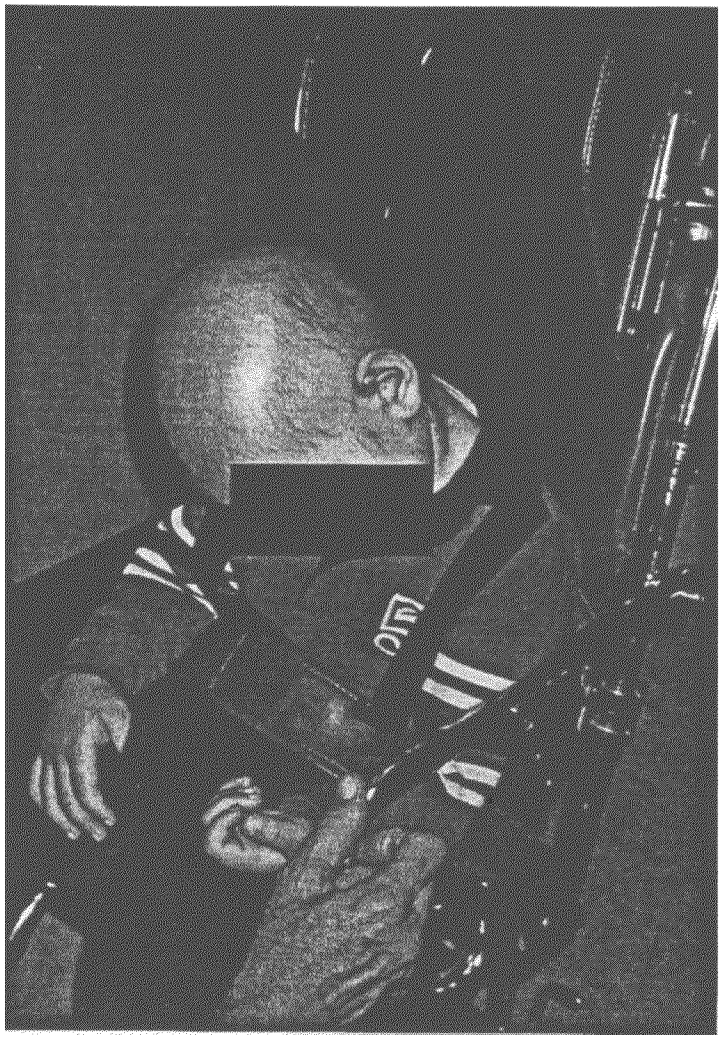

Image 3. A young child post-treatment and after radiotherapeutic overexposure for treatment of a brain tumour. Images 1 and 2 are from this patient.

Optic nerve damage and blindness can also occur from one to five years later in more than 20% of patients who receive 42 Gy in 15 fractions, 55 Gy in 25 fractions, 60 Gy in 30 fractions or 70 Gy in 40 fractions.

Loss of hearing has been reported after irradiation. Sensory neural hearing loss rarely occurs with standard fractionation schemes and doses of 55 Gy or less, but it often occurs after total doses of 65 Gy in standard fractions (Image 4). Higher doses or shorter fractionation schemes can result in necrosis of the ossicles also.

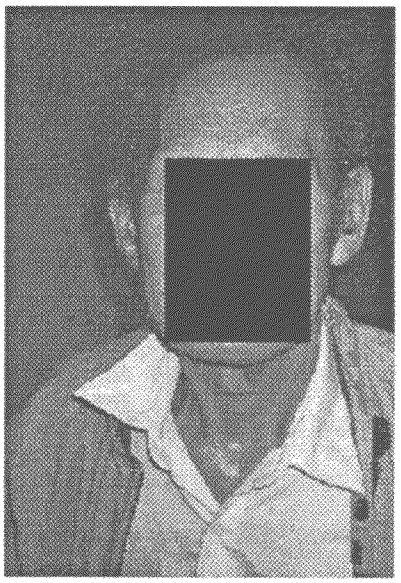

Image 4. A patient who was treated for carcinoma near the right eye and who now has deafness and drainage in the right ear.

A number of patients examined will be at risk for either brain necrosis or hearing loss (and in at least one case, blindness) for years to come. The identifying numbers and treatment particulars of some of them are indicated in the following.

Patient No. 109 was about 3 years old and had received 58 Gy to the cranium in 20 fractions This treatment scheme is calculated to be biologically equivalent to about 36 fractions of 2 Gy each for a total dose of about 72 Gy (see Table I-VI.).

Patient No. 105 was a child who had received 50 Gy to the cranium in 18 fractions.

Patient No. 58 (age 30) had received 58 Gy to the posterior fossa in 22 fractions.

Patient No. 54 (age 35) had received 60 Gy to the posterior fossa in 25 fractions and 52 Gy to the spinal cord in 15 fractions. The former treatment is calculated to be biologically equivalent to about 33 fractions of 2 Gy each for a total dose of about 66 Gy.

Patient No. 47 (age 38) had received 68 Gy to the pituitary area in 28 fractions

Patient No. 106 (child, i.e. more sensitive) had received 63 Gy to the posterior fossa in 25 fractions.

Spinal cord irradiation may result in radiation myelitis which may be either transient or permanent Acute transient myelitis often appears 2–4 months after irradiation. The lesions appear to be due to transient

transient demyelination of ascending motor neurons. Patients affected by myelitis usually present Lhermitte's sign, which occurs with neck flexion or other movements of the body which stretch the spinal cord. Reversal of the transient myelopathy occurs between eight and 40 weeks and does not necessarily progress to late delayed necrosis.

Delayed myelopathy occurs following a mean latent period of 20 months. Nevertheless, the latent period may be shorter if the doses and the dose per fraction are high. This is usually manifested by a discontinuous deterioration and is irreversible. In the cervical and thoracic region, sensory dissociation develops, followed by spastic paresis and then flaccid paresis. In the lumbar cord flaccid paresis is dominant. There is a high fatality rate depending upon the location of the irradiation in the spinal cord. Mortality with cervical or high thoracic lesions reaches 70%, with death resulting from pneumonia or infection of the urinary tract.

About 10% of the total number of patients are at very high risk for spinal cord effects. Some of them were already paralysed. The spinal cord is a relatively radiosensitive structure and overexposure can have disastrous consequences. As with other tissues, the total dose, number of fractions and volume (or length) of spinal cord irradiated are all important. The overall time during which irradiation is undergone is insignificant compared with the number of fractions. Scherer et al. [17] have published information on the tolerance curves for 25–50% incidence of thoracic myelopathy. The data show the following:

Dose/fraction (Gy)	Total dose (Gy)
1	80
2	60
3	40
4	35
5	30–35
6	25

Among the patients examined by the Expert Team, a number of individuals had received about 47 Gy (in 11 fractions or 4.3 Gy per fraction) *Patient No 97* was one of them. From the above table it can be seen that this patient is well over the total dose tolerance level for the spinal cord (about 30–35 Gy for this fraction size). Another patient, *Patient No. 80* had received 50 Gy in 16 fractions (or about 3.1 Gy per fraction). The total tolerance dose for this fraction size is 40 Gy. Both these patients were paralysed. Other patients examined by the Expert Team were not paralysed, but are nonetheless at major risk.

Some examples of patients at very high risk or with current problems in this regard were:

Patient No. 54 had received 52 Gy in 15 fractions of 3.5 Gy per fraction to the thoracic spine. This places the patient at the 25–50% level for risk.

Patient No. 41 had received 57 Gy in 15 fractions (or 3.8 Gy per fraction). Any dose over 40 Gy with this fractionation scheme puts the patient at extremely high risk. The patient was experiencing some early partial paralysis. *(The patient subsequently died.)*

Patient No. 40 had received a calculated spinal cord dose of 51 Gy in 17 fractions (3.0 Gy per fraction). This is well over the 25–50% complication level of 35–40 Gy total dose. She showed some early signs of spinal cord injury when she was examined. Subsequently she experienced significant neurological difficulty.

Peripheral nerves can be affected by radiation although they are typically quite resistant. Doses in the range of 50 Gy in 25 fractions over five weeks can cause brachial plexus injury in 5% of patients. Many of the patients examined by the Team complained of sacral pain and had received high doses to the sacrum. It is possible that scarring about the nerves may have resulted in neuropathy. These problems are not usually encountered since in many countries rotational techniques have replaced the box treatment technique for pelvic tumours. However, the box technique was utilized for all the patients examined.

5.2. SKIN

With high doses of radiation, acute exudative skin reaction is often followed by transient regeneration. Thus, a healing of the initial reaction should not be taken as a sign that no significant overexposure has occurred or that late effects can be ruled out. Delayed effects on the skin may be apparent six months after the radiation exposure and may progress slowly up to ten years. The changes that may occur include telangiectasia, thin dry semitranslucent, pigmentation (sometimes depigmentation) and fibrosis with limitation of motion. Those portions of the skin that are moist and subject to friction, such as the axilla, groin and skin folds are the most sensitive (Image 5). With chronic radiation changes, the skin breaks down as a result of minor trauma (mechanical and ultraviolet). The skin becomes infected easily, is difficult to heal and may have chronic ulceration (Image 6). These ulcers do not heal well and require intensive and prolonged dermatological treatment or plastic surgery. Furthermore, they should be regarded as precancerous.