# Chapter 26 -2

Proprioceptive Neuromuscular Facilitation Approach

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# History

- PNF的理論是根據正常動作發展的順序。
- 在PNF的理論中，日常生活中所有的動作都是以一整套的動作儲存在腦中，並且在本質上都具有可逆性與斜向性。
- 1950年代，一位神經科醫師Dr. Herman Kabat開始治療小兒痲痺與Multiple Sclerosis的病患，並且與Margaret Knott (PT)一同發展PNF的理論。
- 至1951年，已運用在不同種類的病患，包括CVA、SCI、Arthritis與Hand Injury。



- Definition

→**Proprioceptive**:

Sensory receptors that give information concerning movement and position of the body

→**Neuromuscular**: Involving the nerves and muscles

→**Facilitation**: Making easier



# PNF approach as taught by Voss

- Definition by Voss
  - A method of promoting or hastening neuromuscular mechanism response through stimulation of the proprioceptors
- Utilizes sensory tools additively after evaluating the functional problem and identifying the necessary diagonal patterns of movement
- Incorporates attention to therapeutic application of breathing

# The rational requirement for developed movement capacities

- All parts of the body, head and neck, trunk, and limbs, have two diagonal patterns based on normal motor activity, and the motor pattern itself is a method of facilitation.
- Stronger muscles in diagonal pattern influence weaker muscles.
- The skeletal, ligamentous, and muscular systems of the body support these pattern. (Diagonal patterns )



# PNF Diagonal Patterns

- Combinations of the cardinal plane movements of flexion or extension, abduction and adduction, and internal or external rotation
- Inclusion of rotary component in all movement patterns.
- Functional reversing patterns; balance of antagonists
  - Treatment must start with techniques that focus on agonist (lacking balance).
- Performed in all three planes of movement simultaneously
  - Sagittal, Frontal, Horizontal



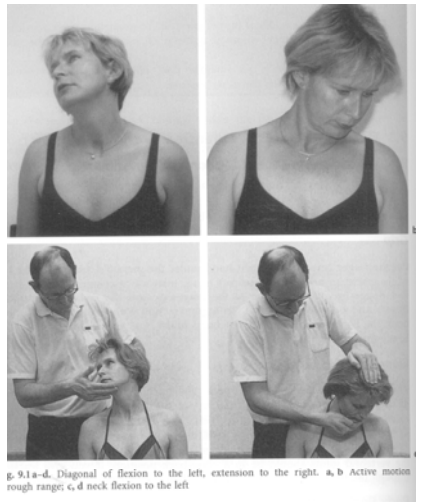
# The two diagonal patterns of movement for each body part

1. Head and Neck, Trunk
2. Upper Extremity (UE)
3. Lower Extremity (LE)
4. Bilateral Symmetrical (BS) D2 Pattern of the Upper Extremities Combined with Trunk Movements



# Head and Neck, Trunk (p216)

- Flexion with rotation to the right (reverse by extension with rotation to the left)
- Head and neck patterns are usually combined with patterns of the trunk and extremities.



g. 9.1 a–d. Diagonal of flexion to the left, extension to the right. a, b Active motion rough range; c, d neck flexion to the left

- Trunk pattern
  - chopping — trunk flexion with rotation
    - leading arm: D1 extension
    - following arm: D2 extension
  - reverse chopping — trunk extension with rotation
    - leading arm: D2 flexion
    - following arm: D1 flexion
  - ★lifting — trunk extension with rotation
    - ★leading arm : D2 flexion
    - ★following arm : D1 flexion
  - ★reverse lifting — trunk flexion with rotation
    - ★leading arm : D1 extension
    - ★following arm : D2 extension



# Upper Extremity

- named by the direction of movement at the shoulder joint
- Patients are always directed to look at their hand while they move.
- All PNF patterns represent functional range of motion.

- Chopping (p.231)
  - Bilateral asymmetrical upper extremity extension with neck flexion to the same side to exercise the trunk flexor muscles.

- Lifting (p.235)
  - Bilateral asymmetrical upper extremity flexion with neck extension to the same side to exercise trunk extension.

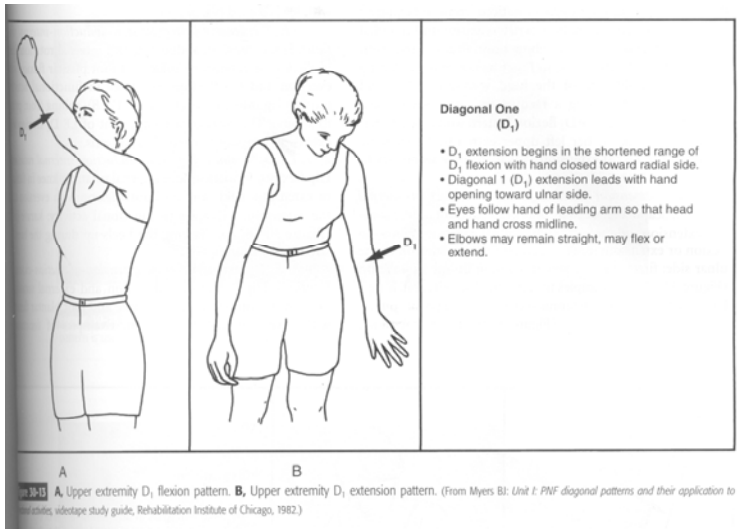


# Upper extremity

- D1 flexion
  - Scapula elevation, abduction, rotation
  - Shoulder flexion, adduction, external rotation
  - Elbow flexion or extension
  - Forearm supination
  - Wrist flexion to the radial side
  - Finger flexion and adduction, thumb adduction
- D1 extension
  - Scapula depression, adduction, rotation
  - Shoulder extension, abduction, internal rotation
  - Elbow flexion or extension
  - Forearm pronation
  - Wrist extension to the ulnar side
  - Finger extension and abduction, thumb palmar abduction



- D2 flexion
  - Scapula elevation, adduction, rotation
  - Shoulder flexion, abduction, external rotation
  - Elbow flexion or extension
  - Forearm supination
  - Wrist extension to the radial side
  - Finger extension and abduction, thumb extension
- D2 extension
  - Scapula depression, abduction, rotation
  - Shoulder extension, adduction, internal rotation
  - Elbow flexion or extension
  - Forearm pronation
  - Wrist flexion to the ulnar side
  - Finger flexion and adduction, thumb opposition




A, Upper extremity $D_1$ flexion pattern. **B,** Upper extremity $D_1$ extension pattern. (From Myers BJ: *Unit I: PNF diagonal patterns and their application to* ...tional activities, videotape study guide, Rehabilitation Institute of Chicago, 1982.)



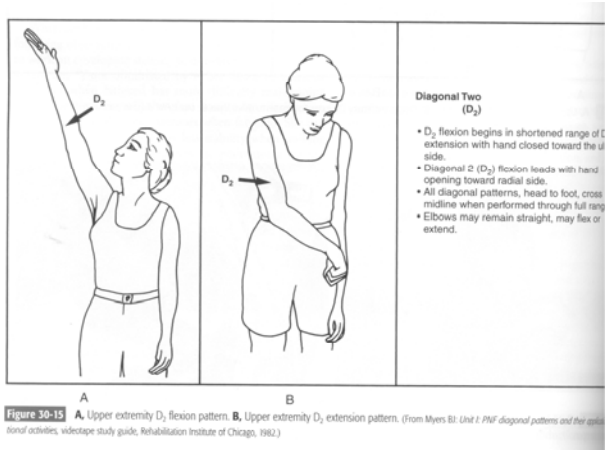
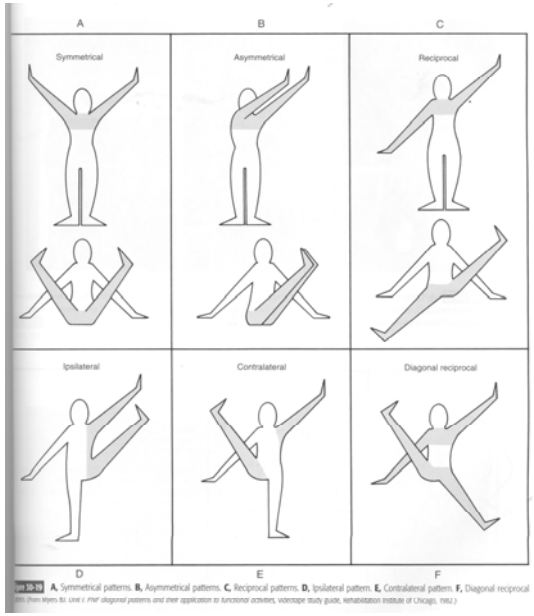



**Figure 30-15** A, Upper extremity $D_2$ flexion pattern. **B,** Upper extremity $D_2$ extension pattern. (From Myers BJ: *Unit I: PNF diagonal patterns and their appli...* ...tional activities, videotape study guide, Rehabilitation Institute of Chicago, 1982.)






A, Symmetrical patterns. **B,** Asymmetrical patterns. **C,** Reciprocal patterns. **D,** Ipsilateral pattern. **E,** Contralateral pattern. **F,** Diagonal reciprocal ... (From Myers BJ: *Unit I: PNF diagonal patterns and their application to functional activities*, videotape study guide, Rehabilitation Institute of Chicago, 1982.)



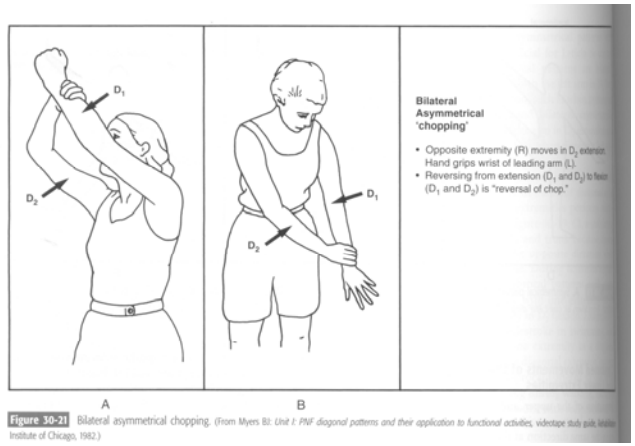
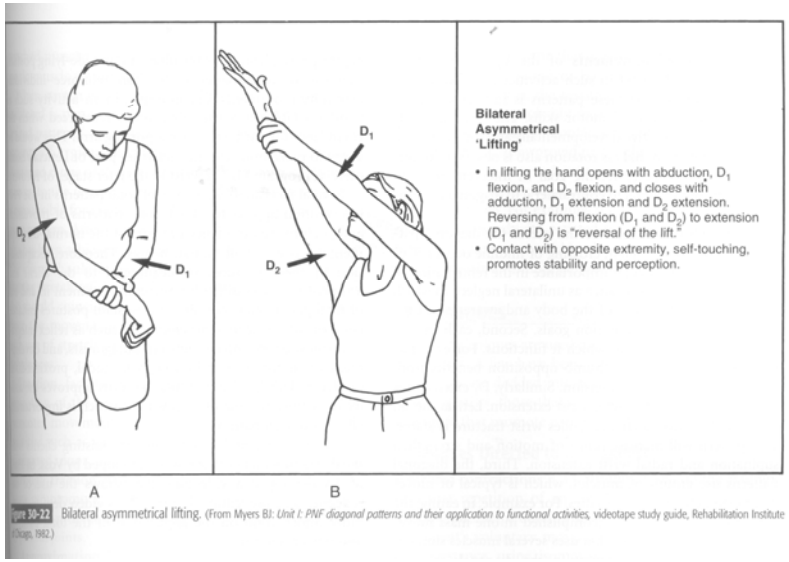



**Figure 30-21** Bilateral asymmetrical chopping. (From Myers BJ: *Unit I: PNF diagonal patterns and their application to functional activities*, videotape study guide, Rehabilitation Institute of Chicago, 1982.)



Bilateral asymmetrical lifting. (From Myers BJ: *Unit I: PNF diagonal patterns and their application to functional activities*, videotape study guide, Rehabilitation Institute (Chicago, 1982.)



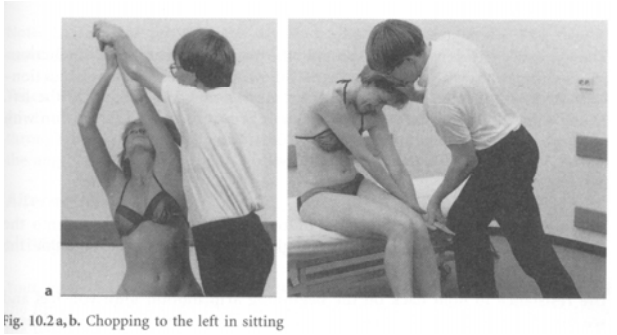
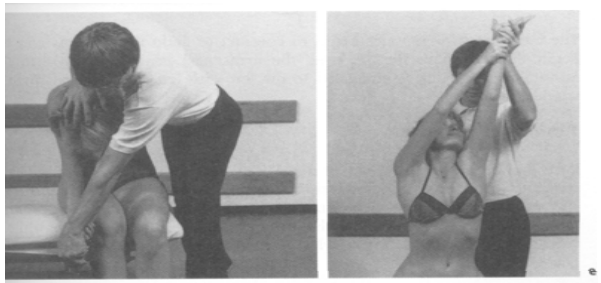


Fig. 10.2 a, b. Chopping to the left in sitting



10.3 a–e. Lifting: a, b lifting to the left in supine; c lifting to the right in prone; lifting to the left in sitting



- Diagonal one (D1) flexion (reverse chop) combines flexion, adduction, and external rotation at the shoulder.




- D1 reverses as D1 extension (chopping), which combines extension, abduction, and internal rotation at the shoulder.

- Diagonal two (D2) flexion (lifting) combines flexion, abduction, and external rotation at the shoulder.




- Diagonal two (D2) reverses as D2 extension (reverse lift), combining extension, adduction, and internal rotation at the shoulder.




# Lower Extremity

- Aim:
  - Used to facilitate functional ambulation
  - Used to retrain bowel and bladder function
- *Lower extremity D1 flexion*
  - hip：flexion, adduction, external rotation.，knee：flexion or extension，ankle：dorsiflexion, inversion，toe：extension。
- *Lower extremity D1 extension*
  - hip：extension, abduction, internal rotation.，knee：flexion or extension，ankle：plantar flexion, eversion，toe：flexion
- *Lower extremity D2 flexion*
  - hip：flexion, abduction, internal rotation.，knee：flexion or extension，ankle：dorsiflexion, eversion，toe：extension
- *Lower extremity D2 extension*
  - hip：extension, adduction, external rotation.，knee：flexion or extension，ankle：plantar flexion, inversion，toe：flexion




# Bilateral Patterns

- *Symmetric patterns*
  - 左右兩邊的上（下）肢同時作相同型態的動作。
  - 例如上肢同時做出D1 flexion 的動作，如同要從椅子上坐起時，兩手同時推椅子的動作。
- *Asymmetric patterns*
  - 左右兩邊的上（下）肢同時作出朝向軀幹某側的動作，使軀幹旋轉。
  - 例如右手作D1 flexion，而左手作D2 flexion的動作。當一手握住另一手作不對稱十的洞坐時，會出現所位的砍(Chopping)與抬(Lifting)的動作，如同網球選手兩手同時握拍，並作反手拉拍時的動作。
- *Reciprocal patterns*
  - 左右兩側的上（下）肢同時作相反的動作，使軀幹容易維持在中線。
  - 例如左手作D1 flexion 的動作，而右手作 D2 extension的動作。如同，投擲棒球時，最先的準備動作一般。

# Applications of Controlled Sensory Input in PNF

- Proprioceptive Stimuli
  - Traction and Approximation
  - Quick Stretch
  - Resistance
- Tactile Stimuli
- Auditory Stimuli
- Visual Stimuli



- Proprioceptive Stimuli
  - Traction and Approximation
    - Traction promotes stability by stimulating joint receptors sensitive to stretch.
    - Approximation promotes joint stability by compression of the joint surfaces.
  - Quick stretch
    - Similar to Rood Approach, but manual contacts to muscles are administered in lengthened range.
    - Always applied to all three components of the diagonal pattern
    - Emphasis on rotational components
    - Therapist's entire body is involved in application of quick stretch rather than just hands or arms
    - For example: D2 extension pattern and QS (F26-7)



For example: D2 extension pattern and QS (F26-7)





# Resistance

- Used to improve muscle contraction
- Therapist resists movement while still being part of the overall diagonal movement pattern of the patient.
- Can be applied in many different ways
  - End of ROM in a pattern
  - Intermittently while patient moves through pattern
  - Continuously throughout range of pattern

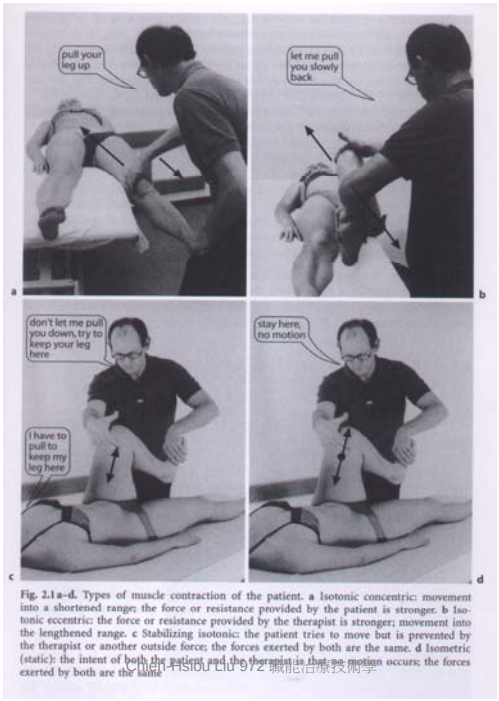



Fig. 2.1a–d. Types of muscle contraction of the patient. a Isotonic concentric: movement into a shortened range; the force or resistance provided by the patient is stronger. b Isotonic eccentric: the force or resistance provided by the therapist is stronger; movement into the lengthened range. c Stabilizing isotonic: the patient tries to move but is prevented by the therapist or another outside force; the forces exerted by both are the same. d Isometric (static): the intent of both the patient and the therapist is that no motion occurs; the forces exerted by both are the same



- Tactile Stimuli
  - 兩種主要的觸覺提供路徑
    1. Patient self-touch
    2. Therapist's manual contacts
  - Always applied in the necessary diagonal pattern (引導個案瞭解動作的方向)
- Auditory Stimuli
  - Tone of Voice
    - Sharp used for maximum stimulation
    - Moderate used to reinforce patient's best effort
    - Soft when patient has pain or is in aroused state
  - Commands
    - Prepare patient for what is going to happen
    - Timed to provide maximum stimulation
- Visual Stimuli
  - Used to facilitate movement
  - Gaze is in direction of movement
  - Timed congruent with other facilitory stimuli at initiation of movement



# Basic Techniques

- Slow Reversal
- Rhythmic Initiation
- Rhythmic Stabilization
- Contract relax
- Hold-relax



- Slow Reversal
  - Active motion changing from one direction (agonist) to the opposite (antagonist) without pause or relaxation.
  - Throwing a ball, bicycling, walking..
  - 利用拮抗肌的收縮之後的放鬆，促進目標肌肉的收縮。
  - Antagonist isotonic contraction (against resistance)→ agonist isotonic contraction

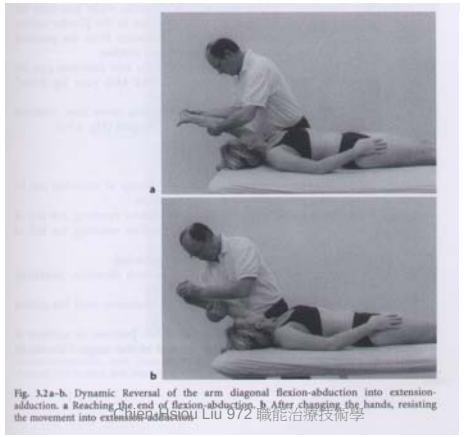



Fig. 3.2a–b. Dynamic Reversal of the arm diagonal flexion-abduction into extension-adduction. a Reaching the end of flexion-abduction. b After changing the hands, resisting the movement into extension-adduction

- Rhythmic Initiation (RI)
  - Rhythmic motion of the limb or body through the desired range, starting with passive motion and progressing to active resisted movement.
  - → To teach patient motion through passive active-assist and resist movement in the same direction
  - → Rhythm is solely uni-direction, effort is focused on the agonist group alone
  - for patient who have trouble initiating movement (Parkinson's disease)

- Description
  1. PROM rhythmically
  2. AROM in the desired direction, PROM for return motion
  3. Resist to active movement by T's
  4. Finish motion independently



- Rhythmic Stabilization
  - Alternative isometric contraction against resistance, no motion intended.
  - Muscle activity: agonistic and antagonistic activity (possible co-contraction)
  - For developing stability

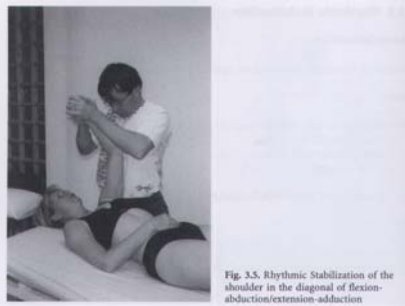


Fig. 3.5. Rhythmic Stabilization of the shoulder in the diagonal of flexion-abduction/extension-adduction



**Contract relax**

→ When pain does not present
→ Increase PROM
→ Intent of movement ( isotonic hold )
→ Work antagonist of desired movement
→ Allow a slight bit of rotation (12"~20")
→ Wait for relax
→ Passive or active into new range
→ Actively to increase strength of agonist into new ROM

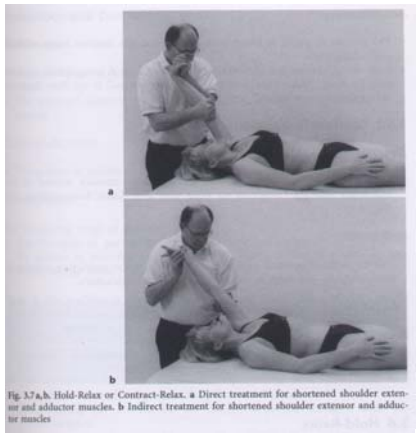


Fig. 3.7a,b. Hold-Relax or Contract-Relax. a Direct treatment for shortened shoulder extensor and adductor muscles. b Indirect treatment for shortened shoulder extensor and adductor muscles



**Hold-relax**

→ Pain with the patient
→ Increase ROM
→ Decrease pain
→ No intent of movement of patient ( isometric hold )
→ Work antagonist or agonist (12"~20")
→ No movement ( even rotation )

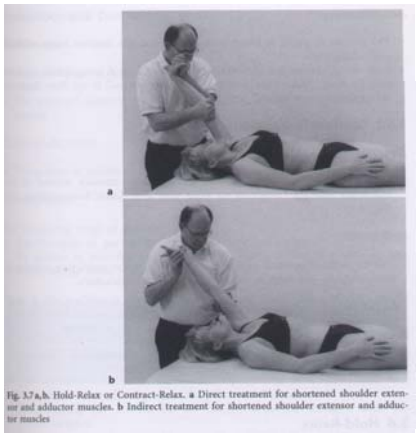
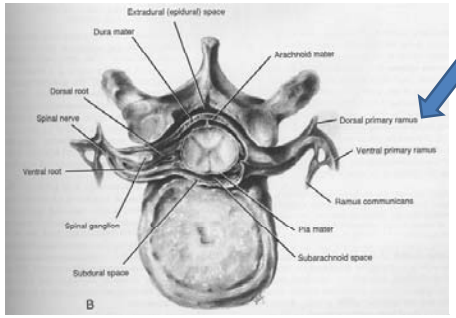
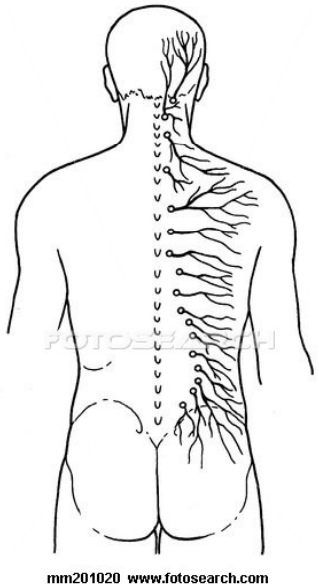


Fig. 3.7a,b. Hold-Relax or Contract-Relax. a Direct treatment for shortened shoulder extensor and adductor muscles. b Indirect treatment for shortened shoulder extensor and adductor muscles

## Primary ramus, posterior




http://members.cox.net/injections/images/snb_images/meninges.jpg




http://www.fotosearch.com/LIF156/mm201020/



## Anti-spasticity splint

http://www.abledata.com/product_images/images/94A1293.jpg

http://www.assistireland.ie/uploadedfiles/Product_Images/Orthoses/Upper_Limb/Progress_Individual_Finger_Ball_Splint_(PRO)_562.jpg



http://news.xinhuanet.com/health/2007-12/09/xin_382120409111221828983 4.jpg

http://yichen610306.pixnet.net/blog/category/457972



## side lying

## Prone extension

http://farm4.static.flickr.com/3197/3144234154_62176a9192.jpg www.universal-pilates.com/english/pilates2.html

## Neck cocontraction

## Prone on elbow

http://blog.lele3.com.cn/html/47/47-356.htm,

http://img1.pckids.com.cn/pckids/0807/18/299428_lzq-yuef-225.jpg