The effects of Chinese calligraphy handwriting and relaxation training in Chinese Nasopharyngeal Carcinoma patients: A randomized controlled trial

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ABSTRACT

Background: Chinese calligraphy handwriting is the practice of traditional Chinese brush writing, researches found calligraphy had therapeutic effects on certain diseases, some authors argued that calligraphy might have relaxation effect.

Objectives: This study was to compare the effects of calligraphy handwriting with those of progressive muscle relaxation and imagery training in Chinese Nasopharyngeal Carcinoma patients.

Design and participants: This study was a randomized controlled trial. Two hundred and eighty-seven Nasopharyngeal Carcinoma patients were approached, ninety (31%) patients were recruited and randomized to one of the three treatment groups: progressive muscle relaxation and guided imagery training group, Calligraphy handwriting group, or a Control group. Seventy-nine (87.8%) completed all of the outcome measures.

Outcome measures: The primary treatment outcome was the changes of physiological arousal parameters measured by pre- and post-treatment differences of heart rate, blood pressure and respiration rate. The secondary outcomes included: modified Chinese version of Symptom Distress Scale, Profile of Mood State-Short Form, and Karnofsky Performance Status measured at baseline, during treatment (after the 2-week intervention), post-treatment (after the 4-week intervention) and after a 2-week follow-up. Effectiveness was tested by repeated measure ANOVA analyses.

Setting: Cancer centre of a major university hospital in Guangdong, China.

Results: Results showed that both of calligraphy and relaxation training demonstrated slow-down effects on physiological arousal parameters. Moreover, calligraphy practice gradually lowered participants' systolic blood pressure (simple main effect of time at pre-treatment measure, \( p = .007 \)) and respiration rate (\( p = .000 \)) at pre- and post-treatment measures as the intervention proceeded, though with a smaller effect size as compared to relaxation. Both of calligraphy and relaxation training had certain symptom relief and mood improvement effects in NPC patients. Relaxation was effective in relieving symptom of insomnia (\( p = .042 \)) and improving mood disturbance, calligraphy elevated level of concentration (\( p = .032 \)) and improved mood disturbance.

Conclusions: Similar to the effects of relaxation training, calligraphy demonstrated a gradually build-up physiological slow-down, and associated with heightened concentration and improved mood disturbance. Calligraphy offered a promising approach to improved health in cancer patients.
1. Introduction

Nasopharyngeal Carcinoma (NPC) is one of the most common cancers in Southeast China, Taiwan and Hongkong, with approximately 10–30 out of 100,000 people, mostly men, diagnosed in Guangdong province yearly (Cao et al., 2006). NPC diagnosed at an early stage has relatively better prognosis than most cancers due to advances in medical care, especially in radiotherapy (RT) medicine (Pan et al., 2009). However, high levels of depression and anxiety in NPC patients had been observed in hospitalized settings (Wen et al., 2000). One of the reasons was that the acute symptoms related to intense RT treatment had significant impact on NPC patients’ everyday experiences (Huang et al., 2000, 2003). These distressful experiences often involved severe pain in oral-pharyngeal cavity, dry mouth and difficulty to swallow, noticeable alteration in appearance, difficulty opening mouth and hearing damages (Lai et al., 2003).

Among psychosocial interventions for reducing treatment-related symptoms and mood disturbance, relaxation and imagery training were most investigated in controlled trials, partly due to its low cost, ease of use and having few if any negative side effects (Yoo et al., 2005). Studies had observed progressive muscle relaxation (PMR) and guided imagery (GI) training could reduce anxiety and improve quality of life among cancer patients (Leon-Pizarro et al., 2007), could reduce mood disturbance and emotional suppression in breast cancer patients (Walker et al., 1999). Findings of these studies conformed to the results of a review article (Luebbert et al., 2001) that found relaxation had significant beneficial effects on treatment-related symptoms (such as nausea, pain, vomiting), emotional adjustment (such as anxiety, depression, hostility, tension, fatigue, confusion, vigor, overall mood), and physiological arousal parameters (such as heart rate, blood pressure and respiration). In view of these findings, the author suggested that relaxation training should be implemented into clinical routine for cancer patients in acute medical treatment.

Art therapy, a complementary and alternative treatment modality, had been proven to have therapeutic effects in cancer patients (Gotze et al., 2009; Svensk et al., 2009). Proponents of art therapy believed that the uninhibited expression of feelings and emotions through art might help to release the fear, anxiety and anger that many cancer patients experienced. Art could also be viewed as a distraction to the pain and discomfort of disease, allowing patient relief from stress. Shufa, or Chinese calligraphy was the writing of Chinese characters by hand using a soft-tipped brush, was traditionally regarded in China as one of the fine arts (Young-Mason, 2003). To date, empirical studies on Chinese calligraphy had been focusing mainly on how to execute and appreciate it artistically by following the practical experiences of the great masters. Little systematic research had been done on the fundamental behaviors associated with the calligraphy practice, such as visual perception, emotions and physiological response. The existing clinical researches on calligraphy handwriting had found that calligraphy had treatment effects on some behavioral and psychosomatic diseases, such as Attention Deficit Hyperactivity Disorder (ADHD) in children (Kao et al., 1997), Alzheimer’s disease (Kao, 2003; Kao et al., 2000a,b), hypertension (Guo et al., 2001; Kao et al., 2001) and diabetes II (Kao et al., 2000a). The authors further argued that the act of brushing caused heightened attention and concentration on the part of practitioners and resulted in their emotional stabilization and physical relaxation (Kao, 2006).

The main purposes of the present study were to compare the effects of calligraphy handwriting on NPC patients’ physiological arousal parameters, symptom distress, mood disturbance and functional status with those of progressive muscle relaxation and imagery training.

2. Methods

2.1. Study design

The study was a longitudinal, randomized, controlled trial with 2 intervention groups and a control group. A $3 \times 2 \times 4$ mixed-effect factorial design was used for assessing physiological arousal parameters, and a $3 \times 4$ mixed-effect factorial design was used for assessing the secondary outcome measures. The protocol for this study was approved by the Review Board of the investigator’s institution.

2.2. Participants and setting

The study was carried out from June 2007 to March 2008 in the in-patient department of Cancer Centre of a
major university hospital in Guangdong, China. Patients diagnosed with NPC based on the American Joint Committee on Cancer Staging (Greene, 2002), and scheduled for RT, aged 18–80 were eligible for this study. Exclusionary criteria included: patients who had finished surgical treatment in the last 3 months; patients who were unable to read and write Chinese with a brush (e.g., illiteracy or physical disability); patients with cardiovascular or respiratory diseases, e.g., essential or secondary hypertension (systolic blood pressure equal to or greater than 140 mmHg, and/or diastolic blood pressure equal to or greater than 90 mmHg), abnormal heart rate or abnormal respiration. 287 eligible patients were approached and 90 (31%) consented to participate. The major reasons for refusal included no time or interest, feeling lack of energy and concentration.

Fig. 1 shows the flow chart of participants of this study. 90 patients who signed the informed consent were included in the study and randomly assigned to one of the three treatment groups: Relaxation \((n = 30)\), Calligraphy \((n = 30)\), and Control \((n = 30)\). The randomization procedure was accomplished by a computer-generated table in blocks of 3 without any restriction or stratification. By the end of the study, a total of 79 patients completed the final assessments: Relaxation \((n = 26)\), Calligraphy \((n = 24)\), Control \((n = 29)\).

2.3. Procedures

To control for the potentially important confounding variables that might have an impact on the outcome measures, patients were monitored for any medication usage, e.g., antidepressant, anti-hypertension drugs. No such medication usage was reported. After the completion of the final assessment, each participant was encouraged to give feedback on effectiveness of the programs and suggestions to improve the intervention procedure. The reasons of participant dropout were also recorded.

2.4. Intervention

2.4.1. Relaxation training

The relaxation training lasted 30 min per day for 4 consecutive weeks; 20-min progressive muscle relaxation (PMR) was followed by 10-min guided imagery (GI). PMR was administered by a clinical therapist in a separate, quiet and adequately lit inpatient ward following the abbreviated form of Jacobsen’s procedure developed by Bernstein and Borkovec (1973). For this study, the instructions led participants in tensing and relaxing 12 major muscle groups working from the hands and arms up to the head and down to the feet. Participants were asked to focus on the contrast between sensations of muscle tension and relaxation. The GI training was delivered by a pre-recorded MP3 audio file read by a female research associate following a script, while the participant was in a relaxed position with the eyes closed. The script began with suggestions for relaxation and deep breathing, and then encouraged the participant to imagine a pleasant special place without any pain and symptoms. Continuous soft instrumental music provided background to the narrator’s voice.

2.4.2. Calligraphy practice

The participants in Calligraphy Group practiced Chinese calligraphy in a quiet, adequately lit inpatient room led by a retired language teacher, who was a senior calligrapher. The time duration of calligraphic writing was 30 min per day for 4 consecutive weeks as the same as that of relaxation group. The content of Chinese calligraphy character was chosen randomly in a handbook of calligraphy writing. To control for the influence of emotional positiveness of the Chinese character, rather than the calligraphy practice intervention on outcome measures, especially on mood status ratings, 20 characters were randomly chosen in the handbook to evaluate the emotional properties of these characters on a 5-point Likert scale (“1” represented “very negative” and “5” represented “very positive”) by 60 college students. The result showed that the emotional positiveness of the sample characters were \(3.118 \pm 0.585\). The calligraphic writing involved brush handwriting by tracing the strokes and structures of the characters displayed in a mixture of commonly used calligraphic styles, i.e., the calligraphic brush was middle-sized, the length of the pen was 28 cm, a 11 by 11 cm “米”-shaped pane was printed on the calligraphic rice paper.

2.5. Baseline and outcome measures

At baseline, demographic and clinical data were collected either from the patients or from the medical records prior to the interventions, and the consent to access the patients’ medical records had been obtained from the medical staff. Demographic information including age, sex, education, marital status and clinical information regarding disease and treatment modality were collected on a demographic form.

2.5.1. Primary outcome measure

The primary outcome was the change of physiological arousal parameters assessed by heart rate (HR), blood pressure (BP), and respiration rate (RR), which were measured at pre- and post-treatment per treatment day, 5 days a week (i.e., Monday to Friday), and for 4 consecutive weeks. HR and BP were measured by Omron Upper Arm Digital Sphygmomanometer, Model HEM-7051. The RR was counted by a clinical nurse using a

![Fig. 1. Flow chart of participants.](image-url)
to 0.80. In the present study, Cronbach’s 
coefficient of the SDS ranged from 
0.70 (McCorkle et al., 1994) to 0.92 (Ragsdale and Morrow, 
1995). Studies have shown that 
levels of symptom distress could be a significant predictor 
of survival in patients with variety types of cancer (Degner 
and Sloan, 1995; Frederickson et al., 1991). The original 
SDS was a 13-item self-rating scale including: frequency 
and intensity of nausea, appetite, insomnia, frequency and 
intensity of pain, fatigue, bowel pattern, concentration, 
appearance, breathing, outlook and cough. In previous 
studies, Cronbach’s \( \alpha \) coefficient of the SDS ranged from 
0.70 (McCorkle et al., 1994) to 0.92 (Ragsdale and Morrow, 
1990). Most studies reported a Cronbach’s \( \alpha \) coefficient 
greater than 0.80. In the present study, Cronbach’s \( \alpha \) coefficient 
of the modified SDS was 0.80, test–retest reliability over 1 week interval was 0.71.

In the present study, the original SDS was firstly 
translated into Chinese according to back-translation 
principles (Baldacchino and Buhagiar, 2003), and then 
modified by adding 5 items that represented NPC patients’ 
distressing experiences associated with radiotherapy and 
chemotherapy. The procedure was performed as follows: 
20 NPC patients were interviewed by the researchers to 
rate for their most distressing symptoms except the 13 
items of original SDS, 5 items were attained upon the 95% 
patients’ congruence. The 5 items were added as follows: 
dry mouth, difficulty opening mouth, oral ulcer, hearing 
difficulty and skin condition.

For the current study, the modified SDS was adminis-
tered consecutive items on 2 pages. The 18 items of the 
modified SDS were calibrated scores ranging from 1 (no 
distress) to 5 (extreme distress) in accordance with the 
original SDS of McCorkle (McCorkle and Young, 1978).

2.5.2.2. Mood disturbance. The Profile of Mood State-Short Form (POMS-SF, Chinese version) was used to assess the 
patient’s negative mood states in this study. The Chinese 
version of POMS-SF was developed by Chi and Lin (2003), 
which consists of 30 items (based on the 65-item questionnaire in the long form) and contains the same 
six subscales: Tension-Anxiety (TA), Depression-Dejection (DD), Anger-Hostility (AH), Fatigue-Inertia (FI), Confusion-
Bewilderment (CF), and Vigor-Activity (VA). A composite 
score, the total mood disturbance (TMD) score, is 
computed by summing each of the individual scores for 
TA, DD, AH, FI and CF, with vigor scores subtracted to 
indicate patients’ total mood disturbance. Each item of the 
POMS-SF is scored on a 5-point Likert scale ranging from 0 
(not at all) to 4 (extremely). Cronbach’s \( \alpha \) coefficient was 
0.93 in a 289 hospitalized cancer sample (Wang et al., 
2004). In this study, Cronbach’s \( \alpha \) coefficient was 0.79.

2.5.2.3. Functional status. Karnofsky Performance Status 
(KPS) provided a global indicator of functional status 
(Karnofsky and Burchenal, 1949). The scale ranges from 
100 (Normal, no complaints, no evidence of disease) to 0 
(Dead) with 10-point intervals, each with explicit descrip-
tors. Lower scores indicate greater symptoms and physical 
restrictions. Inter-rater reliability between two independ-
ent nurses was 0.92 in the current study.

2.6. Statistical analysis

The primary endpoint of intervention efficacy was the 
change in physiological arousal parameters measured at 
pre- and post-treatment, i.e., the significant interaction 
effect of Prepost by Group. The secondary endpoints 
included SDS scores, POMS-SF subscale scores, and KPS 
 rating measured at different time points, i.e., the significant 
interaction effects of Group and Time.

Outcome data analyses were based on study completers 
only. Baseline characteristics were compared among 
groups using one-way Analysis of Variance (ANOVA) for 
quantitative variables and chi-square test for qualitative 
variables performed by SPSS version 11.5 (SPSS Inc., 
Chicago, IL). The intervention effects on secondary out-
come measures were determined by using two-way 
mixed-effects repeated measures ANOVA (RMANOVA) 
with Group as between-subjects factor and Time (Time 
1, pre-treatment; Time 2, during treatment; Time 3, post-
treatment; Time 4, 2-week follow-up) as within-subject 
factor. The intervention effects on physiological parameters 
were assessed by using three-way RMANOVA with 
Group as between-subjects factor and Time, Prepost as 
within-subject factors. Partial ETA squared values were 
reported as measures of effect size. If the sphericity 
assumption was not met, the Huynh-Feldt correction 
would be applied. Post hoc multiple comparisons were 
performed by using the Least Significant Difference (LSD) 
adjustment. The Group, Time and Prepost main effect 
would be interpreted in light of significant three-way and 
two-way interaction and would not be described further.

3. Results

3.1. Sample characteristics

A total of 90 NPC patients meeting inclusion criteria were 
recruited. The demographic and clinical characteristics of
the sample at baseline \((n = 90)\) assessment were presented in Table 1. The mean age of the sample was 49.63 ± 10.81, ranging from 22 to 71 years old. The majority of patients were male (68.9%), and married (93.3%). Only 31 (34.4%) patients had more than 9 years of education. 41 (45.6%) patients were diagnosed with II stage NPC, 49 (54.4%) received a diagnosis of III stage. All patients received RT as their current treatment. The overall mean length of hospital stay was 55 ± 9 days. There was no statistically significant group difference on all of the demographical and clinical variables. 79 patients (87.8%) completed the programs and provided valid data on outcome measures. The numbers of dropouts by treatment groups were: Relaxation, 4; Calligraphy, 6; Control, 1. The rates of dropout were not significantly different across groups \((p = .140)\). Of the 11 dropouts, 3 patients (2 in Calligraphy and 1 in Relaxation) reported that they were too tired to complete the program, 4 patients (2 in Relaxation and 2 in Calligraphy) provided insufficient data on physiological parameters, 1 patient in Calligraphy group and 1 in Control discharged prematurely from hospital due to economic or family issues, 2 patients (1 in Relaxation and 1 in Calligraphy) dropped out due to diminished interest. There were no significant differences between the completers and non-completers on demographic and clinical characteristics except education (non-completers had a higher percentage of illiteracy \((\chi^2 (1, n = 90) = 8.39, p = .039)\). No significant group difference was found on baseline assessments of physiological measures, SDS, POMS-SF, and KPS (all \(p > 0.05)\).

3.2. Intervention effects on physiological arousal parameters

Table 2 summarizes the results of repeated measures of ANOVO. For HR, both of relaxation and calligraphy intervention significantly lowered participants’ post-treatment heart rate, but no pre-post difference was found in the control group (Prepost by Group interaction effect, \(F(2,76) = 20.67, p = .000\), partial \(\eta^2 = .35\)). The mean change of Pre-post measure was –1.72 bpm in Relaxation group, and –1.14 bpm in Calligraphy group. There was no significant difference on the Pre-post change scores between the two intervention groups \((p > .05)\).

For systolic blood pressure (SBP), relaxation and calligraphy intervention significantly lowered participants’ post-treatment SBP, but no pre-post difference was found in the control group (Prepost by Group interaction effect, \(F(2,76) = 35.99, p = .000\), partial \(\eta^2 = .486\)).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic and clinical characteristics of the sample at baseline measures.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relaxation</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>30 or younger</td>
<td>1</td>
</tr>
<tr>
<td>31–55 years</td>
<td>17</td>
</tr>
<tr>
<td>56 years or older</td>
<td>12</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
</tr>
<tr>
<td>Single (divorced)</td>
<td>0</td>
</tr>
<tr>
<td>Married</td>
<td>30</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>6 years or less</td>
<td>7</td>
</tr>
<tr>
<td>7–9 years</td>
<td>13</td>
</tr>
<tr>
<td>More than 9 years</td>
<td>10</td>
</tr>
<tr>
<td><strong>Stage of cancer</strong></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>14</td>
</tr>
<tr>
<td>III</td>
<td>16</td>
</tr>
<tr>
<td>IV</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2

Multivariate test of RMANOVA on significant physiological arousal parameters.

<table>
<thead>
<tr>
<th>Effects</th>
<th>(F)</th>
<th>(df)</th>
<th>(p)</th>
<th>Partial (\eta^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepost</td>
<td>81.31</td>
<td>1,76</td>
<td>.000</td>
<td>.517</td>
</tr>
<tr>
<td>Prepost × Group</td>
<td>20.67</td>
<td>2,76</td>
<td>.000</td>
<td>.352</td>
</tr>
<tr>
<td>SBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>8.68</td>
<td>3,74</td>
<td>.000</td>
<td>.260</td>
</tr>
<tr>
<td>Prepost</td>
<td>207.58</td>
<td>1,76</td>
<td>.000</td>
<td>.732</td>
</tr>
<tr>
<td>Prepost × Group</td>
<td>35.99</td>
<td>2,76</td>
<td>.000</td>
<td>.486</td>
</tr>
<tr>
<td>Time × Prepost</td>
<td>5.51</td>
<td>3,74</td>
<td>.002</td>
<td>.183</td>
</tr>
<tr>
<td>DBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>11.67</td>
<td>3,74</td>
<td>.000</td>
<td>.321</td>
</tr>
<tr>
<td>Prepost</td>
<td>3.50</td>
<td>6,146</td>
<td>.003</td>
<td>.126</td>
</tr>
<tr>
<td>Prepost × Group</td>
<td>355.44</td>
<td>1,76</td>
<td>.000</td>
<td>.824</td>
</tr>
<tr>
<td>Time × Prepost</td>
<td>80.16</td>
<td>2,76</td>
<td>.000</td>
<td>.678</td>
</tr>
<tr>
<td>Time × Prepost × Group</td>
<td>6.89</td>
<td>2,76</td>
<td>.000</td>
<td>.218</td>
</tr>
<tr>
<td>RR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>13.73</td>
<td>3,74</td>
<td>.000</td>
<td>.358</td>
</tr>
<tr>
<td>Prepost</td>
<td>5.21</td>
<td>6,146</td>
<td>.000</td>
<td>.176</td>
</tr>
<tr>
<td>Prepost × Group</td>
<td>331.21</td>
<td>1,76</td>
<td>.000</td>
<td>.813</td>
</tr>
<tr>
<td>Time × Prepost</td>
<td>95.56</td>
<td>2,76</td>
<td>.000</td>
<td>.715</td>
</tr>
<tr>
<td>Time × Prepost × Group</td>
<td>4.60</td>
<td>3,74</td>
<td>.005</td>
<td>.157</td>
</tr>
<tr>
<td><strong>Note</strong>: RMANOVA: repeated measure analysis of variance. HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; RR: respiration rate. Partial (\eta^2): effect size estimate.</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
The mean change of Pre-post measure was $-1.68$ mmHg in Relaxation group, $-1.41$ mmHg in Calligraphy, and $-0.23$ mmHg in Control. There was no significant difference on the change scores between the two intervention groups ($p > .05$). Post hoc comparison revealed that calligraphy not only significantly lowered the post-treatment SBP, but also gradually lowered the pre-treatment SBP (simple main effect of Time at pre-treatment measure in Calligraphy group, $p = .007$), while relaxation only had treatment effect on post-treatment measures ($p < .05$). Regardless of group status, the Pre-post change score was gradually increased as the intervention program went on, as shown by a significant Prepost by Time interaction ($F(3,74) = 5.51, p = .002$, partial $\eta^2 = .18$).

For diastolic blood pressure (DBP), the two intervention groups had different impact on post-treatment measures, and as the intervention proceeded, the treatment effects had a trend to increase, indicated by a significant three-way interaction effect ($F(2,618) = 2.28, p = .040$, partial $\eta^2 = .09$) and all of the two-way interaction effect (all $p < .05$). The mean change of Pre-post measure was $-1.76$ mmHg in Relaxation group, $-1.46$ mmHg in Calligraphy group, and $-0.99$ mmHg in Control.

For RR, different groups exhibited different patterns of treatment effect as the intervention proceeded, as indicated by the significant three-way interaction, $F(6,6228) = 7.10, p = .000$, partial $\eta^2 = .06$. Relaxation training significantly lowered post-treatment RR ($F(1,76) = 433.41, p = .000$, partial $\eta^2 = .85$), the mean Pre-post change was $-1.14$ breath per minute, and the change became larger with the proceeding of intervention, $F(3,74) = 11.83, p = .000$, partial $\eta^2 = .32$. In Calligraphy group, the Pre-post change was significant ($F(1,76) = 69.26, p = .000$, partial $\eta^2 = .48$), although with a less magnitude of $-.47$ breath per minute, and interestingly, the pre-treatment RR gradually slowed down across time points ($F(3,74) = 8.25, p = .000$, partial $\eta^2 = .06$). No two-way interaction or their main effect was found in Control group.

3.3. Intervention effects on symptom distress and functional status

The two interventions had no significant effect on average symptom distress score, which was calculated on the basis of 18 individual items. However, the interventions had different impacts on the following items of modified SDS, as was indicated by significant Time by Group interaction (see Table 3): Insomnia ($F(6,193) = 2.34, p = .042$), and Concentration ($F(6,206) = 2.43, p = .032$). Relaxation significantly improved insomnia at Time 2 ($F(2,76) = 7.56, p = .001$) and Time 3 ($F(2,76) = 5.97, p = .004$), and the treatment gain was maintained at 2-week follow-up ($F(2,76) = 6.38, p = .003$); Calligraphy group significantly scored lower than the other two groups at Time 2 ($F(2,76) = 6.34, p = .003$) and Time 3 ($F(2,76) = 3.69, p = .030$) on Concentration, but the treatment gain was not maintained at 2-week follow-up ($p = .066$).

Relaxation and calligraphy exerted no significant treatment effect on KPS ratings, however, patients’ functional status seemed to get better across the time points, indicated by a significant Time main effect ($F(3,228) = 18.15, p = .000$), a reflection of intervention independent, gradual improvement of patient functioning throughout the course of treatment.

3.4. Intervention effects on mood disturbance

As detailed in Table 4, relaxation training and calligraphy practice had different treatment effects on the following subscales of POMS-SF: TA ($F(6,184) = 2.75, p = .021$), DD ($F(6,224) = 9.65, p = .000$), AH ($F(6,166) = 2.77, p = .025$), FI ($F(6,174) = 4.77, p = .001$), and TMD score ($F(6,169) = 9.65, p = .000$), as were indicated by significant Time by Group interaction effects. Relaxation lowered participants’ TA score at Time 3, and maintained at follow-up; Relaxation and Calligraphy group scored lower than Control on DD subscale at Time 2 and Time 3, but the treatment effect was not maintained at Time 4; Relaxation and Calligraphy group scored lower on AH subscale than Control at Time 3, and maintained at follow-up; Calligraphy lowered FI score at Time 2 and Time 3, but the treatment gain diminished at follow-up assessment.

4. Discussion

The present study tested the effects of Chinese calligraphy handwriting practice in Chinese NPC patients,
which was compared with an established intervention approach—progressive muscle relaxation combined with imagery training and a control group. The primary outcome analyses revealed that the 4-week calligraphy practice intervention demonstrated a slow-down effect on physiological arousal parameters (as was measured by HR, BP, and RR) similar to those of relaxation training, though in different patterns. The secondary outcomes analyses revealed that calligraphy had certain symptom relief and mood improvement effects in NPC patients, providing further evidence on the efficacy of calligraphy practice as a psychosocial intervention alternative.

### 4.1. Intervention efficacy

First of all, primary outcome analyses revealed that similar to the effects of relaxation training, calligraphy practice exerted short-term slow-down effects on physiological arousal parameters, including slower heart rate, decreased blood pressure, and decelerated respiration. Moreover, calligraphy practice demonstrated gradually build-up effects on SBP and RR measures, which were shown by less magnitude of Pre-post change scores, and simple main effects of time at pre-treatment measures. The secondary outcome analyses revealed that calligraphy improved the patients’ concentration level, reduced their mood disturbance scores on Depression-Dejection, Anger-Hostility and Fatigue-Inertia subscales.

Years of experimental investigation had found that calligraphic handwriting act was capable of producing improvements in the writer’s visual attention, physical relaxation, emotional stabilization as well as cerebral activation. A couple of experiments had been carried out to assess the physiological changes of the writers during calligraphic writing (Kao et al., 1986a). Results indicated that subjects experienced relaxation and emotional calmness when they were writing Chinese calligraphy: their respiration rate decelerated, heart rate slowed down, and blood pressure and muscular activities dropped. On the contrary, EEG data showed that cerebral activities increased during Chinese calligraphy writing. The above psychophysiological changes observed during the process of calligraphy handwriting could be explained by the characteristics of calligraphic practice and Chinese character. The calligraphic writing act involves one’s bodily function as well as one’s cognitive activity. Motor control and maneuvering of the brush follow the character configurations. There is, therefore, an integration of the mind, body, and character interwoven in a dynamic graphonomic process (Kao, 2000). This intimate relationship underlies the interactive effects of Chinese calligraphic handwriting on the mind and the body of the writer. In addition, the Chinese character forms a perfect geometric square pattern incorporating such features as hole, linearity, symmetry, parallelism, connectivity, and orientation, utilizing geometric and depth perception brain

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### Table 4

Significant intervention effects on subscales of POMS-SF measures (mean ± SD).

<table>
<thead>
<tr>
<th>Measures</th>
<th>Relaxation</th>
<th>Calligraphy</th>
<th>Control</th>
<th>F</th>
<th>p</th>
<th>$\eta^2$</th>
</tr>
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<tbody>
<tr>
<td>TA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time 1</td>
<td>5.00 ± 1.98</td>
<td>4.96 ± 1.90</td>
<td>4.90 ± 2.93</td>
<td>0.01</td>
<td>.987</td>
<td>.000</td>
</tr>
<tr>
<td>Time 2</td>
<td>4.04 ± 1.25</td>
<td>4.08 ± 1.64</td>
<td>4.79 ± 2.27</td>
<td>1.53</td>
<td>.223</td>
<td>.039</td>
</tr>
<tr>
<td>Time 3</td>
<td>3.08 ± 1.52</td>
<td>3.50 ± 1.69</td>
<td>4.04 ± 1.54</td>
<td>3.39</td>
<td>.099</td>
<td>.082</td>
</tr>
<tr>
<td>Time 4</td>
<td>3.19 ± 1.13</td>
<td>3.19 ± 1.61</td>
<td>4.48 ± 1.99</td>
<td>4.61</td>
<td>.013</td>
<td>.108</td>
</tr>
<tr>
<td>DD</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time 1</td>
<td>5.69 ± 1.78</td>
<td>5.75 ± 2.21</td>
<td>5.24 ± 2.66</td>
<td>0.41</td>
<td>.662</td>
<td>.111</td>
</tr>
<tr>
<td>Time 2</td>
<td>4.42 ± 1.68</td>
<td>4.46 ± 2.02</td>
<td>5.79 ± 2.73</td>
<td>3.43</td>
<td>.038</td>
<td>.083</td>
</tr>
<tr>
<td>Time 3</td>
<td>4.04 ± 1.54</td>
<td>3.79 ± 1.91</td>
<td>5.76 ± 2.78</td>
<td>6.66</td>
<td>.002</td>
<td>.149</td>
</tr>
<tr>
<td>Time 4</td>
<td>4.15 ± 1.22</td>
<td>3.83 ± 1.55</td>
<td>4.62 ± 1.82</td>
<td>1.71</td>
<td>.188</td>
<td>.043</td>
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<td>AH</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Time 1</td>
<td>3.73 ± 1.87</td>
<td>3.50 ± 1.82</td>
<td>3.76 ± 2.52</td>
<td>.098</td>
<td>.906</td>
<td>.003</td>
</tr>
<tr>
<td>Time 2</td>
<td>2.73 ± 1.43</td>
<td>3.12 ± 1.19</td>
<td>3.52 ± 1.94</td>
<td>2.39</td>
<td>.099</td>
<td>.060</td>
</tr>
<tr>
<td>Time 3</td>
<td>2.35 ± 1.33</td>
<td>2.25 ± 1.15</td>
<td>3.59 ± 1.94</td>
<td>6.47</td>
<td>.003</td>
<td>.147</td>
</tr>
<tr>
<td>Time 4</td>
<td>2.28 ± 1.06</td>
<td>2.46 ± 1.25</td>
<td>3.24 ± 1.68</td>
<td>3.77</td>
<td>.028</td>
<td>.091</td>
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<tr>
<td>FI</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Time 1</td>
<td>5.65 ± 2.38</td>
<td>5.42 ± 2.54</td>
<td>5.38 ± 2.29</td>
<td>0.10</td>
<td>.903</td>
<td>.003</td>
</tr>
<tr>
<td>Time 2</td>
<td>5.00 ± 1.36</td>
<td>4.38 ± 1.74</td>
<td>5.62 ± 1.88</td>
<td>3.62</td>
<td>.031</td>
<td>.087</td>
</tr>
<tr>
<td>Time 3</td>
<td>5.00 ± 1.79</td>
<td>3.46 ± 1.53</td>
<td>5.59 ± 1.76</td>
<td>10.65</td>
<td>.000</td>
<td>.219</td>
</tr>
<tr>
<td>Time 4</td>
<td>4.69 ± 1.35</td>
<td>3.96 ± 1.37</td>
<td>4.90 ± 1.68</td>
<td>2.82</td>
<td>.066</td>
<td>.069</td>
</tr>
<tr>
<td>TMD</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time 1</td>
<td>36.16 ± 8.08</td>
<td>37.83 ± 10.34</td>
<td>36.03 ± 13.20</td>
<td>0.21</td>
<td>.809</td>
<td>.006</td>
</tr>
<tr>
<td>Time 2</td>
<td>31.60 ± 6.67</td>
<td>32.71 ± 6.96</td>
<td>36.83 ± 9.92</td>
<td>3.15</td>
<td>.048</td>
<td>.078</td>
</tr>
<tr>
<td>Time 3</td>
<td>29.04 ± 6.28</td>
<td>28.17 ± 6.36</td>
<td>35.66 ± 9.20</td>
<td>8.06</td>
<td>.001</td>
<td>.177</td>
</tr>
<tr>
<td>Time 4</td>
<td>28.00 ± 4.72</td>
<td>28.21 ± 5.76</td>
<td>32.59 ± 8.94</td>
<td>3.89</td>
<td>.025</td>
<td>.094</td>
</tr>
</tbody>
</table>

Note: Each F tests the simple main effects of Group within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Partial $\eta^2$: effect size estimate.

POMS-SF: Profile of Mood State-Short Form; TA: Tension-Anxiety; DD: Depression-Dejection; AH: Anger-Hostility; FI: Fatigue-Inertia; TMD: total mood disturbance.

Time 1: measures at pre-treatment; Time 2: during treatment; Time 3: post-treatment; Time 4: 2-week follow-up.
functions. The writer must follow the pattern with heightened alertness in the process of writing, at the meantime, the writing act involves a cognitive facilitation and emotional calmness process, and thus the concurrent physiological change (Kao et al., 2004). Moreover, because of the softness of the brush tip, the handwriting act involves a 3-D motion, which generates a powerful source of impact on the writer's perceptual, cognitive, and physiological changes during its practice (Kao, 2006). As the intervention went on, the calligrapher gained more control over their maneuvering of the brush, which in turn induced deeper inner calmness and physiological slowdown.

Progressive muscle relaxation is a relaxation technique of stress management developed by American physician Edmund Jacobson in 1934, which is focused on tensing and releasing tensions in the 16 different muscle groups. PMR combined with imagery training had established effects on a variety of outcome measures in cancer patients. Lyles et al. (1982) found relaxation and guided imagery training was effective in reducing treatment-related nausea and physiological arousal (as measured by HR and BP) in chemotherapy cancer patients. Cheung et al. (2001, 2003) found PMR training was associated with an improvement on anxiety and quality of life among colorectal cancer patients. The effectiveness of PMR and GI training on physiological arousal parameters, as was found in the present study, had also been established by existing findings (Lehrer, 1978; Sheu et al., 2003; Sung et al., 2000), and would not be discussed here. However in the current study, relaxation was not associated with improvement of nausea, which might due partly to the statistical floor effect of nausea, for nausea was not a serious complaint in patients receiving radiotherapy as their current treatment. It was observed in the current study that relaxation had an improvement effect on insomnia, which was consistent with the existing findings about insomnia research (Morin et al., 1999). Relaxation training was also associated with improved mood, including Tension-Anxiety, Depression-Dejection, Anger-Hostility subscale and total mood disturbance. The mood regulation effect found in the study was confirmatory to the notion of McCallie et al. (2006) that muscular tension was usually followed as a byproduct of anxiety, one could lower and reduce anxiety by understanding and learning how to self relax those muscular tension. Besides anxiety, it was found that relaxation was also beneficial for moods of depression and anger, as was documented in other applied researches (Leon-Pizarro et al., 2007; Nunes et al., 2007).

4.2. Intervention feasibility

Patients in relaxation group reported that relaxation training could make them feel calm, gain more control over their aversive feelings, was an effective way to focus on bodily sensation instead of a painful reality. Patients in Calligraphy group reported that calligraphy provided a path to calmness and relaxation of emotion, inspired an inner motivation to pursue spiritual growth and beauty appreciation, learned a discipline of being focused and present in spirit, eliminated their fear of death and feeling of worthlessness temperately. Feedback on suggestions to improve the intervention procedure revealed: most patients (76%) in relaxation group complained that the program schedule was too rigid to follow, i.e., on fixed time period of the day, 31% patients reported that practice before bedtime was preferred; in calligraphy group, most suggestions focused on the short length of practice, i.e., 30 min per day, 66% patients reported that 45–60 min was more desirable.

4.3. Study implication

Researches showed that art therapy intervention in cancer patients could serve as a catalyst for healing, could benefit the patients in their quality of life (Visser and Op’t Hoog, 2008), relieve cancer pain (Jones, 2000), and demonstrated a significant symptom relieving effect (Monti et al., 2006). Historically, Chinese calligraphy handwriting was regarded as the most abstract and sublime form of art in Chinese culture, many calligraphy artists were well-known for their longevity. “Shufa” (calligraphy) is often thought to be most revealing of one's personality (examples of calligraphy art could go to website: http://www.chinapage.org/calligraphy.html). To the artist, calligraphy is a mental exercise that coordinates the mind and the body to choose the best styling in expressing the content of the passage. It is a most relaxing yet highly disciplined exercise indeed for one's physical and spiritual well-being. Recent researches found that calligraphy also have therapeutic values in clinical mental health setting (Su and Chen, 1979). The findings in the current study provided further empirical evidence for the therapeutic value of calligraphy as a form of art therapy. As was advocated by the International Society of Calligraphy Therapy (ISCT), calligraphy may play potentially important role in the field of art therapy in both Chinese and non-Chinese populations. Like Chinese handwriting, alphabetic handwriting mostly involves the control and coordination of the muscles of the fingers, hand and arm, subject to visual guidance and monitoring (Kao et al., 1986a;b; Van Galen and Teulings, 1983). With the softness of a Chinese brush, rather than ball pen, fountain pen, pencil, etc., the calligraphic effect, which transforms the flat surface into an imaginary 3-dimensional reality, could be produced.

4.4. Study limitations and future directions

One major limitation of the current study was that although calligraphy has its roots in orient culture, there are difficulties to generalize to other cultures, for people who are unfamiliar with its use, may feel stressful to conduct it. However, some pioneers in western and Arabic culture had shown great interest in English-letter (Arabic) calligraphy & handwriting recently (Gaur and Keith, 2006a,b,c). The second limitation was the small numbers per group mean, so the analysis should be considered exploratory. The third one was related to the intervention procedure. Because we had limited knowledge regarding whether different calligraphic character style and handwriting preference would be associated with different clinical outcomes, it might be valuable to assess those
hypotheses in future researches. Finally, the high refusal rate indicated that the applicability of psychotherapy in Chinese cancer patients should be carefully considered before the initiation of intervention programs. The reasons of the high refusal rate in this study might be related to the facts that the Chinese were more likely to present emotions as physical symptoms (Ying et al., 2000), to inhibit outward expression of negative emotions (Mumford, 1995), and to refuse help for their psychological problems (Ying, 1997), these characteristics of Chinese cancer patients might compromise their perceived effectiveness and acceptance of psychotherapy. Nevertheless, the reasonable dropout rate suggested the programs were easy to comply, could substantially benefit the patients with high motives and resolution. We recommend future researchers to test out the long-term effects of calligraphy in terms of quality of life, spiritual well-being, and disease progression. Furthermore, efforts also were needed to disseminate efficacious components of calligraphy practice in future studies.

5. Conclusions

Similar to the effect of relaxation training, calligraphy demonstrated a gradually build-up physiological slowdown, and associated with heightened concentration and improved mood disturbance. Calligraphy was inexpensive, easy to practice, and involved an innate art appreciation and cognitive facilitation process. Calligraphy handwriting offered a promising approach to improved health in cancer patients.

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