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# Immediate effects of myofascial release on the thoracolumbar fascia and osteopathic treatment for acute low back pain on spine shape parameters: A randomized, placebo-controlled trial

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**Abstract:** Background: Spine shape parameters, such as leg length, kyphotic or lordotic angle, are influenced by low back pain. There is also evidence that the thoracolumbar fascia plays a role in such pathologies. This study examined the immediate effects of a myofascial release technique (MFR) on the thoracolumbar fascia and of an osteopathic treatment (OMT) on postural parameters in patients with acute low back pain (aLBP). Methods: This study was a single-blind randomized placebo-controlled trial. Seventy-one subjects (43.8 ± 10.5 years) suffering from aLBP were randomly and blinded assigned to three groups to be treated with MFR, OMT or a placebo intervention. Spinal shape parameters (functional leg length discrepancy (fLLD), kyphotic angle, lordotic angle) were measured before and after the intervention using video raster stereography. Results: Within the MFR group, fLLD reduced by 5.2 mm, p < 0.001 and kyphotic angle by 8.2 degrees, p < 0.001. Within the OMT group, fLLD reduced by 4.5 mm, p < 0.001 and kyphotic angle by 8.4 °, p = 0.007. Conclusion: MFR and OMT have an influence on fLLD and the kyphotic angle in aLBP patients. The interventions could have a regulating effect on the impaired neuromotor control of the lumbar muscles.

**Keywords:** thoracolumbar fascia, myofascial release, osteopathy, leg length discrepancy, kyphotic angle, lordotic angle

## 1. Introduction

There is ongoing interest in fascia research, particularly as a possible cause of low back pain (LBP) [1]. The pain in these cases is triggered by the nociceptors of the thoracolumbar fascia (TLF) [2]. LBP is one of the main reasons for visiting manual therapists, orthopedists and osteopaths [3]. Acute LBP (aLBP) is etiologically distinguished from chronic LBP. The current medical assumption is that the recovery rate from aLBP within six weeks is 90 % and only 2–7 % become chronic [3]. However, this time period is based on measuring the time between the doctor's visit and the return to work and does not describe the actual duration of the pain [4]. In a meta-analysis of eleven studies (3118 patients), Itz et al. emphasis that the spontaneous recovery of aLBP patients in the first three months is only 33 % [5]. Nevertheless, 65 % still suffer from LBP one year after the onset of pain. Pengel et al. put the recurrence rate with renewed incapacity to work at 33 % of aLBP cases [6], which makes it a critical cost and resource factor in the healthcare systems of industrialized countries [7].

Functional leg length discrepancy (fLLD), on the other hand, is thought to be involved in the process of LBP development [8–11]. LBP patients also show a greater tendency for asymmetry of motor control in the form of pathological muscle activation than healthy individuals [12]. The TLF as a central biomechanical part of the pelvic corset system influences pelvic statics. It can be concluded that other components, including postural parameters such as fLLD or altered kyphotic and lordotic angles, are involved in

these mechanisms and may influence each other over myofascial chains [10,13,14]. The fascia represents, in a manner of tensegrity structure, the link between skin, musculature and bone [1]. Possible treatment approaches for these structures can be myofascial release techniques (MFR) as a single intervention or individual osteopathic manipulative treatment (OMT). Numerous studies document significant biomechanical changes through MFR and OMT on the myofascial system [15–18]. The relationships between postural parameters, muscle activations, changes in TLF and LBP are poorly understood [10,19]. Therefore, this study provides an assessment of the immediate effects of MFR on the TLF and OMT. In a previous pilot study testing the feasibility of this study protocol, MFR treatment showed promise in producing changes in the myofascial chain system [20].

## 2. Materials and Methods

### 2.1 Study design overview

The study is a single-blind placebo-controlled randomized trial with three groups. Measurements were taken pre- and post-intervention conforming to SPIRIT guidelines [21]. The study protocol was retrospectively registered with the German Clinical Trials Register (DRKS00024122) on 22.02.2021. The study has been reviewed and approved by the ethical committee of the Osteopathic Research Institute in Hamburg, Germany (Nr. 019-11), has been carried out in accordance with the declaration of Helsinki and has obtained informed consent from the participants [22].

### 2.2 Setting and participants

The study was conducted in an osteopathic practice, in a medium-sized city in southern Germany. In a previous pilot study, a power and sample size calculation were carried out and the number of participants was set at 25 per group [20]. The acquisition was carried out via direct contact, a notice board and the distribution of information material in the practice or to acquaintances. The study design envisaged carrying out the study in running practice, which is why the participants were continuously recruited during the study period. All test persons received a voucher for a preventive service of their own choice in the amount of 30 euros.

2.2.1 Inclusion criteria

Inclusion criteria were: (a) acute lumbar back pain (aLBP); (b) minimum score of 10 on the ODQ-D; (c) minimum score of 3 on the VAS; (d) less than 6 weeks pain duration; (e) female or male subjects aged 18 to 60 years; (f) prone position for 15 minutes must be pain-free for the subjects.

2.2.2 Exclusion criteria

Exclusion criteria were: (a) generally valid contraindications to physiotherapeutic and osteopathic treatments of the lumbar spine and pelvis; (b) rheumatic diseases; (c) taking medication that affects blood coagulation; (d) taking muscle relaxants; (e) skin changes (e.g. neurodermatitis, psoriasis, urticaria, decubitus ulcers); (d) surgery or other scars in the lumbar region between Th12 and S1.

### 2.3 Randomization and interventions

The volunteers were first screened for eligibility by the investigator. These were assigned covertly to the MFR, OMT or placebo (PLC) group using block randomization. The randomization was carried out internet-based with the Application Research Randomizer, version 4.0 [25]. Subjects were not given any information by the investigator regarding their group membership or the intervention that was being delivered. The investigator then carried out the initial measurements. The subjects received the respective group-specific intervention from an osteopath who had more than 10 years of professional experience in manual therapy and a master's degree. This was followed by the post-intervention measurement. This was only initiated by the investigator. The actual recording of the parameters was done automatically, after a time delay, by a computer system. The

examination and treatment were carried out by the owner of the individual practice for osteopathy (AB).

### 2.3.1 Myofascial release intervention

The MFR group received an intervention as described by Chila and O'Connell [26]. Here, the subject is in a prone position with the arms at the sides of the body and the legs parallel to each other. The head is in a neutral position, the face lies in a recess in the head section of the therapy table. The patient is undressed to such an extent that the TLF between Th12 and S1 is accessible. The therapist stands contralateral to the side to be treated, at the level of the subject's iliac crest (Figure 1). The therapist's cranial hand is positioned thenar-sided immediately adjacent to the lumbar spine with extensive contact at the TLF at the level of L1 to L4 and acts as a palpation hand. The caudal hand doubles the palpation hand and initiates a direct stretch of the fascia laterally to a noticeable tissue resistance. The therapist follows the creep of the myofascial tissue to initiate further stretching of the TLF [1]. The applied force on the tissue is only moderate, ranging from 25 to 35 N and acting tangentially laterally in the direction of the abdominal muscles. The usually applied force during an MFR treatment was previously evaluated by the therapist using a precision scale. The duration of the entire technique is 60 to 90 seconds. However, the decisive factor for the effect is not so much the period of time over which the technique is practiced, but the occurrence of a myofascial release. Ajimsha et al. define this as the restoration of the optimal length of myofascial tissue structures, their functional improvement and the reduction of pain in them [27].



**Figure 1.** MFR and PLC treatment at the TLF. To illustrate the therapist's hand placement, the participant placed her arms on the head of the therapy table.

### 2.3.2 Osteopathic manipulative treatment

The subjects of the OMT group underwent an osteopathic examination. Manual treatment of the structures identified as dysfunctional was carried out, individually adapted to the symptomatology of the individual subjects, as corresponds to the general procedure in osteopathic practice. The interventions used included direct techniques such as high-velocity, low-amplitude, muscle energy, fascia, indirect techniques such as functional techniques or balanced ligamentous tension, as well as visceral and cranial techniques [26]. The applied forces ranged between 3 N (cranial techniques) and 50 N (muscle energy techniques) for each hand, with the exception of high-velocity, low-amplitude techniques with short peak forces due to impulses up to 300 N [28].

### 2.3.3 Control

The subjects in the PLC group were in a prone position with their arms at their sides and their legs parallel to each other. The head was in a neutral position, the face was in a recess of the head part of the therapy table. The subject was undressed to such an extent that the TLF between Th12 and S1 was accessible. The therapist stood contralateral to the side to be treated, at the level of the subject's iliac crest (Figure 1). The therapist's cranial hand was thenar-sided immediately adjacent to the lumbar spine with extensive contact at the TLF at the level of L1 to L4 and acted as a palpation hand. The caudal hand duplicated the palpation hand. Instead of an MFR, both hands were placed on the tissue with minimal pressure, ranging between 4 and 6 N for both hands, and left there for 90 seconds.

### 2.4 Outcomes

By means of VRS measurement, the fLLD in mm, the maximum kyphotic and lordotic angle in degrees were determined. These parameters have been shown to be valid and reliable in a paper by Degenhardt et al. [29]. For the fLLD, the authors gave an ICC = 0.84; 95% confidence interval (CI) = 0.73 – 0.90 and for the smallest detectable change (SDC) 4.21 mm, for the kyphotic angle an ICC = 0.96; 90% CI 0.92 – 0.97 and a SDC of 3.19 °, for the lordotic angle an ICC = 0.91; 90% CI 0.83 – 0.94 and a SDC of 4.24 °.

### 2.5 Statistical analyses

For all parameters, the standard deviation (SD), standard error of the mean (SEM), the mean, the 95% CI, the minimum (min) and maximum values (max) were determined. The outcome variables were normally distributed as assessed by the Shapiro-Wilk test ($p > 0.05$). The homogeneity of the error variances between the groups was fulfilled for all these variables according to Levene's test ($p > 0.05$). Between-subject, within-subject and interaction effects were tested for significance using a mixed ANOVA analysis. Post-hoc analysis was conducted using the Tukey HSD test. The $\alpha$-level was adjusted using Bonferroni correction. The significance level was set at $p = 0.05$.

**Table 1.** Baseline characteristics

| Baseline characteristics | MFR group (n=24) mean ± SD | OMT group (n=24) mean ± SD | PLC group (n=23) mean ± SD | total (n=71) mean ± SD |
|---|---|---|---|---|
| Gender (men/woman) | 12/12 | 14/10 | 8/15 | 34/37 |
| Age (years) | 45.7 ± 9.4 | 43.2 ± 11.4 | 42.3 ± 10.6 | 43.8 ± 10.5 |
| min – max (years) | 20.4 – 59.9 | 20.5 – 59.2 | 23.9 – 59.3 | 20.4 – 59.9 |
| Height(m) | 1.72 ± 0 .1 | 1.75 ± 0.1 | 1.70 ± 0.1 | 1.72 ± 0.1 |
| min – max (m) | 1.60 – 1.92 | 1.61 – 1.89 | 1.59 – 1.89 | 1.59 – 1.92 |
| Weight (kg) | 75.8 ± 13.4 | 78.3 ± 14.3 | 72.3 ± 9.6 | 75.5 ± 12.7 |
| min – max (kg) | 47 -97 | 60 – 110 | 60 – 92 | 47 – 110 |
| BMI (kg/m$^2$) | 25.5 ± 3.6 | 25.5 ± 3.5 | 25.2 ± 3.7 | 25.4 ± 3.5 |
| min – max (kg/m$^2$) | 17.9 – 35.2 | 18.7 – 33.9 | 21.7 – 35.2 | 17.9 – 35.2 |
| fLLD (mm) | 7.3 ± 4.0 | 9.4 ± 5.0 | 8.0 ± 4.9 | 8.2 ± 4.7 |
| min – max (mm) | 0 – 13 | 1 – 18 | 0 – 17 | 0 – 18 |
| ODQ-D (0-100) | 23.2 ± 13.5 | 21.8 ± 11.0 | 22.6 ± 10.3 | 22.5 ± 11.5 |
| min – max | 10 – 68 | 11 – 48 | 10 – 46 | 10 – 68 |
| VAS (0-10) | 5.0 ± 2.1 | 5.5 ± 1.9 | 4.7 ± 1.4 | 5.1 ± 1.8 |
| min – max | 3 – 10 | 3 – 10 | 3 – 9 | 3 – 10 |
| Pain duration (days) | 11.7 ± 6.8 | 10.1 ± 8.5 | 14.4 ± 6.9 | 12.0 ± 7.6 |
| min – max | 1 – 24 | 1 – 29 | 2 – 29 | 1 – 29 |

SD standard deviation. n number. MFR Myofascial release. OMT Osteopathic manipulative treatment. PLC Placebo. fLLD functional leg length discrepancy. ODQ-D Oswestry disability questionnaire in the German version. VAS Visual analogue scale.

Libreoffice Calc version 6.4.7.2 (Mozilla Public License v2.0) was used for the descriptive statistics. The inferential statistics were carried out with the software R version 3.4.1 (Foundation for Statistical Computing).

### 3. Results

The anthropometric data and baseline characteristics are shown in Table 1. Of 83 subjects screened between 29/07/2019 and 13/03/2020, 71 met eligibility criteria and received the interventions or sham treatment (Figure 2). No subject was unblinded accidentally or in any other way.
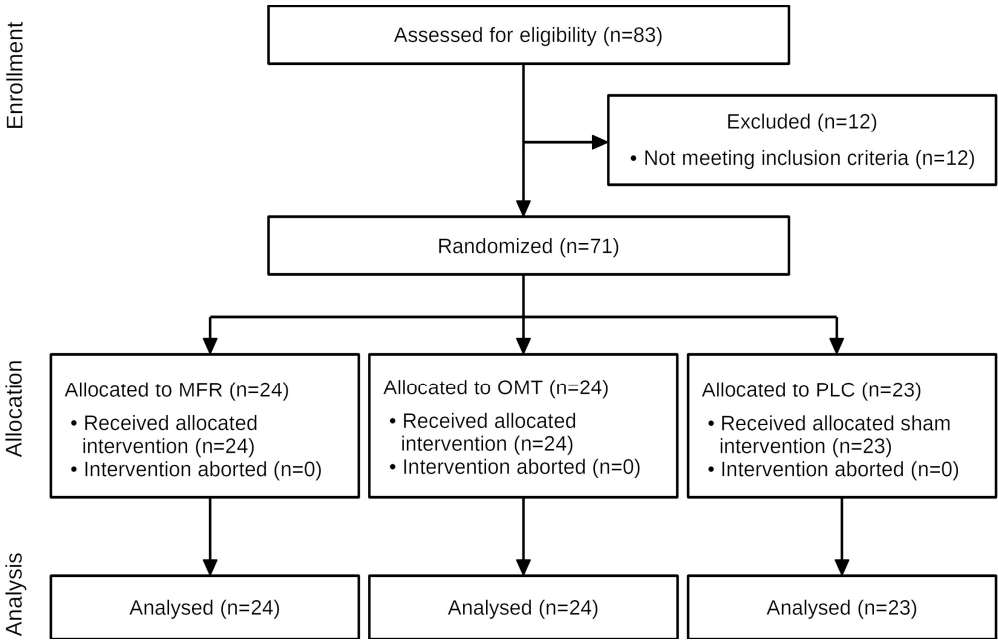


**Figure 2.** Flow diagram of the study. MFR Myofascial release. OMT Osteopathic manual treatment. PLC Placebo. 'Loss to follow-up' has been omitted as it is not relevant to the study design.

The mixed ANOVA showed significant interactions between the measurement time points and the study groups for the fLLD measurement ($F(2, 68) = 9.67$, $p < 0.001$, partial $\eta^2 = 0.22$). After treatment, the groups differed significantly ($p < 0.001$). According to the Tukey HSD, both the MFR group (5.2 mm, $p < 0.001$) and the OMT group (4.5 mm, $p = 0.004$) were significantly different from the PLC group. There was no significant difference between the MFR and OMT groups ($p = 0.23$).

There was also a significant interaction for the kyphotic angle ($F(2,68) = 3.30$, $p = 0.04$, partial $\eta^2 = 0.09$). After treatment, the groups differed significantly ($p = 0.005$). The MFR group (8.23 °, $p = 0.008$) and the OMT group (8.42 °, $p = 0.006$) were significantly different from the PLC group, as shown by the Tukey HSD. There was no significant difference between the MFR and OMT groups ($p = 0.99$).

There was no significant interaction for the lordotic angle ($F(2,68) = 1.87$, $p = 0.16$, partial $\eta^2 = 0.045$) and no significant main effect for time ($F(1,140) = 0.63$, $p = 0.43$, partial $\eta^2 = 0.004$) and group ($F(1,139) = 0.4$, $p = 0.67$, partial $\eta^2 = 0.006$).

Within the MFR group, there was a statistical effect of intervention on fLLD ($F(1,46) = 27.3$, $p < 0.001$, partial $\eta^2 = 0.37$) and kyphotic angle ($F(1,46) = 12.76$, $p < 0.001$, partial $\eta^2 = 0.22$). Within the OMT group, there was a statistical effect of the intervention on fLLD ($F(1,46) = 12.87$, $p < 0.001$, partial $\eta^2 = 0.22$) and kyphotic angle ($F(1,46) = 12.89$, $p < 0.001$, partial $\eta^2 = 0.22$). Within the PLC group, there was no statistical effect of the sham intervention on fLLD ($F(1,44) = 0.074$, $p = 0.787$, partial $\eta^2 = 0.002$) and kyphotic angle ($F(1,44) = 0.101$, $p = 0.75$, partial $\eta^2 = 0.002$).

The SDC for fLLD in the MFR group was exceeded in 19 out of 24 cases (79.2 %) and for the kyphotic angle in 21 out of 24 cases (87.5 %). Within the OMT group, the SDC for the fLLD was exceeded in 16 out of 24 cases (66.6 %) and for the kyphotic angle in 18 out of 24 cases (75 %).

The changes between the baseline measurement and the measurement after treatment, or sham treatment, are shown in Table 2 and Figure 3.

**Table 2.** Changes between baseline and after treatment

| Outcome | MFR group (n=24) mean (95% CI) | OMT group (n=24) mean (95% CI) | PLC group (n=23) mean (95% CI) |
|---|---|---|---|
| fLLD (mm) | -5.2 (-8.8 – -1.6)*** | -4.5 (-8.1 – -1.0)** | -0.4 (-4.0 – 3.2) |
| Kyphotic angle (°) | -8.23 (-15 – -1,4)** | -8.42 (-15 – -1.6)** | -0.8 (-7.7 – 6.1) |
| Lordotic angle (°) | 1.5 (-5.8 – 8.7) | -5.0 (-12.3 – 2.3) | 0.1 (-7.4 – 7.5) |

95% CI 95% confidence interval. n number. MFR Myofascial release. OMT Osteopathic manipulative treatment. PLC Placebo. fLLD functional leg length discrepancy. Significant at the level ** < 0.01. *** < 0.001.
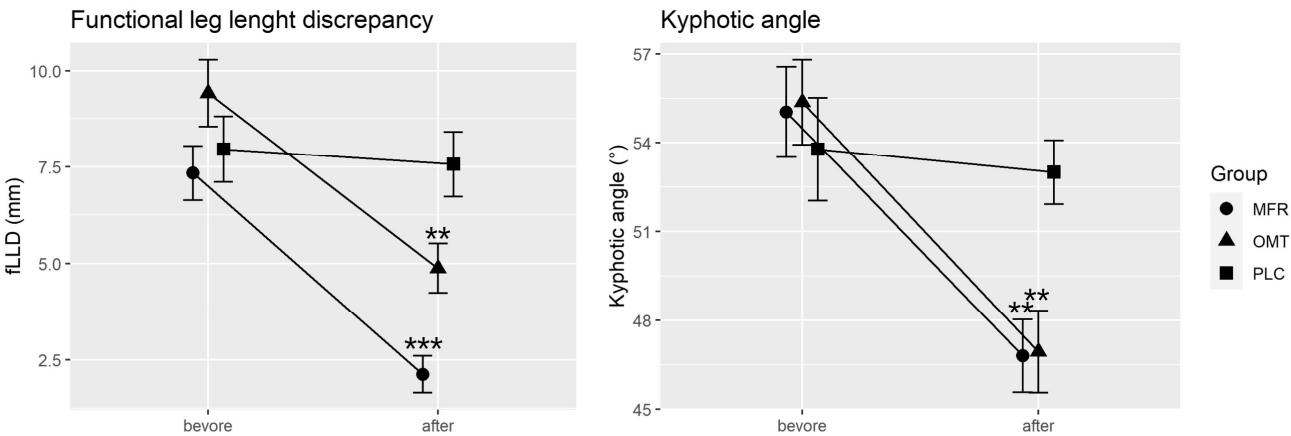


**Figure 3.** Change between baseline and after treatment. MFR Myofascial release. OMT Osteopathic manipulative treatment. PLC Placebo. fLLD functional leg length discrepancy. Error bars represent standard error of the mean. Significant at the level ** < 0.01; *** < 0.001.

## 4. Discussion

This study examined the immediate effects of both MFR on the TLF and individual OMT on spine shape parameters. The main results showed a clear difference between the intervention methods and the sham treatment. Here, in addition to the alteration of the skin receptors, mechanoreceptors in the fascial tissue under the skin could be stimulated (such as in the epi/peri/endomysium, fascia profunda, tendons and joint capsules). The much lighter touch of PLC treatment, on the other hand, can probably only act on cutaneous receptors. Fascial mechanoreceptors could be able to trigger changes in muscle tone, fluid hydration as well as neurological effects, which was likely achieved through the interventions in this study [30,31].

The measured parameters except for the lordotic angle showed a high modifiability by the manual therapy interventions. The fLLD and the kyphotic angle could be significantly reduced. Barnes et al. investigated the relationship of a treatment set of MFR and changes in pelvic symmetry in subjects with fLLD [19]. They discussed that targeted MFR influences the myofascial structures of the pelvis so that the os ilium rotates towards symmetry relative to the os sacrum. Among manual therapists, the hypothesis of leg length change due to anteroposterior ilium rotations is widespread [19,26,32]. However, due to

the low sacroiliac joint mobility, which allows a maximum fLLD change of less than 1 mm after taking into account the biomechanical components [33], this concept seems too reduced to explain the results of this study, with fLLD changes of 5.2 mm, within the MFR group and 4.5 mm, within the OMT group. Furthermore, this does not take into account other spinal shape parameters, such as the kyphotic angle, which was significantly reduced (MFR group: 6.4 °, OMT group: 8.4 °). Stecco et al. emphasize the role of the connection of the fascia to the muscle spindles and its influence on motor control [34]. In the case of LBP, the muscle spindles could be blocked by reduced gliding and increased adhesions of the TLF (Figure 4).
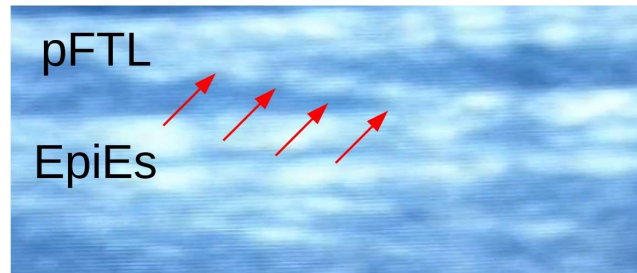


**Figure 4.** Ultrasound picture of an adhesion of the TLF**.** pFTL: posterior layer of the thoracolumbar fascia; EpiES: epimysium of the erector spinae muscle. The red arrows show a clear adhesion between the fascial layers.

According to the asymmetrically altered motor control and activation of the back muscles, especially the erector spinae muscle (ES), unilateral functional scoliosis (fSC) could cause fLLD. Sheha et al. found a high prevalence of fSC in fLLD in a systematic review [35]. The direct modifiability of fLLD by manual intervention, as observed in the study, makes it debatable whether fSC are less an effect than a cause of this phenomenon (Figure 5).
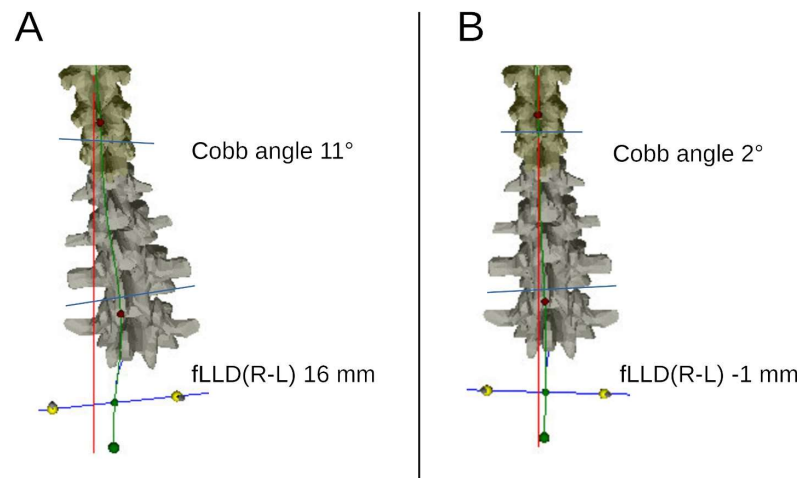


**Figure 5.** Video raster stereography of a patient with temporary functional scoliosis**.** fLLD(R-L) functional leg length discrepancy between right and left leg. The temporary functional scoliosis of 11° and the functional leg length discrepancy of 16 mm (A) corrected almost completely after OMT treatment (B).

In most people, a right-dominant motor postural pattern is present, which leads to a certain physiological asymmetry. This asymmetry is more prevalent in LBP patients, inducing a unilateral pathological activation of the lumbar musculature [12]. Wilczyński et al. found significant correlations between increased ES neuromuscular activity and the Cobb angle of scoliotic postural change [36]. They conclude from their results that

idiopathic scoliosis frequently is the consequence of an asymmetrically increased muscle tone of the ES. Based on this mechanism, the therapeutic interventions of both the MFR and OMT groups could have a direct influence on the neuromuscular activation of the ES in the present study. The results suggest that the investigation of neuromuscular aspects is particularly promising [15]. Further work in this regard is eagerly awaited.

The study presented here fulfilled the criteria of an RCT and had the strengths mentioned above, especially due to the generation of a sufficient number of cases but some limitations. No follow-up measurement was carried out in the present study. In this respect, the clinical relevance of the post-intervention results can only be assumed. The significant effects of the interventions therefore cannot provide any information about longer-term changes in spinal shape parameters, which should be the task of future work. Furthermore, no explicit distinction was made between subjects with specific and non-specific LBP. Only 15 % of all LBP patients have detectable pathologies that lead to the diagnosis of specific LBP [37]. This classification is due to the circumstance that in most cases of LBP there are still no generally accepted diagnostic methods to assess the causal origin of the pain [4]. Even in patients with demonstrable pathology, the causal relationship between pathology and pain is unclear. Rheumatic diseases, the use of anticoagulants, muscle relaxants, skin changes and scars were considered exclusion criteria for this study, which probably increased the percentage of subjects with non-specific aLBP well above 85 %, as at least all rheumatic or surgically treated patients with specific aLBP were not examined.

The results of this study should be seen in the light of the aim to compare two intervention methods with higher pressure targeting the stimulating of the fascia tissue under the skin with a sham intervention using only light touch. The results of this comparison support the interpretation of the observed therapeutic effects that these two modalities are more likely to stimulate the fascial mechanoreceptors under the skin.

## 5. Conclusions

Both MFR on the TLF and OMT showed immediate effects on the spine shape parameters fLLD and kyphotic angle. The fLLD and kyphotic angle reduced significantly within the MFR and OMT groups. These values also exceeded SDC in more than three quarters of cases, demonstrating that these effects are also clinically relevant. Further research should seek to consider the neuromuscular aspects of these associations.

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**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Osteopathic Research Institute in Hamburg, Germany (Nr. 019-11, 25.07.2019).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data can be made available by the author upon request.

**Conflicts of Interest:** The authors declare no conflict of interest.

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