Initial experience with brachytherapy treatment adjuvant to surgical resection of keloid scars in the pediatric population

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ABSTRACT

Objectives. The treatment of keloid scars is based on multiple lines of therapy, with varying levels of efficacy(1), and there is currently no single treatment that guarantees cure and prevents recurrence. In the pediatric population, the treatments used are not standardized, and there is insufficient evidence to support efficacy and complications. The objective of this study was to analyze the patients who required brachytherapy as an adjuvant to surgical resection in recurrent keloid scars.

Materials and methods. A retrospective analysis of patients diagnosed with keloids and undergoing adjuvant brachytherapy in our institution was carried out, while assessing efficacy and implementation in our treatment protocol for keloid scarring.

Results. After various therapeutic lines, 4 patients aged 9-17 years old with recurrent keloid scars around the ear and eligible for adjuvant brachytherapy – administered after surgical resection, in two sessions – were studied and followed up for up to 18-21 months.

Conclusions. Despite our limited experience in the use of adjuvant brachytherapy, the results obtained to date support its efficacy, as reported in the literature. We therefore consider its inclusion in the treatment of keloid scars that have recurred after other treatments to be appropriate.

KEY WORDS: Scar; Keloid; Brachytherapy.

EXPERIENCIA INICIAL DEL TRATAMIENTO BRAQUITERÁPICO EN COADYUVANCIA A LA RESECCIÓN QUIRÚRGICA DE CICATRICES QUELOIDEAS EN POBLACIÓN PEDIÁTRICA

RESUMEN

Objetivos. El tratamiento de las cicatrices queloideas se basa en múltiples líneas terapéuticas, con diferentes niveles de eficacia(1), sin existir actualmente un tratamiento que garantice su curación y prevenga su recurrencia. En la población pediátrica los tratamientos empleados no están estandarizados y no hay evidencia suficiente que avale su eficacia y sus complicaciones. Este trabajo tiene como objetivo analizar los pacientes que han precisado braquiterapia coadyuvante a la resección quirúrgica en cicatrices queloideas recidivantes.

Material y métodos. Análisis retrospectivo de los pacientes diagnosticados en nuestro centro de cicatriz queloidea, en los que se realizó braquiterapia coadyuvante, valorando su eficacia y su implementación en nuestro protocolo de tratamiento de la cicatriz queloidea.

Resultados. Se estudiaron 4 pacientes entre 9-17 años con cicatrices queloideas a nivel auricular, recidivantes a varias líneas terapéuticas, que fueron candidatos para el uso de braquiterapia coadyuvante, administrada posterior a la resección quirúrgica, en dos sesiones, se realizó seguimiento hasta 18-21 meses.

Conclusiones. A pesar de nuestra limitada experiencia en el uso de la braquiterapia coadyuvante, los resultados obtenidos hasta la fecha avalan su eficacia, de acuerdo con lo publicado en la literatura. Consideramos adecuada su inclusión en el tratamiento de cicatrices queloideas recidivantes a otros tratamientos.

PALABRAS CLAVE: Cicatriz; Queloide; Braquiterapia.

INTRODUCTION

Keloid scarring is a pathological scarring process, caused by an exaggerated proliferation of fibroblasts(1) in response to a wound affecting the reticular dermis(2). Treatment should be aimed at restoring normal function, alleviating accompanying symptoms, improving esthetics, and preventing recurrence(3). Multiple therapeutic regimens

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have been used, including pressotherapy, intralesional corticosteroid and/or verapamil injections, cryotherapy, laser therapy, and surgical resection. These treatments alone have high recurrence rates and are associated with multiple adverse effects[4-6].

In this regard, brachytherapy (BT) has emerged as a promising treatment[7]. Its use as an adjuvant to surgical resection has been demonstrated to reduce recurrence by up to 80% in some studies, compared to surgery alone[1,8,9].

The objective of our study was to analyze the results of patients treated with BT in our institution, and to evaluate its inclusion as a therapeutic alternative in the protocol for patients with treatment-resistant keloid scarring.

MATERIALS AND METHODS

A retrospective analysis of patients with keloid scars resistant to conservative/surgical treatment, eligible for BT treatment, and managed at the Pediatric Plastic Surgery Unit from 2017 to 2022 was carried out.

At our center, the use of BT as an adjuvant treatment to surgical resection is reserved for patients with persistent or recurrent keloid scars with at least a first attempt of conservative/surgical treatment. As a first-line treatment, it is used when the size of the lesion is significant and implies a long period of conservative treatment, or when patients undergo multiple surgeries, with an uncertain outcome.

The patients were referred to the Radiation Oncology Department (ROD) for assessment and informed consent. During surgery, the keloid scar was resected, and in the same surgical act and under the supervision of the ROD team, 2-3 4F catheters were placed in parallel, one on each side of the scar, 1-1.2 cm apart. The patient was then transferred to the radiology room, where a simulation CT-scan was performed for planning and dosimetry calculation.

The first BT session was conducted 24 hours following surgery, and high-dose rate brachytherapy was administered, with a total dose of 12-14 Gy in 2 sessions, administered one week apart. The implant was removed after the last BT session.

All patients were followed up at 1 month, 6 months and 1 year, both by the Pediatric Plastic Surgery Department and the ROD, and two of them were also followed up at 18 and 21 months post-surgery.

RESULTS

The study included 4 patients treated with adjuvant BT, of whom 3 were male. 1 patient was of Asian origin, and 1 patient was black, all aged 9-17 years old (Table I).

Case 1

15-year-old male patient with left retroauricular keloid after piercing and foreign body reaction. Initially treated with surgical resection followed by verapamil injections, with recurrence despite treatment. Surgical resection followed by BT was performed in June 2020. At the 21-month follow-up, hypertrophic scarring was observed, and an intralesional triamcinolone injection was conducted, with clinical improvement.

Case 2

9-year-old black male patient with a left preauricular keloid following craniectomy for the resection of an intracranial tumor. The scar caused occasional pruritus. There was evidence of a keloid nodule in the left preauricular region, neither indurated nor painful, with a diameter of approximately 4 × 2 cm. He underwent resection surgery in May 2019, with adjuvant BT. At the 6-month follow-up, minimal hypertrophy was observed, which was treated with 3 intralesional triamcinolone injections. 1-year fol-

Table I. Patient description.

	Case 1	*Case 2*	*Case 3*	*Case4*
Sex	Male	Male	Male	Female
Age	15	9	17	15
Anatomical location	Left retroauricular	Left preauricular	Bilateral retroauricular	Right retroauricular
Pre-treatment	Surgical resection + verapamil injection	No	Triamcinolone injections Surgical resection + Verapamil injections (4)	Surgical resection + verapamil injections (4) Triamcinolone injections (4)
Brachytherapy dose	12 Gy fractionated into 2 sessions	12 Gy fractionated into 2 sessions	14 Gy fractionated into 2 sessions	12 Gy fractionated into 2 sessions
Sequelae	Hypertrophic scar	Hypertrophic scar	Mild hypochromia	Hypertrophic scar
Post-operative treatment	Triamcinolone injection (1)	Triamcinolone injections (3)	No	Triamcinolone injection (1)
Recurrence	No	No	No	No

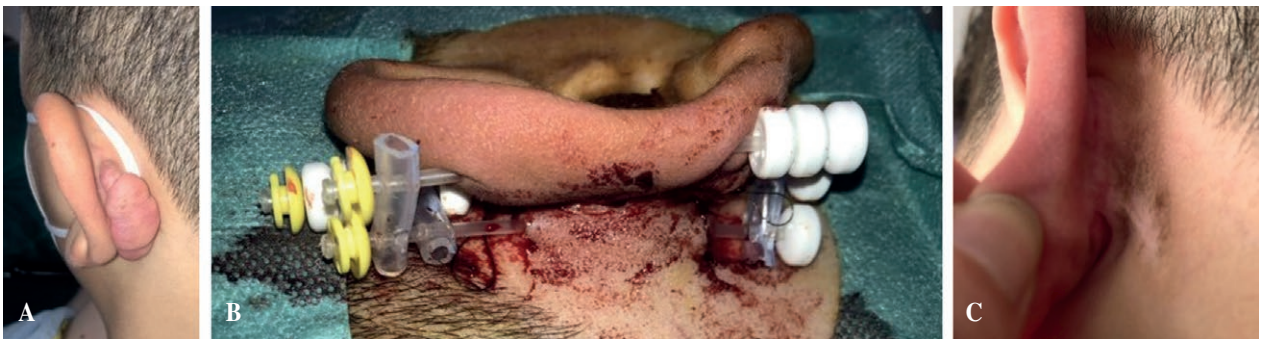


Figure 1. Case 3: A) Left retroauricular keloid. B) Placement of brachytherapy catheters. C) One-year follow-up after brachytherapy.

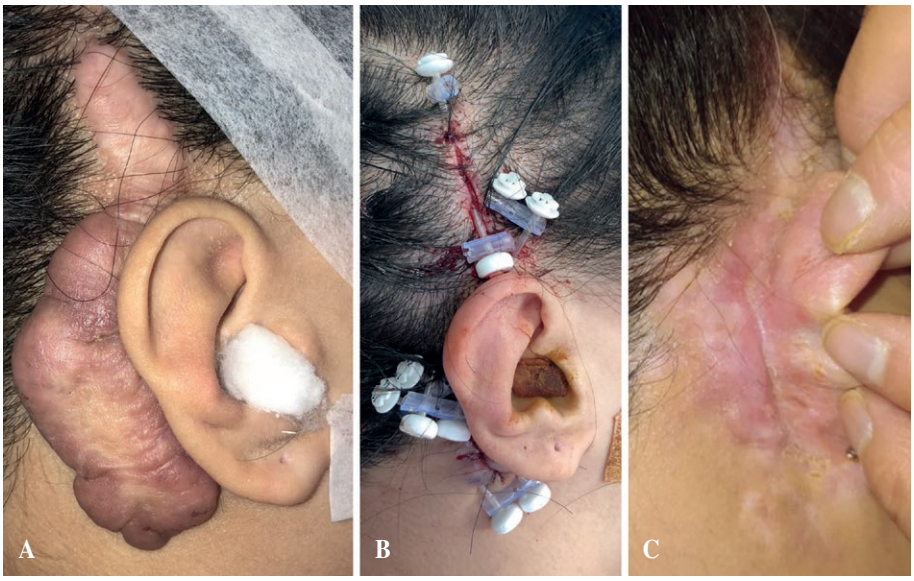


Figure 2. Case 4: A) Right retroauricular keloid. B) Placement of brachytherapy catheters. C) 18-month follow-up after brachytherapy.

low-up showed scarring without growth and no further symptoms.

Case 3

17-year-old male patient, with a history of hellix valgus surgery in 2017, presenting bilateral keloids in the scar area (Fig. 1). He received treatment with intralesional triamcinolone injections 5 times on the right side and 3 times on the left side. In addition, he received treatment with 4 verapamil injections, after surgical resection, without success. In October 2020, keloid resection and posterior BT were carried out. At one-year follow-up, only slight hypochromia was observed on the left side.

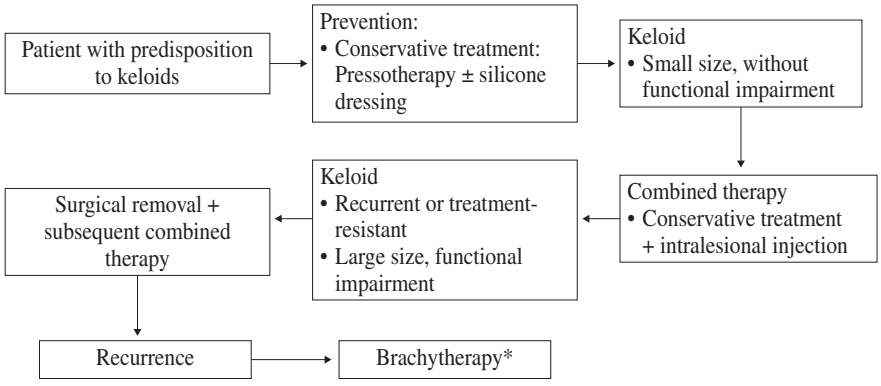
Case 4

15-year-old female patient, of Asian origin, with relevant history of Turner syndrome. Surgery had been performed in 2018 (radical mastoidectomy in the right ear) for cholesteatoma, with subsequent appearance of a large right retroauricular keloid (Fig. 2). She was surgically treated to remove the scar, with intralesional verapamil injections (4 sessions) and later with triamcinolone (4 sessions), with recurrence after treatment. She underwent surgery in November 2020 for scar resection followed by adjuvant BT. She had mild hypertrophy at one-year follow-up, and she was treated with one session of triamcinolone injection, with a good response. No recurrence was noted 18 months following surgery.

DISCUSSION

The treatment of keloid scarring represents a challenge for the healthcare professional. The various therapeutic options available have greatly improved the esthetic and clinical appearance of keloid scars[1,2]. However, recurrence remains a problem to be addressed. Currently, at least 2 or more lines of therapy are combined, with significant differences between institutions[10], which makes it difficult to standardize protocols[6].

At our center, the protocol begins with medical treatment based on pressotherapy and/or silicone dressings,



**The use of brachytherapy does not exclude the need to complement it with other types of treatment. Subsequent conservative treatment is recommended (silicone dressing and, if necessary, injections). In cases where the lesion is very large, in areas that are complex to treat and where treatment will be long, it is recommended to start with surgical resection and BT.*

Figure 3. Keloid management protocol in our institution.

together with intralesional triamcinolone injections (if the predominant symptomatology is pruritus) spaced 3-4 weeks apart, and/or verapamil (if the predominant symptomatology is pain), with a weekly application[3]. Treatment duration depends on the clinical response, as well as on the occurrence of adverse effects, and there is no established time margin for the use of each treatment (Fig. 3).

Cooperation with the ROD has allowed our institution to include BT as a surgical alternative in pediatric patients with treatment-resistant keloids – following the experience gained in adults. For the administration of BT, the Biologically Effective Dose (BED) is used, which makes it possible to control the scarring process without causing serious sequelae in the surrounding healthy tissue[11,12]. Various doses have been proposed, with different intervals between them. Recent studies propose a dose of 30 Gy as having good results and low rates of associated complications. Fractionating the BED into 2 or more doses and administering it in a short interval of time, initiating the first cycle 24 hours following surgery, has shown an efficacy of close to 90% in terms of recurrence reduction[1,5,13,14].

Complications associated with BT are classified as acute and chronic[13]. Among the acute complications, the most frequent are dermatitis/erythema, which can occur in up to 100% of patients, followed by pruritus, pain, wound dehiscence, and infection. Chronic sequelae include skin color alterations, mainly hypo/hyperpigmentation in 5-100% of patients, telangiectases, alopecia, hypertrophy/atrophy, ulceration, and fibrosis. At the pinna level, the most reported complications are dermatitis, ulceration in up to 12.8% of cases, and cartilage necrosis in 5% of cases – related to lesion size rather than BT dose[1,7,11]. Due to these complications and to the limited experience in children, BT remains a second-line treatment in most cases. There are currently no long-term studies on the increased oncological risk in pediatric patients who have been exposed to this therapy[8]. There are anecdotal cases of tumor growths in exposed areas, the vast majority of whom are adult patients, with large keloids and other predisposing risk factors, where direct causality of BT cannot be established[14,15]. Given its low dose and the superficiality of penetration, it is considered to be of low carcinogenic risk[15,16].

Our study provides evidence of this fact, with 3 cases of recurrence despite combined conservative/surgical treatment. Only in one patient was BT considered as the first-line treatment, due to the significant size of the lesion. The results have been satisfactory, with three patients presenting minimal residual hypertrophy (classified as a sequela of BT, but not as a recurrence of the lesion), which has so far been controlled with triamcinolone injections, and only one case of residual hypochromia. It is important to note that the use of BT has not been associated with perilesional skin damage or ulceration in our patients[7].

The limitations of this study include the relatively low number of cases, as well as the heterogeneity of the basic treatments applied. Prospective studies with a larger study population are required to establish the definitive usefulness of this therapeutic alternative.

In our setting, based on the preliminary results obtained, BT has been incorporated into our protocol for the treatment of keloids in the pediatric population, especially in cases where previous treatment has not proven effective.

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