Cervical Pain: A Comparison of Three Pillows

Robert A. Lavin, MD, Marco Pappagallo, MD, Keith V. Kuhlemeier, PhD

ABSTRACT. Lavin RA, Pappagallo M, Kuhlemeier KV. Cervical pain: a comparison of three pillows. Arch Phys Med Rehabil 1997;78:193-8.

Objective: To compare three pillows with regard to pain intensity, pain relief, quality of sleep, disability, and overall satisfaction in subjects with benign cervical pain. The three pillows evaluated were the subjects' usual pillow, a roll pillow, and a water-based pillow.

Study Design: Subjects used their usual pillows for the first week of this 5-week randomized crossover design study. They were subsequently randomly assigned to use each of the other two pillows for 2-week periods.

Setting: Outpatient neurology and physiatry clinics.

Patients: Forty-one subjects with benign cervical pain syndromes and free of cognitive impairments.

Main Outcome Measures: Visual analog scale (VAS), Sleep Questionnaire, Sickness Impact Profile (SIP), and a satisfaction scale rating the pillows.

Results: The water-based pillow was associated with reduced morning pain intensity, increased pain relief, and improved quality of sleep. The duration of sleep was significantly shorter for the roll pillow. Overall SIP findings showed a significant advantage for the water-based pillow over the roll pillow and standard pillow.

Conclusions: Proper selection of a pillow can significantly reduce pain and improve quality of sleep but does not significantly affect disability outcomes measured by the SIP.

BENIGN CERVICAL PAIN syndromes affect a large proportion of the population. Different epidemiologic studies have found a lifetime incidence of 35% to 80%.[1,2] The incidence increases with age and is often accompanied by headaches and pain radiating into the upper extremities.[3-5] Cervical pain is frequently attributed to post-traumatic muscle tears, cervical disk pathology, and zygapophysial joint disease.[6-11]

While numerous orthotic devices purport to treat neck pain and associated headaches, few published evaluations have been found methodologically acceptable.[12] A single study has suggested that soft cervical collars were beneficial for pain reduction[13]; other studies report no significant change in pain levels.[14-16] Although soft cervical collars do not limit cervical active range of motion, it has been suggested that they may be beneficial if worn during sleep to limit unconscious neck movement.[13,17,18] Cervical pillows have not been studied in conjunction with cervical pain.

In this study three types of pillows—standard, roll, and commercially developed water-based pillows—were evaluated in a diverse neck pain population, with and without cervicogenic headaches, to determine whether pain levels, sleep patterns, and daily function were influenced by the type of pillow used.

MATERIALS AND METHODS

Subjects

Forty-six subjects with neck pain were recruited through a newspaper advertisement. Individuals with a history of dementia, neoplasm, or known infection in the cervical region were excluded. Five subjects were lost to follow-up before completion of the study. All subjects were evaluated at an outpatient center between April and June, 1995. There were 20 men and 21 women between the ages of 26 and 76 years ($\bar{x}$ = 48yrs). The duration of neck pain ranged from 1 month to 25 years. Only one subject experienced neck pain for 1 month, and four experienced it for longer than 3 months and less than 6 months. Neck pain for 6 months or more was reported by 88% of the subjects, and 78% of the subjects reported having it for one year or more.

Twenty-three subjects experienced daily neck pain, and 13 of these subjects characterized the pain as constant. The remaining subjects experienced neck pain at least once weekly. Twenty-nine subjects awoke from sleep because of neck pain; 13 of these subjects awoke every night, while another 14 subjects awoke at least once each week. Seventeen subjects indicated that pain interfered with normal activity or work. Twenty-seven subjects had previously sought medical attention, chiropractic treatment, or physical therapy. Twenty-five subjects were taking medications. The most frequently used medications were nonsteroidal anti-inflammatory drugs and acetaminophen. The factors most commonly associated with neck pain exacerbations were emotional stress, sleep, weather changes, recumbency, physical activity, and exposure to cold.

The initial assessment included a complete history and physical examination. Mechanical neck pain was further evaluated by assessing pain associated with active range of motion, cervical compression maneuvers, resisted extremity maneuvers, and cervical or trapezius muscle tenderness. Most subjects complained primarily of axial neck pain exacerbated by these maneuvers. None of the subjects had sensory or motor abnormalities associated with radiculopathy; however, intermittent radicular pain complaints in the upper extremities were reported by some of the study subjects. None of the subjects exhibited myelopathic abnormalities on clinical examination. Cervicogenic headaches were determined to occur simultaneously with neck pain exacerbations and varied with cervical movements and various stress maneuvers such as manual traction and compression of the cervical spine. Twenty-two subjects had headaches that were temporally associated with exacerbations of their neck pain. These headaches were considered a manifestation of the severity of neck pain exacerbations and were not associated with migraine symptoms. The reported onset of neck pain was often insidious or attributed by the subject to trauma after a motor

From the Department of Physical Medicine and Rehabilitation (Drs. Lavin, Kuhlemeier) and Department of Neurology (Dr. Pappagallo), The Johns Hopkins University School of Medicine, Baltimore, MD.

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Reprint requests to Robert A. Lavin, MD, JHU Department of Physical Medicine and Rehabilitation, Good Samaritan Professional Office Building, Suite #406, 5601 Loch Raven Boulevard, Baltimore, MD 21239.

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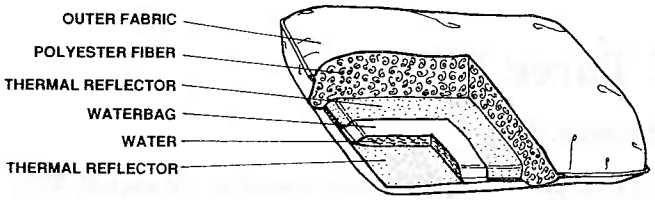

Fig 1. Diagram of cutaway view of cervical water-based pillow.[a]

vehicle accident or to "arthritis." No attempt was made to determine the anatomic location of the cervical pain generators.

All subjects agreed to maintain a stable medication regimen during the course of this 5-week study. They were also instructed to continue their usual work, household activities, exercise regimen, and modalities. Subjects did not receive physical therapy or manipulation during this study.

Pillows

The pillows compared included the subject's current pillow (usually a standard down or foam pillow served as the reference or "standard pillow"), a water-based pillow (Mediflow Waterbase Pillow[a]), and a roll pillow (Cervi-Garde, model 1540[b]). The water-based pillow consisted of approximately four inches of soft polyester fiber over a 3.8-cm water base at the bottom of the pillow which was filled with 2,360mL of water. The water volume could be adjusted to change the firmness of the pillow. It is schematically represented in figure 1. The water-filled pouch was covered by a thermal reflector fabric to prevent heat transfer from the skin of the user to the water-filled pouch. A cylindrical polyester fiber-filled roll pillow, 43cm length × 17.8cm diameter, was chosen for comparison because it was the most commonly marketed type of cervical pillow. At least seven cervical roll pillows with similar dimensions and composition were available from different distributors.[c]

Study Design

All subjects were instructed to sleep using their usual pillow during the first week of the study. Subsequently, they were randomly assigned to use either the roll pillow or the water-based pillow for 2 weeks and then to switch to the remaining pillow for the final 2 weeks of the study. The roll pillow was used subsequent to the standard pillow by 19 of the subjects while the water-based pillow was used subsequent to the standard pillow by 22 of the subjects.

Outcome measures included daily scores for pain intensity, pain relief, quality of sleep, and level of function recorded in a diary. The daily diary consisted of a visual analog scale (VAS) with verbal descriptors for pain intensity and a 0% to 100% scale with verbal descriptors of pain relief.[19-20] The scales were completed upon awakening and again prior to sleep. The daily sleep questionnaire[21] was completed every morning to assess the length of time it took to fall to sleep, the number of times the individual awoke, the degree of difficulty falling back to sleep, the duration of sleep, the quality of sleep, how rested the individual felt, and how the sleep compared with the individual's perception of normal sleep. Subjects kept a daily record of medication consumption and any changes in "as needed" or over-the-counter medications. At the end of each trial period with a given pillow, the subjects were asked to rate their level of satisfaction with the pillow and to complete the Sickness Impact Profile (SIP).[22] The satisfaction scale consists of seven categories: very satisfied, satisfied, slightly satisfied, neutral, slightly unsatisfied, unsatisfied, and very unsatisfied. For the purpose of data analysis, these categories were subsequently collapsed into three groups by combining the first three categories into a satisfied group and the last three categories into an unsatisfied group. Subjects rated their relative satisfaction with each pillow independent of their ratings of the other pillows. Thus, a subject could assign the same level of satisfaction rating to all three pillows.

Some subjects were unable to complete a particular pillow trial, usually because of increased incidence and severity of neck pain and headaches associated with use of a particular pillow. These subjects were requested to end the trial with that pillow and to complete the satisfaction scale and the SIP. They were also instructed to switch to the remaining pillow if the study was not yet completed. In addition to the initial evaluation visit, subjects had a second visit at the end of the study to collect the diaries and to discuss benefits or problems associated with the pillows.

Table 1: Effect of Pillow Type on Pain Intensity

Pillow Type	Morning*	Evening†
Roll	4.67 ± .46	4.17 ± .48
Standard	4.83 ± .42	4.31 ± .44
Water	3.75 ± .36	3.67 ± .40

A lower value is associated with less pain. Values are mean ± SE.
* Morning $p < .01$ (roll vs standard $p > 0.5$, roll vs water $p < .005$, standard vs water $p < .025$).
† Evening $p > 0.1$.

Statistical Analysis

Satisfaction and sleep responses were compared statistically using the nonparametric Kruskal-Wallis rank ordering test using each day's responses for each subject as the unit of analysis. Using each night's sleep report as an independent event was considered a more valid analysis than averaging of the nonparametric responses. SIP scores and VAS scores for pain intensity and pain relief were analyzed with two-way (treatment and subject) analysis of variance (ANOVA). The unit of analysis for VAS was the mean VAS score for a subject over the trial period for each pillow type.

RESULTS

Average pain intensity scores and comparison of scores by analysis of variance are given in table 1. There was a significant effect of pillow type on morning pain intensity scores ($p < .01$), but not evening pain intensity scores ($p > 0.1$). Tukey's tests for multiple comparisons revealed that pain intensity in the morning was not different for the roll and standard pillows ($p > 0.5$), but was less with the water pillow than either the roll pillow ($p < .005$) or the standard pillow ($p < .025$). Average pain relief (table 2) was influenced by pillow type both in the morning ($p < .01$) and the evening ($p < .05$) with greater pain relief being seen in patients using the water pillow compared to patients using the roll pillow.

During the course of the roll pillow trial, 10 subjects dropped out during the trial period and gave uniformly negative comments regarding the roll pillow. An additional two subjects did

Table 2: Effect of Pillow Type on Pain Relief Compared to the Standard Pillow

Pillow Type	Morning	p	Evening	p
Roll	2.42 ± .42	<.01	2.76 ± .44	<.05
Water	3.87 ± .41	<0.1	3.86 ± .42	<0.1

A higher value is associated with greater pain relief. Values are mean ± SE.

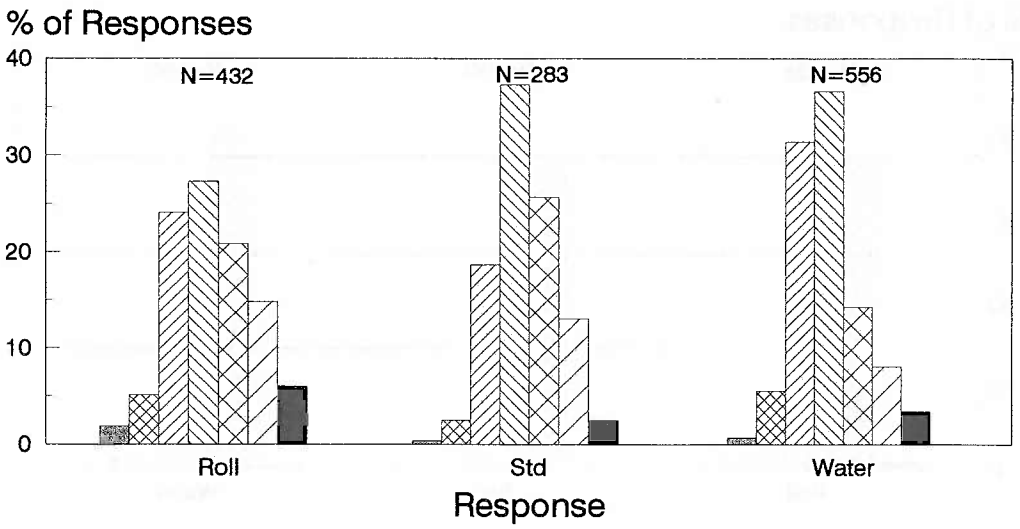

Fig 2. A comparison of three pillows: subjects rated the overall quality of their sleep the previous night (▨, no response; ▨, 0 [extremely good]; ▨, 1; ▨, 2; ▨, 3; ▨, 4; ■, 5 [extremely poor]).

not record any responses on the VAS scales but indicated in the comment section that they could not tolerate the roll pillow for even one night. One subject stopped using the standard pillow before the end of the trial and two subjects discontinued the water-based pillow prematurely.

The daily sleep questionnaire[21] results are outlined in figures 2 through 6. The figures are organized with the most desirable responses on the left and the least desirable responses on the right. In all five items surveyed, the rank order from best to worst was: water-based pillow, roll pillow, then standard pillow. The rank order was worse than average in all five items for both the standard and roll pillows; there were no differences in the duration of time required to fall asleep (fig 4; $p > 6.18$), the numbers of awakenings during the night (fig 5; $p > .47$), and the number of awakenings with difficulty falling back asleep (fig 6; $p > .15$). In contrast, the water-based pillow was significantly better than average in overall sleep quality (fig 2; $p < .01$) and perception of sleep compared to normal (fig 3; $p < .005$). The duration of sleep was significantly affected by pillow type ($p < .05$). The mean hours of sleep were 6.6 hours (SE = .19) for the standard pillow, 6.3 hours (SE = .17) for the roll pillow, and 6.6 hours (SE = .17) for the water-based pillow. The standard pillow and water pillow were associated with a significantly longer sleep duration than the roll pillow ($p < .025$ for each).

The water-based pillow was significantly better for overall satisfaction than the other two pillows ($p < .001$) when the number of satisfactory responses were compared with the number of neutral or unsatisfactory responses. Twenty-two subjects were satisfied with the water-based pillow, as opposed to 17 who were either neutral or unsatisfied. This is in contrast to the roll pillow, with which seven subjects were satisfied and 29 were neutral or unsatisfied. The standard pillow satisfied only four subjects, with 36 subjects either neutral or unsatisfied.

SIP results are given in table 3. Although none of the subscores related to the physical dimension were significant by themselves, the overall physical dimension showed a significant ($p < .05$) relationship with pillow type. Tukey's multiple comparisons test showed this difference to be due to the water-based pillow versus standard pillow comparison ($p < .025$). The components making up the SIP psychosocial dimension consistently showed lower values associated with the water-based pillow but none of these differences in subscales individually or collectively reached statistical significance. Three of five independent subscales (sleep, rest, eating, and home manage-

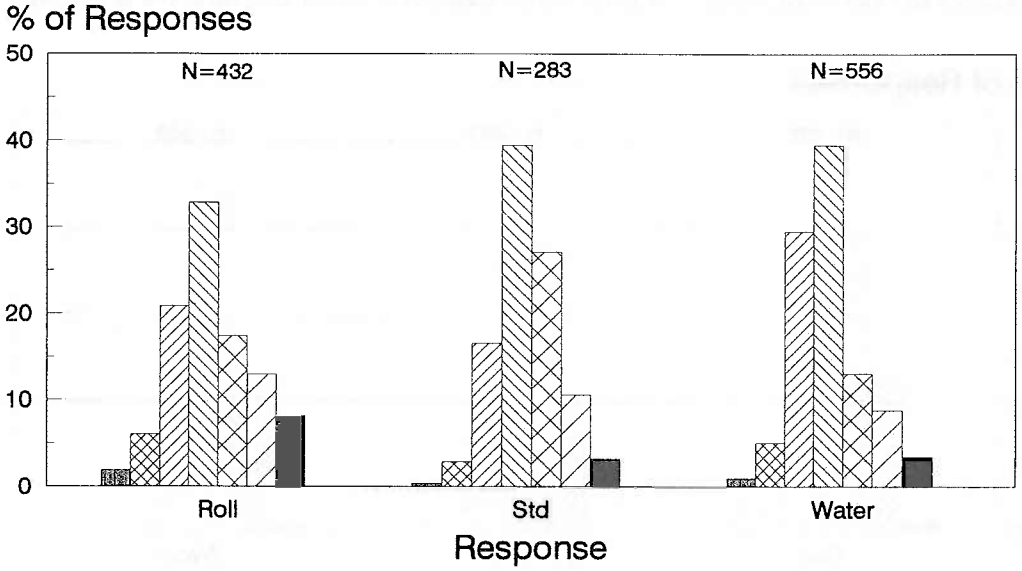

Fig 3. A comparison of three pillows: subjects rated their sleep the previous night compared to normal (□, no response; ▨, 0 [much better]; ▨, 1; ▨, 2; ▨, 3; ▨, 4; ■, 5 [much worse]).

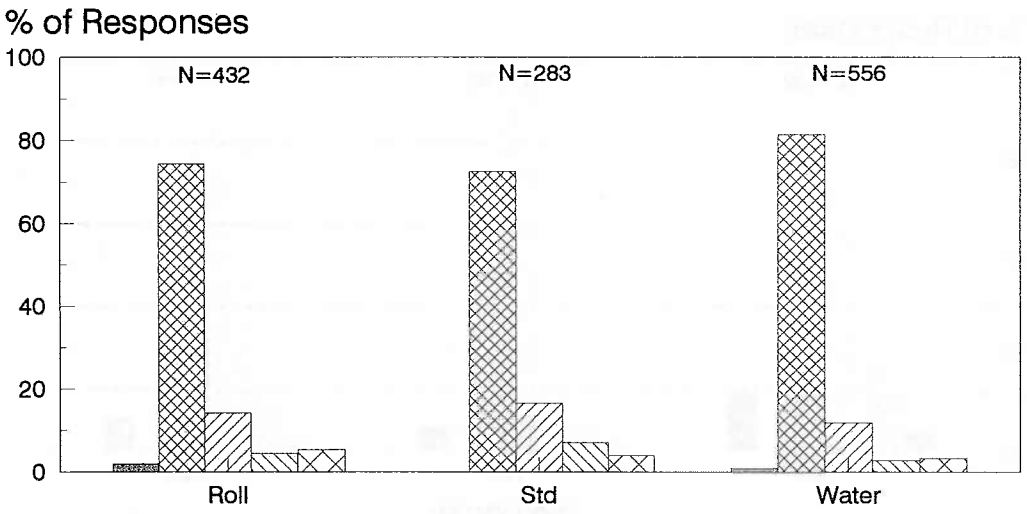

Fig 4. A comparison of three pillows: subjects reported how long it took to fall asleep the previous night (▨, no response; ▨, 0-30min; ▨, 30-60min; ▨, 60-90min; ▨, longer than 90min).

ment) showed a significant overall effect of pillow type. The water-based pillow showed a significant advantage over the standard pillow with regard to sleep/rest ($p < .01$) and home management ($p < .01$). The standard pillow showed a significant advantage ($p < .05$) over the roll pillow in the eating category. When all subscores were totaled, the water-based pillow showed lower sickness impact than the standard pillow ($p < .01$) and the roll pillow ($p < .025$).

DISCUSSION

The use of soft cervical supports is controversial. They do not immobilize the neck but may contribute to comfort.[3,13,17,18] We studied cervical pillows to assess pain relief, sleep, and disability. In this crossover study, the water-based pillow was consistently associated with statistically significant improvements in the overall quality of sleep on the SIP and sleep questionnaire and modest improvements in pain intensity and pain relief scores. The water-based pillow pain relief and morning pain intensity mean VAS scores were consistently better than the other pillows. The evening pain relief might be due to a beneficial carryover phenomenon of decreased daytime pain, or a general association by the subjects of less pain while using the water-based pillow unrelated to the report time.

Neck pain and cervicogenic headaches are often worse in the morning after awakening and improve over the course of the day.[3] These headaches are often attributed to diverse cervical pathology, such as upper cervical zygapophysial joint injury or degeneration, irritation of the greater occipital nerve, and reflex paraspinal and trapezius muscle spasm.[8-10,23-25] During the daytime, individuals with neck pain may guard against excessive movements or postures associated with pain. Conversely, if neck pain is exacerbated during sleep by poor head and neck support, then it is not surprising that individuals frequently awaken experiencing increased morning headaches and neck pain.[3,13,17,26] Consequently, adequate head and neck support during sleep might have a beneficial carryover effect on daytime pain relief. Possibly the significant improvement in the physical dimension score and the home management subscores for the water-based pillow on the SIP may reflect this phenomenon.

Studies by Nicassio and Wallston[27] found that enhanced quality of sleep may also help an individual to improve coping skills and to better deal with associated stress. This study concurs with other studies that have documented a relation between pain and disturbed sleep in fibromyalgia, rheumatoid arthritis, and other painful musculoskeletal disorders.[28-31] The etiologic relationship between pain and disturbed sleep remains unclear.

The quality of sleep, pain relief, and the level of satisfaction with the water-based pillow are not associated with any signifi-

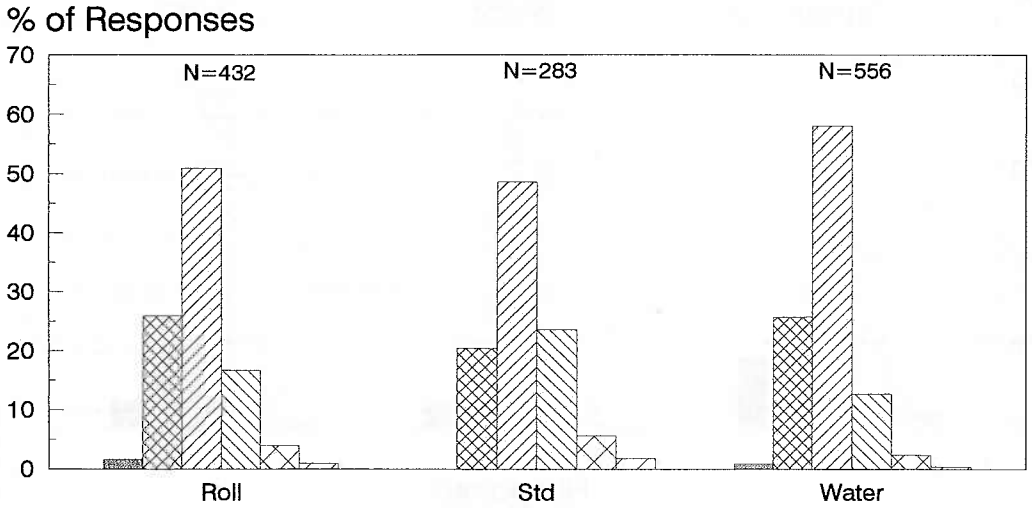

Fig 5. A comparison of three pillows: subjects reported how many times they woke during the night (▨, no response; ▨, 0 times; ▨, 1-2 times; ▨, 3-4 times; ▨, 5-6 times; ▨, more than 6 times).

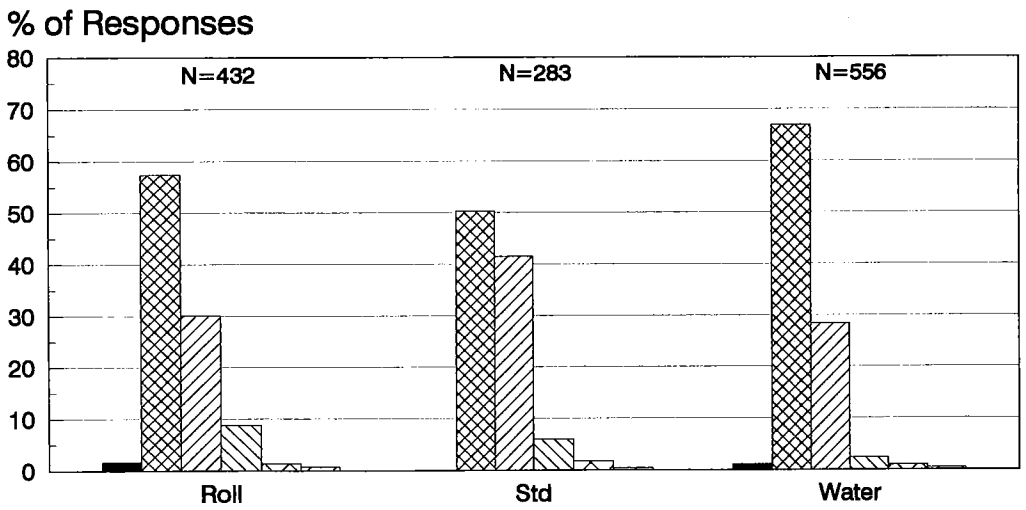

Fig 6. A comparison of three pillows: subjects reported how many times they woke during the night and had trouble getting back to sleep (▩, no response; ▩, 0 times; ▨, 1-2 times; ▧, 3-4 times; ▩, 5-6 times; ▨, more than 6 times).

cant increase in duration of sleep when compared with the standard pillow. Interpretation of this observation must be qualified by the reliance on self-report with regard to the objective measurement of length of time to fall asleep, number of awakenings from sleep, difficulty falling back to sleep, and duration of sleep.

The water-based pillow had the highest satisfaction score, followed by the roll and standard pillows. There may have been a selection bias against the standard pillow, as subjects recruited into the study were presumably dissatisfied with their usual "standard" pillows. There may also be a selection bias in the roll pillow data because a large number of negative respondents stopped using this pillow prematurely. Although the same number of subjects were assigned to use the water-based and the roll pillows, there is a consistently lower number of observations for the roll pillow data because of this higher drop-out rate. The standard pillow was only evaluated for 1 week, half the time assigned to the two other study pillows, which explains the lower number of observations (N) for the standard pillow pooled data.

Many studies have suggested a strong placebo effect in pain patients, and the distribution of a new device purported to relieve pain would undoubtedly influence subjects' responses.[32,33] Results from the SIP, however, suggest more than a placebo effect for the water pillow because it was favored over both the standard and roll pillows. The results from the SIP physical dimension and sleep subscale corroborate evidence from the sleep and VAS findings.

The presumed positive effects of the water-based pillow may be due to its ability to spontaneously conform to the position and shape of the head and neck. The polyester fiber is compressed by the head and neck, and it transfers this weight to the supporting noncompressible water-filled pouch. This water-filled pouch spontaneously redistributes the weight of the head and neck during changes in sleep positions. The movement between the head and the fluid-filled pouch may also be dampened by the compressible polyester fiber. The flat surface of the bed was considered to be important for maintaining the appropriate orientation of the pillow during use.

Subjects complained that the roll pillow tended to compress or flatten out during use, and that it was difficult to maintain in position because of its cylindrical shape. Additionally, there are several proposed reasons for the ineffectiveness of the cervical roll pillow. The diameter of the roll pillow is inadequate to simultaneously support both the head and neck, which might contribute to neck pain in some individuals. Also, when the roll pillow is placed under the neck in the supine position it may promote cervical extension, which is poorly tolerated by many individuals with neck pain. Finally, it is interesting that the small number of subjects who were satisfied with the roll pillow were generally also satisfied with the water-based pillow, whereas the converse was not true.

Table 3: Raw Values of SIP. Subscores, Dimensions, and Total Score With *p* Values for Differences Among Pillow Types

Dimension	Behavior Related To	Raw Value			Type			
		Roll	Std	Water	Overall*	Std vs Roll†	Roll vs Water†	Water vs Std†
	Ambulation	2.3	2.8	1.7	<0.1	—	—	—
	Mobility	2.8	2.0	1.7	<0.1	—	—	—
	Body Care/Movement	5.8	6.4	4.6	<0.1	—	—	—
Total Physical		10.9	11.3	7.9	<.05	>0.5	<0.1	<.025
	Communication	2.8	1.8	1.7	>0.1	—	—	—
	Alertness behavior	6.4	5.8	4.4	>0.1	—	—	—
	Emotional behavior	4.9	5.9	3.9	<0.1	—	—	—
	Social Interaction	10.2	10.0	9.2	>0.1	—	—	—
Total Psychosocial		24.2	23.5	19.4	<0.1	—	—	—
	Sleep/rest	4.6	6.3	3.3	<.01	<0.2	<0.2	<.01
	Eating	1.3	0.6	0.7	<.05	<.05	<0.1	<0.5
	Work	6.8	4.8	4.1	<0.1	—	—	—
	Home management	4.4	5.3	2.9	<.01	>0.5	<0.1	<.01
	Recreation/pasttimes	4.9	6.1	4.6	<0.1	—	—	—
Total Overall		57.2	58.0	43.0	<0.1	>0.5	<.025	<.01

* By 2-way analysis of variance.
† By Tukey's multiple comparison procedure.

More research is needed to evaluate the presumed benefits of pillows and other supports with regard to pain reduction and sleep parameters. A better understanding of the design of pillows and other sleep support systems would benefit individuals with chronic neck pain and potentially decrease reliance on medications and other medical interventions.

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Suppliers

a. International Water Pillow Ltd., 11-130 Konrad Crescent, Markham, Ontario, Canada L3R 0G5.
b. Bell-Horn, 451 North Third Street, PO Box 3408, Philadelphia, PA 19123.
c. Jackson Cervipillow (Professional Care System, St. Louis, MO); Duro-Med Cervical Contour Pillow (Duro-Med Industries, Inc., Jesup, GA); Contour Cervical Pillow (Henry Schein, Port Washington, NY); Orthopillow (Meyer Distributing Co, Rancho Cucamonga, CA); Round Pillow (Sammons, Western Spring, IL); Support Pillow Roll (Flaghouse Rehab, Mount Vernon, NY); Round Cervical Pillow (Continental S.E.L., Oscala, FL).