Acupuncture as *Neuromodulation*

ISLA- New Approaches in Medical Laser Therapy

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*Chair & Assistant Professor*

*Physical Medicine & Rehabilitation*

*Mayo Clinic Florida*
Goals of Presentation

Demonstrate Classical acupoints’
1. anatomic basis
2. effects require nerve stimulation and
3. intact CNS pathways
4. Laserneedle acupoint stimulation = optimal acupuncture(?)
What is Acupuncture?

• *acus “needle”* + *punctura “to puncture”*

• a group of procedures that stimulate precise body locations (acupuncture points) to produce clinical effects

• 361 Classical acupuncture points were described by ~200 A.D.

• Classical acupoints are grouped according to those with similar therapeutic properties on 1 of 12 Principal meridians (channels)

• Meridians named for the organ they influence (Heart, Gallbladder, Bladder, etc)
Acupuncture Meridians
Acupuncture “Pain”

Pain = obstruction of blood and/or energy flow in a meridian

(example: lumbar pain caused by block in Bladder channel)
Does Laser Acupuncture Work?
Clinical Evidence of Low Level Laser (LLL) Acupuncture Efficacy

• Clinical effectiveness of laser acupuncture: a systematic review (18 RCTs)
• Laser acupuncture benefits
  – myofascial pain
  – postoperative nausea + vomiting
  – chronic tension headache
• “a viable alternative to more traditional forms of stimulating acupuncture points”

Laser Acupuncture Efficacy for Pain

• Laser acupuncture for musculoskeletal pain
• 49 RCTs were of proper quality + described laser parameters adequately
• 31/49 (63%) → + outcomes
• inadequate laser dosage ↔ - outcomes
• LLL acupuncture benefits greater in long term than short term (!)
LLL Acupuncture: Musculoskeletal Pain

Pain at End of Intervention

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Std. mean difference IV, random, 95% CI</th>
<th>Std. mean difference IV, random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Myofascial pain/musculoskeletal trigger point</td>
<td>Kannan 2012</td>
<td>2.66</td>
<td>1.23</td>
<td>15</td>
<td>2.18</td>
<td>0.7058</td>
<td>30</td>
<td>5.1%</td>
<td>0.52 [-0.11, 1.15]</td>
</tr>
<tr>
<td></td>
<td>Carrasco 2009 (1)</td>
<td>6.73</td>
<td>1.65</td>
<td>10</td>
<td>6.75</td>
<td>1.49</td>
<td>10</td>
<td>4.2%</td>
<td>-0.01 [-0.89, 0.86]</td>
</tr>
<tr>
<td></td>
<td>Carrasco 2009 (2)</td>
<td>6.6</td>
<td>2.32</td>
<td>16</td>
<td>6.8</td>
<td>1.74</td>
<td>10</td>
<td>4.2%</td>
<td>-0.19 [-1.07, 0.69]</td>
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<tr>
<td></td>
<td>Carrasco 2009 (3)</td>
<td>7.04</td>
<td>1.72</td>
<td>10</td>
<td>5.97</td>
<td>1.6</td>
<td>10</td>
<td>4.2%</td>
<td>0.62 [-0.29, 1.52]</td>
</tr>
<tr>
<td></td>
<td>Dunker 2007</td>
<td>3.2</td>
<td>2.5</td>
<td>32</td>
<td>3.2</td>
<td>2.3</td>
<td>32</td>
<td>4.2%</td>
<td>0.01 [-0.49, 0.49]</td>
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<tr>
<td></td>
<td>Matsukani 2007</td>
<td>4.7</td>
<td>2.9</td>
<td>10</td>
<td>4.6</td>
<td>2.0</td>
<td>10</td>
<td>4.2%</td>
<td>0.04 [-0.64, 0.92]</td>
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<tr>
<td></td>
<td>Kirpal 2006</td>
<td>2.18</td>
<td>1.63</td>
<td>23</td>
<td>2.77</td>
<td>1.57</td>
<td>20</td>
<td>5.2%</td>
<td>0.36 [-0.97, 0.24]</td>
</tr>
<tr>
<td></td>
<td>Subtotal (95% CI)</td>
<td>2.05</td>
<td>1.43</td>
<td>20</td>
<td>2.97</td>
<td>2.33</td>
<td>20</td>
<td>5.0%</td>
<td>0.41 [-0.16, 0.98]</td>
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<tr>
<td></td>
<td>Halkgud 2003</td>
<td>3.41</td>
<td>2.0</td>
<td>31</td>
<td>5.77</td>
<td>2.1</td>
<td>31</td>
<td>5.4%</td>
<td>-1.27 [-1.71, -0.62]</td>
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<tr>
<td></td>
<td>Gur 2002</td>
<td>1.27</td>
<td>0.76</td>
<td>20</td>
<td>2.44</td>
<td>0.98</td>
<td>20</td>
<td>4.9%</td>
<td>0.17 [-1.00, 0.62]</td>
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<tr>
<td></td>
<td>Chen 1997 (6)</td>
<td>1.94</td>
<td>1.87</td>
<td>9</td>
<td>3.25</td>
<td>1.32</td>
<td>3</td>
<td>2.9%</td>
<td>-0.68 [-2.03, 0.67]</td>
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<tr>
<td></td>
<td>Chen 1997 (7)</td>
<td>0.83</td>
<td>1.29</td>
<td>7</td>
<td>3.25</td>
<td>1.32</td>
<td>2</td>
<td>1.9%</td>
<td>0.19 [-1.54, 0.24]</td>
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<tr>
<td></td>
<td>Ceccherelli 1989</td>
<td>4.96</td>
<td>13.17</td>
<td>13</td>
<td>37.42</td>
<td>16.58</td>
<td>14</td>
<td>4.1%</td>
<td>-1.30 [-2.72, -0.89]</td>
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<tr>
<td></td>
<td>Subtotal (95% CI)</td>
<td>3.84</td>
<td>0.33</td>
<td>303</td>
<td>71.78</td>
<td>37.02</td>
<td>303</td>
<td>97.7%</td>
<td>-1.18 [-1.87, -0.49]</td>
</tr>
</tbody>
</table>

Myofascial Pain Syndrome

Lateral Epicondylitis

Temporomandibular Joint Pain

Laws JAMS 2015; 8(1):2-16

(1) mean mm; (2) laser; (3) laser with placebo; (4) laser with active Ringer's lactate; (5) vs. dry needling;
LLL Acupuncture: Musculoskeletal Pain

<table>
<thead>
<tr>
<th>Pain Measured at Follow-up (6-26 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study or subgroup</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>i. Myofascial pain/musculoskeletal trigger point</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
</tr>
<tr>
<td>Heterogeneity: Tau-square = 1.18; Chi-square = 78.58, df = 9 (p &lt; 0.00001); I² = 89%</td>
</tr>
<tr>
<td>Test for overall effect: Z = 2.58 (p = 0.01)</td>
</tr>
<tr>
<td>ii. Lateral epicondylitis</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
</tr>
<tr>
<td>Heterogeneity: Tau-square = 0.55; Chi-square = 5.87, df = 1 (p = 0.02); I² = 83%</td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.70 (p = 0.09)</td>
</tr>
<tr>
<td>iii. Temporomandibular joint pain</td>
</tr>
</tbody>
</table>

Laws JAMS 2015; 8(1):2-16
LLL Acupuncture: Musculoskeletal Pain

• Positive studies occurred when appropriate laser energy provided:
  – ≥ 10 mW laser output power
  and
  – energy dose of ≥ 0.5 J per point

• Joules = Power (W) * Time (sec)
  – 50 sec at 10 mW or 5 sec at 100 mW

• Negative studies either did not properly describe laser parameters or applied inadequate dosage

*Laws JAMS 2015; 8(1):2-16*
What Is A Classical Acupuncture Point?

穴 位 = 穴 (xué) = hole, cave + 位 (wèi) = position, location
Acupuncture Point: “Hole”

- **Palpable depression**
- **Cleft** between bones, ligaments, tendons, muscles fibers, and/or muscles

*O’Connor & Bensky 1981*
Acupuncture Point: “Position”

Cun system:
- Proportional measurement system
- Surface anatomic landmarks
- Normalized to patient
- **Approximate Locations**

*O’Connor & Bensky 1981*
Acupuncture Point: “Sensitivity”

- “Our ancestors said ‘select five points to find the correct one’”
  
  *Dr Shi Neng-yun 1996*

- “…when locating the precise position of an acupuncture point, the most important single guide is sensitivity…”
  
  *O’Connor & Bensky 1981*
What Is Stimulated at Acupoints?

- Interstitial connective tissues \((\text{Langevin})\)
- Perivascular spaces \((\text{Ma})\)
- Hypodermic interstitial fluid migration channels \((\text{Li})\)
- Bonghan circulatory system \((\text{Soh})\)
- Cutaneous intrinsic visceral afferent nervous systems \((\text{Silberstein})\)
- Neurovascular bundles \((\text{Dorsher})\)
Anatomic Evidence

*Acupuncture Points Stimulate Nerves*
Microscopic Evidence
Acupuncture Point Histology

- Acupoints have been surgically isolated in
  - Humans
    *Senelar 1979*
  - Animals
    *Kim 2015*

- Similar histologic findings

- Often anatomically discrete 1-2 mm
Macroscopic Evidence
Classical Acupoints: Orbit & Maxilla

SJ-23
GB-1
SI-18
GB-14
BL-2
BL-1
ST-1
ST-2
LI-20
ST-3
Back Shu Points
## Back Shu Points + SANS Innervation

<table>
<thead>
<tr>
<th>Organ</th>
<th>Shu Point</th>
<th>Spinal Level</th>
<th>Sympathetic Segmental Innervation</th>
<th>Osteopathic Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>BL-13</td>
<td>T3</td>
<td>T2-T5 (T2-T7)</td>
<td>T3-T9</td>
</tr>
<tr>
<td>Pericardium</td>
<td>BL-14</td>
<td>T4</td>
<td>T1-T4 (T1-T5)?</td>
<td>C8, T1-T8?</td>
</tr>
<tr>
<td>Heart</td>
<td>BL-15</td>
<td>T5</td>
<td>T1-T4 (T1-T5)</td>
<td>C8, T1-T8</td>
</tr>
<tr>
<td>Liver</td>
<td>BL-18</td>
<td>T9</td>
<td>T7-T9 (T5-T10)</td>
<td>T6-T11</td>
</tr>
<tr>
<td>Gallbladder</td>
<td>BL-19</td>
<td>T10</td>
<td>T7-T10 (T5-T10)</td>
<td>T6-T11</td>
</tr>
<tr>
<td>Spleen</td>
<td>BL-20</td>
<td>T11</td>
<td>T6-T10 (T5-T11)</td>
<td>T7-T10</td>
</tr>
<tr>
<td>Stomach</td>
<td>BL-21</td>
<td>T12</td>
<td>T6-T10 (T5-T11)</td>
<td>T7-T10</td>
</tr>
<tr>
<td>Triple Energizer</td>
<td>BL-22</td>
<td>L1</td>
<td>Cortex T6-L2&lt;br&gt;Medulla T11-L1</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>BL-23</td>
<td>L2</td>
<td>T11-L1 (T10-L2)</td>
<td>T9-L2</td>
</tr>
<tr>
<td>Large Intestine</td>
<td>BL-25</td>
<td>L4</td>
<td>Proximal 2/3 T11-L1 (T6-L1)&lt;br&gt;Distal 1/3 L1-L2 (T6-L2)&lt;br&gt;(White- afferent S2-S4)</td>
<td>T9-L1</td>
</tr>
<tr>
<td>Small Intestine</td>
<td>BL-27</td>
<td>S1</td>
<td>T9-T11 (T6-T12)</td>
<td>T6-T11 duodenum/jejenum</td>
</tr>
<tr>
<td>Bladder</td>
<td>BL-28</td>
<td>S2</td>
<td>T11-L2&lt;br&gt;(White -afferent S2-S4)&lt;br&gt;S2-S3 parasympathetic</td>
<td></td>
</tr>
</tbody>
</table>
Back Shu Points + SANS Innervation

• Back Shu points used to directly influence Organ function
• 10/12 acupuncture Organs’ back Shu points located at ~ same spinal levels as the SANS outflow to those organs
• Given 17 possible spine levels (12 thoracic + 5 lumbar + 2 sacral), odds this is coincidental ~ 1 in 2 trillion (1/17**10)
LU-1 Lateral Cord Brachial Plexus
GB-27

Lateral Femoral Cutaneous Nerve

©Primal Pictures 2006
Comparison: Distributions of Femoral/Saphenous Nerves and the Spleen Meridian
Spleen channel in leg has six direction $\Delta$ of 10-40° ($\bar{x} = 20°$)

Each direction $\Delta$ follows the femoral and saphenous n. distributions from groin to instep of foot

Likelihood this is by chance = 1 in 34 million
Physiologic Evidence

*Acupuncture Effects Result from Nerve Stimulation*
Peroneal Nerve and ST-36

ST-36 → ↓ Temporomandibular Joint Pain
Peroneal Nerve and ST-36

Transection (or local anesthetic block) of sciatic or peroneal nerve → - analgesic effect ST-36
Peroneal Nerve and ST-36

Transection (or local anesthetic block) of femoral or tibial nerve → + analgesic effect  ST-36
Peroneal Nerve and ST-36

Tourniquet of thigh or isolation of circulation to ST-36 → + analgesic effect

Lu GW. Am J Physiol Regul Integr Comp Physiol. 1983
Peroneal Nerve and ST-36

Pre-treating sciatic nerve with capsaicin → analgesic effect ST-36

Okada Brain Res 1996
Acupuncture and CNS Damage

= neurologically intact

= motor/ sensory deficit

Research Group of Acupuncture Anesthesia, Peking Medical College, 1973
CNS Efferent Modulation of Acupuncture’s Effects

- Lesion of hypothalamus’ arcuate nucleus or depletion of pituitary endorphins → elimination of acupuncture analgesia
  

- Inter-collicular decerebration or thoracic cord transection eliminates effect on bladder of stimulating calf nerves
  
  McPherson J Phys 1966

- Sectioning Vagus nerve eliminates ST-36 stimulation effect on gastric acid secretion
  
  Noguchi Jap J Physiol 1996
fMRI Evidence of Acupuncture Neuromodulation of Pain

• acupuncture activates with specificity brain areas that subserve both the sensory and affective interpretation of painful stimuli

• stimulation of LI-4 + ST-36
  – activates analgesic/ anti-inflammatory structures (e.g. hypothalamus, nucleus accumbens)
  – inhibits areas subserving reaction to pain (e.g. rostral anterior cingulate cortex, amygdala + hippocampus)

*Wu MT et al. Radiology 1999; 212(1):133-41*
Consistent with Traditional Chinese Medicine Concepts

“channels are ‘spaces’ (間隙 jiàn xì) within body’s fibrous connective tissues .... the concept of channel includes these spaces and everything wrapped within them ... this includes blood vessels, bones, lymphatics, nerves, tissues, and interstitial fluids”

Wang JY. Applied Channel Therapy in Chinese Medicine, 2008
Clinical Application

*Neuroanatomic Acupuncture with Laserneedle*
Why Use Laser?

Theoretical Advantages

• **NO PAIN**

• chronic illnesses (e.g. osteoarthritis) are Yin deficiency states -laser is inherently tonifying

• laser safer- use over artificial joints, near defibrillators, pacemakers, spinal cord stimulators is safe

• ?stimulates stem cells in repair
Why Laserneedle?

• Most commercially available lasers are single channel and low power → limited depth of energy delivered below skin
• Laserneedle has greater power + beam focus → depth of energy delivery
• IR (6-8 cm), red (2-4 cm) lasers
• Treat 12 points simultaneously
• Acupoints on deeper nerves have more visceral/autonomic effects
Pilot Study of Neuroanatomic Laserneedle Acupuncture

• 30 subjects (2/3 F) of mean age 70 years (range 42-95) receiving metal needle treatment
• chronic, severe (7/10-8/10 VAS) knee or shoulder joint pain from osteoarthritis
• minimal or no response to standard medical treatments
• not surgical candidates (poor health)
Bilateral Knee Osteoarthritis
Treat the Nerves Innervating the Joints

• Shoulder
  – lateral pectoral nerve - anterior
  – suprascapular nerve - posterior
  – axillary nerve - inferior

• Knee
  – femoral nerve → superior knee + medial retinacular nerve → medial knee structures
  – sciatic nerve → posterior knee + lateral retinacular nerve → lateral knee structures
  – saphenous (medial) and peroneal (lateral) nerve branches → inferior knee structures
Shoulder Acupoint Selections-
Anterior

LI-14: supraclavicular nerve, axillary nerve, lateral brachial cutaneous nerve
Shoulder Acupoint Selections

SI-9
SI-11
SI-12
TE-14
SI-9
SI-10
SI-11
SI-12
SUPRASCAPULAR
SUPERIOR BRANCH OF AXILLARY
INFERIOR BRANCH OF AXILLARY
CUTANEOUS BRANCHES
NERVE TO TERES MINOR
RADIAL
TERES MAJOR
TERES MINOR
INFRASPINATUS
SUPRASPINATUS
DELTOID
# Shoulder Acupoint Selections

<table>
<thead>
<tr>
<th>Muscle Trigger Point</th>
<th>Corresponding Acupoint</th>
<th>Nerve Influenced</th>
</tr>
</thead>
<tbody>
<tr>
<td>anterior deltoid</td>
<td>Jubi</td>
<td>axillary branch of lateral pectoral +/- axillary</td>
</tr>
<tr>
<td>anterior deltoid</td>
<td>LI-15</td>
<td>supraclavicular</td>
</tr>
<tr>
<td>lateral deltoid</td>
<td>LI-14</td>
<td>axillary</td>
</tr>
<tr>
<td>posterior deltoid</td>
<td>TE-14</td>
<td>supraclavicular</td>
</tr>
<tr>
<td>posterior deltoid, teres major</td>
<td>SI-9</td>
<td>axillary</td>
</tr>
<tr>
<td>supraspinatus</td>
<td>SI-12</td>
<td>suprascapular</td>
</tr>
<tr>
<td>infraspinatus</td>
<td>SI-11</td>
<td>suprascapular</td>
</tr>
</tbody>
</table>
## Shoulder Acupoint Indications

<table>
<thead>
<tr>
<th>Acupoint</th>
<th>Actions</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jubi</td>
<td>“raise arm”</td>
<td></td>
</tr>
<tr>
<td>LI-14</td>
<td>Meeting point of Large Intestine with Small Intestine &amp; Bladder channels</td>
<td>shoulder pain, arm pain</td>
</tr>
<tr>
<td>LI-15</td>
<td>Meeting point of Large Intestine with Small Intestine &amp; Triple Energizer channels</td>
<td>shoulder pain, arm pain</td>
</tr>
<tr>
<td>TE-14</td>
<td>Meeting point of Triple Energizer channel with Yang linking vessel</td>
<td>shoulder pain, shoulder joint soft tissue diseases</td>
</tr>
<tr>
<td>SI-9</td>
<td>“true shoulder”, activates the Small Intestine channel, alleviates pain, benefits the shoulder</td>
<td>shoulder or scapular pain, shoulder disorders</td>
</tr>
<tr>
<td>SI-12</td>
<td>Meeting point of Small Intestine channel with Large Intestine, Triple Energizer, and Gallbladder channels</td>
<td>benefits the shoulder and scapula</td>
</tr>
<tr>
<td>SI-11</td>
<td>“celestial gathering”, activates the channel, moves qi, relieves pain</td>
<td>shoulder or scapular pain</td>
</tr>
</tbody>
</table>
Knee Acupoint Selections- Anterior

intermediate cutaneous nerve of thigh

lateral cutaneous nerve of thigh

infrapatellar branch of saphenous nerve

infrapatellar point

ST-34

GB-34

SP-10
Knee Acupoint Selections - Posterior

- Medial femoral cutaneous nerve
- Posterior cutaneous nerve of thigh
- Common peroneal nerve

Image shows anatomical diagram with labeled nerves and acupoints.
# Knee Point Selections

<table>
<thead>
<tr>
<th>Muscle Trigger Point</th>
<th>Corresponding Acupoint</th>
<th>Nerve Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>vastus medialis</td>
<td>SP-10</td>
<td>femoral nerve, medial retinacular nerve</td>
</tr>
<tr>
<td>medial gastrocnemius</td>
<td>KI-10</td>
<td>saphenous nerve</td>
</tr>
<tr>
<td>vastus lateralis</td>
<td>ST-34</td>
<td>lateral femoral cutaneous nerve</td>
</tr>
<tr>
<td>lateral gastrocnemius</td>
<td>BL-39</td>
<td>common peroneal nerve, lateral retinacular nerve</td>
</tr>
<tr>
<td>peroneus longus</td>
<td>GB-34</td>
<td>common peroneal nerve</td>
</tr>
<tr>
<td>n/a</td>
<td>infrapatellar point</td>
<td>branch of saphenous nerve</td>
</tr>
</tbody>
</table>
# Knee Point Selections

<table>
<thead>
<tr>
<th>Acupoint</th>
<th>Actions</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-10</td>
<td>“sea of blood”, dispels stasis</td>
<td>medial thigh pain</td>
</tr>
<tr>
<td>KI-10</td>
<td>He sea point on Kidney channel, activates channel, alleviates pain</td>
<td>knee disorders, medial thigh pain</td>
</tr>
<tr>
<td>ST-34</td>
<td>Xi cleft point on Stomach channel, activates the channel, alleviates pain</td>
<td>knee disorders</td>
</tr>
<tr>
<td>BL-39</td>
<td>Lower He sea point on Triple Energizer channel, activates channel, relieves pain</td>
<td>leg muscle cramp or paralysis</td>
</tr>
<tr>
<td>GB-34</td>
<td>Hui point for tendons and muscles, He sea point on Gallbladder channel, activates channel, relieves pain, benefits the joints</td>
<td>leg pain, knee disorders</td>
</tr>
</tbody>
</table>
Results: Knee & Shoulder Arthritis

![Bar graph showing VAS pain scores for metal and laser acupuncture needles. The metal needle has a score of 5.9, and the laser needle has a score of 3.1. The difference is statistically significant (p < 0.001).]
Overall Results

• laser treatment preferred by 9/10 subjects with knee & shoulder arthritis pain compared to treatment with metal needles
• no complications from the laser treatments
• treatment response lasted 5-21 days (mean >17 days)
• Cheng RS, Pomeranz B., Yu G. Dexamethasone partially reduces and 2% saline treatment abolishes electroacupuncture analgesia: These findings implicate pituitary endorphins. Life Sci 1979; 24:1481-86.


• Ellis A. The Clinical Experience of Dr Shi Neng-yun. Berkeley (CA): Thin Moon Publishing; 1996.

References

References


References


References