BIOMECHANICAL TESTING OF A SPINAL ALIGNMENT CUSHION (ROPHI™ CUSHION) IN ADULTS WITH LOWER BACK PAIN.

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INTRODUCTION
Back pain has become a worldwide problem, affecting 80% of the western world [1]. It is often related to poor posture or movement, causing tissue overload and pain [2]. The associated symptoms of pain and disability often interfere with work, daily activities and sleep [3-5]. A large prospective cross-sectional study found a highly significant relationship between Lower Back Pain (LBP) and quality of sleep, with reports of a 55% increase in restless/light sleep following the onset of pain [6]. This highlights, that sleep disturbance is a clinically important symptom of LBP [7].

Rotation is an essential movement of the spine and is incorporated into many daily activities [8,9]. However, excessive repetitive rotation can lead to tissue damage [10]. To overcome this, Gracovetsky [11] advised a sleeping posture similar to that of the foetal position. This was thought to limit unnecessary rotation of the lumbar spine, through maintenance of a “neutral” position. A further method to alleviate such pain and posture, involves sleeping in a side lying foetal position with a cushion between the legs. This position is thought to align the spine, reduce further pain and alleviate pressure on the opposing leg.

The Rophi™ cushion attempts to utilise this theory to provide spinal alignment and improved sleeping posture. However, there is little biomechanical evidence available on changes in pain and posture when using such devices. This study aims to assess the subjective experience and biomechanical effects of the Rophi™ cushion in participants with lower-mechanical back pain (LBP), when sleeping in the semi-foetal position.

METHODOLOGY
Fifteen participants with simple mechanical LBP (aged 44 ± 9.7 years; BMI 27.01 ± 4.28 kg/m²) were recruited. Volunteers with were screened for eligibility using the Red Flags Screening form [12]. Volunteers with multiple red flags were excluded.

Participants were asked to complete a short assessment, aimed at assessing sleep quality, sleep patterns, pain and back stiffness. Participants were then asked to use the Rophi™ cushion for one week, before completing a second assessment. The “Pain and Comfort during Sleep” assessment was based on Jacobson et al. [13]. This focused on 4 main aspects: 1) Sleep comfort, 2) Quality of sleep, 3) Back pain when waking 4) Joint or Muscle stiffness when waking. Visual Analogue Scales (VAS) consisted of a line with anchor words to discriminate between “None” and “Extreme”. Participants were asked to rate each variable in turn and place a mark on the scale at the point that best represented their perception of their subjective experience. In addition, two questions regarding the perceived benefit of the cushion post-intervention were asked.

The kinematics of the pelvis, lower limbs, lumbar and thoracic spine were recorded using a 10-camera Oqus Qualysys motion capture system [14]. The calibrated anatomical system technique (CAST) allowed segmental analysis in the sagittal, coronal and transverse planes [15]. All data were analysed using Visual3D (C-Motion Inc.) and SPSS. Participants were required to make a conscious effort to lie in a semi-foetal position on a standardised bed, with and without the Rophi™ cushion (Figure 1). Head and neck position were standardised using an orthopaedic cushion.

RESULTS AND DISCUSSION
Participants showed a significant reduction in the number of days poor sleep quality experienced (p=0.026) and the number of mornings participants awoke with back pain (p=0.04). However, due to variation in subjective experience there was no significant improvement in the number of days participants awoke with joint or muscle stiffness overall, though on average this appears to reduce. There was also a significant 36% reduction (p=0.01) in back pain intensity experienced...
during sleep after one week of using the Rophi™ cushion. Similarly back stiffness experienced when waking, showed a 33% improvement on average (p=0.003).

A 38% improvement was seen in perceived sleep comfort (p=0.003) through use of the Rophi™ cushion. On average participants rated the Rophi™ cushion comfortable with a skew towards “Excellent comfort” on the VAS scale. Overall participants perceived a benefit from the cushion, with the majority of participants skewed towards it being “Extremely beneficial”.

Kinematic results show that the main significant differences in joint angles occurs at the hip (in all three planes) and between the lower lumbar region and the pelvis (in the coronal plane). This indicated that the Rophi™ cushion causes a reduced adduction angle of the hip by approximately 5°; (p=0.0001), moving towards a more neutral position and causes the hip to externally rotate by approximately 7° (p=0.0000). Small yet significant changes in the pelvic to lower lumbar alignment in the coronal plane (0.6°) was seen consistently for all participants (p=0.02). There were no further significant differences in joint position at the knee, within the lumbar spine region (Upper lumbar to lower lumbar) or between the lumbar and thoracic spine. Overall it appears the individual is moved towards a more neutral position when using the Rophi™ cushion.

The small changes in hip and sacro-pelvic alignment when using the Rophi™ cushion are coupled with an improved subjective experience post-intervention. It is possible that the potential risk of muscle strain or pain caused by torsional stress is alleviated due to the adjustment towards a more neutral position. Though results show that on average the individuals spent most of the night in a side lying position, it is possible that the legs are not necessarily aligned on top of one another. Due to the increased pressure at the knee this position is not a long term, sustainable sleeping posture for all individuals. With the Rophi™ cushion, it is possible this pressure is reduced and the cushion acts as a mechanism to prevent the torsional stress possible in alternative positions, training the individual to sleep in this manner.

CONCLUSIONS
The Rophi™ cushion aims to alter spinal alignment to a more neutral position in order to improve sleep quality and reduce back pain on waking. The findings of this intervention in a group of individuals with simple mechanical lower back pain, suggests that the cushion shows benefits in repositioning of the hips and the lower back. In turn, this could be responsible for the improvement in back pain and sleep comfort experienced.

This simple one-week intervention showed, a reduction in the number of days poor sleep quality was experienced; a significant reduction in frequency and intensity of lower back pain experienced; a significant reduction in back stiffness when waking and a significant improvement in sleep comfort.

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REFERENCES