STRENGTH SOLE TESTING

PHYSIO DIRECT

Hands on Physiotherapy

- Spinal Physio
- Sport Physio
- General Physio
- Hydrotherapy
- Gym Facilities
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- Pilates
- Headache Treatment

CONDUCTED BY PHYSIO DIRECT

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PROJECT OVERVIEW

AIM:

To test the impact of the Strength Soles on the stabilising muscles around the spine (Transversus abdominis (TA), Internal Oblique (IO), External Oblique (EO), Multifidus (M/F) and Erector Spinae (ES)) in various positions on three subjects.

METHOD:

Three subjects were tested individually in eleven different positions. Real time ultrasound imaging was used to observe TA, IO, EO, M/F and ES on both the left and right. Testing was first performed without the Strength Soles and then retested with the Strength Soles. The images from the real time ultrasound unit were video recorded and reviewed at a later date.

Subject 1: Female, fit, 55 years old, not used the Strength Soles prior to testing
Subject 2: Female, fit, 49 years old, used the Strength Soles for 3 months at home on an ad hoc basis prior to testing
Subject 3: Male, very fit, 23 years old, used Strength Soles for 6 months whilst at work prior to testing

CONCLUSION:

In the majority of tests activities, increased activity was observed in M/F when the Strength Soles were used. IO was also observed to be more active in tests with the Strength Soles than without. The activation and control of TA along with IO was observed to be better in some of the tests when Strength Soles were used.

Whilst measures were taken to eliminate testing errors, it should be noted that some limitations may exist. These may include the sample size, psychological factors, 'learned' effect of testing several times, testing and interpretation error. 'Physio Direct will only confirm the outcome of this report and the tests outcomes when this report is cited or reviewed in total'.

RESULTS

STATIC STANDING

NO STRENGTH SOLES

- Normal appearance of a relatively thin EO overlying a thicker IO and a thin TA was observed in all three subjects (see Figure 1)
- Normal appearance of M/F and ES with even spacing and gentle lordotic curve of the lumbar facet joints without any overlying ES contraction was observed in all three subjects

STRENGTH SOLES

- In all subjects when standing on the Strength Soles TA and IO appeared to be more dynamic in nature – sliding slightly laterally (see Figure 2). This movement seemed to be somewhat associated with respiration but was absent when Strength Soles were not used
- The appearance of M/F and ES was unchanged by the use of the Strength Soles in all subjects and again appeared normal

OVERALL IMPRESSION

- 'Dynamic' appearance of TA with the Strength Soles
- M/F unchanged by Strength Soles

SHOULDER ABDUCTION WITH NO WEIGHT

NO STRENGTH SOLES

- All subjects demonstrated a co-contracting pattern of TA with IO (TA and IO contract together essentially acting as one muscle – this is not ideal as TA should work independent of IO)
- Subject 1 demonstrated ES activity only, no M/F activity was observed
- Subject 2 demonstrated trunk rigidity during this test, bracing the spine with ES
- Subject 3 demonstrated a slight M/F contraction (slight depression of the lumbar facet joints with overlying ES activity)

STRENGTH SOLES

- Subject 1 and 2 showed signs of TA isolation with a subsequent IO contraction which was associated with repeated testing and hence possibly fatigue
- Subject 3 demonstrated no changes in contraction pattern again producing a co-contraction of TA with IO
- All subjects showed less ES activity and a gentle depression of the lumbar facet joints indicative of a good M/F contraction

OVERALL IMPRESSION

- Improvements in activation and control patterns of both TA and IO with Strength Soles in two of the three subjects
- Increased M/F activation with Strength Soles

Shoulder Abduction With A 5kg Weight

No Strength Soles

- All subjects demonstrated a co-contracting pattern with TA and IO working together as one muscle. It was also observed that there was more activity (indicated by thicker cross sectional size) in both TA and IO when compared to the previous test; shoulder abduction without a weight
- Subject 1 and 2 showed no signs of M/F activation and appeared to have a 'braced' spine
- Subject 3 demonstrated a some mild M/F activity with overlying ES contraction

Strength Soles

- All subjects showed increased IO activity and again had a co-contracting pattern of IO with TA when compared to the previous test of shoulder abduction with no weight
- Subject 1 showed little difference in M/F and ES activation however Subjects 2 and 3 demonstrated better M/F contractions evidenced by a gentle drop in the lumbar facet joints

Overall Impression

- More IO activity with the weight as compared to with no weight
- Improved M/F contractions with two of the three subjects with Strength Soles evidenced by a gentle drop in the lumbar facet joints without a large overlying ES contraction

Lift A 5kg Box Off A Waist High Bench

No Strength Soles

- Subject 1 demonstrated a phasic contraction of TA and IO evidenced by TA and IO working in an on/off pattern related to the movements performed
- Subject 2 demonstrated a static co-contraction of TA and IO evidenced by initial simultaneous activation of TA and IO which were then statically maintained throughout the test movement
- Subject 3 demonstrated an excellent initial contraction of TA in isolation to IO followed by IO activation whilst TA contraction was maintained throughout the test movement
- Subject 1 demonstrated little activity through M/F and ES
- Subjects 2 and 3 demonstrated ES contraction only, no M/F activation was noted

Strength Soles

- Subjects 1 and 2 demonstrated little change from no Strength Soles test, maintaining a phasic contraction of TA and IO
- Subject 3 again demonstrated an excellent contraction of TA followed by IO
- Subject 1 demonstrated substantial ES activity with little M/F activation
- Subjects 2 and 3 showed better M/F activity with an appropriate gentle lumbar facet joint drop with only minor overlying ES activity

Overall Impression

- TA and IO contractions seemed unchanged by Strength Soles
- Improved M/F contractions in two of the three subjects with the Strength Soles

Lift a 5kg Box Off a Waist High Bench With Rotation

No Strength Soles

- Similar results to lifting a box without rotation however increased IO and EO activity (indicated by thicker cross sectional size and lateral sliding movement) associated with rotation
- Subjects 1 and 2 demonstrated a slight drop in the lumbar lordosis however it seems to be due to more superficial ES activity rather than a deep M/F contraction
- Subject 3 demonstrated only minor activation of M/F followed by ES contraction

Strength Soles

- Subject 1 and 2 demonstrated static co-contractions of TA and IO with increasing IO activity with rotation
- Subject 3 demonstrated good activation and isolation of TA followed by a large IO contraction associated with rotation
- All three subjects demonstrated appropriate activation of M/F followed by a large contraction of the overlying ES

Overall Impression

- TA and IO contractions were largely unchanged by the Strength Soles
- Subject 3 demonstrated appropriate patterns with and without Strength Soles
- More appropriate M/F contraction were observed when the Strength Soles were being used

Lean Forwards / Backwards / Side to Side From The Ankle Joint

No Strength Soles

- All subjects demonstrated TA and IO co-contracting patterns with increased IO and EO recruitment associated with lateral trunk movement
- Slight ES contraction was evident in all three subjects with greater activation of ES at the extremes of the test movements. Only minimal activation of M/F was observed

Strength Soles

- All subjects demonstrated increased recruitment in TA and IO in all positions.
- Subject 1, 2 and 3 demonstrated appropriate M/F activity when leaning forwards
- Subject 1 and 2 demonstrated overlying superficial ES activity when leaning backwards and side to side

Overall Impression

- Increased activation of TA and IO was observed with the Strength Soles
- When using the Strength Soles M/F was activated in all three subjects when leaning forwards only – this is of particular interest when considering working in a standing position

Bend Forwards From the Waist

No Strength Soles

- All three subjects demonstrated appropriate patterns of TA isolation followed by increasing IO recruitment as they bent further forward
- Due to the curved nature of the probe it is difficult to see M/F and ES accurately in this position

Strength Soles

- When compared to no Strength Soles, an increased IO contraction is evident in all three subjects especially with increasing flexion. TA is activated appropriately in all three subjects
- Due to the curved nature of the probe it is difficult to see M/F and ES accurately in this position

Overall Impression

- Increased recruitment of IO with the Strength Soles
- Difficult to assess M/F activity

Squat To Get A 5kg Box Off The Floor Without Lifting

No Strength Soles

- All subjects demonstrated a static co-contraction of TA and IO (TA and IO working together as one muscle in a static 'braced' position)
- All subjects demonstrated slight M/F activation. Subject 1 also displayed some ES activity

Strength Soles

- All subjects demonstrated excellent and appropriate activation of TA followed by IO
- All subjects demonstrated M/F activation followed by ES (more ES activity due to increased load)

Overall Impression

- Improved and appropriate control of TA and IO seen with the Strength Soles
- Improvements in M/F activation were also noted with the Strength Soles

SQUAT AND PICK UP A 5KG BOX OFF THE FLOOR

NO STRENGTH SOLES

- Similar static co-contraction pattern as observed without picking the box up however more oblique activity as the box was lifted
- Subject 1 demonstrated static 'brace like' activity of ES suggesting no activation of M/F
- Subjects 2 and 3 demonstrated slight M/F activation with increased ES recruitment as the weight was lifted

STRENGTH SOLES

- Same as without lifting the box – all subjects demonstrated excellent and appropriate activation of TA followed by IO, but with increased IO recruitment as the box was lifted
- All subjects demonstrated excellent and appropriate activation of M/F evidenced by a gentle drop in the lumbar facet joints followed by increased ES recruitment when weight was lifted

OVERALL IMPRESSION

- Improved and appropriate TA and IO activation when using the Strength Soles
- Excellent M/F recruitment when using the Strength Soles

STAND TO RUNNING MAN

NO STRENGTH SOLES

- All subjects demonstrated static co-contraction of TA and IO (TA and IO worked together as one muscle and maintained a static position throughout the test), more IO recruitment as the subjects reached further forwards
- All subjects demonstrated some minor M/F recruitment but ES became more contracted with increased reach

STRENGTH SOLES

- Subject 1 demonstrated static co-contraction with TA and IO (TA and IO working as one muscle in a 'braced' position)
- Subjects 2 and 3 demonstrated initial TA isolation followed by IO, increased IO recruitment with increased reach
- All subjects demonstrated appropriate M/F activation followed by ES recruitment

OVERALL IMPRESSION

- Two of the three subjects demonstrated improved TA and IO recruitment and patterning with the Strength Soles
- Slightly improved M/F recruitment with the Strength Soles

SIT TO STAND

NO STRENGTH SOLES

- Subject 1 and 2 demonstrated appropriate activation of TA followed by IO
- Subject 3 demonstrated a co-contracting pattern of TA with IO (TA and IO working together as one muscle)
- All subjects demonstrated slight M/F recruitment followed by an ES contraction

STRENGTH SOLES

- All subjects demonstrated very nice and appropriate activation of TA followed by IO
- All subjects demonstrated appropriate recruitment of M/F followed by ES activation

OVERALL IMPRESSION

- Improved TA and IO recruitment with the Strength Soles
- Better M/F activation with the Strength Soles demonstrated by a drop in the lumbar facet joints

CONCLUSION

- The Strength Soles appear to enhance the recruitment of M/F in the majority of testing movements
- TA and IO showed improvements in timing and appropriateness of contraction patterns in some of the testing movements however to a lesser degree than M/F
- The Strength Soles were associated with increased IO activity in many of the testing movements

- It should be noted that there may be some limitations to the testing procedure:
  - Small sample group (three fit active adults)
  - It is possible there may have been a learned effect as testing was first conducted without Strength Soles and then with the Strength Soles. It can not be disguarded that the subjects 'learned' the movements, were more confident and hence demonstrated better patterns of contraction when Strength Soles were used
  - It may be possible that psychological factors may have interfered with testing (e.g. 'trying' harder or being more conscientious when wearing the Strength Soles)
  - The use of real time ultrasound imaging and the assessment/review of the images are subject to interpretation rather than quantitative measure

- Such limitations provide direction for future research with greater sample sizes incorporating different age groups, fitness levels and exposure to the Strength Soles
- EMG studies, although more invasive would produce quantitative muscle activity scores that would reduce interpretation required in visual assessment

REAL TIME ULTRASOUND IMAGES

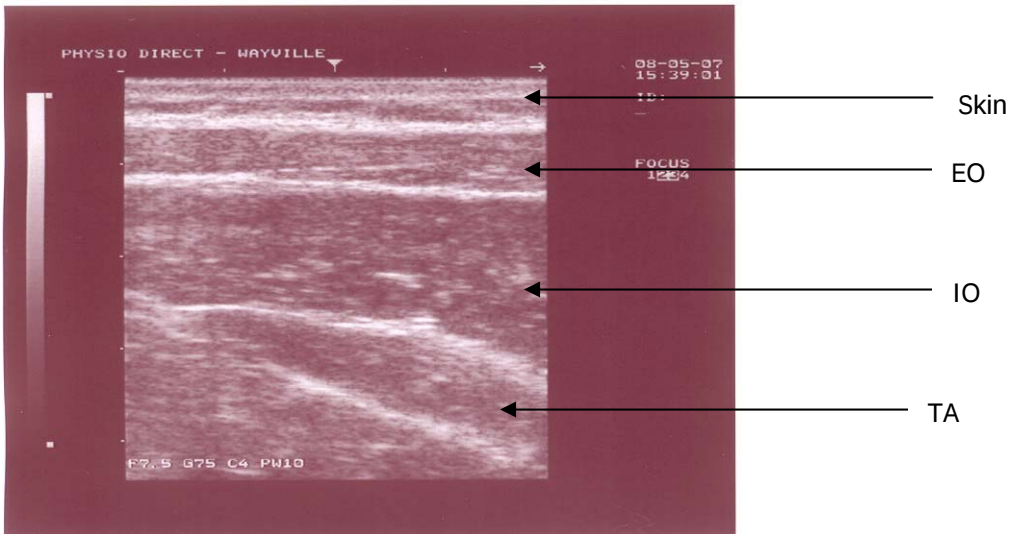

Figure 1. TA at Rest (no strength soles) – note the relative cross-sectional sizes and positions of IO to EO and TA

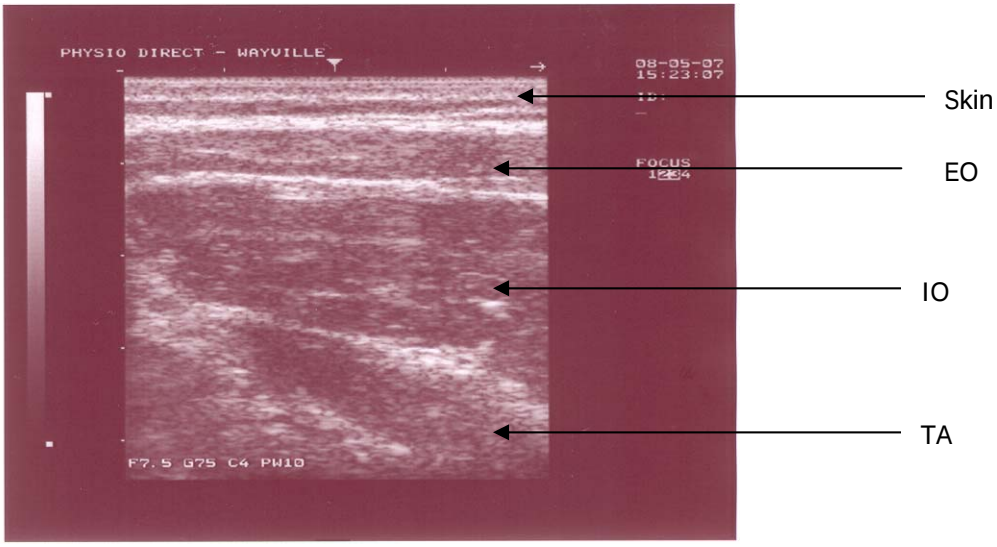

Figure 2. Isolation of TA (with strength soles) – note the lateral shift of TA relative to IO and EO which remain relatively unchanged when compared to TA at Rest (Figure 1)

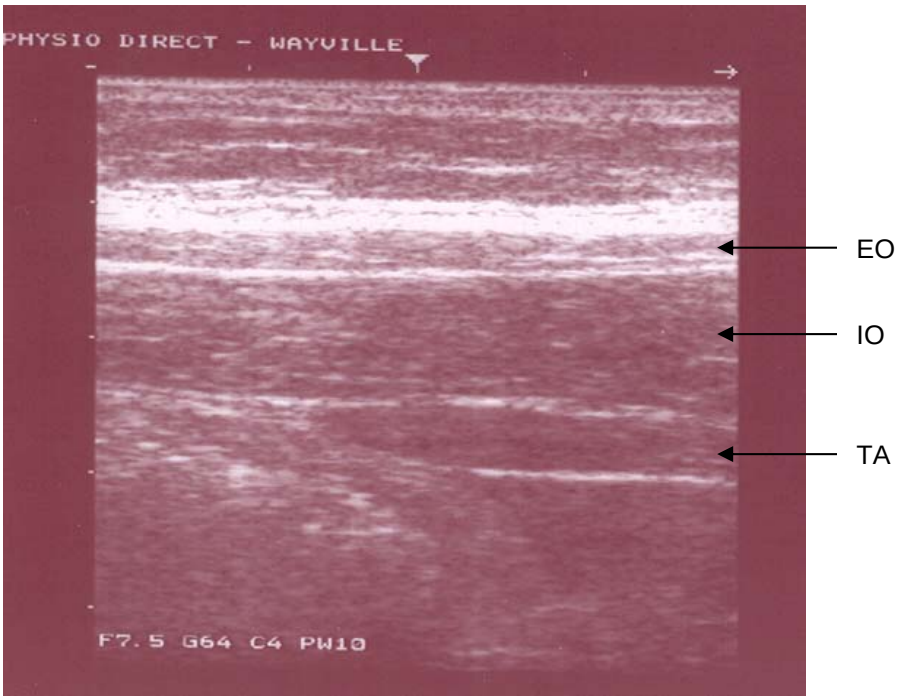

Figure 3. Standing **without** STRENGTH SOLES – notice the relative thin cross section of Transversus Abdominus indicating poor activation.

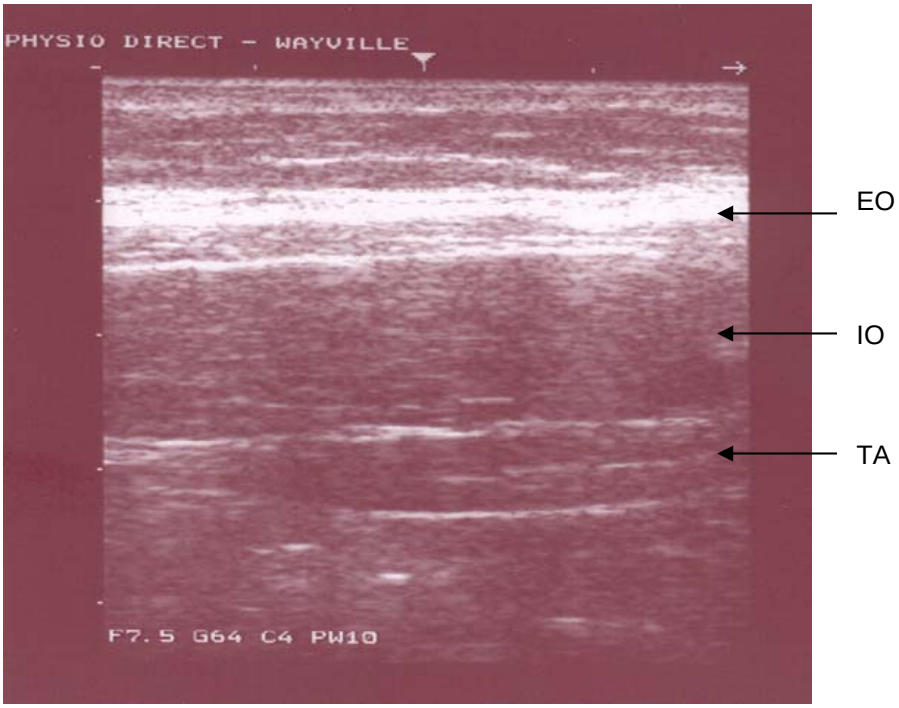

Figure 4. Standing **with** STRENGTH SOLES – notice the thicker cross-section width of Transverse Abdominus indicating increased activation.

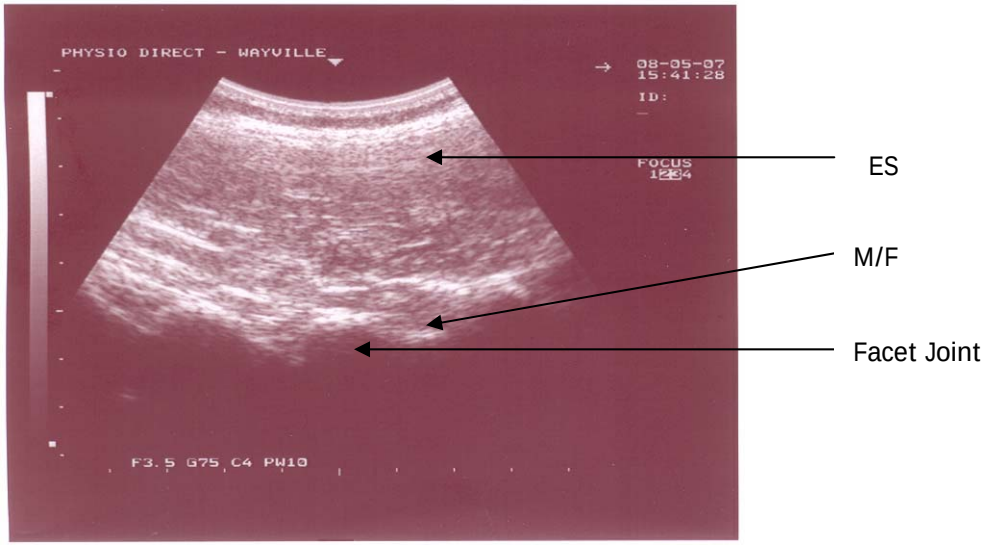

Figure 5. MF Resting (no strength soles)

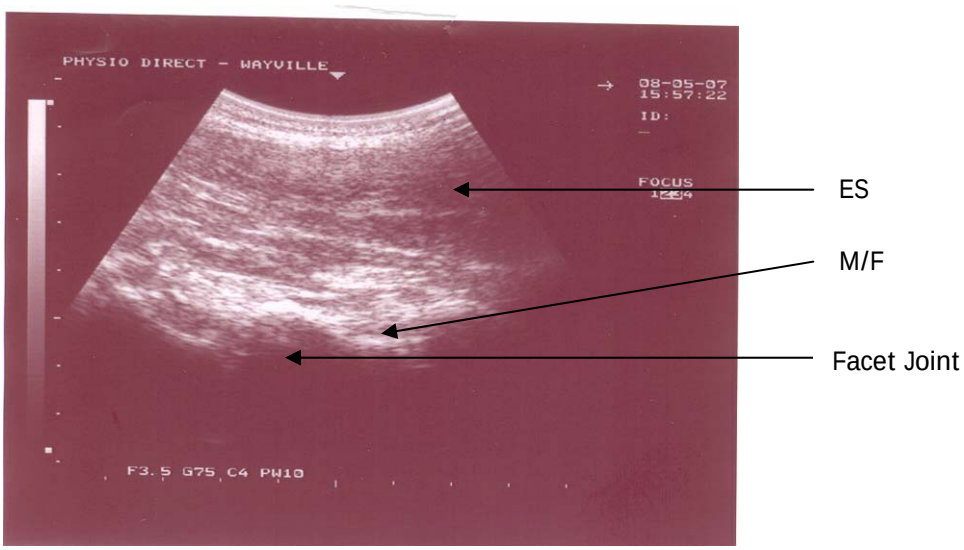

Figure 6. A good M/F contraction (with strength soles) – note the even positioning of the lumbar facet joints and the slight drop in the uniform curve when compared to M/F at rest (Figure 3)