, see Table 2). There was also an increased quality of life on the physical component of the SF36 (P = 0.049) and a strong trend (P = 0.065) toward improved mental health self-reporting while patients slept on the test mattress compared to their own conventional mattresses. Other parameters, including recorded hours of nightly sleep and Epworth sleepiness score were not significantly different.

Discussion

The principle findings of this pilot study are that sleep architecture of patients with severe LBP is qualitatively disturbed. The most striking abnormalities included reduced REM latency, duration and percent. Slow wave sleep was also markedly reduced (1/4 normal). Although this study is small and subject to Type 1 error, patients experienced significant improvements in quality of life indicators but no demonstrable improvements in polysomnogram-measured sleep parameters while sleeping on a test (in this case, TempurPedic™) mattress.

The relationship between pain and sleep is likely co-dependant. Pain promotes disruption of sleep[3–5] and abnormal sleep may promote greater pain,[8–11] and a "vicious cycle" may develop. Depression, a common manifestation or accompaniment of chronic pain, may further aggravate the cycle by reducing pain thresholds.[8,9] Poor sleep appears to induce hyperalgesia.[10,11] Restorative sleep would be expected to promote deceleration of the cycle. While these mechanisms may be theoretically plausible, evidence remains scant about interventions to interrupt the cycle sleep deprivation-related pain, which may be further exacerbated by depression/anxiety.[12] This relationship of pain and sleep disorders has been best studied in patients with fibromyalgia.[13,14] Reduced sleep spindles[15] and,[14] and abnormal "alpha-delta" sleep[16-18] have been reported. Greater alpha activity has also been noted in patients with juvenile[19] and adult[20] rheumatoid arthritis. Data from patients with pelvic pain demonstrates reduced REM and increases of both Stage 1 and slow wave sleep.[21] Although reduced self-reported quality of sleep has been described by patients with LBP,[3] only one study commented on lower sigma power in PSG of patients with LBP.[4] Our patients demonstrated similar footprints of pain on PSGs, namely reduced REM and slow wave sleep typical in patients with other pain syndromes.

Despite numerous claims of various manufacturers, remarkably little is known about the effects of various mattresses on sleep in normals[22,23] or patients with pain. The quality of conventional mattresses (soft vs. hard) did not have a predictable effect on self-reported sleep quality.[23] Patients with chronic LBP reported better sleep, less pain and better function after 28 days of sleep on adjustable airbeds.[24] Price and colleagues reported that an air mattress overlay was associated with longer and less interrupted sleep.[25] The use of specially designed overlay bedding was associated with reduced pain and better self-reported sleep in 19 patients with rheumatologic pain,[25] but PSGs were not performed. These studies did not prospectively randomize or blind patients or researchers.

Our study has several notable limitations. The study is very small so any observations should be generalized with great caution. The lack of normative PSG data (or a normal cohort) to perform statistical comparisons to our patients, limits our ability to assert other than general, qualitative effects of severe LBP on sleep architecture. Secondly, the relationship of pain and sleep is complex and coincident non-pain related sleep disorders (5 patients had obstructive apnea, periodic leg

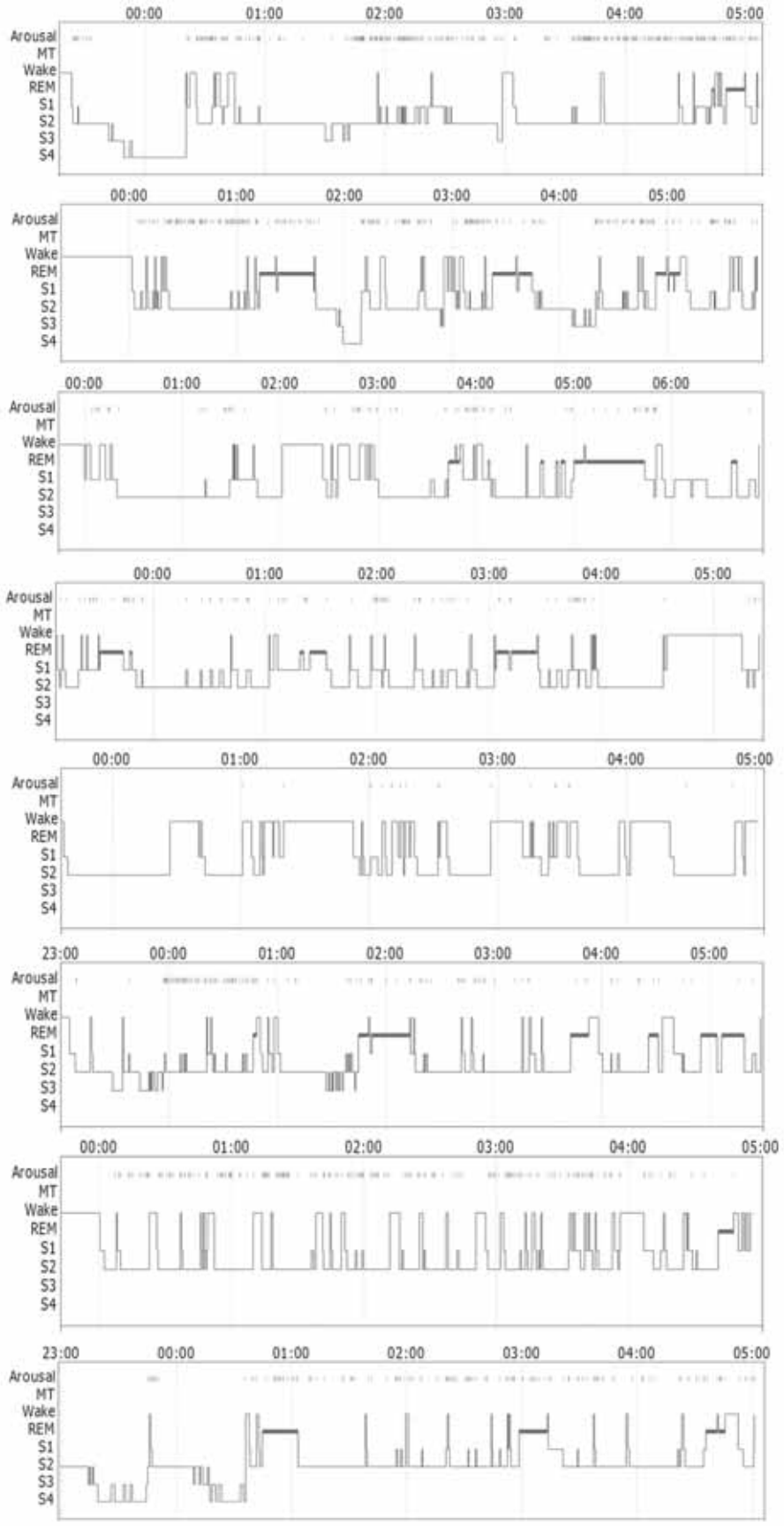

Fig. 1. Hypnograms of 8 subjects sleeping on conventional spring mattresses.

Table 2. Pain and Quality of Life of Patients

	Conventional Mattress	*TempurPedic™ Mattress*	P-*value*
Daytime analogue pain score (0–5)	3.0	2.1	0.08
Hours of self-reported sleep	6.5	6.9	0.22
Oswestry back pain score (0–100)	40.8	32.3	0.009
Epworth sleepiness scale (0–24)	7.6	5.9	0.28
SF-36			
Physical component score (0–100)	39.1	43.2	0.05
Mental health score (0–100)	47.3	54.0	0.07
Bodily pain (0–100)	36.3	43.6	0.06
Role limitation – physical (0–100)	38.5	47.4	0.009
Physical function (0–100)	39.1	39.6	0.74
General health (0–100)	48.6	49.6	0.80
Vitality (0–100)	45.2	53.3	0.03
Social function (0–100)	45.3	51.4	0.04
Role limitation – emotional (0–100)	41.8	48.1	0.05
Mental health (0–100)	45.8	51.1	0.05

SF-36 scores range from 0 to 100; 50 is the median with a standard deviation of 10. A higher score signifies a better state of self-reported health.

For the Epworth sleepiness scale and the Oswestry Back Pain scales higher scores signify greater symptoms.

movements or both) could have affected our observations and promoted, in some cases, LBP. Sleep-disordered breathing causes fragmentation of sleep irrespective of pain, and so the presence of obstructive apneas in so many patients could contribute to our false negative result. A very large cohort might be required to demonstrate PSG differences on conventional vs. test mattresses (if such a difference exists), unless those with co-existent, non-pain sleep disorders can be excluded. Thirdly, we cannot discount the placebo effect to explain the improvement in some variables. Patients could not be blinded entirely to the test mattress during PSG and since they received the mattress for their personal use at home, it is possible their hope that the mattress would help relieve their symptoms contributed to the observed effect. Another limitation is that while all patients slept on their own "conventional" spring mattress prior to PSG and sleeping on the test mattress, these findings do not necessarily imply that all conventional mattresses are inferior to the test mattress for patients with LBP. Perhaps most importantly, one patient who experienced a severe exacerbation of LBP during the study did not complete the second half. Accordingly, it is very likely that differences in quality of life variables between one month of sleep on conventional and test mattresses are overestimated. If we assume she'd have reported maximal values for LBP, sleep and QOL questionnaires, differences between groups are not significantly different. It should be noted however, that she did not attribute her exacerbation to the test mattress.

In conclusion, this preliminary study suggests that sleep architecture is abnormal in patients with severe LBP. Significant limitations prevent strong conclusions, but use of the specific test mattress used (TempurPedic™) was associated with improved daytime symptoms but no demonstrable objective changes in sleep architecture. Insofar as these results are consistent with previous results suggesting an association of pain and abnormal sleep, and LBP is epidemic in the U.S., further studies may be warranted to more rigorously examine the hypothesis that therapies aimed at enhancing sleep may attenuate symptoms in these patients.

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