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Pediatric thenar flaps: a modified design, case series and review of the literature☆,☆☆

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ABSTRACT

Background: Fingertip injuries are extremely common in children, and severe trauma with pulp loss requires soft-tissue reconstruction to restore length, bulk, and sensibility. The thenar flap is a well-described technique but there are few reports of its use in pediatric patients.
Methods: Pediatric thenar flap reconstructions were retrospectively identified from October 2000 to October 2010 at a single institution.
Results: Sixteen pediatric patients (eleven male, five female) underwent thenar flap procedures. The average age was 10.8 years (1.1–17.8 years). The average defect size was 1.5 cm × 1.5 cm (1 cm^2–2 cm^2). Division and inset occurred on average 16 days later (12–24 days). Average follow-up was 6.8 months (4.1–9.6 months). The average total active range of motion (TAM) in flexion was 248° (235°–260°) [normal maximum: 260°]. All patients had 85° metacarpophalangeal joint (MCPJ) range of motion (ROM) [normal maximum: 85°]. The average proximal interphalangeal joint (PIPJ) ROM was 103° (95°–110°) [normal maximum: 110°] in flexion, and an average 60° distal interphalangeal (DIPJ) ROM (55°–65°) [normal maximum: 65°] in flexion. Objective sensibility in the flap was ascertained as an average static two-point discrimination of 7 mm (6 mm–10 mm) in 10 compliant patients and was grossly intact in all other patients. There were no complications.
Conclusions: The thenar flap is a safe and effective option for pediatric fingertip amputation injuries requiring soft-tissue reconstruction.

Fingertip injuries are the most common hand injury in the pediatric population necessitating a visit to the emergency department [1]. The majority of these injuries can be treated conservatively, but often the injury is severe enough to warrant surgical treatment. Severe trauma with fingertip amputation requires soft-tissue reconstruction to restore length, bulk, and sensibility, especially in children to preserve long-term functionality. There are numerous possible treatment options including primary closure, healing by secondary intention, skin grafting, local tissue rearrangement, or free tissue transfer or perforator flaps [2–6], and each plan must be customized to the individual.

The thenar flap was first described by Gatewood in 1926 [7], and has since been well reported in the literature with several modifications for reconstructing adults injuries. However, there are few reports of its application for pediatric patients. Two-staged elective reconstructions have traditionally been avoided in children because of concerns over the morbidity associated with two surgical procedures and two anesthetics. Delayed flaps also require more care and attention to splinting, wound care, preventing flap avulsion, and wound healing complications. We report our experience with a modified thenar flap reconstruction in pediatric fingertip injuries in a series of sixteen patients. This is the largest case series of pediatric thenar flaps reported to our knowledge.

1. Materials and Methods

Institutional review board approval for review of all thenar flap reconstructions from October 2000 to October 2010 was obtained, and all pediatric fingertip reconstructions were retrospectively identified. Patients younger than 18 years of age were included and patients with incomplete data, concomitant injuries, and patients with previous history of hand injury or surgery were excluded. The history, operative course, outcomes, and any complications were reviewed.

1.1. Operative Technique

Indications for a thenar flap reconstruction at our institution include: a volar oblique injury with total or sub-total pulp loss involving the region from the level of the distal interphalangeal joint (DIPJ) to the distal tip, exposure of distal phalanx without bone loss and no tendon or neurovascular disruption. All operations were

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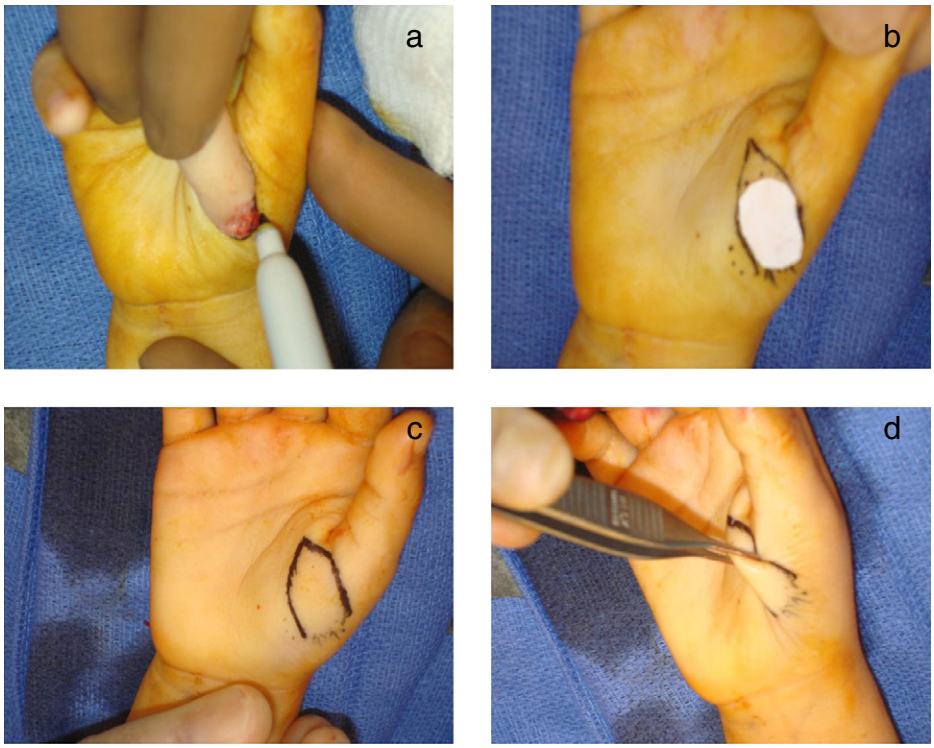

Fig. 1. Thenar flap preparation and design. (a) Template designed by flexing the finger defect onto the thenar eminence to make an imprint. (b) Template designed by cutting a 1:1 ratio on sterile foil or paper. (c) Final tracing of defect on thenar eminence. (d) Donor site is pinched with Adson forceps to ensure primary closure can be obtained.

performed under general anesthesia with appropriate antibiotic prophylaxis and under sterile tourniquet. The fingertip injury was irrigated and debrided of any devitalized tissue and the donor site was inspected and measured. A template was designed by either flexing the finger defect onto the thenar eminence to make an imprint, or by cutting a template in a 1:1 ratio on sterile foil or paper (Fig. 1). Thenar flaps were designed as proximally-based flaps. The flap is placed on the glabrous skin of the thenar eminence with the proximal portion of the flap at the level of the most proximal aspect of the metacarpophalangeal joint (MCPJ) crease, and positioned with the MCPJ flexed to near 90° and the proximal interphalangeal joint (PIPJ) in limited flexion to prevent a possible future contracture. The flap was designed in the shape of a pentagon with the width of the flap equal to the circumferential arc of the fingertip defect rather than the straight-line distance between the defect skin edges. This width must compensate for the arc of fingertip tissue that is lost. It is dissected from distal to proximal, incorporating subcutaneous tissue and fascia (Fig. 2). Dissection proceeds in a subfascial plane to preserve vascularity of the flap. Care was taken to identify and avoid injury to the radial digital nerve to the thumb (Fig. 2). The flaps are designed with distal redundancy in anticipation that the most distal portion may not be sufficiently vascularized. The flaps are then loosely inset with the apex of the pentagon projecting beyond the fingertip defect margin to provide bulk for a rounded tip. The donor site was closed primarily in all cases in a tension-free manner. The distal and middle phalanges of the affected digit were placed in close approximation to the thumb proximal phalanx to make the affected digit and thumb a single unit and prevent motion or sheer of the flap (Fig. 3). The flap was then dressed with non-adherent Telfa (Covidien, Mansfield, MA) under the pedicle to prevent kinking. Additionally, the affected digit and thumb are secured together with Steri-Strips (3M-Nexcare, Two Harbors, MN) to prevent movement. A bulky plaster cast was then used in a dorso-volar orientation to prevent any movement of the thumb and affected digit and wrapped in gauze and splinted. Specifically, the splint utilized is a wrap-around dorsal blocking splint that simultaneously immobilizes the affected digit and thumb while keeping the wrist in a neutral position, the MCPJ maximally flexed and preventing extension of the affected digit. By splinting in this manner, the hand and fingers are kept in a maximally protected position while preventing movements that may compromise the reconstruction.

The patients returned to the operating room for flap division on average, 16 days later (range: 12–24 days). In standard sterile, tourniquet controlled fashion, the flap was divided and any non-viable distal thenar flap tissue is debrided. The PIPJ was then put through passive range of motion (ROM) to release any fibrosis and prevent contracture. The flap is loosely inset, and dressed with petroleum gauze and a dry dressing. All donor sites were closed primarily and all patients were discharged home on the day of surgery.

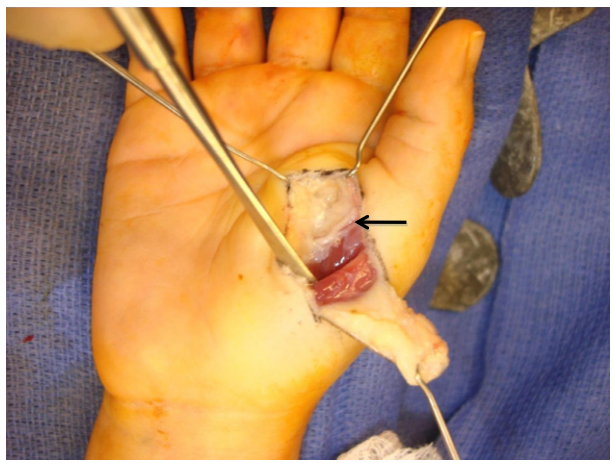

Fig. 2. Thenar flap has been raised. Black arrow denotes radial digital nerve to thumb. Special care must be taken to avoid injury to this nerve when raising the flap.