Tai Chi Chuan and Bone Health Among Breast Cancer Survivors

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This project was funded by Sally Schindel Cone and grant R25 CA102618 from the National Cancer Institute.
Breast Cancer

### Estimated New Cases*

<table>
<thead>
<tr>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breast</strong></td>
<td>182,480</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>100,330</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>71,560</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>40,100</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>30,670</td>
</tr>
<tr>
<td>Thyroid</td>
<td>28,410</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>27,530</td>
</tr>
<tr>
<td>Ovary</td>
<td>21,650</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>21,260</td>
</tr>
<tr>
<td>Leukemia</td>
<td>19,090</td>
</tr>
<tr>
<td><strong>All Sites</strong></td>
<td>692,000</td>
</tr>
</tbody>
</table>

### Estimated Deaths

<table>
<thead>
<tr>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breast</strong></td>
<td>40,480</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>71,030</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>25,700</td>
</tr>
<tr>
<td>Pancreas</td>
<td>16,790</td>
</tr>
<tr>
<td>Ovary</td>
<td>15,520</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>9,370</td>
</tr>
<tr>
<td>Leukemia</td>
<td>9,250</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>7,470</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>5,840</td>
</tr>
<tr>
<td>Brain &amp; other nervous system</td>
<td>5,650</td>
</tr>
<tr>
<td><strong>All Sites</strong></td>
<td>271,530</td>
</tr>
</tbody>
</table>

- Approximately 89% of breast cancer patients survive 5 or more years
- > 2 million breast cancer survivors
- Represent 22% of all cancer survivors

Progression of Bone Loss

- Increased Resorption
  - Measured by Cross-linked N-teleopeptide of type I collagen (NTx)

- Mineral Density

- Fracture Risk
  - Measured by bone specific alkaline phosphatase (BSAP)
Breast Cancer and Bone Health

Chemotherapy directly induces bone loss. Indirect effects of chemotherapy:
- Hypogonadism
  - Severely decreased BMD
- SERM
  - Tamoxifen has an adverse effect on premenopausal women
  - Tamoxifen use rapidly declining in favor of aromatase inhibitors (AI)
- AI alter bone metabolism, leading to decreased BMD and increased fractures

Regardless of treatment, breast cancer patients have altered bone metabolism and decreased BMD.


Burden of Bone Loss

– 20% of hip fracture patients die < 1 year
– 20% of hip fracture patients admitted to a nursing home
  • Additional 10% require human assistance
– Decreased activities of daily living
  • 90% cannot climb 5 stairs 12 months post-fracture
  • 40% cannot shower alone 12 months post-fracture
– Decreased emotional well-being
  • 80% feared losing their independence
  • 68% feared having to enter a nursing home

Tai Chi Chuan (TCC) and Bone Health

– Tai Chi Chuan
  • Slow, circular, fluid movement patterns
  • Mechanical loading and energy expenditure similar to brisk walking
– TCC is a therapeutic intervention for various health concerns
  • Hypertension, arthritis, balance, many more
– Biological mechanisms
  • Constant weight shifting, vertical posture, and knee flexion
– Limited trials among postmenopausal women
  • TCC increased BMD compared to control condition
  • No studies in cancer patients
Completed breast cancer treatment

Assessment #1
Blood Draw

Eligible

Randomize

TCC
3x/week
60 min
sessions
12 weeks

PST
3x/week
60 min
sessions
12 weeks

Post Intervention

Assessment #2
Blood Draw

Study Schema
Intervention

- 60 minute sessions, 3 times/week, 12 weeks
- Tai Chi Chuan (TCC) group
  - 15-move, short form sequence of basic (Yang-style) TCC
  - Ideal for those not familiar with TCC
- Non-exercise control group
  - Psychosocial support therapy (PST)
  - Facilitated by a trained counselor and exercise psychology graduate student
  - Emphasis on behavioral coping strategies, peer support, and psychoeducation
Primary Outcomes

– Bone resorption
  • Change in N-telopeptide (NTx)

– Bone formation
  • Change in bone specific alkaline phosphatase (BSAP)

– Bone remodeling index
  • Comprehensive variable representing balance between resorption and formation
  • $\Delta Z_{BSAP} - \Delta Z_{NTx}$
### Baseline Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Control n=9</th>
<th>Tai Chi Chuan n=7</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>52.6</td>
<td>53.8</td>
<td>0.78</td>
</tr>
<tr>
<td>Bone Specific Alkaline Phosphatase (BSAP) (μg/L)</td>
<td>7.77</td>
<td>8.18</td>
<td>0.71</td>
</tr>
<tr>
<td>N-telopeptides of type I collagen (NTx) (nM BCE)</td>
<td>21.3</td>
<td>16.9</td>
<td>0.36</td>
</tr>
<tr>
<td>6 Minute Walk Test (distance in meters)</td>
<td>624</td>
<td>618</td>
<td>0.85</td>
</tr>
<tr>
<td>Resting Heart Rate (beats per minute)</td>
<td>76</td>
<td>74</td>
<td>0.61</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>24.2</td>
<td>25.8</td>
<td>0.55</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mm Hg)</td>
<td>125</td>
<td>118</td>
<td>0.15</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mm Hg)</td>
<td>82</td>
<td>76</td>
<td>0.08</td>
</tr>
<tr>
<td>% Body Fat</td>
<td>41.1%</td>
<td>39.9%</td>
<td>0.68</td>
</tr>
</tbody>
</table>
Change in bone formation between intervention groups

Control Group

Tai Chi Chuan Group

P=0.06
Decline in bone resorption between intervention groups

Control Group: Decline in NTx = 2.0
Tai Chi Chuan Group: Decline in NTx = 6.5

P = 0.09
Change in bone remodeling index between intervention groups

Control Group

Tai Chi Chuan Group

P=0.04
Summary
– High rate of bone loss for breast cancer survivors
– TCC was safe and well-accepted by cancer survivors
– Non-significant changes in bone resorption and formation favoring TCC
– TCC significant increase in bone remodeling index
Future Research

– Larger RCTs of longer duration
– More sensitive measure of bone health
  • Bone mineral density (BMD)
    – ≥ 12 months
– Predictors of fracture risk
  • Balance
  • Strength

“The quality of life is determined by its activities”
- Aristotle
Acknowledgements

- Karen Mustian
- Gary Morrow
- Joseph Roscoe
- Jason Purnell
- Oxana Palesh
- Tom Darling
- Nancy Ziemboc
- Participants