TAMARS Report

21st Century Back Care

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Report Summary

TAMARS is a technology assisted back pain treatment that claims to provide a sandardised form of mobilisation to the entire spine. An additional mode of treatment known as reflex is also used throughout a treatment. Less evidence exists for reflex but it is claimed that it improves spinal alignment by stimulating a reflex response in the paraspinal muscles. The treatment is in regular clinical use through 21st Century Back Care, and has previously received positive subjective feedback. However, the biomechanical effects are still unknown and would provide a better link between the effectiveness of the treatment in LBP sufferers.

The aim of the study was to investigate the biomechanical effects of TAMARS treatment during clinical and functional everyday tasks, in people with LBP.

A total of 8 volunteers all suffering with simple mechanical LBP were eligible to participate. Each participant performed five tasks, all of which were functional and clinically relevant movement patterns involved within everyday activities. Whilst the participants performed each task their movements were recorded using a 10 camera Oqus Qualisys motion capture system. The data collected by these cameras provided a three-dimensional analysis of the spinal and lower limb movements. In addition to the biomechanics all participants completed questionnaires which subjectively assessed their back pain, back stiffness and the impact their LBP has on daily life.

Following 4 weeks treatment of TAMARS participants showed a trend towards improved range of motion (ROM) in forward flexion. Immediate and long term reductions in side flexion and rotation were reported for all predominantly forward bending tasks such as

forward flexion, sit to stand and walking. This suggests that these decreases in ROM are a result of improved control in spinal movement.

Improved control was also identified in the angular velocity and acceleration of the side to side movement of the lumbar spine. Significant reductions were seen during the initial 15% of the participant's gait (stance phase).

Subjectively the majority of participants perceived TAMARS to have a positive impact on both their levels of pain and stiffness. General activity levels were improved with less interference in daily activities such as walking, sleeping and work.

Overall the findings of the study have identified that both short and long term applications of TAMARS have a clinically significant influence on spinal control during functional and clinical tasks, causing a greater degree of spinal stability and reducing the participant's pain. It is proposed that the improved control is due to an increased proprioception of the surrounding muscles.

1. Background

Back pain is a global problem, with reports that a possible 80% of the western world will endure at least one episode of disabling lower back pain (LBP) within their lifetime (Frymoyer and Cats-Baril, 1991). The large majority (80-90%) of individuals will recover within 12 weeks (Andersson, 1999), however permanent disability accounts for 5-15% of patients (Liebenson, 1996). This combination of high prevalence and duration of recovery has led to a substantial financial burden both here in the UK and worldwide (Maniadakis & Gray, 2000 and Walker *et al*. 2003). To help reduce these statistics and improve the patient's quality of life, adequate forms of treatment need to be established.

A wide variety of therapeutic modalities for LBP are practised across a range of different disciplines (chiropractors, osteopaths and physiotherapists) (Rubinstein, 2011). This can include specific exercises, non-steroidal anti-inflammatory drugs and spinal manipulative therapy. Spinal manipulation therapy is also a common form of therapy for both chronic and acute LBP and comprises of both spinal mobilisations and spinal manipulation techniques. Although these techniques differ in style they both aim to positively influence common factors associated with back pain, such as joint stiffness and muscle tightness (Koes *et al*., 1996; Latimer, 1996).

Randomised control trials and systematic reviews have been widely used to examine the effectiveness of spinal manipulation therapy on pain, mobility and disability. The updated Cochrane review (Rubinstein, 2011) identified that spinal manipulative therapy has a significant short term improvement in pain relief and function, however when treating chronic LBP and when compared with other forms of treatment it is neither superior of inferior.

TAMARS is a technology assisted treatment that claims to provide a standardised mobilisation of the entire spinal region. Like spinal mobilisations applied by a clinician, TAMARS aims to reduce back pain and improve daily function within back pain sufferers by increasing mobility and improving alignment of the vertebrae through a technology assisted form of spinal mobilisation and reflex stimulation (TAMARS website). Although some subjective evidence already exists for TAMARS, and it is in regular clinicial use through 21st centruty back care, the biomechanical effects are still unknown and would provide a better link between the effectiveness of the treatment in LBP sufferers.

2. Aims

This study aims to investigate the biomechanical effects of TAMARS treatment during functional everyday tasks, in people with LBP.

2.1 Objectives

- To establish whether the application of TAMARS can immediately alter the spinal motion during functional and clinical tests in people with LBP.
- To establish whether the application of TAMARS can alter the spinal motion during functional and clinical tests in people with LBP over a period of 4 weeks.
- To subjectively assess the impact of TAMARS on back pain, stiffness and daily life in LBP sufferers.

3. Method

3.1 Participants

A total of 8 volunteers (Age=43.9 ± 5.5 years, BMI=25.8 ± 3.76) all suffering with simple mechanical LBP were eligible to participate within the study. Written informed consent was acquired from all volunteers prior to participation and the study received full approval from the Faculty of Health Research Ethics Committee, University of Central Lancashire. The study was performed in accordance with the Declaration of Helsinki (WMA, 2008).

3.2 Protocol

All participants attended an initial session which comprised of one 45 minute treatment session of TAMARS and two data collection processes (Pre and Post-intervention). On completion of this each participant was invited to undergo a further three treatments of TAMARS followed by a final data collection session at the end of the treatment program. The same clinician who was fully trained in TAMARS provided treatment to the entire spinal region of all participants. No participant had more than 4 treatments within a 4 week period and each session lasted no longer than 45 minutes. The final data collection was also set apart from the final treatment as to gain a better long term understanding of the effects of TAMARS.

3.3 Data Collection

During all data collection sessions small retro-reflective spherical markers and clusters of markers were placed on specific anatomical landmarks of the lower limbs and spine. Using the calibrated anatomical system technique (Cappozzo *et al*., 1995; Preuss and Popovic,

2009) these markers determined the participants position of the lower limbs and provided segmental analysis of the lumbar (lower and upper) and thoracic (lower) spine in all three planes of movement.

Each participant performed five tasks, all of which were functional and clinically relevant movement patterns involved within everyday activities. The five tasks included forward flexion, spinal rotation in sitting, lateral side flexion, moving from a sitting to a standing position and a 10m walk (Figure 1). For each task, the participants performed five repetitions so that an average could be calculated.

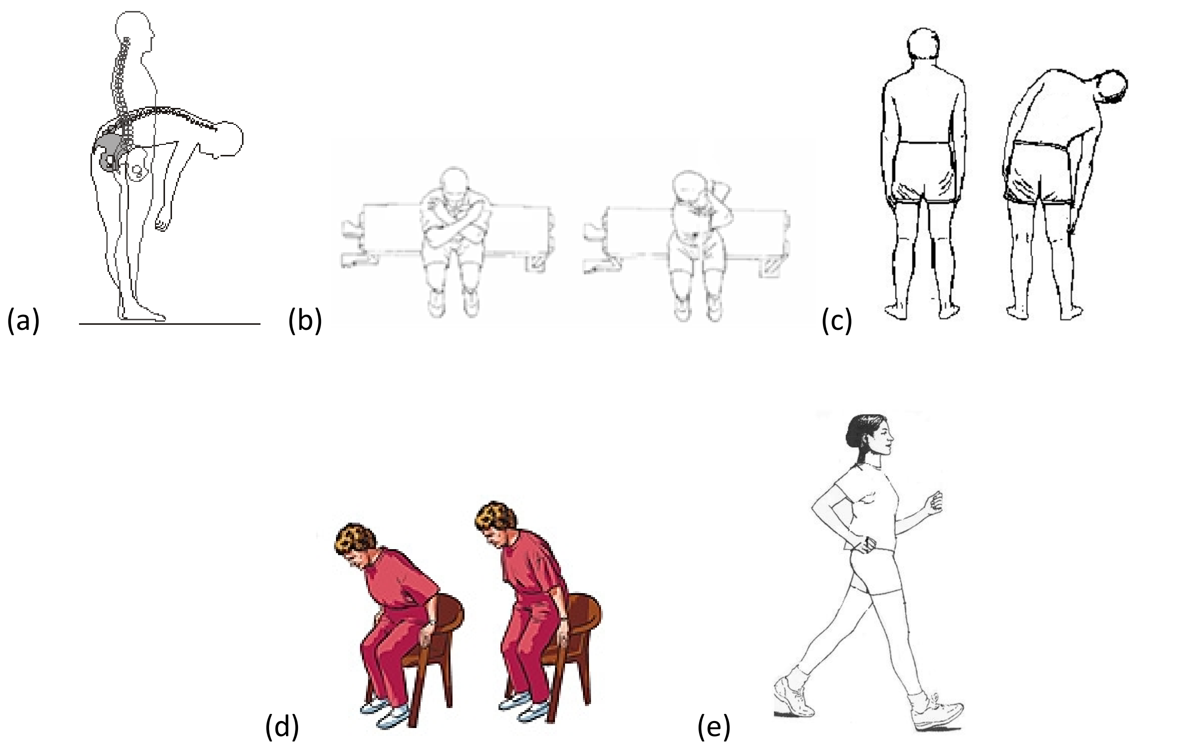

Figure 1 (a) forward flexion task, **(b)** spinal rotation task in sitting **(c)** lateral side flexion, **(d)** sitting to standing task and **(e)** 10 metre walking task.

Whilst the participants performed each task their movements were recorded using a 10 camera Oqus Qualisys motion capture system. The data collected by these cameras were related to the three-dimensional coordinates of the retro-reflective markers on the lower limbs and spine (Figure 2).

(a) (b)

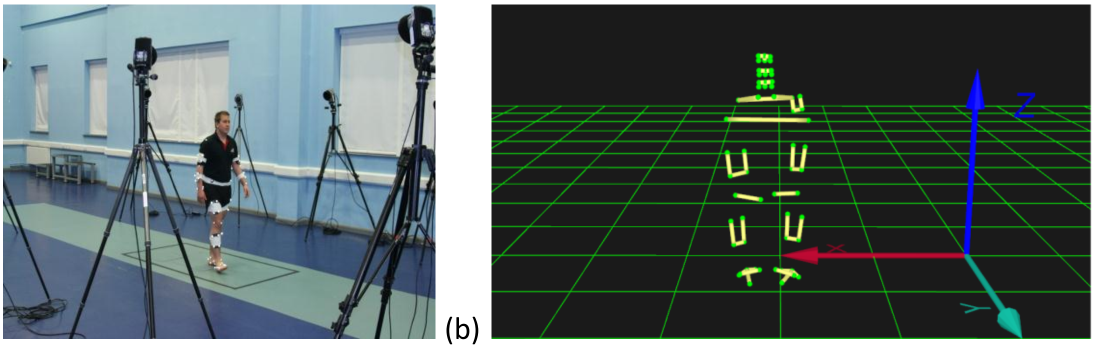

Figure 2 (a) 10 Camera Oqus Camera Set Up in the Movement Laboratory, Brook Building, UCLan **(b)** Example spine/lower limb Qualisys Track Manager Model.

3.4 Subjective Assessment of Pain and Stiffness

In addition to the biomechanical data all participants were subjectively assessed on levels of back pain, back stiffness and the impact it has on daily life. This was assessed using the Brief Pain Inventory (Short Form), previously used to examine lower back pain sufferers (Keller et al., 2004). The inventory which consisted of 9 short questions assessed the participant's pain severity and its impact over the previous 24 hours. To provide a post intervention comparison, the questionnaire was repeated at the end of the treatment program. In addition, two questions which asked the participants to describe their back pain and back stiffness to before the treatment started, were included in the questionnaire. These questions followed the principles associated with global rating of change (GRC) scales, which have been recognised as a valid, quick and simple method of assessing change (Kamper *et al.*, 2009).

3.5 Data Analysis

Data was collected at baseline (PRE), immediately after TAMARS treatment (POST) and at the end of the study (END). A repeated measures ANOVA was used to determine the differences over time in spinal range of motion (ROM) across all three planes of movement for all movement tasks, and the angular velocity and acceleration of the lumbar spine during the stance phase of gait. The subjective evaluation of back pain, back stiffness and its impact on daily life between baseline and end of study data was analysed using a paired t-test.

4. Results

A full set of biomechanical data was collected from all 8 participants who volunteered for the study. Each participant attended all 4 treatment sessions of TAMARS and completed both of the subjective questionnaires.

4.1 Forward Flexion

During the forward flexion task participants experienced no immediate changes in ROM following treatment with TAMARS. Significant changes were however present following the 4-week treatment protocol in the sagittal and coronal planes. Changes in sagittal plane movement were predominantly seen in the lower and upper lumbar regions where a 30% increase ($p=0.079$) and significant 12% decrease ($p=0.015$) were respectively present (Figure 3). The greatest coronal plane change also occurred within the lower lumbar region where the ROM significantly decreased from 6.4° to 3.1°, a reduction of 49% ($p=0.008$).

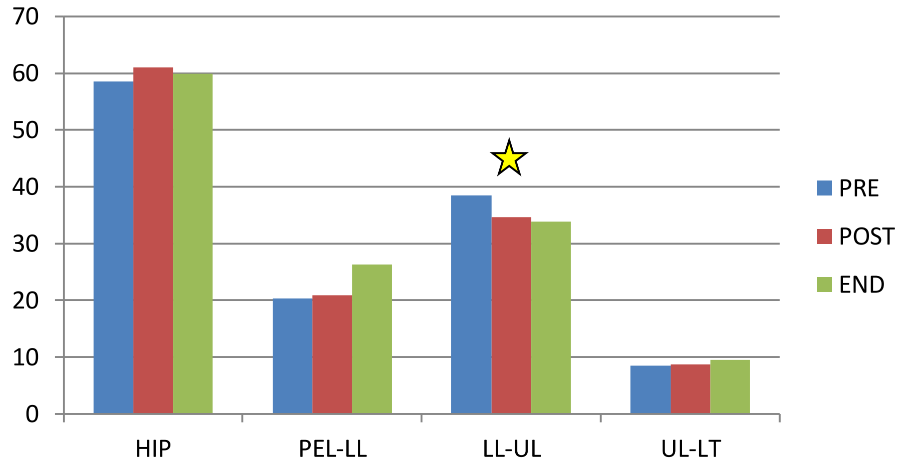

Figure 3. The range of sagittal plane movement of the Hip, Lower Lumbar, Upper Lumbar and Lower Thoracic regions during forward

4.2 Rotation in Sitting

When performing spinal rotation in sitting, TAMARS had an immediate effect on the transverse plane, reducing the ROM. The greatest changes of the transverse plane were found in the lower lumbar region where significant reductions were immediately seen during both rotations to the left (p=0.025) and right (p=0.01). These reductions were maintained until the end of the study (Figure 4).

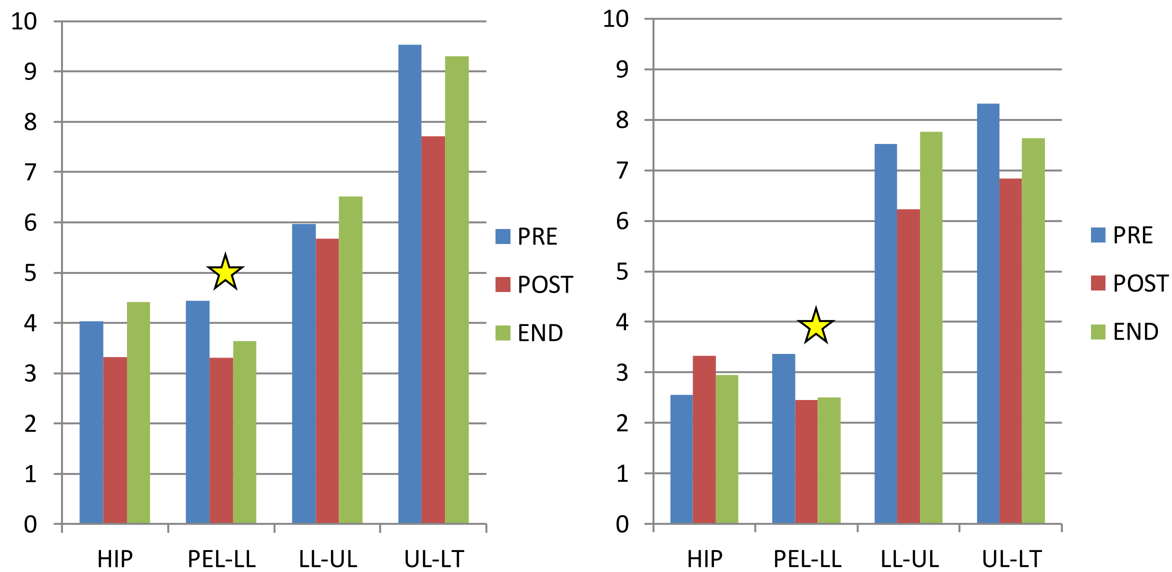

Figure 4. The range of coronal plane movement of the Hip, Lower Lumbar, Upper Lumbar and Lower Thoracic regions during forward rotation in sitting to the left (a) and right (b).

4.3 Side Flexion

Data collected during the side flexion task provided inconclusive findings.

4.4 Sit to Stand

Whilst moving from a sitting to standing position TAMARS immediately produced changes in the coronal plane ROM. Although only small (0.367°) the most significant change of the coronal plane was found in the lower thoracic region ($p=0.026$) whereas the greatest change of 50% occurred in the hip ($p=0.073$). The decrease in coronal plane hip ROM was not sustained in the long term, however, did show a 24% reduction from baseline (Figure 5).

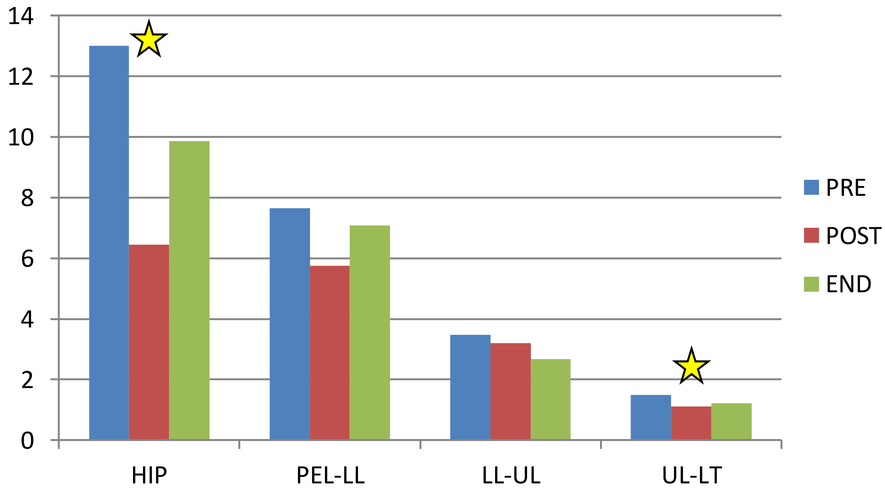

Figure 5. The range of coronal plane movement of the Hip, Lower Lumbar, Upper Lumbar and Lower Thoracic regions during a sit to stand task.

4.5 Gait

The greatest impact of TAMARS during the 10m walking task was found within the coronal plane. A significant reduction in the coronal plane ROM (5° to 3.3°) was identified in the lower lumbar region immediately following treatment ($p=0.046$). This reduction was maintained in the long term whilst additionally producing a significant reduction in upper lumbar movement (p=0.026) (Figure 4.9). A small, 0.56°, but significant reduction (p=0.05) was also seen in the transverse plane of the upper lumbar region (Figure 6).

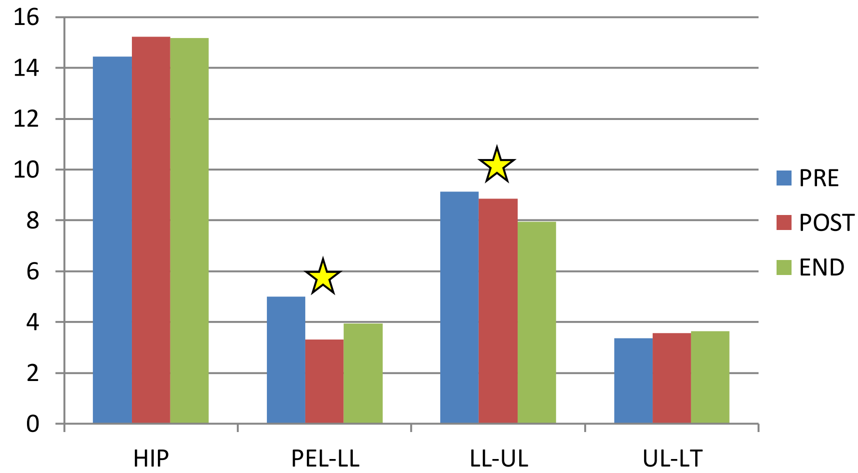

Figure 6. The range of coronal plane movement of the Hip, Lower Lumbar, Upper Lumbar and Lower Thoracic regions during a 10m walk.

4.6 Velocity

TAMARS significantly influenced the angular velocity of the lumbar region during the initial 15% of gait. The immediate effects were seen within the coronal plane where the range of angular velocity significantly reduced by 29% and 16% for the lower (p=0.038) and upper lumbar (p=0.014) regions respectively. Significant long term reductions in the coronal plane were seen in the lower lumbar (p=0.033), declining from 65.5°/s at baseline to 38.2°/s at the end of study (Figure 7).

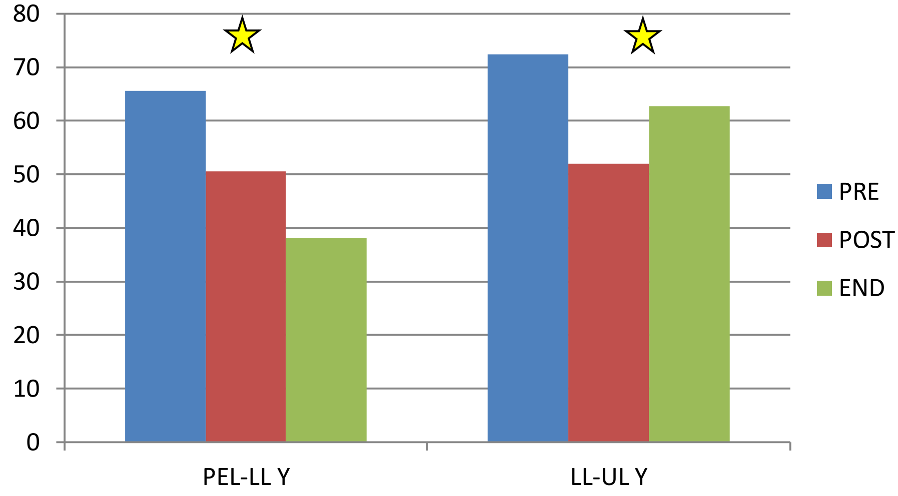

Figure 7. The range of angular velocity within the coronal plane of the Lower and Upper Lumbar Spine during the initial 15% of gait.

4.7 Acceleration

Following treatment with TAMARS angular acceleration of the coronal plane was significantly reduced during the initial 15% of gait. Immediate coronal plane reductions of 29% were seen within the lower lumbar region (p=0.09). Significant long term reductions in angular acceleration were also seen in the coronal plane of the lower lumbar region (p=0.019) (Figure 8).

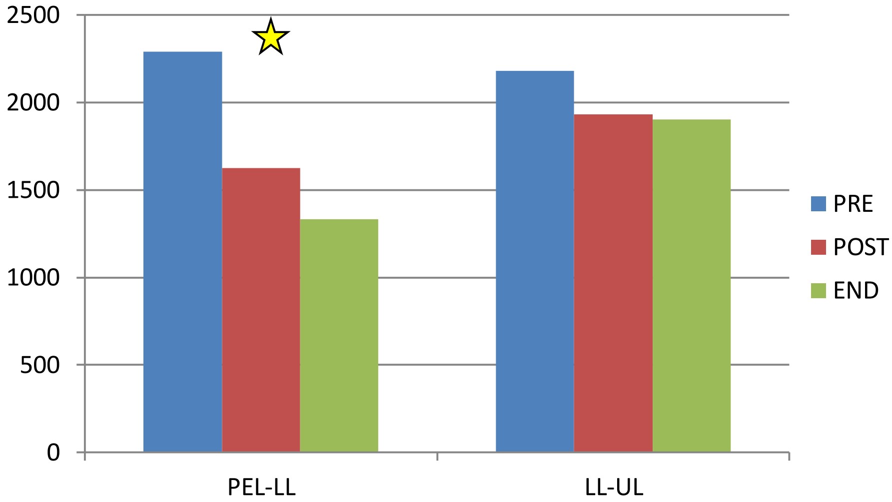

Figure 8. The range of angular acceleration within the coronal plane of the Lower and Upper Lumbar Spine during the initial 15% of gait.

4.8 Subjective

The subjective data collected identified back pain and back stiffness to improve following the 4-week treatment protocol of TAMARS with a trend towards "completely recovered". Improvements were seen across all aspects of daily life. The most significant improvements were noted in the participant's rating of pain, with their perceived worst (p=0.022) and least (p=0.034) pain in the past 24 hours to have both reduced. Significant improvements were also noted in the participant's mood (p=0.049) and general activity levels (p=0.05) (Figure 9).

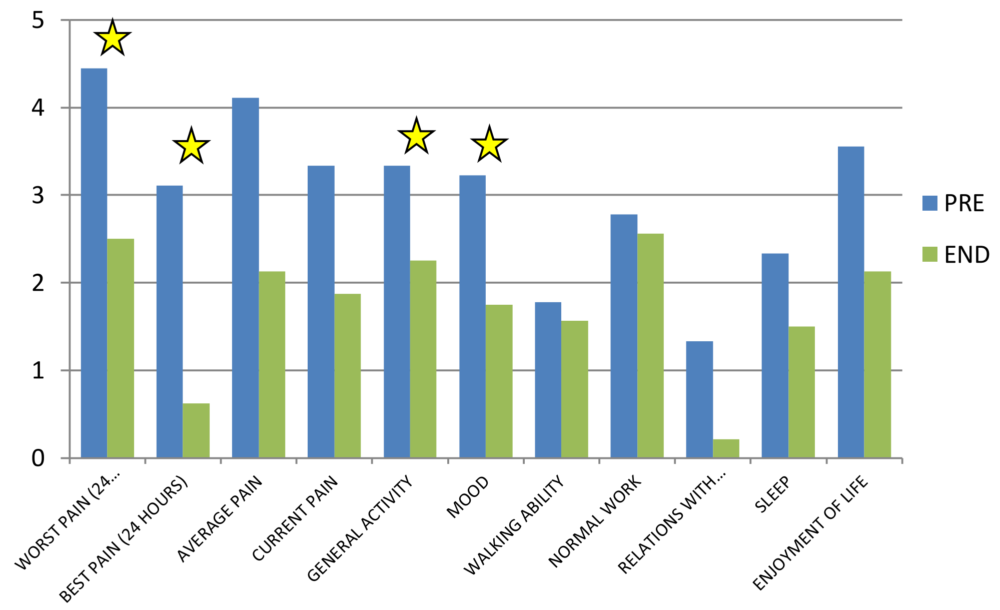

Figure 9. Subjective Data taken PRE and END study

5. Discussion

TAMARS is a form of treatment that claims to reduce back pain and improve daily function within back pain sufferers by increasing mobility of the vertebrae through a technology assisted form of spinal mobilisation. To assess the biomechanical effects of this treatment ROM, angular velocity and angular acceleration were measured during tasks that encouraged movement in all three planes (sagittal, coronal and transverse). Overall the findings identified treatment with TAMARS produced changes in ROM, angular velocity and angular acceleration during different clinical and functional movements, whilst subjectively improving lower back pain symptoms such as pain and stiffness.

Following treatment with TAMARS forward flexion was the only task in which participants showed a trend towards increased ROM of the dominant plane. During this task an increased sagittal plane movement occurred within the lower lumbar region only, a reduced mobility occurred in the upper lumbar. This would indicate that TAMARS had a biomechanically positive impact on the lower lumbar region during a forward flexion task by increasing ROM in the sagittal plane over a 4 week period. A significant reduction was also seen in the upper lumbar which is most likely a consequence of previously compensating for stiffness within the lower lumbar region, implying a more efficient movement across the entire lumbar region following TAMARS.

For all the other tasks participants experienced a decrease in ROM of the non-dominant planes. For example, during predominantly sagittal plane movements such as forward flexion, sit to stand and walking, participants experienced immediate and long term reductions in ROM of the coronal and transverse planes. Once again these changes indicate an improved movement control, helping to alleviate tissue overload pain, a common cause associated with lower back pain (Comerford and Mottram, 2001) which provides a possible explanation for the participant's perceived reduction in pain.

Compared with ROM previous research has stated that more dynamic motion factors such as velocity and acceleration are better able to distinguish differences between healthy and back pain sufferers (Marras *et al.*, 1999). This provides a possible explanation as to why improvements in mobility of the dominant planes were seen during only one clinical task.

The rationale behind these parameters being a more detailed form of assessment could relate to their better ability to distinguish changes in joint control. The significant reductions in angular velocity and acceleration across the lumbar region following TAMARS provides further evidence for the treatment to provide an improved control in spinal movement.

Subjectively the majority of participants perceived TAMARS to have a positive impact on both their levels of pain and stiffness. General activity levels were improved with less interference in daily activities such as walking, sleeping and work.

Overall this study have identified short and long term applications of TAMARS to positively influence the spinal biomechanics during functional and clinical tasks. It can be concluded that TAMARS positively influences spinal control rather than causing an improved mobility as previously claimed. This improved control may be due to an increased proprioception of the surrounding muscles, causing a greater degree of spinal stability and therefore reducing the participant's pain.

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