Health-Related Quality of Life after Intensity Modulated Radiation Therapy for Localized Prostate Cancer: Comparison with Conventional and Conformal Radiotherapy

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Received November 9, 2005; accepted December 26, 2005; published online March 14, 2006

Objective: No previous studies have reported the longitudinal health-related quality of life (HRQOL) for intensity modulated radiation therapy (IMRT). We compared HRQOL after IMRT with that after conventional and after conformal radiation therapy (XRT).

Methods: A total of 110 patients underwent XRT (34 patients underwent conventional radiation therapy and 76 underwent conformal radiation therapy) and 30 underwent IMRT for clinically localized prostate cancer between 2000 and 2002. We measured the general and disease-specific HRQOL using the Medical Outcomes Study 36-Item Health Survey and University of California, Los Angeles, Prostate Cancer Index, respectively.

Results: There were no significant differences in the preoperative characteristics and HRQOL scores of the two groups. Repeated measure analyses of variance revealed significantly different patterns of alteration in several general HRQOL domains between XRT and the IMRT groups. In the urinary domain, there was no difference in the alteration patterns between the two groups. The XRT group suffered worse bowel function at 3 and 6 months than the IMRT group (P < 0.05). In the XRT group, sexual function decreased at 3 months and remained substantially lower than the baseline level. However, the IMRT group showed no significant difference from the baseline level at any of the observation periods. At 18 months the XRT group showed worse sexual function than the IMRT group.

Conclusion: The two approaches showed different longitudinal profiles regarding general and disease-specific HRQOL during the first 2 years after treatment. The IMRT approach produced little impairment in bowel and sexual function.

Key words: prostate cancer – intensity modulated radiation therapy – conventional radiotherapy – conformal radiation therapy – quality of life

INTRODUCTION

The incidence of early-stage prostate cancer in Japanese men is clearly increasing, although the rate is still lower than that in Western countries (1). Men who are newly diagnosed with localized prostate cancer face a sometimes difficult choice among the principal treatments of watchful waiting, radical prostatectomy, radiation therapy (external beam or brachytherapy), hormonal ablation and a combination of these modalities. Recent research suggests that radical prostatectomy reduces the disease-specific mortality, overall mortality, and risk of metastasis and local progression compared with expectant management (2). Moreover, when limited to clinical stage T1 or T2 prostate cancers, biochemical outcomes are comparable for most men undergoing radical prostatectomy, external beam radiation or brachytherapy (3). Hence, the basis on which patients select the primary therapy has shifted toward considerations of the health-related quality of life (HRQOL) (4–5). Although the probability of eradicating prostate cancer is increased by increasing the radiation dose (6–7), classic radiotherapy techniques at doses >70 Gy result in high rates of severe rectal and bladder toxicity (8). Intensity modulated radiation therapy (IMRT) has been shown to improve the local control and disease-free survival in patients with localized prostate cancer (9). No comparison of conventional external beam or conformal radiation and IMRT has been...
performed in a randomized trial. Zelefsky et al. reported that IMRT reduced acute and rectal toxicities significantly compared with conventional radiotherapy techniques (10). With regard to conformal radiotherapy, Potosky et al. (11) reported survey results at three separate points: 6, 12 and 24 months after treatment. In their study, urinary function declined slowly for the first 6 months and then remained relatively stable. Rectal function decreased during the first 6 months and then improved thereafter. Sexual function declined rapidly during the first 6 months and then continued to decline slowly thereafter.

To our knowledge, there have been no well-constructed studies that measured HRQOL after IMRT using internationally validated outcome methods. This is the first longitudinal survey that compares HRQOL after IMRT with that after conventional or conformal radiation in Japanese men.

PATIENTS AND METHODS

PATIENT POPULATION

Between January 2000 and December 2002, 110 patients were treated using conventional external beam or conformal radiation (34 patients underwent conventional radiation therapy and 76 underwent conformal radiation therapy) (XRT group) and 30 were treated using IMRT (IMRT group) with or without hormone therapy. The patients who suffered from localized prostate cancer (T1–T3N0M0) were treated at Tohoku University Hospital and its two affiliated hospitals and Kurashiki Central Hospital.

We recommended radiotherapy with neoadjuvant endocrine therapy if the patient had a tumor with a clinical stage of cT3a or higher. However, the final determination of the treatment modality was made by the patient after thorough discussion of the options.

IMRT was performed at Tohoku University Hospital. Three gold markers were implanted transperineally through 18 guage needles under transrectal ultrasound guidance before radiotherapy. Two markers were implanted toward the base of the prostate gland or at midgland, and one marker was implanted toward the apex. No noticeable complications occurred from the implantation procedure. Subsequently, the patients underwent CT simulation in preparation for the treatment planning. Daily doses were delivered under an image guide using dual fluoroscopy with a flat panel on-board imager system that was developed in the department of radiation oncology at Tohoku University (12). Daily set-up error could be reduced to <1 mm using this system (13). The conventional four-field box (34 patients) or three-dimensional conformal external-beam radiation therapy (76 patients) was performed at Miyagi Cancer Center, Furukawa City Hospital and Kurashiki Central Hospital. All patients were informed of their cancer diagnosis before being asked to fill out the HRQOL questionnaires. Each patient who agreed to participate in this study received from his urologist a questionnaire, an informed consent form and a prepaid envelope for returning the questionnaire. The baseline interview was conducted after the diagnosis. Follow-up interviews were conducted in person at scheduled study visits of 3, 6, 12, 18 and 24 months after the treatment.

QUALITY OF LIFE METHODOLOGY

We measured the general and prostate-specific HRQOL using two types of scales. The general HRQOL was assessed using the Medical Outcomes Study 36-Item Short Form (SF-36) (14). The general scales cover eight domains, four physical and four emotional. The eight scales are scored separately from 0 to 100, a higher score representing a better quality of life. The prostate-specific HRQOL was assessed using the University of California, Los Angeles, Prostate Cancer Index (UCLA PCI), which is a 20-item questionnaire that quantifies prostate-cancer-specific HRQOL in six separate domains of urinary function, urinary bother, bowel function, bowel bother, sexual function and sexual bother (15). The six scales are scored separately from 0 to 100, a higher score representing a better outcome. Both questionnaires have already been translated into Japanese, and their validity and reliability have been tested (16–17).

STATISTICS ANALYSIS

Quality of life scores for the various domains are shown as mean ± SD in scales of 0–100, with a higher score always representing a better HRQOL. Differences in the distributions of the background variables were evaluated using non-parametric procedures (χ² or Mann–Whitney tests). The inspection value was shown using average ± SD and statistical analysis was performed using the repeated measure analyses of variance (ANOVA) or Mann–Whitney U test. P < 0.05 was considered significant.

RESULTS

PATIENT CHARACTERISTICS

Table 1 presents information on the background characteristics of the patients with localized prostate cancer who subsequently underwent IMRT or XRT. A margin of 5 mm around the clinical target volume was added. Prescribed doses for the prostate and seminal vesicles were 78 Gy (median 76, range 74–80) for IMRT. The mean dose of the XRT was 69.6 Gy (median 70, range 66–72).

There were no significant differences in age between patients in the IMRT group and in the XRT group. The two groups were comparable in terms of mean patient age, serum prostate-specific antigen (PSA) values, Gleason scores and clinical tumor stage. The two groups showed similar levels of comorbidities and sociodemographic characteristics. More patients in the XRT group received neoadjuvant or adjuvant hormonal therapy than in the IMRT group (both P < 0.001).
HRQOL ASSESSMENT

A comparison of HRQOL scores between the IMRT and XRT groups is shown in Table 2 (general scales) and Table 3 (disease-specific scales). The total numbers of questionnaires returned were 140 (30 and 110 for the IMRT and XRT groups, respectively), 121 (26 and 95), 116 (26 and 90), 132 (27 and 105), 97 (22 and 75) and 117 (26 and 91) at baseline, 3, 6, 12, 18 and 24 months after radiotherapy, respectively.

At baseline, there were no significant differences in any of the general HRQOL domains between the two groups. Repeated measure ANOVA revealed that the patterns in the alterations of the several SF-36 domains, including physical function \( (P < 0.001) \), role limitation due to physical problems \( (P = 0.001) \), emotional problems \( (P < 0.001) \), mental health \( (P = 0.043) \) and bodily pain \( (P = 0.020) \), were different in the two treatment groups. The XRT group scored lower in role limitations due to emotional problems and physical problems than the IMRT group \((P < 0.05)\).

In the urinary function and bother domain, which reflects urinary leakage, no statistically significant differences were found between the two study arms. The two treatment groups showed similar urinary function and bother scores throughout the follow-up period. In the bowel function and bother domain, no significant difference was observed at the baseline. At 3 and 6 months after treatment, however, the IMRT group had a significantly better bowel function score than did the XRT group \((P = 0.010 \text{ and } 0.014, \text{ respectively})\). Furthermore, there were significant differences in the alteration pattern between the two treatment arms \((P = 0.047)\). The patterns in the alteration of sexual function were different between the two groups \((P < 0.001)\). In the XRT group, sexual function decreased at 3 months and remained substantially lower than the baseline level. In contrast, the IMRT group showed no significant difference in sexual function between baseline and any of the observation periods. At 18 months the IMRT group showed better sexual function than the XRT group \((P < 0.05)\). No significant differences between the conventional and the conformal radiation therapy groups were observed at the baseline and at any of the postoperative times (data not shown). When the XRT group was limited to those without adjuvant hormonal therapy \((n = 44)\), sexual function after radiotherapy was equivalent to the values recorded in the IMRT group \((P > 0.05)\). However, it tended to be scored lower than the baseline value \((P < 0.05)\).

THE IMPACT OF IMRT ON HRQOL

Since endocrine therapy might have affected the recovery of HRQOL, the impact of IMRT alone on HRQOL was further analyzed using a study cohort of 12 patients. When evaluating UCLA PCI, no differences in urinary and bowel function were apparent between pre- and any post-treatment periods. Furthermore, similar to urinary and bowel function, sexual function appeared to be equivalent at every point among those who received IMRT alone (Fig. 1).

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Table 1. Demographic and clinical characteristics of the study population

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>XRT</th>
<th>IMRT</th>
<th>P-value</th>
</tr>
</thead>
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<tr>
<td>No. of patients</td>
<td>110</td>
<td>30</td>
<td>0.143</td>
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<tr>
<td>Age at survey (years)</td>
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<tr>
<td>Mean ± SD</td>
<td>73.2 ± 5.0</td>
<td>71.4 ± 6.0</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>73.5</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>47–83</td>
<td>56–83</td>
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<tr>
<td>PSA at diagnosis (ng/ml)</td>
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<td>0.306</td>
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<td>33.4 ± 41.8</td>
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<tr>
<td>Median</td>
<td>18.6</td>
<td>17.2</td>
<td></td>
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<tr>
<td>Range</td>
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<td>2.9–108</td>
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<td>Clinical tumor stage</td>
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<tr>
<td>T1</td>
<td>25</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>31</td>
<td>8</td>
<td></td>
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<tr>
<td>T3</td>
<td>54</td>
<td>15</td>
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<td>Gleason score</td>
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<tr>
<td>( &lt; 6 )</td>
<td>38</td>
<td>10</td>
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<tr>
<td>( \geq 7 )</td>
<td>72</td>
<td>20</td>
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<td>Neoadjuvant therapy</td>
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<tr>
<td>LH-RH analogue</td>
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<td>11</td>
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<tr>
<td>Antiandrogen</td>
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<tr>
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<td>7</td>
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<td>Adjuvant therapy</td>
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<tr>
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<td>LH-RH analogue</td>
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<tr>
<td>Antiandrogen</td>
<td>21</td>
<td>0</td>
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<td>LH-RH analogue plus antiandrogen</td>
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<tr>
<td>Part-time worker</td>
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<td>Retired /no job</td>
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<td>Marital status</td>
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<td>Married</td>
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<tr>
<td>Unmarried</td>
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<td>Selected conditions</td>
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<td>Diabetes</td>
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<tr>
<td>Cardiovascular disease</td>
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<td>5</td>
<td></td>
</tr>
<tr>
<td>Other cancer</td>
<td>14</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>45</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal disease</td>
<td>24</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

XRT, patients who underwent conventional or conformal radiation therapy. IMRT, patients who underwent intensity modulated radiation therapy. SD, standard deviation; PSA, prostate-specific antigen.

\(^{a}\)Mann–Whitney U-test.

\(^{b}\)\(\chi^2\) test.

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Table 2. SF-36 scores of patients in the treatment groups

<table>
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<tr>
<th></th>
<th>XRT</th>
<th>IMRT</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Repeated measures ANOVA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical function</td>
<td></td>
<td></td>
<td><strong>0.184</strong></td>
</tr>
<tr>
<td>Baseline</td>
<td>79.4 ± 21.0</td>
<td>83.9 ± 16.8</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>78.1 ± 20.2</td>
<td>82.5 ± 15.0</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>81.3 ± 19.8</td>
<td>83.1 ± 14.5</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>77.0 ± 23.4</td>
<td>81.5 ± 17.9</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>78.9 ± 21.0</td>
<td>80.7 ± 19.8</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>73.8 ± 22.1</td>
<td>82.3 ± 16.5*</td>
<td></td>
</tr>
<tr>
<td>Role limitation due to physical problems</td>
<td><strong>0.014</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>73.0 ± 25.4</td>
<td>75.8 ± 24.9</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>71.9 ± 26.6</td>
<td>77.9 ± 19.8*</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>71.3 ± 28.3</td>
<td>78.9 ± 20.5</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>71.8 ± 25.7</td>
<td>78.0 ± 30.1</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>69.6 ± 27.5</td>
<td>76.1 ± 22.5*</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>68.7 ± 28.3</td>
<td>77.3 ± 24.5*</td>
<td></td>
</tr>
<tr>
<td>Bodily pain</td>
<td><strong>0.544</strong></td>
<td></td>
<td></td>
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<tr>
<td>Baseline</td>
<td>79.0 ± 22.5</td>
<td>83.4 ± 22.2</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>74.8 ± 23.6</td>
<td>79.8 ± 22.4</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>80.1 ± 22.0</td>
<td>76.7 ± 24.0</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>75.7 ± 24.1</td>
<td>80.3 ± 16.2</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>79.0 ± 22.3</td>
<td>82.1 ± 21.3</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>71.0 ± 27.2</td>
<td>79.2 ± 16.8*</td>
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</tr>
<tr>
<td>General health perception</td>
<td><strong>0.030</strong></td>
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<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>55.5 ± 15.9</td>
<td>56.8 ± 17.8</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>56.2 ± 16.4</td>
<td>59.7 ± 13.9</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>56.6 ± 17.9</td>
<td>59.7 ± 15.0</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>57.0 ± 18.0</td>
<td>60.6 ± 15.4</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>57.5 ± 17.7</td>
<td>54.7 ± 17.2</td>
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</tr>
<tr>
<td>24 mos.</td>
<td>56.6 ± 19.0</td>
<td>59.2 ± 19.1</td>
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<tr>
<td>Mental health</td>
<td><strong>&lt;0.001</strong></td>
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<tr>
<td>Baseline</td>
<td>67.8 ± 20.6</td>
<td>71.9 ± 18.8</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>68.6 ± 19.9</td>
<td>74.8 ± 15.8</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>72.0 ± 19.8</td>
<td>70.2 ± 18.6</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>69.0 ± 20.2</td>
<td>72.4 ± 14.8</td>
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</tr>
<tr>
<td>18 mos.</td>
<td>73.2 ± 18.6</td>
<td>72.0 ± 16.8</td>
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<tr>
<td>24 mos.</td>
<td>71.0 ± 18.6</td>
<td>75.0 ± 20.1</td>
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<tr>
<td>Role limitation due to emotional problems</td>
<td><strong>0.027</strong></td>
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<tr>
<td>Baseline</td>
<td>73.0 ± 27.7</td>
<td>79.8 ± 23.7</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>68.5 ± 28.7</td>
<td>83.7 ± 18.5*</td>
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</tr>
<tr>
<td>6 mos.</td>
<td>74.8 ± 29.6</td>
<td>76.4 ± 21.9</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>74.3 ± 26.2</td>
<td>83.0 ± 27.5*</td>
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<tr>
<td>18 mos.</td>
<td>73.1 ± 29.4</td>
<td>78.0 ± 22.4</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>66.3 ± 30.6</td>
<td>75.8 ± 26.3*</td>
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</table>

Table 2 (continued). SF-36 scores of patients in the treatment groups

<table>
<thead>
<tr>
<th></th>
<th>XRT</th>
<th>IMRT</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Repeated measures ANOVA</td>
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<td></td>
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<tr>
<td>Social function</td>
<td></td>
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<td><strong>&lt;0.001</strong></td>
</tr>
<tr>
<td>Baseline</td>
<td>80.0 ± 23.1</td>
<td>77.4 ± 19.5</td>
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</tr>
<tr>
<td>3 mos.</td>
<td>78.6 ± 21.2</td>
<td>84.1 ± 21.4</td>
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</tr>
<tr>
<td>6 mos.</td>
<td>80.4 ± 26.9</td>
<td>83.9 ± 19.7</td>
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<tr>
<td>12 mos.</td>
<td>80.2 ± 24.4</td>
<td>84.7 ± 20.6</td>
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<td>18 mos.</td>
<td>85.2 ± 20.2</td>
<td>79.0 ± 24.2</td>
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<tr>
<td>24 mos.</td>
<td>75.8 ± 25.8</td>
<td>78.8 ± 22.5</td>
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<tr>
<td>Vitality</td>
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<tr>
<td>Baseline</td>
<td>64.3 ± 19.6</td>
<td>65.1 ± 16.4</td>
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<tr>
<td>3 mos.</td>
<td>59.7 ± 20.9</td>
<td>68.8 ± 17.3</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>61.9 ± 21.1</td>
<td>61.2 ± 17.8</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>60.5 ± 21.1</td>
<td>63.9 ± 16.6</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>62.6 ± 20.0</td>
<td>61.4 ± 18.4</td>
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<tr>
<td>24 mos.</td>
<td>59.4 ± 22.4</td>
<td>64.9 ± 20.8</td>
<td></td>
</tr>
</tbody>
</table>

XRT, patients who underwent conventional or conformal radiation therapy. IMRT, patients who underwent intensity modulated radiation therapy.
SF-36, the Medical Outcomes Study 36-Item Short Form.
Data are presented as mean ± SD.
Statistically significant changes between XRT and IMRT are indicated as * (P < 0.05).

DISCUSSION

IMRT is a sophisticated method of delivering radiation treatment and represents a promising new advance in the field of radiation oncology. Many investigators have reported that general HRQOL is relatively good after radiotherapy (18–19). In the present study, patients who underwent IMRT and XRT had different longitudinal profiles of HRQOL. Among men treated using XRT, fatigue appeared to be the most common complication. XRT has been found to be associated with increases in fatigue from pre-treatment until the 12 month follow-up (20). Our study revealed that those who underwent XRT reported more limitations due to physical or emotional problems after treatment. On the other hand, the IMRT group had no significant changes in general HRQOL scores compared with the baseline.

According to previous studies on bladder morbidity, the rate of urinary leakage was between 32 and 38% and the rate of incontinence requiring the use of a pad was between 3 and 15% (21–22). Litwin reported that urinary function remained stable throughout the 2 years after radiation (23), which was similar to our data. However, because that study was based on the UCLA PCI, there was no examination of bladder outlet obstruction, and some of the men may have had obstructive symptoms. Recently, the Expanded Prostate Cancer Index Composite (24), which added irritative symptoms to the UCLA PCI, was introduced in a Japanese version (25), and if it had been used, the change in urinary function might have become clearer.
Our findings confirm the previously published observations that bowel irritability and bleeding may occur following XRT for localized prostate cancer but that the symptoms tend to improve with time (26–28). IMRT has the added potential of reducing the treatment-related toxicity by the conformal avoidance of normal tissue. Zelefsky et al. reported acute toxicity in 772 patients treated with at least 81 Gy. Acute grade 2 genitourinary toxicity was observed in 4% (10). In our questionnaire study, there were no significant differences in bowel function and bother scores between baseline and any post-treatment period.

Our findings confirm the longitudinal trends in sexual function observed by Litwin et al. (29), in which the patients

### Table 3. UCLA PCI scores of patients in the treatment groups

<table>
<thead>
<tr>
<th></th>
<th>XRT</th>
<th>IMRT</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urinary function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>87.1 ± 21.1</td>
<td>92.0 ± 16.6</td>
<td>0.826</td>
</tr>
<tr>
<td>3 mos.</td>
<td>89.9 ± 16.6</td>
<td>93.2 ± 16.1</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>87.6 ± 21.6</td>
<td>92.2 ± 16.7</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>87.4 ± 19.8</td>
<td>92.1 ± 17.3</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>87.7 ± 18.1</td>
<td>92.0 ± 16.6</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>83.4 ± 24.3</td>
<td>92.7 ± 13.5</td>
<td></td>
</tr>
<tr>
<td><strong>Urinary bother</strong></td>
<td></td>
<td></td>
<td>0.598</td>
</tr>
<tr>
<td>Baseline</td>
<td>84.0 ± 23.5</td>
<td>82.3 ± 26.8</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>84.8 ± 20.2</td>
<td>87.5 ± 16.2</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>85.5 ± 25.2</td>
<td>82.3 ± 25.0</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>85.7 ± 23.2</td>
<td>88.9 ± 22.3</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>85.9 ± 20.9</td>
<td>90.9 ± 18.2</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>82.3 ± 24.4</td>
<td>86.5 ± 24.2</td>
<td></td>
</tr>
<tr>
<td><strong>Bowel function</strong></td>
<td></td>
<td></td>
<td>0.047</td>
</tr>
<tr>
<td>Baseline</td>
<td>86.8 ± 16.2</td>
<td>86.2 ± 17.6</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>82.6 ± 16.2</td>
<td>91.5 ± 10.5*</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>81.2 ± 18.4</td>
<td>87.1 ± 16.7*</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>84.9 ± 15.0</td>
<td>83.1 ± 15.9</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>85.4 ± 14.2</td>
<td>85.5 ± 16.5</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>81.9 ± 14.8</td>
<td>83.7 ± 17.7</td>
<td></td>
</tr>
<tr>
<td><strong>Bowel bother</strong></td>
<td></td>
<td></td>
<td>0.303</td>
</tr>
<tr>
<td>Baseline</td>
<td>89.0 ± 20.6</td>
<td>89.5 ± 22.1</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>85.8 ± 20.7</td>
<td>91.2 ± 9.2</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>86.0 ± 24.2</td>
<td>92.7 ± 13.8</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>89.8 ± 16.9</td>
<td>88.0 ± 18.8</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>87.1 ± 17.8</td>
<td>89.8 ± 19.9</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>80.1 ± 25.8</td>
<td>86.5 ± 19.4</td>
<td></td>
</tr>
<tr>
<td><strong>Sexual function</strong></td>
<td></td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td>Baseline</td>
<td>14.1 ± 20.4</td>
<td>15.1 ± 18.2</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>8.7 ± 15.2</td>
<td>13.1 ± 17.3</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>7.0 ± 14.0</td>
<td>15.8 ± 18.5</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>7.3 ± 13.7</td>
<td>14.8 ± 15.6</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>6.9 ± 13.2</td>
<td>18.0 ± 21.6*</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>6.9 ± 13.0</td>
<td>15.5 ± 12.3</td>
<td></td>
</tr>
<tr>
<td><strong>Sexual bother</strong></td>
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<td></td>
<td>0.256</td>
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<tr>
<td>Baseline</td>
<td>76.3 ± 31.3</td>
<td>73.4 ± 27.3</td>
<td></td>
</tr>
<tr>
<td>3 mos.</td>
<td>80.4 ± 29.3</td>
<td>74.0 ± 30.4</td>
<td></td>
</tr>
<tr>
<td>6 mos.</td>
<td>80.0 ± 31.2</td>
<td>77.1 ± 27.5</td>
<td></td>
</tr>
<tr>
<td>12 mos.</td>
<td>77.6 ± 32.3</td>
<td>74.1 ± 28.1</td>
<td></td>
</tr>
<tr>
<td>18 mos.</td>
<td>72.6 ± 35.6</td>
<td>71.6 ± 32.1</td>
<td></td>
</tr>
<tr>
<td>24 mos.</td>
<td>77.2 ± 33.5</td>
<td>71.7 ± 35.9</td>
<td></td>
</tr>
</tbody>
</table>

XRT, patients who underwent conventional or conformal radiation therapy; IMRT, patients who underwent intensity modulated radiation therapy; UCLA PCI, University of California, Los Angeles, Prostate Cancer Index. Data are presented as mean ± SD. Statistically significant changes between XRT and IMRT are indicated as * (P < 0.05).

**Figure 1.** Longitudinal changes in the mean UCLA PCI scores over time for patients with IMRT monotherapy. (A) Urinary function and bother; (B) bowel function and bother; (C) sexual function and bother.
undergoing XRT for early-stage prostate cancer began to show declining sexual function during the second year after treatment. On the other hand, Beckendorf et al. reported that 67% of male patients treated using XRT alone showed preserved sexual function at 2 years post-treatment (30). In our study, most of the patients treated with XRT also received neoadjuvant or adjuvant hormonal ablation, which may have contributed to the sexual impairment of the XRT group. Thus, a depressed level of testosterone due to hormonal therapy may explain some of the depressed sexual function and bother scores. IMRT did not cause a loss of potency in men with localized prostate cancer during the first 2 years. One of the reasons for the high rate of erectile function preservation with IMRT may be that it is a highly conformal radiotherapeutic approach, enabling more conformal treatment of the prostatic fossa and sparing of the surrounding normal tissue, including penile erectile tissue. Interestingly, our study found that erectile dysfunction after treatment was not a burden to the patients, although a significant deterioration of sexual function was observed in the XRT groups. Kakehi suggested that Japanese patients with decreased sexual activity felt less sexual dissatisfaction than did American patients (17). In particular, elderly Japanese men, unlike their American counterparts, do not report dissatisfaction with their sex life, even when reporting erectile dysfunction (31). The reason why the patients of the XRT group had better sexual bother scores despite their low sexual function scores may be that most of them were not only more than 70 years old but also received hormonal ablation.

Our study has several limitations. First, it had relatively few patients, especially in the IMRT group, consistent with its design as a feasibility study of longitudinal collection. Second, we did not assess HRQOL before the initiation of hormonal ablation, which may constitute another potential flaw in our study. Third, the treatment was not carried out in a randomized fashion but selected by the patient and his urologist. This may have introduced a sampling bias if the two groups had apparent or unapparent baseline differences. Because there were no significant differences with regard to age, pre-treatment PSA level, tumor stage distribution, morbidity or sociodemographic characteristics between the two treatment groups, the substantial differences in the postoperative HRQOL could be attributed mainly to the treatment approach. And finally, patients who chose not to participate in the study may have had HRQOL outcomes that were either better or worse than those in this study.

Despite these limitations, our observations have important implications for men who are faced with the choice of radiation for early-stage prostate cancer. Additional studies documenting differences in long-term cancer control and HRQOL after XRT and IMRT are necessary.

Acknowledgment

This work was supported in part by a grant (11-10) from the Ministry of Health and Welfare of Japan.

References


