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COMPARATIVE STUDY

Comparing AquaStretch with supervised land based stretching for Chronic Lower Back Pain☆

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Aquatic therapy;
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Kinesiophobia;
Perceived disability

Summary *Objective:* Chronic Lower Back Pain (CLBP) is a major health problem affecting 70–85% of the population in the UK. AquaStretch, a new form of assisted stretching in water, is compared with supervised land based stretching (LBS) for subjects with CLBP looking at pain reduction, kinesiophobia and disability.
Method: 29 subjects were randomly allocated into three groups, LBS (N = 10), AquaStretch (N = 10) and Control (N = 9). Modified Oswestry Low Back Pain Questionnaire (MOLBPQ) and Tampa Scale of Kinesiophobia (TSK) questionnaires were completed in weeks 1, 6, and 12. Visual Analogue Scale (VAS) pain scores were collected weekly till week 12. Treatment groups received two 30 min sessions per week for 12 weeks, control group continued their normal physical activity.
Results & conclusion: Statistical significance ($p < 0.05$) was observed in the AquaStretch group for pain reduction ($P = 0.006$), kinesiophobia ($P = 0.029$), and perceived disability ($P = 0.001$). Both techniques are suggested to be beneficial for CLBP patients however AquaStretch has key additional benefits including time efficiency, cost effectiveness and the ability to be performed by qualified individuals other than physiotherapists. A reduction in pain post eight weeks of treatment using AquaStretch versus twelve weeks of land based stretching could result in potentially less treatment time needed and a possibility of less medication. Future research is recommended to determine the duration of AquaStretch benefits, and to compare AquaStretch with land based physical therapy programmes for CLBP and to research the potential reduction of Medication required for chronic pain conditions for both its relative clinical effectiveness together with potential health cost savings.

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Introduction

Chronic Lower Back Pain (CLBP) is a major health problem, affecting 10 million people daily in the United Kingdom (Briggs et al., 2011). CLBP is defined as pain, muscle tension or stiffness localised below the costalar margin and above the gluteal fold; with or without leg pain or another indication of neural dysfunction (van Middelkoop et al., 2010). The classification of 'chronic' is pain lasting longer than three months (van Middelkoop et al., 2010). CLBP is further subdivided into two groups, specific and non-specific, with a vast majority (90%) being non-specific (symptoms without a specific cause) (Wand and O'Connell, 2008). Studies by Haines et al. (1997) and Fairbank et al. (2011) described CLBP as having many classifications. CLBP needs to be treated as a dynamic and multifactorial cause of disability that has psychological and anatomical complexities (Haines et al., 1997).

It is estimated that between 70 and 85% of the working population have reported an episode of lower back pain that has limited their physical activity, affected work performance and quality of life (Andersson, 1999; Deyo and Weinstein, 2001; Goodwin and Goodwin, 2000; Liddle et al., 2004) with many reporting long bouts of absenteeism from work (Breivik et al., 2006; Freburger et al., 2009; Fritz et al., 2001). The cost of treatment for CLBP exceeds £9 billion per annum to the British National Health Service (NHS) (Morone et al., 2011), with a large proportion of this cost being direct medical intervention.

There are a wide variety of treatments used for managing and treating CLBP, but there is no "gold standard". However the effectiveness of long term maintenance has been established (Liddle et al., 2004). A biopsychosocial approach (including exercise, manual therapy, and behavioural therapy) is currently recommended as the way of managing CLBP (Airaksinen et al., 2006; Duthey, 2013; Vogel, 2009; Scottish intercollegiate guidelines network, 2012). Education and motivation are recognised as positive factors (Skouen et al., 2002). Cognitive behavioural change is also a key component when planning a programme for CLBP sufferers.

Despite contradictory research outcomes, two principles have been established: some forms of exercise can reduce pain in CLBP, and those exercises need to be supervised and patient-specific to ensure correct execution and assist in patient compliance (Bronfort et al., 2011; Field, 2008; Hofmann et al., 2013; Liddle et al., 2004; and Morone et al., 2011; Vogel, 2009; Scottish Intercollegiate Guidelines Network, 2012). Additionally, the combination of exercise and manual therapy has shown to be more effective in reducing CLBP than manual therapy alone (Liddle et al., 2008; Vogel, 2009; Preyde, 2000; Torstensen et al., 1998). As yet the effectiveness of assisted stretching in water for CLBP is unknown.

A systematic review of peer reviewed journals by Olson et al. (2012) of aquatic exercise and land exercise in subjects with CLBP found only three articles that satisfied stringent inclusion criteria. Olson et al. (2012) concluded there were similarities between exercising on land and in water in the short term (6–8 weeks). When comparing land and water exercise, it is evident that both disciplines are beneficial for treating CLBP.

Aims and objectives

The aim of this study was to compare AquaStretch with supervised land based stretching (LBS) and measure three outcomes: pain, perceived disability, and fear of movement (kinesiophobia). AquaStretch is essentially assisted stretching in water to free anatomical restrictions, theoretically in the fascia connective tissue, that inhibit flexibility.

The objectives of this study were

- To review the literature relevant to Land Based Stretching and AquaStretch
- To look at the effect CLBP has on disability, wellbeing and pain.
- To review and analyse the data and results of this study.
- To identify areas of further research needed for AquaStretch.
- To identify practical applications AquaStretch can provide.

Method

Study design

The study is a repeated measure randomized controlled trial (RCT) using a blind selection of sealed envelopes to assign participants to each of the three groups, Land Based Stretching (LBS), AquaStretch (AS) and Control (C).

Subjects

42 subjects were recruited to the trial via posters displayed at Aspire National Training Centre (ANTC) Stanmore, Facebook and *My News* (a local magazine), although only 29 actually took part in this research with no subjects dropping from the study once it commenced. The inclusion criteria for the study were: aged between 18 and 70, self-reported CLBP for 3 months or more (Dionne et al., 2008), no surgical intervention to the lower back, no specific injury to the lower back, and not pregnant. Exclusion criteria were: acute back pain lasting 1–6 weeks, osteoporosis, stenosis, fractured vertebrae, history of back surgery, spondylosis and spondylitis.

The study was approved by the Health Studies Sub-Committee (HSESC) at Middlesex University. The subjects were fully informed and could withdraw from the study at any time without penalty. Criterions were assessed via telephone interview by the researcher and followed up with a meeting to confirm and validate self-reported inclusion criteria and introduce volunteers to the research study. A full explanation of the study was presented with each subject receiving a copy of the trial. All subjects signed a consent form and completed the first set of questionnaires: Visual Analogue Scale (VAS), Modified Oswestry Low Back Pain questionnaire (MOLBPQ) and Tampa Scale of Kinesiophobia (TSK). Subjects were asked not to participate in any form of additional therapy for the duration of the study. They were asked to refrain from taking any pain-

relief or anti-inflammatory medication on the data collection and intervention days.

Each volunteer self-selected a sealed envelope to allocate the group to which they would be assigned. All treatments were performed at ANTC between April 30 and June 24 2014. AquaStretch and LBS groups both received treatment sessions twice a week for 12 weeks. The Control group maintained any pre-trial treatment and/or exercise programme (if applicable).

The mean age of all subjects was 46 ± 17 years. Between the groups the subjects' age did not differ significantly. The AquaStretch mean was 48 ± 18 years, the LBS group 51 ± 16 years and the control group mean was 41 ± 17.

Gender was not taken into account for this trial but could be a subject in future studies.

Data collection

Visual Analogue Scale (VAS)

Pain perception was measured using a VAS, subjects indicating a value between 0 and 10 (0 = 'no pain', 10 = 'worse pain ever'). Its use has been widely validated in research (Bolognese, 2003; Aoki et al., 2012). All subjects submitted VAS measures by email once a week.

Modified oswestry low back pain questionnaire (MOLBPQ), Tampa Scale of Kinesiophobia (TSK)

Two questionnaires that have been validated in research were used in the trial; MOLBPQ for self-reported disability (Baena-Beato et al., 2012; Duthey, 2013, Muller et al., 2004a; Muller et al., 2004b) and the TSK for kinesiophobia (Fritz et al., 2001; Swinkels-Meewisse et al., 2003; Picavet, 2002). All MOLBPQ, and TSK questionnaires were completed at the first meeting and again at weeks 6 and 12.

The trial groups

The 29 subjects were assigned via random, blind selection into three groups: control group, land-based stretching and AquaStretch.

The control group

The control group comprised 9 subjects (1 male and 8 females). Control group subjects were instructed to continue their normal levels of physical activity throughout the study period without changes. They were specifically instructed to avoid any new form of treatment for CLBP.

Land-based stretching

This group comprised 10 subjects (2 male 8 female). The subjects attended a group stretch session at ANTC lasting 30 min twice a week. These sessions were lead and supervised by a qualified Personal Trainer (DipPT). Both static and dynamic stretches for the Lumbo Pelvic Hip Complex (LPHC) and Upper body stretches were performed as recommended by the National Academy of Sports Medicine (NASM). All stretches performed have been recognised as reliable and valid for correcting muscular imbalance (Clark and Lucett, 2011). All stretches performed are described in appendix A.

AquaStretch

The AquaStretch group comprised 10 subjects (2 male and 8 female). Subjects were asked to attend two 30 min AquaStretch sessions a week at ANTC where the pool temperature is maintained at 30 °C. AquaStretch positions and length of time to perform each stretch were based on descriptions by Denomme and Jasinskas (2013). AquaStretch 4 step procedure and technique are described in appendix B.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS v21.0.0). Results were considered statistically significant at 95% confidence level ($p < 0.05$). A repeated measure one way ANOVA was used to find the mean within each group.

Results

Table 1 summarises the results from Figs. 1–3.

The study showed no violation of significance using Mauchlys test of sphericity for three variables ($p > 0.05$): (MOLBPQ significance value $p = 0.109$. TSK significance value $p = 0.568$, VAS significance value $p = 0.056$). Additionally a Shapiro–Wilk's test ($p > 0.05$) (Shapiro and Wilk, 1965; Razali and Wah, 2011) and a visual inspection of the histograms, normal Q–Q plots and box plots showed the scores were normally distributed for all three variables as significant values were all greater than $p > 0.05$ therefore parametric tests were applied to all data.

Discussion

Self-reported level of pain (intensity) improved within both AquaStretch and LBS groups. However it is evident that at week 6 the comparison between LBS and AquaStretch indicates that LBS group perceived less pain than the

Table 1 Summary of results.

Measure		Control	AquaStretch	LandStretch
VAS	Average Pre score	4.38	5.4	5.75
	Average Post Score	4.89	2.6	2.65
	$P < 0.05$	1	0.006	0.339
MOLBPQ	Average Pre score	40	45.6	34
	Average Post Score	31.56	33.2	25.8
	$P < 0.05$	1	0.001	0.35
TSK	Average Pre score	41.79	37.1	36.8
	Average Post Score	39.33	28.8	32.6
	$P < 0.05$	1	0.029	0.183

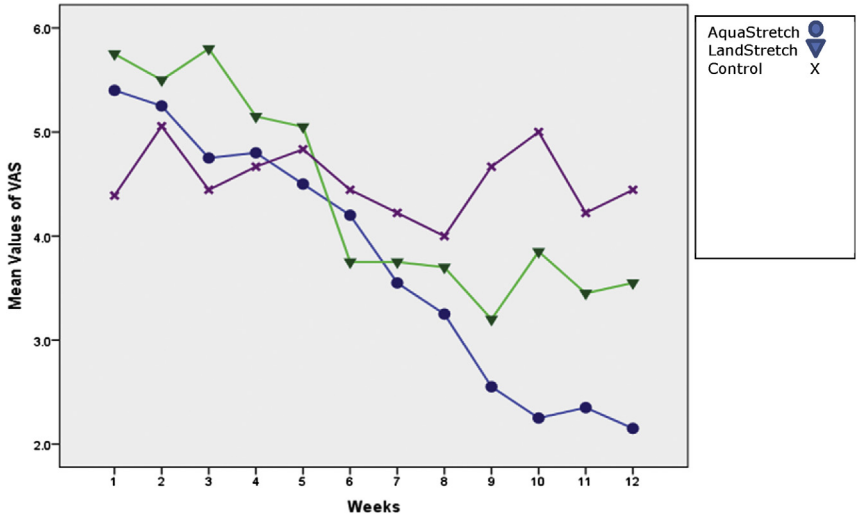

Figure 1 Mean Score Values over time for VAS in AquaStretch, LBS and Control Group. Perceived pain over 12 weeks with (P = 0.006) shown for AquaStretch whereas the LBS group did not show a significant improvement (P = 0.339). By comparison the control group's pain increased by 1.25% over the same period. Baseline mean VAS values for pain were control (4.39), LBS (5.75) and AquaStretch (5.4). At week 12, the mean scores were control (4.44), LBS (3.55), and AquaStretch (2.15).

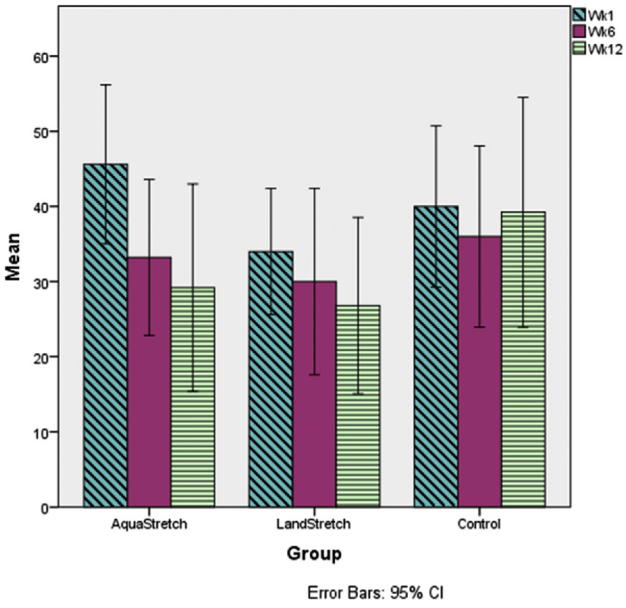

Figure 2 Mean value scores over time for MOLBPQ in AquaStretch, LBS and Control. Mean percentage of reduction in perceived disability (MOLBPQ) revealed AquaStretch to have the greatest improvement (P = 0.001) over both LBS (P = 0.350) and control (P = 1). Only the AquaStretch Group showed a statistically significant improvement as P < 0.05. Baseline mean MOLBPQ scores were control (40.0), LBS (34.0), and AquaStretch (45.6). Week 12 mean MOLBPQ scores were control (39.2), LBS (26.8), and AquaStretch (29.2).

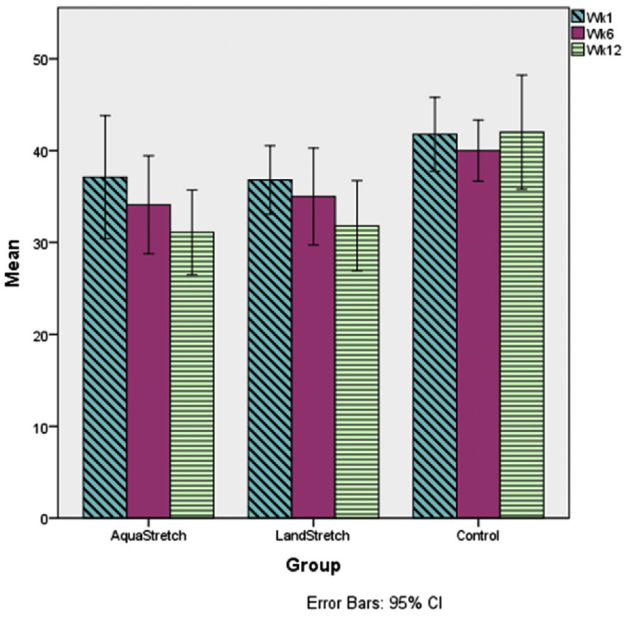

Figure 3 Mean value scores over time for TSK in AquaStretch, LBS and Control. The mean TSK scores revealed that the AquaStretch group decreased their fear of movement (P = 0.029) compared to LBS (P = 0.183) and control (P = 1) The control group mean was worse in week 12 than week one. Baseline TSK mean scores were control (41.8), LBS (36.8), and AquaStretch (37.1). Week 12 TSK mean scores were control (42.0). LBS (31.8), and AquaStretch (31.1).

AquaStretch group (Fig. 2) which concurs with other research studies of short duration that land exercise and water are comparable for relieving pain in CLBP sufferers (Bello et al., 2010; Olson et al., 2012). Additional research into pain and water exercise have demonstrated that water exercise can reduce pain in subjects through a variety of movement based exercise (Bello et al., 2010; Silva et al.,

2007). However it is evident from the data of this current study that between week's 6 and 12 the reduction in pain starts to plateau for the LBS group but continues to improve in the AquaStretch group, as found in previous longitudinal research (Silva et al., 2007). This plateauing in the LBS subjects may in part reflect their inability to dynamically stretch into positions and directions on land because they were restricted by the force of gravity and solid surfaces including floors and walls, whereas the AquaStretch subjects were free to move in any and all directions. Consequently, the LBS subjects potentially did not resolve some restrictions in their fascia and soft tissue as effectively. As yet there is no additional data re AquaStretch to draw a comparison from. However research into water exercise has found benefits to include a reduction in heart rate and blood lactate (Benelli et al., 2004), a reduction in systolic and diastolic blood pressure (Sramek et al., 2000), improvements in walk time, depression, anxiety and physical activity (Minor et al., 1989) and flexibility (Wang et al., 2006).

Research advocates movement as essential for subjects with CLBP (Bronfort et al., 2011; O'Sullivan et al., 1997); despite the lack of agreement and "gold standard" for type of exercise (Liddle et al., 2004). However research has revealed that movement has a significant benefit in cognitive health and therefore resulting in improvement to quality of life in subject with pain (Vlaeyen et al., 1995). Therefore it is no surprise that, despite the AquaStretch group increasing their physical ability, the percentage difference is minimal between groups. This increased physical ability would be expected to indicate a decrease in disability (MOLBPQ). However it was found that the MOLBPQ results revealed that AquaStretch subject's disability decreased rapidly over the initial 6 weeks but slowed down considerably over the following 6 weeks. This could be due to the age of some participants as mentioned in a study by Landi et al. (2010) or the effects of external influences.

Future studies utilising a larger sample size would enable statistical analysis on a greater array of CLBP presentations, together with differing levels/stages of pain and a more extensive age and gender range. In addition a trial to include regular additional follow-up examinations to evaluate the continued benefits of using the AquaStretch technique could be of importance in evaluating the cost effectiveness of the treatment.

One source of possible error was the timing of the completion of questionnaires. Due to circumstances and environmental factors these were completed at home on the day of the intervention rather than acutely post intervention (Wareham et al., 2002). Although the questionnaires have been validated and regularly used in research they are subjective by nature and rely on self-reporting accuracy and can be affected by other elements of daily life (Osaba et al., 1998) However research has validated this as an appropriate method for data collection within this subject group (Hunt et al., 1985; Schipper and Levitt, 1985).

As this is a pilot study there are many areas that this research did not look at including age and its relationship to pain, this question rose due to the early significant reduction of pain in the two younger subjects from the AquaStretch group. Likewise the difference that a subjects past activity/sporting levels could have on the trial and whether this might significantly influence outcomes. Areas of additional research could be whether pain scores maintained or continued to improve if treatment continued. Additionally, if a subject performs yoga or similar flexibility exercises to help self-manage their pain would AquaStretch improve their overall pain levels.

Conclusion

The findings of this study have revealed AquaStretch to be a beneficial additional technique to help in the reduction of pain, disability and kinesiophobia in subjects with CLBP. Though it appears AquaStretch is a very effective way of treating CLBP, it is evident that a combination of both AquaStretch and land based stretching would provide a more cost effective treatment programme for sufferers of CLBP, though more research is needed to support this thinking. The trial has added to the current research to prove that longer duration treatment is of significant benefit to subjects with chronic pain and fear of movement. Additional studies would benefit from higher participant numbers to highlight the significant changes. The trial has also demonstrated that both interventions benefit individuals through motivation, correction of technique and the social interaction that accompanies a professionally lead programme.

Furthermore this study suggests the need for further research to establish the difference that age can make in the reduction in time needed to alleviate pain; if pain is a result of muscular imbalance. Likewise future research could be of interest in using this technique for individuals with long term medical conditions to see if it is beneficial or as a form of recovery for elite sports individuals.

As a practical technique used to decrease pain and increase mobility AquaStretch could be a valuable addition to the current techniques available for CLBP. As the biopsychosocial model is the recommended path for individuals with CLBP then a treatment that assists with the kinesiophobia associated with this or any long term pain condition could be an asset.

Due to its specific and replicable application, AquaStretch can be used by many health care professionals and wellness instructors as it is easy to learn. This would allow for physiotherapy assistants, aquatic fitness or wellness instructors to perform the technique. With the recommended duration for physiotherapy treatment being between 20 min and 1 h condition dependant as stated by the NHS trust foundation (2014). A treatment that reduces the long term need for intervention and has significant results could reduce both the workload and financial costs to the NHS.

This study received no financial funding or had any participant bias and was based on a Masters dissertation at Middlesex University. London, England.

Appendix A. Exercises

Land Based exercises

Exercise	Description
Gastrocnemius	Place hands on a wall, slide heel to be stretched back, lean forwards with heel of the back foot on the ground, lean until you feel a stretch in the back calf muscle. Hold for 30 s minimum. Repeat other leg
Dynamic Gastrocnemius	Heel down, leg straight, body at 45° to floor. Hands on wall. Lift support leg and rotate side to side. Feel stretch in anchored gastrocnemius.
Soleus	Bend both knees, move body weight forwards into forefoot keeping heels down, feet face forwards.
Hamstring	Stand with one leg forwards (can be placed on chair). Bend back leg and rest hands on bent knee or place on wall. Lift toes of front leg, back straight bottom moves backwards. Hold for approx. 30 s.
Quadriceps	Stretching leg moves back lower body into a lunge position (Leg can be placed on a chair behind you) Draw tummy in tuck bottom under.
Adductor	Stand with legs wide shift body weight to one side bending knee (can place the leg on a chair).
Abductor	Cross one leg over the other. Keep body weight in straight leg, Raise arm (same side as crossed leg) over the head to create an arc.
Roll down	Standing straight engage abdominals and pelvic floor. Tuck chin to chest, relax arms and exhale as you roll down vertebrae by vertebrae until you can go no further, Stay there for three breaths then slowly roll back up from the base of the spine to the head, maintaining abdominal compression.
Seated leg crossover	Sitting upright cross one leg over the other draw the knee to the opposite chest, turn the body into the knee, place opposite hand on the floor behind you maintain an upright posture.
Knees bent feet together open legs	Sitting tall bend knees and draw feet up placing soles of feet together, hold feet allow legs to open and relax down.
Lay down arms wide palms up	Lay on floor face up. Open the arms in line with the shoulder palms face up.

Description of Land Based Stretches for Lumbo Pelvic Hip Complex from NASM corrective exercise (Clark and Luckett, 2011) performed twice a week for 30 min.

Appendix B. AquaStretch technique

4 step technique	
Play	Client is asked to move (play) with their body's movement until they experience pain or restriction.
Freeze	Client freezes in exact position they feel pain or tension
Pressure	Facilitator applies pressure to area of pain or restriction, whilst client maintains frozen position.
Move	Client is asked to move, if they feel the need to move.

Clients are asked to play after wall hang, One leg standing and shoulder roll. Clients then freeze when they experience pain, restriction, or tension. Facilitator then applies pressure and clients moves, if they feel the need to move. After each grip the client plays to ensure they have no remaining points of pain, restriction or tension.

Hold	Description grips scripted for right foot
Wall Hang Procedures	Client positioned in the corner with in pool railings or hold onto side using weights. A neck collar can be used for comfort, but is not encouraged.
Foot grip	Right foot right hand on top. Stand on the right side of the client at 45°. Base of thumb is over the space between the 4th & 5th metatarsal. Fingers wrap under the arch of the foot. Left hand cups the calcaneous. Grip is firm. Top hand plantar flexes the foot. Both hands tilt the foot so the bottom surface of the foot is facing midline, in inversion.
Ankle grip	Facilitator faces client right foot with right hand on top. Thumb grips below lateral malleolus, use side of first finger or middle finger, grip below the medial malleolus.

(*continued*)

Hold	Description grips scripted for right foot
	Heel of left hand cups under the heel of the foot. Press heel upwards towards pelvis, and plantar flex foot down
Toe grip	Facilitator stands 45° to client. Using hand closest to client wedge thumb between 1st & 2nd metatarsal (thumb faces midline). Maintaining flat thumb on top of the right foot provide a medial pressure. Using the hand furthest from the client, grip the toe and provide slight distal distraction outwards.
IT band pump	Proximal hand, facilitator places pad of thumb just below ITB & wraps hand around top of thigh. Using a pump action facilitator flexes clients knee with distal hand and extends client's knee with proximal hand. Pressure is applied to ITB with pad of thumb on extension. Facilitator holds pressure on tender point when found and uses circular motion to trigger intuitive movement.
Hip rock & roll	Facilitator places proximal hand flat on S1-L5 joint, distal hand cups under client's knees. Client is instructed to bring knees to chest and extend as client moves facilitator allows back to drop then lifts on extension facilitator moves hand up back with each pump until hand reachesL1/L2.
One Leg Standing weighted procedures	Appox 3 kg weight is placed on leg proximal to poolside. Client stands with proximal leg parallel to wall and holds wall with both hands to assist traction. Water should be approximately waist deep on client.
One leg standing & Hip Fulcrum	Facilitator uses foot grip, leans away from client to create traction, move anteriorly to posterior in the horizontal plane. During hip extension move medially, proximal hand applies pressure in the lumbo-sacral region. Distal hand supports under the elevated leg just above knee. Client is asked to bend/ straighten leg. Facilitator follows and accents flexion/extension then adds hip rotation.
Lean back	Client stands with legs wide, feet stay planted on floor with approx 3 kg weights on both legs.
	Facilitator stand behind client. Sides of hands on trapezius, middle finger supports jaw, Thumbs support under Occiput. Lean client back accent rotational movement.
Lean forwards	Client leans forwards and holds the wall, with approx 3 kg weights on both legs. Facilitator pressures one hip forward and begins hip movements. Maintain pressure whilst client moves. Repeat left side then alternate.
Shoulder roll	Client stands sideways and holds pool wall. Facilitator places proximal hand on top of shoulder, upper trapezius, and supraspinatus. Distal hand holds clients arm midway between shoulder and elbow, assisting client to rotate shoulder and adding traction.

Description for AquaStretch technique as described by Eversaul et al. (2013), Eversaul and Sherlock (2013), Huss (2014), Denomme and Jasinskas (2013).

AquaStretch is a one-on-one, assisted stretching and myofascial release technique. It is performed in shallow water and uses weighted resistance.

AquaStretch is a 9-step procedure, the purpose of this technique is to release myofascial adhesions which can form between muscle fibres, tendons, ligaments, nerves, organs, lymph glands, blood vessels, or anywhere within the body that has fascia. (Eversaul and Sherlock, 2013).

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