Original Article

Versatility and reliability of the Keystone flap in oncological reconstructions

A versatilidade e confiabilidade do retalho Keystone em reconstruções oncológicas

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■ **ABSTRACT**

Introduction: The Keystone flap is an island flap with reliable vascularization and simple dissection, first described in 2003. Despite its distinct advantages, there are few scientific publications on this matter, and it is not a common option in the clinical practice of reconstructive surgery. This article aims to report the experience of a cancer referral center with Keystone flaps in oncological reconstructions. **Methods:** A retrospective study was carried out data from medical records of patients who performed oncological plastic reconstruction with keystone flaps, operated by the Surgery team of the Cancer Institute of the State of São Paulo, in addition to the analysis of pre, intra and postoperative photographic records. **Results:** Nine patients were identified, all with comorbidities and a mean age of 52.7. Skin defects followed after oncological resections: five in the lower extremities, three in the trunk and one in the face. The mean of the skin resected area was 52.6cm^2. The reconstructions were performed under shortened surgical time. There were no postoperative complications or flap losses. The average hospital stay was 2.2 days. **Conclusion:** The Keystone flap is technically simple and a reproducible option for covering wounds of different sizes and locations. Due to its reliability, simple and quick dissection, shortened hospital stay and low morbidity in the donor area, it should be considered for reconstructing cancer wounds from different locations in patients of all ages.

Keywords: Surgical flaps; Skin neoplasms; Surgery, plastic; Surgical oncology; Reconstructive surgical procedures.

■ **RESUMO**

Introdução: O retalho Keystone é um retalho em ilha, de vascularização confiável e dissecção simples, descrito pela primeira vez em 2003. Apesar de suas vantagens, é ainda pouco citado na literatura especializada e longe de se tornar opção de escolha na prática clínica da cirurgia reconstrutiva. O objetivo deste artigo é apresentar a experiência de um serviço oncológico de alta complexidade no uso de retalhos Keystone em reconstruções. **Métodos:** Um estudo retrospectivo foi desenvolvido por meio do levantamento de dados de prontuário de pacientes operados pela equipe de Cirurgia Plástica do Instituto do Câncer do Estado de São Paulo, além de análise de registros fotográficos pré, intra e pós-operatórios. **Resultados:** Nove pacientes foram identificados, todos portadores de comorbidades e média de idade de 52,7 anos. Os defeitos cutâneos se seguiram após ressecções oncológicas, sendo cinco em extremidades inferiores, três em tronco e um em face. A média da área ressecada foi de 52,6cm^2. As reconstruções foram realizadas sob abreviado tempo cirúrgico. Não houve complicações pós- operatórias ou perdas do retalho e o tempo de hospitalização médio foi de 2,2 dias. **Conclusão:** O retalho Keystone é uma opção tecnicamente simples e reprodutível para a cobertura de ferimentos de tamanhos diversos e em localizações variadas. Devido à sua confiabilidade, dissecção simples e rápida, abreviado tempo de internação e baixa morbidade à área doadora, deve ser considerado na reconstrução de feridas oncológicas de diversas localizações, em pacientes de todas as idades.

Descritores: Retalhos cirúrgicos; Neoplasias cutâneas; Cirurgia plástica; Oncologia cirúrgica; Procedimentos cirúrgicos reconstrutivos.

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INTRODUCTION

The Keystone flap was first described in 2003[1]. It is an island flap based on fasciocutaneous perforators recruited from the periphery of the wound to be treated. Thus, it has the reliable vascularization of a perforating flap, combined with the simple dissection and reproducibility of a local flap[2]. Despite its advantages, it is still little mentioned in the specialized literature and is far from becoming an option of choice in the clinical practice of reconstructive surgery[3].

OBJECTIVE

This article aims to present the experience of a highly complex oncology service in the use of Keystone flaps in reconstructions. This series of cases aims to reinforce this flap's versatility and safety in managing defects of different volumes and locations.

METHODS

A retrospective study was developed by collecting data from the medical records of patients operated on by the Plastic Surgery team of the Cancer Institute of the State of São Paulo (ICESP) between February 2017 and January 2020. The following information was collected: epidemiological data; histological type; comorbidities; location and size of the resected area; hospitalization time; complications. Pre, intra and postoperative photographic records were obtained.

RESULTS

A total of nine patients were treated with the Keystone flap (six women and three men), with a mean age of 52.7 years, four hypertensives, three people with diabetes and two smokers (Table 1). All defects followed after oncological resections, five in the lower extremities, three in the trunk and one in the face. Melanoma was the most frequent neoplasm. The mean resected area was 52.6cm², with a median of 31.4cm². In all cases, the donor area was closed primarily.

The anesthetic-surgical time had an average of 289 minutes. This time includes the anesthetic act, the duration of tumor resection and reconstruction by plastic surgery. The mean hospital stay was 2.2 days. The reconstructions were completed with a single surgery, except for one patient who needed to have the scar retouched due to "dog ears," which was later performed under local anesthesia. There were no postoperative complications or flap losses. No patient was excluded from the sample.

Table 1. Clinical characteristics of nine patients with malignant skin lesions treated with resection and reconstruction with a Keystone flap.

	Genre	Age	Comorbidities	Etiology	Location	Resected area	Complications	Anesthetic-surgical time	Hospitalization time
N1	F	71y	SAH, DM, Depression, Obesity	Transiting metastasis of melanoma	L Leg	19.77cm²	-	315 min	3 days
N2	F	73y	Breast cancer	SCC	R Ankle	31.4cm²	-	146 min	2 days
N3	F	54y	Smoking, SAH, Depression	Inguinal lymphadenectomy for metastatic melanoma	R Inguinal	21.3cm²	-	481 min	3 days
N4	F	76y	SAH, obesity	Infiltrative BCC	L Nasolabial sulcus	4.35cm²	-	238 min	1 day
N5	M	27y	-	Sarcoma	Low back	163.5cm²	-	281 min	4 days
N6	M	66y	Smoking, SAH, previous AMI	Melanoma	R Thigh	43.96cm²	-	280 min	2 days
N7	F	31y	Obesity	Sarcoma	R leg	38.46cm²	-	255 min	1 day
N8	F	50y	Iron deficiency anemia, arrhythmia	Sarcoma	Low back	32.97cm²	-	287 min	2 days
N9	M	62y	Smoking, alcoholism	Melanoma	Back	117.75cm²	Dog ear	318 min	2 days

BCC: Basal Cell Carcinoma; SCC: Squamous Cell Carcinoma; DM: *Diabetes Mellitus*; SAH: Systemic Arterial Hypertension; AMI: Acute Myocardial Infarction.

DISCUSSION

The advantages of locoregional reconstruction have already been widely discussed in the literature[4]. Short surgical time, stable vascularization and the satisfactory aesthetic result of coverage using tissues adjacent to the defect are some of them[2]. The Keystone flap combines these benefits with its versatility, and can be used in limb reconstruction[2], trunk and face[5], as demonstrated in our series (Figures 1 to 3).

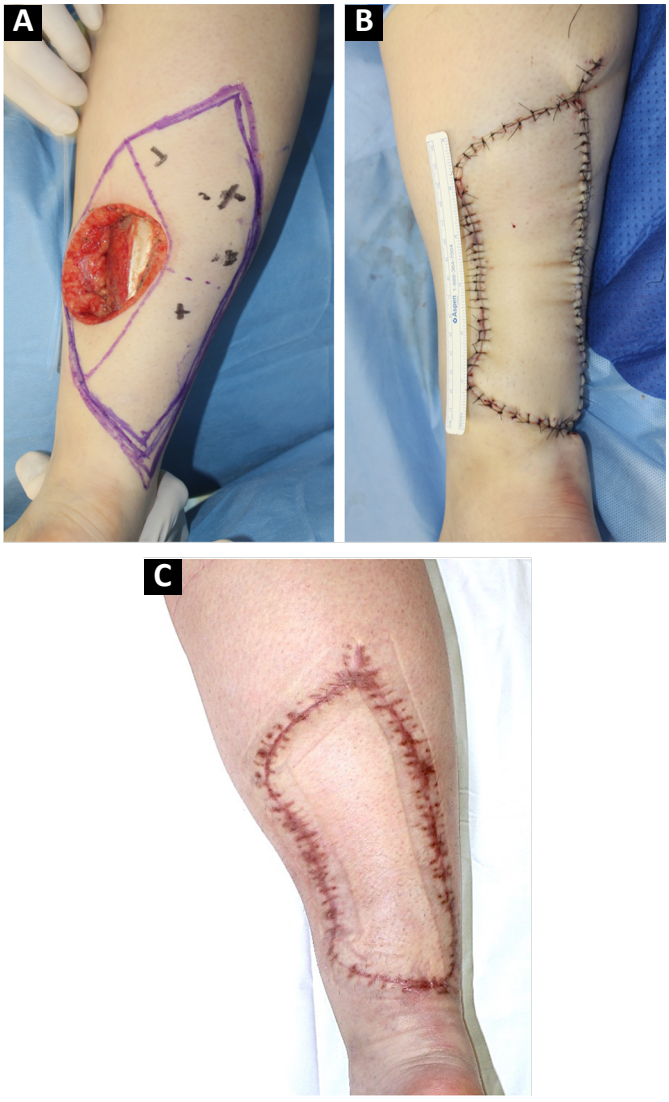

Figure 1. Defect of 38.46 cm² in the right leg after sarcoma resection. **A:** Demarcation of the retail; **B:** Final aspect of the reconstruction; **C:** Late postoperative period.

Described by Behan et al. in 2003[1], the Keystone flap is a fasciocutaneous island flap[3,4]. Its trapezoidal geometry, with a longer axis parallel to the defect, ensures the recruitment of perforating vessels in the vicinity of the wound, making its vascularization

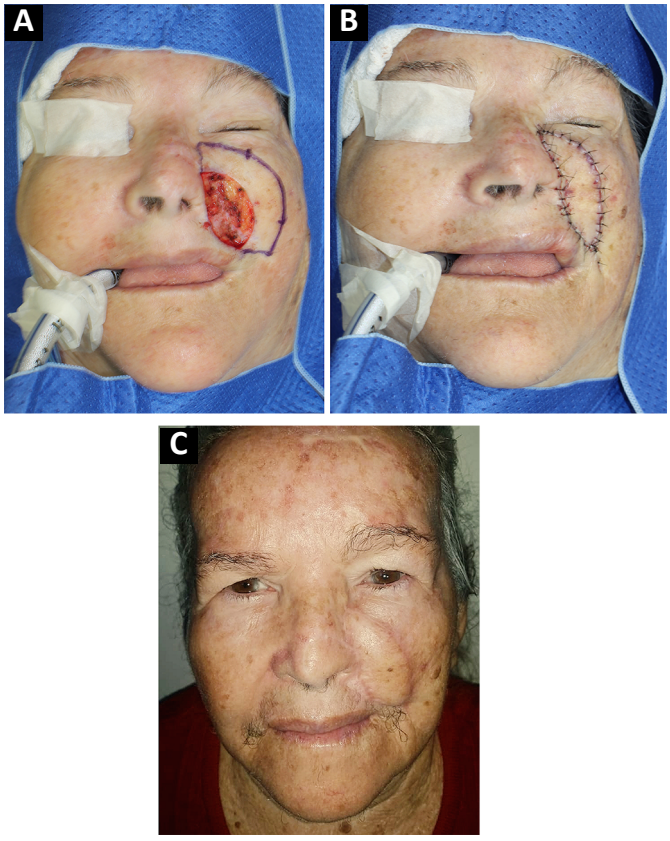

Figure 2. Defect of 4.35 cm² in the left nasolabial sulcus after resection of infiltrative basal cell carcinoma. **A:** Demarcation of the retail; **B:** Final aspect of the reconstruction; **C:** Late postoperative period.

reliable. This design also allows for the advancement of tissue with little morbidity to the donor area, so the closure in at least one of the extremities will be similar to the V-Y[6] flap. All donor areas were closed primarily, without major morbidities in this series.

The vascularization of this flap is proportional to the extension of the drawn skin island, as long as the area of contact with the underlying fascia is maintained, through which the perforating vessels emerge[3,4]. This concept allows the manufacture of Keystone flaps of different sizes5. The rate of complications described in the literature is 4%, mainly dehiscence and partial necrosis7. In our series, the reconstructed area ranged from 4.35cm² to 163.5cm², without any complications with the vascularization of the flap.

The main limitation of the Keystone flap occurs when it is used in areas of inelastic skin, which restricts its advancement and makes it impossible to close the donor area without tension. Thus, it is not recommended to reconstruct the anterior face of the leg, irradiated or extensively traumatized areas[8]. In addition, its reliability in mucosal coverage (intraoral and intranasal) has not yet been studied[3,9]. None of our patients met these restrictions.

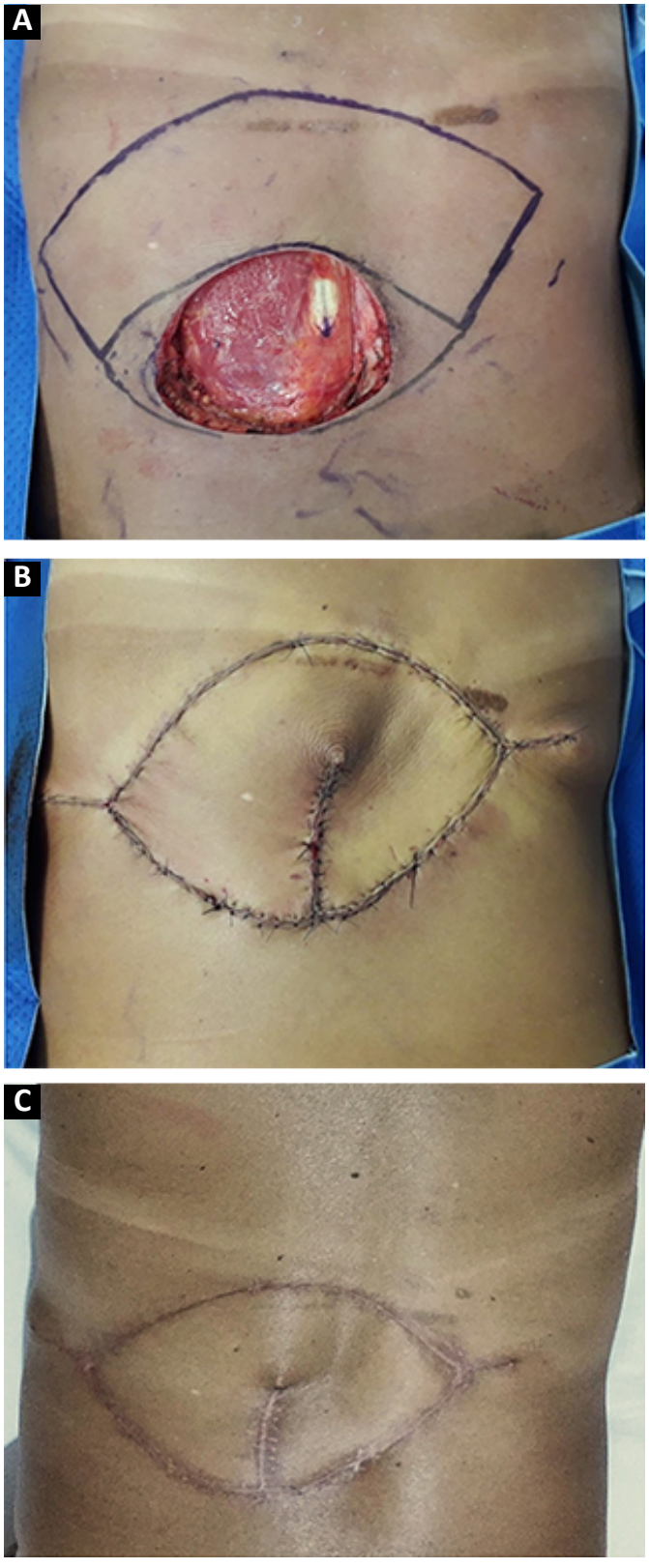

Figure 3. Defect of 32.97 cm² in the lumbar region after sarcoma resection. **A:** Demarcation of the retail; **B:** Final aspect of the reconstruction; **C:** Late postoperative period.

CONCLUSION

The Keystone flap is a technically simple and reproducible option for covering wounds of different sizes and in different locations. Due to its reliability, simple and fast dissection, shortened hospital stay and low morbidity to the donor area, it should be considered in reconstructing oncological wounds of different locations in patients of all ages.

COLLABORATIONS

RDAR Analysis and/or data interpretation, Conception and design study, Conceptualization, Data Curation, Methodology, Project Administration, Writing - Original Draft Preparation, Writing - Review & Editing.

VPFP Data Curation, Investigation, Writing - Original Draft Preparation, Writing - Review & Editing.

GMC Conceptualization, Data Curation, Project Administration, Writing - Original Draft Preparation, Writing - Review & Editing.

GGT Data Curation, Methodology, Writing - Review & Editing.

FFB Conceptualization, Supervision, Writing - Review & Editing.

RG Project Administration, Resources, Supervision.

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