Objective: To compare the efficacy of narrowband UV-B (TL-01) phototherapy with oral 8-methoxypsoralen photochemotherapy (8-MOP psoralen–UV-A [PUVA]) in patients with chronic plaque psoriasis (CPP).

Design: Open, randomized, controlled study.

Setting: Phototherapy unit in a dermatology hospital.

Patients: Fifty-four patients with CPP.

Interventions: Patients received whole-body threshold erythemogenic dose of either 3-times weekly TL-01 or twice-weekly oral 8-MOP PUVA, based on minimal erythema or phototoxic doses. Patients were treated until completely clear.

Outcome Measures: Number of treatments to clear, number of days in treatment, number of days in remission, and adverse effects of both therapies were assessed.

Results: Forty-five patients completed the study. Those in the PUVA group required significantly fewer treatments to clear ($P = .03$). There was no significant difference in the number of days to clear or number of days in remission. A similar percentage of patients in the TL-01 and PUVA groups developed minimal perceptible erythema, showing that the regimens were equally erythemogenic. Asymptomatic, well-defined erythema occurred only in the PUVA group. Pruritus and polymorphic light eruption occurred equally in both groups, but only patients in the PUVA group developed nausea.

Conclusion: Narrowband UV-B phototherapy, used 3 times weekly, is as effective for the treatment of CPP as oral 8-MOP PUVA used twice weekly.

Arch Dermatol. 2003;139:325-328

Oral 8-methoxypsoralen photochemotherapy (8-MOP psoralen–UV-A [PUVA]) is a well-established and effective treatment for psoriasis.\textsuperscript{1-5} The main concern with PUVA is the risk of nonmelanoma skin cancers\textsuperscript{6-8} and more recently the risk of melanoma.\textsuperscript{9} The action spectra of phototherapy for psoriasis\textsuperscript{10,11} led to the development by Philips (Eindhoven, the Netherlands) of a fluorescent lamp emitting narrowband UV-B between 311 and 313 nm, referred to as the TL-01 lamp. This has been shown to be more effective than broadband UV-B in the treatment of psoriasis.\textsuperscript{12-17} A review of these treatments and guidelines has been published by the British Photodermatology Group.\textsuperscript{18}

Narrowband UV-B (TL-01) phototherapy has gradually replaced PUVA as the first-line treatment for chronic plaque psoriasis (CPP) in our unit. Patients prefer it because they do not have to wear protective eyewear, take tablets, or experience adverse effects such as nausea. Also, TL-01 has the advantage of being suitable for use during pregnancy and in children. A recent audit of adverse effects of TL-01 and oral 8-MOP PUVA in our unit showed that both treatments were well tolerated.\textsuperscript{19} The long-term skin cancer risk is thought to be less than that of PUVA.\textsuperscript{20-21} Therefore, TL-01 has considerable advantages over PUVA and, if its efficacy was equal to PUVA, would be preferred.

Van Weelden et al\textsuperscript{22} reported that TL-01 was as effective as PUVA in 10 patients after 4 weeks of treatment. Tanew et al\textsuperscript{23} confirmed that both treatments were equally effective but suggested that oral 8-MOP PUVA was superior for patients with severe plaque psoriasis. During this trial, 2 other groups\textsuperscript{24,25} have reported studies comparing these modalities. One showed PUVA to be more effective. We performed a randomized, controlled trial to compare TL-01 and PUVA in terms of efficacy, time to clear, remission, and adverse effects to help decide if one had an advantage in the treatment of CPP.
The trial was approved by the ethics committee of the City of Dublin Skin and Cancer Hospital (Dublin, Ireland), and patients gave written informed consent to participate in the study. Fifty-four consecutive patients with CPP affecting trunk and limbs were recruited from outpatient clinics between January 1999 and June 2000. All patients had at least 8% psoriasis extent on the trunk and limbs as assessed by the rule of nines by one observer (P.C.). Patients had not received any specific antipsoriatic treatment within 2 weeks prior to the study or phototherapy for 4 months beforehand. Exclusion criteria included age younger than 16 years, pregnancy or lactation, renal or hepatic disease, active systemic therapy within the previous 8 weeks for psoriasis, abnormal photosensitivity, or previous failure or intolerance to phototherapy.

Psoriasis area and severity index score (PASI), skin type, and phototherapy risk factor profiles were established for each patient. Patients with skin types I, II, and III, representative of our local population, were included and randomly allocated to either treatment group. Patients wore UV protective goggles, and men wore genital protection in the cabinet. Aqueous cream (Emulsifying Ointment British Pharmacopoeia [30% w/w] | Ovelle Pharmaceuticals Ltd, Dundalk, Ireland), purified water, and phenoxethanol was used as required. Vioform HC cream (3% chloroquinol and 1% hydrocortisone; Novartis, Dublin, Ireland) was applied twice daily to flexural psoriasis, and tar pomade (6% coal tar, 2% salicylic acid, yellow soft paraffin, emulsifying wax, liquid paraffin, and polysorbate 80 | Foran Chemicals Ltd, Dublin) was applied to the scalp. The end point of the study was complete clearance of psoriasis. Patients were reviewed once weekly during the study and monthly after clearance for 12 months by a blinded observer (P.C.) to determine the duration of remission in days. Relapse was defined as 50% of the original extent. Outcome measures included the number of treatments to clear, the number of days in treatment, the number of days in remission, and adverse effects.

### NARROWBAND UV-B PHOTOTHERAPY

Eight 2 × 2-cm sites 1.5 cm apart on unaffected upper back skin were exposed to narrowband UV-B (50, 70, 100, 140, 200, 280, 390, 550, 770, and 1080 mJ/cm²) from a bank of 4 TL-01 fluorescent tubes. The first 8 test doses were used for patients with skin types I and II and the last 8 were used for those with skin type III. The minimal erythema dose was defined as the dose that caused just perceptible erythema 24 hours after irradiation. Irradiance (3.22-5.39 mW/cm²) was measured monthly at a distance of 20 cm midway along the center of the bank of 4 tubes using the calibrated IL1400A radiometer and sensor. The UV-B time dosage table was adjusted accordingly.

Phototherapy was administered 3 times a week on Monday, Wednesday, and Friday. Psoriasis plaques were assessed for scale, erythema, and induration at each visit. The treatment regimen is outlined in Table 1. Incremental increases of the previous dose were made at each visit to a maximum dose of 2140 mJ/cm². Psoriasis plaques were assessed at each visit for scale, erythema, and induration. The grade of erythema, pigmentation, pruritus, polymorphic light eruption, and any adverse effect was recorded at each visit.

### ORAL 8-MOP PUVA

Oral 8-MOP crystalline tablets (10 mg of Deltapsoralen; Crawford Pharmaceuticals, Milton Keynes, England) at a dose of 0.6 mg/kg rounded up to the nearest 10 mg were taken 2 hours before UV-A exposure. Patients who could not tolerate 8-MOP (3 patients) were given 5-MOP (20 mg of Pentaderm; Crawford Pharmaceuticals) at a dose of 1.2 mg/kg. Patients were treated twice weekly on Monday and Thursday or Tuesday and Friday. They were UV-A protective spectacles for 24 hours after treatment.

Eight 2 × 2-cm squares 1.5 cm apart on unaffected upper back skin were exposed to UV-A 2 hours after ingestion of psoralen at a distance of 20 cm from a bank of 6 Waldmann UV-A fluorescent tubes (Waldmann GmbH, Schwenningen, Germany). The first 8 test doses (0.5, 0.7, 1.0, 1.4, 2.0, 2.8, 3.9, and 5.5 J/cm²) were used for patients with skin types I and II, and patients with skin type III received the second 6 doses (2.0, 2.8, 3.9, 5.5, 7.7, and 10.8 J/cm²). The minimal phototoxic dose was defined as the dose that induced minimal perceptible erythema 72 hours after irradiation. Irradiance (7.4-8.3 mW/cm²) was measured monthly at a distance of 20 cm midway along the center of the bank of tubes using a calibrated Waldmann PUVA meter and sensor (Waldmann GmbH).

### DOSIMETRY

Whole-body UV-B was given in a Waldmann 5000 cabinet (Waldmann GmbH) incorporating twenty-four 100-W Philips TL-01 fluorescent lamps (311-313 nm). Whole-body UV-A was given in a Waldmann 6000 cabinet incorporating forty 100-W Waldmann UV-A fluorescent lamps (315-400, peak 352 nm). Irradiance was measured each month by a person standing in the cabinet at 20 cm from the bulbs at 4 sides of the cabinet at 3 levels (shoulder, umbilicus, and lateral thigh), using a IL1400A radiometer and calibrated sensor. The mean of 12 readings was taken. Tables for UV time and dosage with 20% and 10% incremental scales were adjusted accordingly each month. The IL1400A radiometer and sensors were calibrated annually against a reference standard (A. Coleman, Medical Physics, Guys and St Thomas’ Hospital Trust, London, England).

### STATISTICAL ANALYSIS

Median and interquartile values were calculated. The data were not normally distributed and, therefore, a nonparametric test was used to compare data. The number of treatments, days in treatment and days in remission were compared using the Mann-Whitney test. A P value less than 0.05 was deemed significant, and 95% confidence intervals were calculated. Sample size estimation as previously reported suggested that for 80% power to detect a decrease in median exposure of 25% at the 5% significance level, 2 groups of 50 patients would be required.
and 25 to the PUVA group. The 2 groups were well matched for age, sex, skin type, psoriasis extent, and PASI score (Table 2). A similar number of patients in each group received previous courses of TL-01 and/or PUVA. Our aim was to recruit 100 patients; however, many patients refused to participate because they did not want PUVA therapy, citing protective eyewear and taking tablets as the main reasons for refusal.

Forty-five patients completed the study. Six patients failed to complete treatment (TL-01, 4; PUVA, 2); 2 went on holidays during the treatment period and 4 defaulted. Three were withdrawn (TL-01, 1; PUVA, 2) because of flaring and required inpatient treatment (Figure 1). Data on the number of treatments, the number of days to clear, and the number of days in remission are presented for the 45 patients who completed the study (Table 3). There was a statistically significant difference in the number of treatments to clear for those receiving PUVA therapy ($P = .03$). There was no significant difference in the number of days to clear or duration of remission (Table 3). Remission data are available for 43 of 45 patients and are presented in Table 4.

Both groups were divided according to PASI score. Those with a PASI score less than 14 were in the low PASI group, and those with a score of 14 or higher were in the high PASI group. There was no significant difference in the number of treatments to clear, days in treatment, or number of days in remission between the 2 treatments.

A similar percentage of patients in each group (TL-01, 75%; PUVA, 80%) developed grade 1 erythema, showing that the regimens were equally erythemogenic (Figure 2). Grade 2 erythema occurred only in the PUVA group. Pruritus and polymorphic light eruption occurred equally in both groups, but only patients in the PUVA group developed nausea. No other significant adverse effects of treatment were noted.

**COMMENT**

Oral 8-MOP PUVA therapy is effective in the management of CPP and is the yardstick against which new forms of phototherapy should be measured. In this study, patients were treated with equi-erythemogenic dosages of 3-times weekly TL-01 or twice-weekly oral PUVA until completely clear. Patients were well matched and a similar number in both groups had previously been treated with phototherapy and PUVA. There was no statistically significant difference in the number of days taken to clear or days in remission between the groups. Adverse effects were comparable with both therapies. Patients treated with PUVA received fewer treatments, and this was the only statistically significant difference between the groups. However, the power of this study is limited because of difficulty in recruiting sufficient numbers.

Other groups have compared TL-01 and PUVA using half-body comparison and randomized controlled studies.

### Table 2. Demographic Data and Pretreatment Psoriasis Extent and PASI Scores of Both Treatment Groups

<table>
<thead>
<tr>
<th></th>
<th>TL-01 (n = 29)</th>
<th>PUVA (n = 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female</td>
<td>17/12</td>
<td>13/2</td>
</tr>
<tr>
<td>Age, mean (range), y</td>
<td>36 (27-50)</td>
<td>39 (28.5-52)</td>
</tr>
<tr>
<td>Skin type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>III</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Extent, mean (range), %</td>
<td>15 (12-22)</td>
<td>15 (10.5-25.5)</td>
</tr>
<tr>
<td>PASI score, mean (range)</td>
<td>13.9 (12.2-17.5)</td>
<td>15.2 (10.8-18.9)</td>
</tr>
<tr>
<td>Previous phototherapy</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>MED or MPD</td>
<td>335 mJ/cm² (220-390)</td>
<td>1.4 J/cm² (1.0-2.8)</td>
</tr>
</tbody>
</table>

### Table 3. Clearance and Remission Data of Treatment Groups*

<table>
<thead>
<tr>
<th>Datum</th>
<th>TL-01 (n = 24)</th>
<th>PUVA (n = 21)</th>
<th>$P$ Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of treatments</td>
<td>25.5 (18.0-32.5)</td>
<td>19 (14.6-25.0)</td>
<td>.03</td>
</tr>
<tr>
<td>Days to clear</td>
<td>67 (47.9-81.7)</td>
<td>66 (52.9-92.6)</td>
<td>.46</td>
</tr>
<tr>
<td>Remission in days‡</td>
<td>288.5 (170.6-365.0)</td>
<td>231 (162.7-365.0)</td>
<td>.40</td>
</tr>
</tbody>
</table>

*Data are median (90% confidence interval) unless otherwise specified. †Mann-Whitney test; $P < .05$ is significant.

### Table 4. Remission Data of Treatment Group*

<table>
<thead>
<tr>
<th>No. of Months in Remission</th>
<th>TL-01 (n = 24)</th>
<th>PUVA (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>23 (96)</td>
<td>18 (95)</td>
</tr>
<tr>
<td>6</td>
<td>16 (67)</td>
<td>13 (68)</td>
</tr>
<tr>
<td>9</td>
<td>23 (96)</td>
<td>8 (42)</td>
</tr>
<tr>
<td>12</td>
<td>7 (37)</td>
<td>10 (42)</td>
</tr>
</tbody>
</table>

*Data are number (percentage) of patients.

Abbreviations: MED, minimum erythema dose; MPD, minimum phototoxic dose; PASI, psoriasis area and severity index; PUVA, psoralen–UV-A; TL-01, narrowband UV-B.

Figure 1. Flowchart of patients with chronic plaque psoriasis randomized to treatment. PUVA indicates psoralen–UV-A; TL-01, narrowband UV-B.
trolled trials.23,25 Van Voorhees et al.26 treated 10 patients with twice-weekly TL-01 and PUVA until there was a sustained benefit to one half of the body. Patients then chose which treatment they preferred. There was no difference between these modalities in 5 patients, but PUVA was superior in 2 and TL-01 in 3. Seven patients favored whole-body treatment with TL-01, and 3 preferred PUVA. Tanew et al.23 in another half-body comparison, treated patients 3 times weekly with TL-01 and PUVA up to a maximum of 18 exposures. There was no significant difference in PASI score reduction on each side after 15 exposures. However, when patients were stratified according to pretreatment PASI score, those patients with the highest scores cleared better with PUVA. We therefore divided our patients according to pretreatment PASI score but failed to confirm that PUVA was more effective for patients with higher PASI scores.

Gordon et al.25 randomized 100 patients to receive either twice-weekly TL-01 or PUVA.25 Clearance of psoriasis was faster and occurred in a greater proportion of patients with PUVA. Patients treated with PUVA remained clear for longer also. In a recent half-body comparison, Dawe et al.26 treated 18 patients with 3-times weekly TL-01 and twice-weekly trimethylpsoralen bath UV-A and reported that both treatments were equally effective. Remission data from this study28 and that of Dawe et al.26 show no significant difference between TL-01 and PUVA. However, if TL-01 is only used twice weekly, remission data with PUVA are superior.25 It seems from these studies that TL-01 is as effective as PUVA but only if used 3 times weekly. Twice-weekly PUVA is as effective as 3-times weekly PUVA.3 Three-times weekly TL-01 is preferable to daily therapy,27 but there are no published data comparing 3-times weekly and twice-weekly TL-01.

In our unit we favor twice-weekly PUVA and 3-times weekly TL-01, as used in the present study, to be the optimum regimens for our predominantly skin type I (25%) and type II (50%) population.29 We have been using TL-01 since 1996, and it has gradually displaced PUVA as the phototherapy of choice for 70% patients with CPP. It is safer because of a lower long-term risk factor profile21 compared with PUVA.7,9 It is more popular with patients because they do not have to take tablets or wear protective spectacles. Also, it can be used during pregnancy and in children. The advantages of TL-01 compared with PUVA may only be worthwhile if TL-01 is as effective as PUVA for the treatment of CPP. Our results are consistent with those of other studies and suggest that 3-times weekly TL-01 is as effective as twice-weekly PUVA. Others have suggested that patients with more severe psoriasis may respond better to PUVA, but we were unable to reproduce their findings.21 Therefore, we recommend TL-01 as the phototherapy of choice for patients with CPP.

Accepted for publication July 30, 2002.

This study was presented at British Association of Dermatologists 2001 annual meeting, Cardiff, Wales (Br J Dermatol 2001;145 [suppl 39]:25).

We thank Imelda Waters, SRN, Nora Treacey, SRN, and Sister Felicity Fitzpatrick at the Day Care Unit, City of Dublin Skin and Cancer Hospital, for their help in conducting this study. We also thank Kathleen O’Sullivan, University College Cork, Cork, Ireland, for the statistical analysis.

REFERENCES