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VIEWPOINT
Reconstructive

Three-dimensional Planning for Lower Extremity Soft-tissue Reconstruction after Sarcoma Resection: Systematic Review and Reflections

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INTRODUCTION

Soft-tissue sarcomas are a rare and surgically-challenging solid tumor most commonly found in the lower extremity.[1] As recently described in this journal, reconstructive planning for soft-tissue sarcomas follows the reconstructive ladder, aiming to replace "like-with-like" by incorporating primary closure, grafts, and vascularized local or free flaps as required to facilitate wound healing.

Recently, our institution began using three-dimensional (3D) computer-assisted design software in the reconstructive planning of soft-tissue defects due to sarcoma resection of the extremities. The prevalence of 3D modeling and planning for reconstruction after head and neck cancer is well described.[2] Although we borrow from principles in that domain, and from studies on 3D planning for reconstruction of lower extremity soft-tissue defects due to noncancerous causes, we have not encountered any published discussion of our management approach. Our objective was to assess whether the literature instructs on 3D planning for soft tissue reconstruction of sarcoma in the extremities.

METHODS

We performed a systematic review utilizing PRISMA guidelines (Fig. 1). Our search query was designed to encompass all publications using 3D planning techniques for reconstruction of soft-tissue defects from sarcoma resection in the extremities. Additional exclusion criteria included publications only mentioning radiotherapy planning or bony defect reconstruction, and those without clinical data. Screening was independently conducted using Covidence systematic review software by two authors (A.F.D. and M.N.L.).

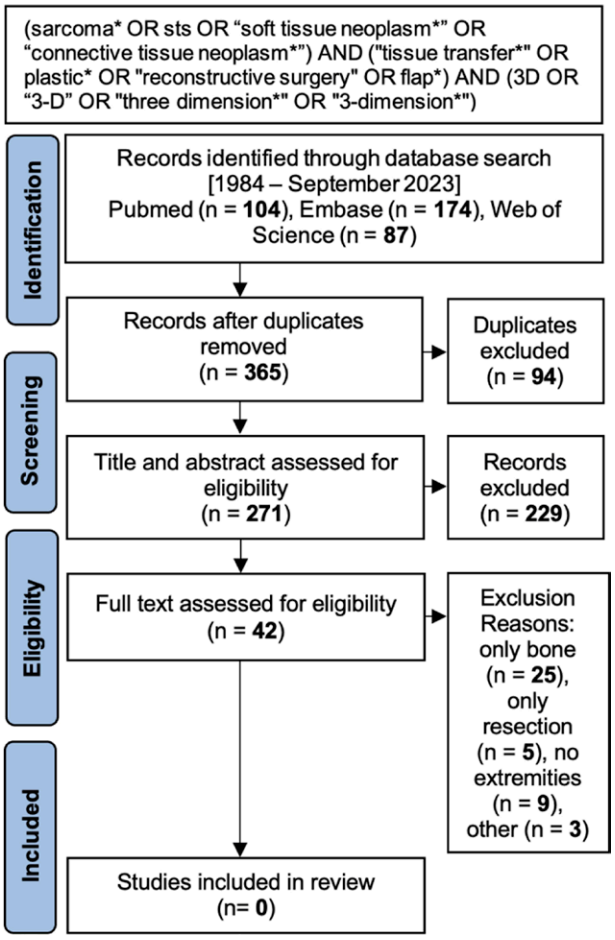

Fig. 1. PRISMA flow diagram.

RESULTS

Removal of duplicates, title and abstract screening, and full text review yielded zero articles meeting inclusion criteria.

DISCUSSION

The literature does not provide explicit instruction on 3D modeling and planning for soft tissue defects resulting from sarcoma resection of the extremities. We selected several articles that did not meet inclusion criteria but provide proof-of-principle and translatable techniques in

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volumetric flap planning for soft-tissue reconstruction of the extremities.

Two studies discussed their use of 3D planning to identify the type, size, and shape of a soft-tissue flap designed for reconstruction of complex heel defects. Elleban et al described how the precision of this workflow helps minimize donor site morbidity for an anterolateral thigh free flap.[3] Similarly, Chae et al applied this process to a radial forearm free flap. In both studies, flap design was guided by 3D-printed mockups, which represented a computer-assisted subtraction of the soft-tissue defect from a model of the intact contralateral extremity.[4] The 3D model was then used digitally or physically to verify the efficacy of a fasciocutaneous or a musculocutaneous flap before its application. In a third study, Cui et al noted the opportunity to gain clarity in spatial relationships between tumor and adjacent perforator vessels, which can help plan local flap elevation.[5]

In our experience, a 3D printed model of a tumor's soft-tissue involvement serves an analogous function to the subtracted mirror-model for a noncancerous soft-tissue defect. Providing insight into tissue deficits and composition, a 3D model of tumor architecture may refine and streamline reconstructive planning. It may also improve patient counseling and decrease anesthetic exposure. We recommend outcomes studies examining flap design with 3D tumor model use investigating these endpoints.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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