Multi-modal
Peri-operative Pain Management –
An Evidence-based
Physiotherapy Perspective

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Contents

* Introduction

* Peri-operative Physiotherapy Management
  - From Past to Present: Illustration with Surgical Conditions
  - Physiotherapy Pain Management: Musculo-skeletal Conditions

* Summary
Physiotherapy in Hong Kong

- Physiotherapy (PT) started in Hong Kong more than ½ century
- Queen Elizabeth Hospital (QEH) opened 1963
- HK PT Training School opened in 1960 & moved to QEH in 1963

(Smith, 1978)
In 2012/13,

* 444,342 operations conducted at hospitals of Hong Kong Hospital Authority
  ➢ Over 19,000 inter-mediate to ultra-major operations at QEH
* Peri-operative physiotherapy service provided

(Hospital Authority Statistical Report 2012-2013)
Common Problems after Surgery

- Wound pain / musculoskeletal pain
- Cardiorespiratory dysfunction
- Circulatory venous dysfunction
- Pneumonia & other infection
- Joint swelling
- Joint lack of movement
- Muscle atrophy
- Postural imbalance
- Pressure ulcer

Vital Signs
- Temperature
- Blood Pressure
- Pulse
- Breathing Rate
- Pain (5th vital sign)

Complex & multi-faceted

50% inadequate management of post-operative pain

(Chung & Lui, 2003; McCaffery & Pasero, 1997; Sinatra, 2010; Sivrikaya, 2012)
The Biopsychosocial Model of Pain

Pain Represents a Biopsychosocial Problem, with Maladaptive Changes in the Central Nervous System (CNS), Musculoskeletal System and the Cognitive Level

(Bastian et al., 2014; Main & Williams, 2002; Nijs et al., 2015)
The Pain Cycle:

Pain Affects Mobility & Functions

Multi-modal Peri-operative Pain Management & Fast-tracked Rehabilitation

(Meyr & Saffran, 2008)
Peri-operative Pain Management

- Pre-operative
- Intra-operative
- Post-operative

Pharmacological Approach

Non-Pharmacological Approach: Physiotherapy

(Spry, 2005)
Non-pharmacological Approach

- Multi-modal: Physical, cognitive, behavioral & others
- Enhance recovery & shorten hospital stay
- Prevent development of chronic pain
- Safe, effective & individualized care

(Gandhi & Viscusi, 2009; Hartrick, 2004; Sivrikaya, 2012)
Multi-modal PT Management for Surgical Pain

Pain Relieving Modalities
(e.g. acupuncture, TENS, heat / cold therapy, IFT, US, MTP etc.)

Early Supervised Mobilization

Education / Psychological Support

Tailored-Exercise Program

Graded Muscle Strengthening

Wound Support & Transfer Technique

(Meyr & Saffran, 2008)
Usual Patient’s Journey – PT Perspectives

* Pre-operative
  - Baseline assessment & physical conditioning
  - Psychological preparation
  - Education

* Intra-operative

* Post-operative
  - Pain management
  - Post-operative rehabilitation
  - Home care & advice

Objectives:
* Achieve the best possible physical condition
* Use the less time
* Diminish complication risks
* Facilitate further rehabilitation
* Early recovery / discharge & full social participation

(Varela et al., 2013)
Multi-modal Peri-operative PT Pain Management Delivery Model

**Ward**
Pre-operative education & fast-tracked rehabilitation to our needy patients

**Day Care Centre**
Enhanced one-stop pre-admission service (same day surgery, same day discharge)

**OPD Clinic**
Continuum of care: timely referral to PT OPD to enhance recovery

**Community**
Tailor-made home program / pain control; patient empowerment
### Summary of Effects of Physiotherapy for Patients Receiving Abdominal / Cardiothoracic Surgeries

<table>
<thead>
<tr>
<th>Study</th>
<th>Subject Characteristic</th>
<th>Design</th>
<th>Treatment Regime</th>
<th>Measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheifetz et al., 2010</td>
<td>Patients scheduled to undergo major abdominal surgery via laparotomy (n=75)</td>
<td>RCT</td>
<td>Intervention group wore abdominal binder</td>
<td>1. Preoperative measurements of 6-minute walk test (6MWT) distance</td>
<td>The intervention group got improved 6MWT distance by day 5 was greater (p &lt; 0.05). No blinder group got significantly increased pain and symptom-associated distress following surgery (p &lt; 0.05)</td>
</tr>
<tr>
<td>Herdy et al., 2008</td>
<td>Patients scheduled for CABG in hospital (n=56)</td>
<td>RCT</td>
<td>Intervention group consisted of phase I cardiac rehabilitation associated with respiratory physical therapy for at least 5 days preoperatively until discharge</td>
<td>1. Time to endotracheal extubation</td>
<td>The intervention group got a shorter time to endotracheal extubation (1054 +/- 666 min, P = 0.05), a reduction in the incidence of pleural effusion (relative risk [RR] = 0.2; 95% confidence interval [CI]: 0.5-0.8), pleural effusion (RR = 0.15; 95% CI: 0.03-0.8), atelectasis (RR = 0.15; 95% CI: 0.03-0.8), pneumonia (0 vs. 7 cases, p = 0.004), and atrial fibrillation or flutter (RR = 0.2; 95% CI: 0.05-0.8) as well as a shorter length of hospital stay (p&lt; 0.001)</td>
</tr>
<tr>
<td>Manzano et al., 2008</td>
<td>Patients scheduled for elective upper abdominal surgery (n=31)</td>
<td>RCT</td>
<td>Intervention group received chest physiotherapy on the day before surgery and on the second postoperative day</td>
<td>1. Spirometry</td>
<td>The intervention group presented improved oxygen-hemoglobin saturation during the immediate postoperative period (p &lt; 0.03)</td>
</tr>
<tr>
<td>Mackay et al., 2005</td>
<td>Patients undergoing open abdominal surgery, at high risk of developing postoperative pulmonary complications (n=56)</td>
<td>RCT</td>
<td>Intervention group received early mobilisation</td>
<td>1. Incidence of clinically significant postoperative pulmonary complications</td>
<td>There was no significant difference between groups in the incidence of postoperative pulmonary complications (absolute risk reduction -3%, 95% CI: -22 to 19%), fever, physiotherapist time, or the number of treatments (p&gt;0.05)</td>
</tr>
</tbody>
</table>
Pre-operative Physiotherapy
Pre-operative Education Talk

* Pre-operative **anxiety** influences patients to experience **more pain** after surgery

* Pre-operative information
  - **Decrease** post-operative **pain**
  - **Reduce** pre-operative **anxiety**
  - **Improve** patients’ **satisfaction** with post-operative **pain management**

(Irwin & Tecklin, 2004; Sjoling et al., 2003)
Educational Leaflet

* Educate wound support technique
* Reinforce breathing & coughing exercise
* Emphasize early mobilization
Pre-op Optimization

* Incentive spirometers
* Cardio-pulmonary fitness assessment & training for optimizing surgical outcomes (Irwin & Tecklin, 2004)

Incentive spirometers for adult and children

Lung function test  Cardio pulmonary exercise test  Aerobic exercise training
Post-operative Physiotherapy
Post-op PT Care

Post-operative chest physiotherapy & breathing exercises

Huffing is a forced expiratory technique with exhaling through an open mouth & throat – less painful!

Wound support coughing / huffing

Augmented transfer technique & bedside mobility training
Early Limb Mobilization & Training

Ankle & toes mobilizing exercise (ankle pump), & anti-embolism stocking prevent deep vein thrombosis

Wound support vest, early ambulation & exercise training
Fast-tracked Rehabilitation & Early Mobilization:
Enhance Recovery & Reduce Morbidity
Multi-modal approach incorporates surgeons, anesthesiologists, physical therapists & nurses, with:
- Comprehensive pre-operative assessment & education
- Evidence based practice in anesthesia
- Minimally invasive procedures and analgesia
- Early feeding & ambulation

Early physiotherapy – early extubation, sitting in a chair for > 1 hour on the post-operative day, & ambulation by post-operative day one

(Ambrosino & Gabbrielli, 2010; Makhabah et al., 2013; Patel & Hall, 2013)
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<tr>
<td>Barker et al., 2013</td>
<td>Patients undergoing metal-on-metal hip resurfacing arthroplasty (n=80)</td>
<td>RCT</td>
<td>Intervention group consisted of accelerated post-operative physiotherapy programme</td>
<td>1. Oxford Hip Score (OHS) 2. Hip disability and Osteoarthritis Outcome Score (HOOS) 3. EuroQol (EQ-5D) 4. UCLA activity score 5. Hip range of motion 6. Hip muscle strength</td>
<td>Intervention group led a higher one year the mean OHS (p &lt; 0.001) as well as statistically significant increase in HOOS (p &lt; 0.0005) and UCLA activity score (p &lt; 0.019) and improved EQ 5D (p &lt; 0.0005) 80% of the intervention group fully met their self-selected goal Increased hip range of motion in terms of flexion, extension and abduction (p &lt; 0.05)</td>
</tr>
<tr>
<td>Wang et al., 2011</td>
<td>Patients after resection of colorectal cancer (n=106)</td>
<td>RCT</td>
<td>Intervention group were encouraged to have early oral feeding and movement for early discharge</td>
<td>1. Gastrointestinal functions 2. Postoperative complications 3. Hospital stay time</td>
<td>Intervention group led to faster restoration of gastrointestinal functions (p &lt; 0.01) and lower 30-day complications (p &lt; 0.05) and shorter postoperative hospital stay time (p &lt; 0.01) No significant difference was observed in the readmission rate 30 d after both groups</td>
</tr>
<tr>
<td>Serclova et al., 2009</td>
<td>Patients scheduled for open intestinal resection (n=105)</td>
<td>RCT</td>
<td>Intervention group was fast-track (FT) rehabilitation with the emphasis on an interdisciplinary approach</td>
<td>1. Post-operative pain 2. Duration of restoration of gastrointestinal functions 3. Post-operative complications 4. Post-operative length of stay (LOS)</td>
<td>Intervention group led to significantly better control of postoperative pain and faster restoration of GI functions (p&lt;0.001), better food tolerance, shorter hospital stay (p&lt;0.001) and significant lower postoperative complications within 30 postoperative days (p=0.003)</td>
</tr>
<tr>
<td>Larsen et al., 2008</td>
<td>Patients scheduled to undergo elective primary total hip replacement, total knee replacement or unicompartmental knee arthroplasty (n=87)</td>
<td>RCT</td>
<td>Intervention group consisted of a new accelerated perioperative care and rehabilitation procedure</td>
<td>1. LOS in hospital 2. EQ-5D from baseline to 3-month follow-up</td>
<td>Intervention group reduced mean LOS (p &lt; 0.001); was accompanied by a greater gain in QOL (p = 0.03)</td>
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**Fast-tracked rehabilitation program**

**reduced incidence of pulmonary complications, enhanced recovery & reduced length of stay in post-operative patients**
Recent Advances in Multi-modal Peri-operative PT Management
Recent Advances in Multi-modal Peri-operative PT Management - 1

* Facilitate patient recovery & reduce morbidity with advanced equipment
* Promote early mobilization on bed / in upright position for patients with stable acute condition

(Patel & Hall, 2013)

Active / Passive Limb Mobilizer – at bed’s end for early lower limb mobilization (cycling in bed)
Recent Advances in Multi-modal Peri-operative PT Management - 2

Neuromuscular Electrical Stimulation with Graded Muscle Strengthening Exercise – prevent disuse muscle atrophy & muscle weakness

Acupuncture & Acu-TENS – provide pain relief & facilitate mobilization
Recent Advances in Multi-modal Peri-operative PT Management

Tilt-table – graded weight bearing exercise & vaso-motor training

Tilt-table with In-built Computerized Stepper – additional benefit of stepping exercise to strengthen very weak lower limb muscles for fragile patient
Past

Off ventilator; multiple pieces of accessories carried for ambulatory training; labour-intensive

Present

Portable ventilator & monitor incorporated to mobility aid – facilitate early mobilization; adequate support; less effort & reduce pain

Various walking aids to facilitate ambulation
Multi-modal Peri-operative PT Pain Management in Musculoskeletal Conditions
Common problems encountered by patients

* Musculoskeletal pain upon movement
* Kinesiophobia (Fear to move)
* Joint swelling
* Joint stiffness
* Muscle atrophy
* Postural imbalance

Significantly affect mobility, leading to more symptoms of depression, low self-efficacy and quality of life (Svensson et al., 2011)

Emphasis of physiotherapy program for patients after orthopaedic surgery

* Early pain relief for better pain management
* Early rehabilitation for physical optimization
## Literatures on Benefits of Physiotherapy Program for Patients Receiving Orthopaedic Surgery

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<tr>
<th>Study</th>
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<th>Results</th>
</tr>
</thead>
</table>
| Villadsen et al., 2014       | Patients scheduled for hip or knee arthroplasty due to severe osteoarthritis (n=153) | RCT    | The intervention group consisted of an 8-week preoperative supervised exercise program twice a week for 1 h as adjunct treatment to the standard arthroplasty procedure | 1. Pain scale  
2. Self-reported physical function measured on the activities of daily living (ADL) subscale in the Hip disability and Osteoarthritis Outcome Score (HOOS)  
3. The Knee injury and Osteoarthritis questionnaires | There was no statistically significant difference in effects between hip or knee patients (p=0.7370)  
Three months postoperatively, no difference was found between groups for ADL or pain (p>0.05)  
Intervention group got a statistically significant effect of exercise over the entire period (baseline to 3-months postoperatively) (p=0.0029) |
| Stevens-Lapsley et al., 2012 | Patients scheduled to undergo a primary unilateral total knee replacement (TKA) (n=66) | RCT    | Intervention group consisted of standard rehabilitation plus neuromuscular electrical stimulation (NMES) applied to the quadriceps muscle (initiated 48 hours after surgery; twice per day at the maximum tolerable intensity for 15 contractions) | 1. Muscle strength of quadriceps and hamstring  
2. Knee range of motion  
3. Timed up and go test  
4. Stair-climbing Test  
5. Six-minute walk test  
6. Self-report measures | Knee extension active range of motion (p<0.05) at 3.5 week  
At 52 weeks, improvements with NMES were still significant for quadriceps and hamstring muscle strength, functional performance, and some self-report measures |
| Rahmann, Brauer & Nit, 2009  | Patients undergoing primary hip or knee arthroplasty (n=65) | RCT    | Participants were randomly assigned to receive supplementary inpatient Physiotherapy, beginning on day 4: aquatic physiotherapy, nonspecific water exercise, or additional ward physiotherapy | 1. Strength  
2. Gait speed  
3. Functional ability | Hip abductor strength was significantly greater after aquatic physiotherapy intervention than additional ward treatment (P.001) or water exercise (P.011). No other outcome measures were significantly different at any time point in the trial, but relative differences favored the aquatic physiotherapy intervention at day 14 |

### Supervised Physiotherapy program reduced pain, improved **muscle strength and functional performances** for patients after orthopaedic surgery.
<table>
<thead>
<tr>
<th>Study</th>
<th>Subject Characteristic</th>
<th>Design</th>
<th>Modalities</th>
<th>Measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebadi et al., 2012</td>
<td>Non-specific chronic low back pain</td>
<td>RCT</td>
<td>1) Continuous US (1 MHz &amp; 1.5 W/cm) plus exercise&lt;br&gt;2) Placebo US plus exercise</td>
<td>1. Functional disability, measured by Functional Rating Index&lt;br&gt;2. Visual analog scale.&lt;br&gt;3. Lumbar flexion and extension range of motion (ROM)</td>
<td>Both groups had improved regarding function (FRI) and global pain (VAS) (P &lt; .001). Lumbar ROM as well as holding time during the Sorensen test and median frequency slope of all measured paravertebral muscles did not change significantly in either group (P &gt; .05). Improvement in function and lumbar. ROM was significantly greater in the group receiving US (P &lt; .05)</td>
</tr>
<tr>
<td>Nelson &amp; Zvirbulis, 2013</td>
<td>Early OA knee</td>
<td>RCT</td>
<td>1) Pulsed electromagnetic field (PEMF), for 15 min twice daily&lt;br&gt;2) Placebo PEMF</td>
<td>1. VAS pain score</td>
<td>Results showed VAS pain score decreased in the active cohort by 50 ± 11 % versus baseline starting at day 1 and persisting to day 42 (P&lt;0.001). The overall decrease in mean VAS score for the active cohort was nearly threefold</td>
</tr>
<tr>
<td>Cramer et al., 2014</td>
<td>Chronic neck pain</td>
<td>RCT</td>
<td>1) Placebo US&lt;br&gt;2) Active TENS, Pulsed PEMF, for 15 min twice daily</td>
<td>1. VAS pain score&lt;br&gt;2. Pain at rest&lt;br&gt;3. FMRS&lt;br&gt;4. ROM&lt;br&gt;5. SLS&lt;br&gt;6. MRI&lt;br&gt;7. Other</td>
<td>Group differences for the Lysholm, SF-36, Physical function, ADL, and VAS pain intensity were all significant (P &lt; .001). Furthermore, no significant differences were noted for any of the circumferential measurements either between groups or time points</td>
</tr>
<tr>
<td>Waterman et al., 2012</td>
<td>Patients undergoing ACL reconstruction</td>
<td>RCT</td>
<td>1) Active TENS&lt;br&gt;2) Placebo TENS&lt;br&gt;3) No TENS</td>
<td>1. Pain and fatigue at rest&lt;br&gt;2. Movement pressure pain thresholds (PPTs)&lt;br&gt;3. 6 minute walk test (6MWT)&lt;br&gt;4. Range of motion (ROM),&lt;br&gt;5. Five time sit to stand test (FTSTS)&lt;br&gt;6. Single leg stance (SLS).</td>
<td>Pain with movement (during the 6MWT) was significantly less during active TENS (4.0 ± 0.4) when compared to placebo (4.7 ± 0.4) (p&lt;0.05) or no TENS (5.0 ± 0.4) (p&lt;0.05). Fatigue with movement (during the 6MWT) was significantly different after treatment between active TENS (4.4 ± 2.3) and placebo TENS (5.5 ± 2.6) (p&lt;0.05), and between active TENS and no TENS (5.0 ± 2.7) (p&lt;0.01). PPTs over the anterior tibialis muscle were significantly increased during active TENS when compared to no TENS (p&lt;0.05). There were no significant differences in ROM, FTSTS , SLS and 6MWT</td>
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</table>

**Physiotherapy electro-physical modalities (i.e. ultrasound, electromagnetic therapy, cryotherapy and transcutaneous electrical nerve stimulation etc.) were all effective for pain management in various orthopaedic conditions**
Multi-modal Peri-operative PT Pain Management in Open Surgery: Patients with Fractured Femur
No. of IP Discharges and Deaths in Fractured Femur in HA Hospitals (2010-2014)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of IP Discharges and Deaths</th>
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<tbody>
<tr>
<td>2010</td>
<td>10,600</td>
</tr>
<tr>
<td>2011</td>
<td>10,800</td>
</tr>
<tr>
<td>2012</td>
<td>11,000</td>
</tr>
<tr>
<td>2013</td>
<td>11,200</td>
</tr>
<tr>
<td>2014</td>
<td>11,400</td>
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</tbody>
</table>

Average number: HA: 11,704

High patient volume suffering from fractured femur. Overall increased by ~7%.
Pre-operative Education: Lower Anxiety & Pain Level

- Education of positioning & activity modification to reduce patients’ pain level
- Promote concept of self pain management

Cochrane Database of Systematic Reviews (2014): Pre-operative education lowered post-operative anxiety & pain level after surgery (McDonald et al., 2014)

- Pamphlets / booklets to enhance self pain management
- Individualized & tailor-made education
- Positioning to reduce pain
Multi-modal Peri-operative Pain Management in Patients with Fractured Femur

**Acute Pre-operative and Post-operative Pain Management**

- **Cryotherapy / Cryopneumatic therapy**
  - ↓ pain, swelling & stiffness

- **Transcutaneous electrical nerve stimulation (TENS)**
  - ↓ pain, user friendly and portable

- **Heat therapy**
  - ↓ pain & muscle spasm

- **Magnetic therapy & ultrasound**
  - enhance soft tissue healing
Early Ambulatory Training: ↓ Post-operative Pain Level

Protocol: Approximately four hours post-operatively, with the local anaesthetic still effective, each patient was assessed by a physiotherapist and commencing full weight-bearing exercises using walking aids, and gait reeducation (Smith et al., 2012)

Early ambulatory training for patients with THR / TKR could ↓ pain level, ↓ length of stay and improved functional performances overall

Different mobile pain relieving devices & walking aids for early ambulation on level ground & stairs
Multi-modal
Peri-operative PT Pain Management in
Day Surgery Patients / Patients with
Minimally Invasive Surgery
Patients with **Day Surgery or Same Day Surgery** in HA Hospitals (2010-2014)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Surgeries</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>98,000</td>
</tr>
<tr>
<td>2011</td>
<td>100,000</td>
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<tr>
<td>2012</td>
<td>102,000</td>
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<td>2013</td>
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<td>2015</td>
<td>108,000</td>
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<tr>
<td>2016</td>
<td>110,000</td>
</tr>
<tr>
<td>2017</td>
<td>112,000</td>
</tr>
<tr>
<td>2018</td>
<td>114,000</td>
</tr>
</tbody>
</table>

Overall increased by ~6% in HA hospitals

Average number: HA: 110,356

(Clinical Data Analysis and Reporting System, Hospital Authority, accessed 14 April 2015)
Patients with **Knee Arthroscopic Surgery** in QEH (2010-2014)

![Bar chart showing the number of surgeries from 2010 to 2014.](Clinical Data Analysis and Reporting System, Hospital Authority, accessed 14 April 2015)

- **2010**: 80
- **2011**: 100
- **2012**: 120
- **2013**: 140
- **2014**: 160

Average number: QEH: 96

Overall increased by ~33% in QEH
Overview of Multi-modal Peri-operative PT Pain Management in Day Surgery Centre

- Relatively young, better physical ability
- One-stop peri-operative service
- Early & timely PT response & services
- Pain relief and functional training to facilitate same day discharge and earlier return to work / sports

Functional training to facilitate same day discharge

A set of pre-prepared package of home-based pain management & exercises program for patient empowerment

Cryotherapy
Heat therapy
Manual therapy and home-based exercises
Sports taping
Patients with Anterior Cruciate Ligament (ACL) Surgery

Arrange Timely FU at PT OPD upon D/C from Day Surgery Centre

Pain Management Program

Cryotherapy & cryopneumatic therapy

Magnetic therapy
Structural Training Program after ACL Surgery

Accelerated rehabilitation program

- Supervised strengthening exercises
- Agility & speed training
- Computerized assessment & isokinetic training

PAIN CYCLE

- Tailored Exercise
- Graded Muscle Strengthening
- Early Supervised Mobilization

Working specific muscles at a constant rate with accommodating resistance

Protect vulnerable soft tissue while training → more safe & less pain
Education Materials Designed for Patients with ACL Surgery

Pamphlets, booklets & display boards

Comprehensive & easily accessible information for patients to learn about pain management & home exercises
Hydrotherapy for Pain Relief in Orthopaedic Conditions

Underwater gymnasium for orthopaedic clients

Hydrotherapy class and individualized exercise

**Hydrotherapy**: thermal treatment using water as a media with temp ranged from 28 – 35°C

By using different water properties (buoyancy, viscosity, hydrostatic pressure etc.) to achieve various therapeutic purposes (i.e. ↑ROM, ↑strength and ↓pain)

(Becker, 2009)
Hydrotherapy for patients with OA knee had a better pain relief & functional improvement with possible mechanism of decreased kinesiophobia (fear to move) & concurrent improvement in symptom & quality of life measures (Lau, Chung & Cheung, 2013).

Under-water exercise was a better starting media for rehabilitation than land exercise for OA patients because of less joint loading (Cochrane Database of Systematic Reviews 2009; Roper et al., 2013).
Physiotherapy multi-modal interventions tackle different elements of pain cycle at various time points of peri-operative phases.

Tackling multiple elements of pain cycle → achieve a synergistic effects and hence a better outcome in our multi-modal peri-operative pain management.
Thank You