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Impact of osteopathic manipulative treatment on range of motion of the pelvis during the one-sided tilt test: a pilot study

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1. Introduction

Osteopathic manipulative treatment (OMT) has been reported to reduce significantly low back pain (Licciardone *et al.* 2005). However, the mechanics by which osteopathic treatment may produce an increased joint range of motion remains unclear. The one-sided tilt test is an active voluntary movement used by osteopaths to analyse the one-side range of motions at the right and left side from a static position (Chila 2010). This test also allows the osteopath to immediately evaluate the effect of OMT. Nevertheless, interpretation of this test is based on the subjective observation of how well the lumbar spine compensates sacral base declination. Few studies have examined the impact of OMT on low back or pelvis range of motion (Lenehan *et al.* 2003) but never in a 3D. Thus, there is a challenge to bring quantification measurements for clinical interpretation of the one-sided tilt test though three-dimensional kinematic analysis. This could bring an understanding on the musculoskeletal strategies when this test is performed after the low back is treated with OMT. The aim of this blind pilot study was to measure the immediate effect of OMT on range of motion (ROM) of the sacro-lumbar joint and the pelvis spatial orientations during the one-sided tilt test.

2. Methods

2.1 Participants

Thirteen asymptomatic elite women rugby players (24.4 ± 1.2 years, 72.7 ± 10.9 kg, 168.9 ± 8.2 cm) were recruited after completing a consent form and a medical history questionnaire to identify possible contraindication to OMT. This study was designed by the Institute of Osteopathy in collaboration with the M2S lab (#2018-277) according to the Declaration of Helsinki.

2.2 Osteopathic intervention

Two groups were randomly constituted, a treated group who received OMT (N=5) and a control group who not received OMT (N=8).

One standardised OMT (45-min duration) was given to the treated group included patient history taking, diagnostic osteopathic testing and OMT by one experienced osteopath. OMT treatments were individualized for the patient by combining musculoskeletal techniques. The control group received (45-min duration) only a succession of tests without intention of treat.

2.3 Experimental protocol

Athletes were instructed to perform three trials of the one-sided tilt test on each side (right and left). Participant had to bend his knee allowing the pelvis to tilt to the same side. Participants were equipped with 47 markers previously used by Raabe and Chaudhari (2016) for lumbar spine study (Figure 1a). Markers trajectories were obtained from a 24-camera motion capture system (Vicon, Oxford, UK).
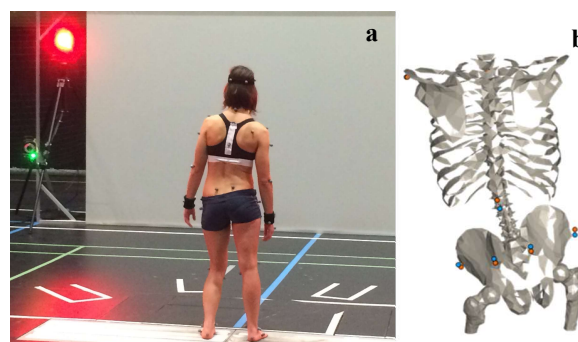

Figure 1: Overview of the experimental setup (a) and illustration of experimental and model markers used (b)

2.4 Data Analysis

CusToM was used to analyse the experimental data (Muller *et al.* 2019). A full body kinematic model was used with three rotational degrees of freedom (DOF) at the hip, one at the knee and two at the ankle. Three rotation DOF were modelled at the sacro-lumbar joint and the thoraco-lumbar joint. The DOF of interest, namely pelvis spatial orientations and sacro-lumbar joint, were respectively modelled with Euler-Cardan rotation

sequence XYZ (anterior tilt, ipsilateral side, contralateral rotation) and ZXY (extension, contralateral side, ipsilateral rotation). A hundred frames of first trials of each session (before and after) were chosen to scale the kinematic model through an optimization-based identification to match participants' anthropometry. Joint angles were not directly deduced by marker set but were computed by multibody kinematic optimization (Begon *et al.* 2018) (Figure 1b). Minimal and maximal joint angles of pelvis spatial orientations and sacro-lumbar joint were used to compute ROM for each trial. ROM were averaged over the three repeated trials prior and after the intervention (OMT vs. control). Effects were measured using logistic regression as between group differences ($p < 0.05$).

3. Results and discussion

Pelvis and lumbar ROM were presented in Table 1 for the control group and in Table 2 for OMT group.

ROM (°) - Control group	Before	After
Lumbar extension	16.4 ± 8.8	15.4 ± 5.3
Lumbar contralateral side	17.6 ± 8.3	13.3 ± 4.1
Lumbar ipsilateral rotation	10.9 ± 7.5	7.9 ± 2.2
Pelvis anterior tilt	12.9 ± 12.0	10.8 ± 6.6
Pelvis ipsilateral side	28.3 ± 13.7	26.9 ± 2.9
Pelvis contralateral rotation	22.8 ± 11.2	25.9 ± 14.7

Table 1 Control group means ROM (all participants and all trials) over both side pre- and post-intervention.

ROM (°) - OMT group	Before	After
Lumbar extension	11.6 ± 5.2	18.2 ± 12.3
Lumbar contralateral side	12.1 ± 4.9	15.8 ± 7.8
Lumbar ipsilateral rotation	8.3 ± 3.6	10.9 ± 4.4
Pelvis anterior tilt	10.4 ± 8.2	17.7 ± 8.3
Pelvis ipsilateral side	24.2 ± 6.1	29.1 ± 7.9
Pelvis contralateral rotation	21.0 ± 14.9	27.4 ± 10.0

Table 2 Mean of ROM (all participants and all trials) pre- and post-OMT.

An opposite kinematics was observed between the lumbar spine (extension, contralateral side, ipsilateral rotation) and the pelvis (anterior tilt, ipsilateral side, contralateral rotation) on both sides. No statistically differences were showed on lumbar and pelvis side ($p = 0.201$, $p = 0.116$) and on lumbar and pelvis rotation ($p = 0.051$, $p = 0.635$) before and after intervention. However, we observed an increase of all ROM after OMT compared to the control group. However, only lumbar flexion/extension ($p = 0.049$) and pelvis tilt ($p = 0.03$) were significantly different between groups (Table 2). The subjectivity of active voluntary movements could have introduced social desirability bias to the observed improvements in ROM due to OMT. Personalisation of the model is limited to the marker's placement prior and after the intervention. Future studies with symptomatic participants, larger sample, and sham treatment are needed to confirm the benefits of the treatment and the assessment method.

4. Conclusions

The main finding of this blind pilot study suggests that OMT could increase the lumbar flexion/extension (~ 5.6°) and pelvis tilt (~ 6.9°) during the one-sided tilt test. This approach could be implemented as an additional tool to identify limited ranges of motion of the low back and provide a new approach to objectify the osteopath diagnosis and treatment.

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