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Original research article

Adjuvance in refractory keloids using electron beams with a spoiler: Recent results

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ABSTRACT

Aim: To present clinical results of adjuvant irradiation of excised refractory keloid wounds using a novel bolus-free technique developed within our group to irradiate the skin surface with a linear accelerator.

Background: The use of a bolus to increase surface dose over a newly excised keloid presents several problems. Previous solutions are unsatisfactory. Our technique is promising but needs to be evaluated in practice.

Materials and methods: Twenty refractory skin keloids in 19 patients were excised and irradiated in Hospital Plató (Barcelona, Spain) using a 6 MeV electron beam with a 4-mm aluminium spoiler. 15 Gy in fractions of 3 Gy were delivered to the excision site plus a safety margin. All patients were examined during the follow-up (median: 40 months, interval: 12–68 months) and toxicities were recovered.

Results: At the end of the follow-up period, 76% of the cases had not recurred, while the complete response rate amounted to 53%. Residual hypertrophic scars were classified as partial responses. After therapy, itching and pain were observed in 30% of the patients, as well as one telangiectasia and two hyperchromatic scars.

Conclusion: Our technique avoids using a bolus while combining the benefits of electron beam therapy in keloids (fewer secondary effects, and fewer and shorter treatments) with a dose deposition adequate for skin surface treatments. Our results are in line with the most successful therapies evaluated in the literature, as secondary effects are acceptable and recurrence rates are low.

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1. Background

Keloid scars are benign dermal tumours that develop as a result of a skin wound overhealing.[1] The healing of wounds seems to be regulated by a series of cellular growth factors and the equilibrium between matrix degradation and collagen biosynthesis. When a normal healing process occurs, anti-fibrotic factors end up inhibiting fibroblast development and fibroblast synthesis of collagen.[2] However, when this process fails, the scar keeps growing. This results in a characteristic hard tumour that extends beyond the margins of the wound. Keloids are unattractive and may cause pruritus, dysesthesia and burning.[3]

Hypertrophic scars (HS) are similar, but must not be confused with keloids. HS stay confined within the bounds of the original wound and tend to regress over time. There are also inmunohistochemical differences between both entities.[2,4–7]

One of the most frequent sites reported for keloid scars are the ear lobes,[8] while keloids on palms and soles are very rare.[9] Black and Hispanic populations have a higher incidence ratio compared with Caucasians.[2,10] In some cases, keloids have been removed from wounds as small as a site from vaccination.[11] Moreover, it is common to find them following second or third degree burns. A family history of keloids is often mentioned, although the exact path of inheritance is still unclear.[2,9] In all cases, keloids represent a serious aesthetic problem, with negative psychosocial consequences, especially for young people.[4,6,7]

Treatment options are multiple. The initial approach was surgical excision, but it was soon shown to be ineffective[12] because of the high recurrence rate, reported to be at least 50%, and as high as 100% in some studies[13,14] From then on, several other therapies have been tried, including silicone gel sheeting, intradermal corticosteroids, pressure therapy, cryosurgery, radiotherapy, and laser therapy.

Nowadays, an established treatment in resistant or refractory keloids is surgical excision followed by radiotherapy. Recurrence rates for the first year are as low as 10% in selected cases.[3,7,15,16] A typical protocol consists of excision followed by the first session of radiotherapy, which will continue through the following days. Dosages and timing differ between teams and institutions.

Various modalities have been proposed and used for the post-excision treatment of keloids, including kilovoltage X-rays, brachytherapy, and megavoltage electrons. Each has its advantages and its disadvantages, although equipment availability is often the most important factor when choosing modality.

Superficial X-rays can deliver very homogeneous doses to the skin surface,[15] but have a high absorption rate to any bone below the irradiated area.[17] Beta radiation can be delivered using dermal 90Sr applicators[18] and Iridium-192 brachytherapy is delivered with a radioactive source attached to a wire that passes through a catheter placed under the suture. Electron beams are delivered using high-energy lineal accelerators, with the lowest energy levels (4–6 MeV) being the most appropriate for skin treatments. Dose homogeneity is easily achieved, and treatment can be applied in five minutes per day of treatment. However, entry-surface doses are too low with electrons and require a bolus in contact with the skin.[19]

2. Aim

A new method to increase the surface dose and to reduce the electron penetration range was published by our group as a hygienic alternative to the conventional bolus. The method consists in adding an aluminium spoiler at the end of the electron applicator, which results in an optimal radiation beam for skin irradiation.[20]

Historically, beam spoilers have been employed in photon therapy to increase the build-up dose near the surface, but their use in conjunction with electron beams in clinical practice after surgery has not been previously evaluated.[20] Between 2007 and 2012, our institution treated 20 keloids in 19 patients using this modality.[21] In what follows, we evaluate our clinical results and discuss them in the light of the existing literature.

3. Materials and methods

Nineteen patients with 20 keloid scars were included in the study according to the following criteria:

1. Keloids had proved resistant to previous treatments. Specifically, all cases had received at least two rounds of corticosteroids. Additionally, four cases underwent surgery before being treated with corticosteroids.
2. The complete extralesional surgical removal could be planned in one session with primary default closure without skin grafts or transposition. Irradiation was planned and started the same day.
3. Physical characteristics of the scar were adequate. Desired depth of treatment was below 1 cm and the irradiated site could be isolated. For instance, flatness was achieved by fixing the surgical ear bed or by using thermoplastic masks with holes in the irradiated site.
4. Three patients had been previously irradiated with electron beam therapy, and the keloid was close to a tumour site for two of them:
    1. One patient received 15 Gy in 5 fractions for a keloid. Afterwards, a squamous carcinoma was diagnosed with a biopsy in the underlying site. An excision with negative margins followed, but the patient developed a new keloid, which was excised and treated at our centre.
    2. Another patient received 60 Gy in 30 fractions at the site of a parotid gland tumour. The keloid appeared in the non-irradiated margin of the excision.
    3. The third patient had an initial keloid dating back to 1998, which was excised and grew back, excised again in 2003 and treated with corticosteroids and 15 Gy in 5 fractions, but proved resistant once again. In 2008 the keloid was excised and treated with our technique.

Average age was 38.5 years (range 16–80). The main sites for treatment were earlobe (10 cases) and thorax (7 cases) (Fig. 1). See Table 1 for the patients' demographics.