PILLOW DESIGNS AND THEIR EFFECT ON PROMOTING SLEEP QUALITY, PAIN REDUCTION, AND CERVICAL SPINE ALIGNMENT IN ADULTS: A SYSTEMATIC REVIEW OF CONTROLLED TRIALS

Ahmed Radwan PT, DPT, PhD, Philip Fess BS., Darcy James BS., John Murphy BS., Joseph Myers BS., Michelle Rooney BS., Jason Taylor BS., Lisa Torii BS.

Abstract

Sleep is a physiological necessity that when compromised can negatively affect an individual’s mood, quality of life, productivity at work and social behavior. Despite the physiological component of neck pain, there is also an economic burden to be considered. Multidisciplinary medical expenses, lost wages, decreased productivity at work and disability compensation all contribute to the economic impact of neck pain. In the literature, varieties of pillow quality and temperature have been linked to reduction in pain and improvement in sleep quality. However, there is controversy in the literature regarding the type and characteristics of a pillow that best serve the purpose of decreasing neck pain, improving cervical spine alignment and quality of sleep. This review gathered the available evidence in the literature of controlled trials that was published since the year of 2000. Methodological quality of the reviewed articles was deemed low to moderate according to the PEDRO Scale. However, the combination of Latex (rubber), cool cervical pillow with shoulder support seem to have the best evidence for reducing pain, and promoting sleep comfort and quality.

Introduction

Neck pain has a point prevalence of 9-14% of the population at any given time, chronic or acute, with 33% of adults reporting lifetime prevalence (Erfanian, Tenzif, & Guerriero, 2004). Reports of point prevalence neck pain is largest between the years of 50 and 59, while females have greater lifetime prevalence of 30% when compared to males with a lifetime prevalence of 15% (Erfanian et al., 2004).

Neck pain can have an impact on the quality of sleep an individual gets at night. Not only can neck pain impact an individual’s quality of sleep, it can also cause tension headaches, negatively impact a person’s quality of life and their ability to work (Persson, 2006; Shields, Capper, Polak, & Taylor, 2006). While there is evidence which would suggest there is a relationship between the pillow an individual uses and the individual’s report of waking during the night, there is not any specific evidence to say one pillow type works better than another (Gordon, & Grimmer-Somers, 2011). There is some evidence which reports patients giving positive feedback after using specific pillows which provided neck support, with some patients requiring more time than others to adapt to the new pillow (Liu, Lee, & Liang, 2011).

Finding a comfortable position to sleep in can be quite challenging with neck pain and it can have a negative influence on the quality of rest. A low quality pillow can lead to poor cervical spinal alignment, cervical pain and a deprived night’s sleep. An appropriate pillow should provide proper support for the cervical spine’s natural lordotic curve, which can reduce neck pain, associated headaches and improve quality of sleep (Persson, 2006). There are limited numbers of studies that have been conducted to examine the role of a pillow as it relates to cervical pain, spinal alignment and sleep quality. Nonetheless, there appears to be some controversy pertaining to the effectiveness of high quality pillows, associated cervical pain and quality of sleep.

To our knowledge, there is currently no compilation of this data. Having all data in a systematic review will guide healthcare practitioners to the pillow design that best fit their patients based on the patient’s complaints and impairments. This is the purpose of this intended systematic review.

Methodology

Study Question:
This study aims to answer the question of which pillow design is the best in regards to decreasing neck pain, promoting spinal alignment and sleep quality, through performing a systematic review of controlled trials.

Study Criteria

The inclusion criteria for our research includes studies that were conducted between the
years of 2000-2014, controlled trials, peer reviewed, performed on adults (18+ years) and published in the English language.

Search Strategy

The article search was conducted using a combination of the following key words: Pillow and Ergonomics, Pillow and Pain, Pillow and Spine, Pillow and Alignment. Several databases were searched including: CINAHL, Medline, Medline Complete, ScienceDirect, CochraneCollaboration, Psychinfo, EMBASE, and PEDRO. The researchers then conducted a grey literature search within the following data bases; DARE, Proquest and Google Scholar. The search was completed through searching within individual ergonomics journals (Applied Ergonomics, Human Factors, Ergonomics, and Industrial Ergonomics).

After the relevant articles had been located, the researchers then performed a snowballing technique within each article’s reference list to expand our search for appropriate articles. Initial search resulted in 16 articles related to mattresses and their effect on back pain, spinal alignment, and quality of sleep.

Further critical appraisal by independent reviewers was performed. Two reviewers independently scored each article according to the PEDRO scale to determine the methodological quality of reviewed articles and to increase the reliability of the systematic review. In case of discrepancy in the findings of both reviewers, a third reviewer had to perform further critical appraising and scoring (Portney and Watkins, 2009).

Results

Six articles qualified to be included in this systematic review. The inclusion criteria included the following: article from the years 2000 to 2014; controlled trials; peer reviewed; adult participants; an intervention was required; and articles written in the English language. The articles are summarized in the following table. The articles were related to the effects of different pillows and pillow designs on reducing neck pain, and promoting sleep quality and cervical spine alignment.

Discussion

Pillows and cervical spine pain:

Regarding the shapes of cervical pillows and their effect on pain and comfort, Liu et al. (2011) performed a comparative study using ten pillow combinations based on four different pillow designs including standard, cradle, cervical, and shoulder pillows. Results demonstrated that pillow design preferences were shared by all participants and concluded that pillow number four which was a combination of a standard pillow, cervical pillow, and shoulder pillow was the most comfortable for participants who had no back complaints and preferred to sleep on their back. The study also designed a prototype for the optimum pillow design for back sleepers (Liu et al. 2011).

Additionally, Gordon et al. (2010) examined the effect of different pillow types on cervical spine stiffness and waking pain. The different kinds of pillows used as independent variables were as follows: 1) polyester pillows 2) foam regular (Comfort Classic) 3) foam contour (Medirest) pillows 4) Standard Dulopillo latex pillows and 5) Feather pillows. A random allocation block design blinded field trial was done within the participants’ own home where they got the chance to sleep on each pillow for one week. It was concluded that the feather trial pillow produces the highest frequency of waking symptoms amongst the participants. Furthermore, the greatest number of “drop-outs” occurred during the week the participant was using the feather pillow. It was also concluded the latex pillow performed the best and can be recommended to help control waking symptoms of headaches and scapular/arm pain.

Similarly, Gordon et al. (2009) evaluated the frequency of waking cervical symptoms in 106 adult participants. The participants slept on various pillow types including their own, polyester, foam, feather, rubber and foam contour pillows. The results revealed that the rubber pillow performed better with regards to waking cervical pain, improved sleep quality, and pillow comfort. The polyester, foam contour, and rubber pillows did not produce waking pain, while regular foam and feather produced more frequent waking pains. Moreover comfort and quality ratings for the feather pillow were significantly lower when compared to own.

Pillows and quality of sleep:

Gordon et al. (2010) performed a study to describe the performance of pillows that participant’s usually slept on in regards to waking cervico-thoracic symptoms, pillow comfort and sleep quality. With
regards to pillow comfort, subjects chose from categories of perfectly comfortable, quite comfortable, barely comfortable and uncomfortable. The study revealed that pillow comfort and sleep quality were moderately associated with an $r^2 = 0.55$ ($p = 0.02$). However, they reported that pillow comfort and sleep quality did not necessarily correlate with reports of waking symptoms. Feather pillow users all rated their sleep quality and pillow comfort consistently low, while users of polyester and latex pillows rated their sleep quality and pillow comfort high. Latex, foam contour, and polyester pillows perform better than foam regular or feather pillows. It worth mentioning that poor-sleep quality was reported by more than 50% of participants sleeping on their own pillows.

Additionally, Setokawa et al. (2007) examined the impact of body temperature on sleep quality. Setokawa et al., cooled the occipital region in order to cause a decrease in body temperature, and examined subjective ratings of sleep after awakening. The participants of the study were seven students, three women and four men with an average age of 20.6 years old. All participants had the chance to sleep on both a control pillow (a water pillow with room water temperature) and an experimental pillow that contained ice water.

Participants evaluated their sleep subjectively upon awakening including describing sleep latency, sleep time, number of times awoken during the night, and the soundness of sleep. They also answered the Oguri-Shirakawa-Azumi (OSA) sleep questionnaire answering questions regarding sleepiness, sleep maintenance, worries, integrated sleep feeling, and sleep initiating. Higher scores were associated with better sleep quality. Overall, the participants evaluated their sleep quality as improving with the cooling of the occipital region.

**Pillows and cervical spine stability:**

Gordon et al. (2011) examined cervical spine stability in a randomized controlled trial including 95 participants. Participants included side-sleepers ages 18 and older with exclusion criteria including a history of cervico-thoracic spine surgery, injury or accident to the cervico-thoracic spine in the preceding year, or currently receiving treatment for neck symptoms. Patients acted as their own controls during the study. Five pillows were tested during the study including foam regular, foam contour, latex, feather, and polyester. Participants slept on each pillow for 10 continuous minutes. Patients assumed a standardized right side lying position with their head resting on the pillow. Landmarks of each patient were palpated including the external occipital protuberance, and spino processes of C2, C4, and C7 in which a reflective marker was used to mark these locations.

A digital image was recorded at the start (0 minutes) and end (10 minutes) of each pillow trial. The position of each landmark was digitized from each image using ImageTool software. From this, linear coordinates were used to calculate the intersegmental slope. The direction of the slope was considered positive or negative; positive meaning that the distal landmark was higher than the proximal landmark and vice versa. The results of the study demonstrated that there was no significant difference in the change in slope over a 10 minute time period between pillows included in the study. This suggested that the pillows used in the study altered the support they provided to the head and neck in a similar mechanism over the 10-minute time period.

**Conclusion**

Six articles qualified for inclusion in this systematic review that was designed in an attempt to determine the best available cervical pillow that promoted pain reduction, sleep comfort, and cervical stability. Despite the low to moderate methodological quality of the controlled trials included in this review according to the PEDRO Scale, some valid conclusions could still be drawn. According to the current review:

- Patients experienced the least amount of pain when using a pillow that had multiple dimensions including the combination of a standard pillow, cervical pillow, and shoulder pillow
- Rubber (latex) pillows seems to provide the least waking symptoms, and the greatest sleep quality and comfort amongst sleepers
- Feather pillows were ranked the lowest in terms of pillow comfort, sleep quality and waking cervical pain.
- Cooling the occipital region while sleeping significantly improved sleep comfort and promoted sleep.
- Currently, there is no sufficient evidence regarding the pillow that would provide the best cervical spine stability while sleeping.

**References**


Biographical Sketch

Dr. Ahmed Radwan, PT, DPT, PhD, is an assistant Professor, Physical Therapy Program, Utica College, New York. His teaching, research and clinical expertise include biomechanics, ergonomics, and rehabilitation of musculoskeletal pathologies. Dr. Radwan can be reached at aradwan@utica.edu

Darcy James graduated from Elmira College in 2012 with a Bachelors of Science, where she interned with the Sports Medicine department for four years. She has completed her clinical affiliations at Fitness Forum in Rome, NY and BOCES of Onedia-Herkimer-Madison Counties and currently work as a PT aide at Fitness Forum, in Rome, NY. Her next two clinical affiliations before graduating as a doctor of physical therapy include Jones Memorial Hospital in Wellsville, NY and Huntsville Memorial Hospital in Huntsville, Texas.

John Murphy is a student at Utica College. He received his Bachelor of Science (B.S.) degree at Le Moyne College in Syracuse, NY. He is currently attending Utica College and working on his Doctor of Physical Therapy (DPT) degree. During his curriculum, he has had clinical affiliations with both

Michelle Rooney holds a BS in Health Studies and Minor in Spanish from Utica College. She completed an acute care clinical at Montefiore
hospital located Bronx, New York and an outpatient clinical at Lutheran Medical Center located in Brooklyn, NY.

Joseph Myers holds a Bachelors of Science (B.S.) degree. He completed two clinical rotations thus far, one in the acute care at JFK Medical Center in Edison, NJ and the second in inpatient rehabilitation at Upstate University Hospital in Syracuse, NY. He is expected to graduate in May of 2015 with a Doctoral degree in physical therapy from Utica College, New York.

Jason Taylor holds Bachelor of Science degree in Movement/Sport Sciences. He graduated from Purdue University in 2010 with a degree in health and kinesiology. After had completed his undergrad, He took a year off from school to become a personal trainer. After completion of his Doctorate degree in physical therapy, he plans on specializing in orthopedics and working at an outpatient facility in a teaching hospital.

Alissa Torri holds a BS in Health Studies from Utica College, Minor in Gerontology. She completed two clinical rotations thus far at sub-acute/long term nursing facility and at an outpatient clinic. After graduating in May 2015 with her DPT, she plans on returning to Illinois and specializing in Pediatrics.

Philip Fess holds a B.S. Health Studies. He completed a clinical affiliation at St. Lukes home rehab center as well as Upstate Medical University Human Institute for performance, where he presented an in-service on Evidence Based Practice of kinesiotaping. Currently he is completing an internship at SPI (Sport performance Institute)
<table>
<thead>
<tr>
<th>Author (year)</th>
<th>PEDro</th>
<th>Participants’ number and Present Condition</th>
<th>Interventions</th>
<th>Outcome</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordon et al., (2011)</td>
<td>6</td>
<td>95 Asymptomatic participants</td>
<td>Researcher examined the effects of pillow type on segmental stability (external occipital protuberance, spinous processes of C4, C7, and T3) by comparing five types of pillows: polyester, foam regular, foam contour, latex, and feather.</td>
<td>Primary: Spinal alignment: as measured by the extent of segmental drop at 0 and 10 minutes</td>
<td>This study revealed that pillows of different content and shape supported each spinal segment significantly different after 10 minutes. The feather pillow demonstrated the least amount of segmental stability at all levels.</td>
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<td>Liu et al., (2011)</td>
<td>6</td>
<td>30 Asymptomatic participants</td>
<td>Researcher examined the effect of pillow design on pain and comfort</td>
<td>Primary: Pain: as measured by patient comfort Secondary: Height of head to pillow</td>
<td>A pillow that is composed of a standard pillow, cervical pillow, and shoulder pillow was most comfortable for all patients. Pillow height pillow positively influences pillow comfort.</td>
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<tr>
<td>Gordon et al., (2010)</td>
<td>6</td>
<td>106 Side sleepers, generally healthy, not currently seeking treatment for cervico-thoracic spine symptoms</td>
<td>Experimental pillows: polyester, foam regular, foam contour, latex, feather</td>
<td>Primary: Cervical stiffness Secondary: Headache</td>
<td>Latex pillows are recommended to help control waking headache and scapular/arm pain while feather trial pillow produces the highest frequency of waking symptoms amongst the participants.</td>
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<tr>
<td>Setokawa et al., (2011)</td>
<td>5</td>
<td>7 Asymptomatic participants</td>
<td>Comparing the effect of pillow temperature between room temperature condition (26 degrees C) and ice temperature condition (16 degrees C)</td>
<td>Primary: Sleep quality: as measured by PSG* analysis, changes in skin temperature, and subjective ratings of sleep quality using (OSA) questionnaire</td>
<td>Sleep quality improved with cooling of the occipital region.</td>
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<td>Gordon et al., (2009)</td>
<td>5</td>
<td>106 Asymptomatic participants</td>
<td>10 week trial of five different pillows (polyester, foam regular, foam contour, feather, rubber). Each pillow tested for one week with a washout week between trial pillows with subjects own pillow</td>
<td>Primary: Waking cervical pain Secondary: Pillow comfort and sleep quality</td>
<td>Rubber pillows performed the best with regards to waking cervical pain, sleep quality and pillow comfort. Feather and Foam contour perform the worst with these respects.</td>
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<td>Gordon et al., (2010)</td>
<td>4</td>
<td>106 Asymptomatic participants</td>
<td>Participants provided 7 consecutive days of data on their own pillow which was either (polyester, foam contour, foam regular, rubber or feather) and reported waking symptoms, sleep quality and pillow comfort.</td>
<td>Primary: Cervical Pain Secondary: Pillow Comfort and Sleep Quality</td>
<td>Poor sleep quality were significantly related to waking cervical stiffness. Latex pillow rated the highest while the feather pillow rated the lowest with regards to sleep quality and pillow comfort.</td>
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