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Case report

Reverse posterior interosseous flap for defects of the dorsal ulnar wrist using previously burned and recently grafted skin

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ABSTRACT

Background: In the severely burned patient, coverage of exposed bone in the dorsal ulnar wrist can be a difficult problem. This is especially challenging in patients with a high percentage total body surface area (TBSA) where donor flaps can be scarce. The use of previously burned and/or recently grafted skin as flaps is an option. It has been postulated that use of previously burned skin can result in higher rates of local or distant flap failures. The reverse posterior interosseous flap (PIF) is an axial flap, based on the retrograde posterior interosseous artery, to provide coverage of the hand. Here we describe utilization of the PIF, using previously burned and/or recently grafted skin for coverage of dorsal ulnar wrist defects.

Methods: This is a case series of three patients, with extensive burns (range 35–83%TBSA), where defects of the dorsal ulnar wrist necessitated coverage. Each patient underwent PIF(s) utilizing previously burned and/or grafted skin, all within three months after their initial burn event.

Results: Case 1: 28 year old male who suffered 35% TBSA via blast mechanism developed a chronic open wound over the dorsal ulnar wrist with exposed tendon. The patient successfully underwent a left PIF using previously grafted skin.

Case 2: 23 year old male with 83% TBSA. Bilateral ulnar styloids were exposed. PIFs were performed bilaterally, using previously burned and recently grafted skin. Coverage was successful but received leech therapy post-operatively for venous congestion.

Case 3: 37 year old male with 52% TBSA, with the most severe burns isolated to his bilateral upper extremities; the ulnar head was exposed. The posterior interroseous artery was explored and PIF was attempted, but there was no retrograde flow in the distal artery due to a deeper injury than previously recognized. The patient ultimately underwent a pedicled abdominal flap for coverage.

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Conclusions: Defects of the distal ulnar wrist after deep and extensive burns can be problematic. Use of the reverse PIF using previously burned skin, even those that has just been recently grafted is a viable option for this difficult patient population. However, it may not be possible in all patients. Vigilance and early intervention for post-operative venous congestion are important.

1. Introduction

Soft tissue coverage of upper extremity defects is challenging, especially when bone, tendons or joints are exposed. The upper extremities are the most common areas of burn involvement [1]. The dorsal ulnar at the level of the wrist is particularly prone to exposure as the amount of native soft tissue coverage is thin. This problem is compounded in burn patients where limited donor options and contiguous areas of burn involvement often exist. Options for flap coverage of wounds in this area includes radial forearm or ulnar artery pedicled flaps [2,3]. Both however may have significant donor site morbidity [4]. Additionally, pedicled groin or abdominal flaps offer a reliable option for reconstruction, but require multiple operations and can result in significant hand stiffness [5]. The reversed posterior interosseous artery flap (rPIF) represents a viable option as well. In addition, the use of previously burned and recently grafted skin as flaps has been reported in the literature but its use has been limited [6]. Several authors have postulated that use of burned skin can result in higher rates of local or distant flap failures due to altered microcirculation within the subcutaneous tissue [7].

The (rPIF) is a fasciocutaneous flap, based on retrograde flow into the posterior interosseous artery from its distal anastomosis to the anterior interosseous artery [8]. The rPIF allows coverage of the dorsal wrist, thumb, hand, and first webspace [9]. First described as a reverse flow pedicled flap in 1986 [10,11], the advantages of the rPIF include proximity to the hand, minimal injury to the main lymphatics and vessels of the forearm and the potential to primarily close the donor; depending on skin paddle size [6]. Disadvantages include variable perforator anatomy and possible disruption of the anterior interosseous artery anastomosis. Here we describe our experience using previously burned skin in reverse posterior interosseous flaps for coverage of dorsal ulnar wrist defects.

2. Methods

A review of the senior author's personal records identified three patients, with thermal injury mechanism (range 35–83%TBSA), who underwent four rPIF procedures for soft-tissue defects exposing the dorsal ulnar styloid. Each patient underwent rPIF utilizing previously burned and grafted skin, all within three months after their initial burn event and 6–10 weeks following attempted grafting.

2.1. *Relevant anatomy*

As has been previously described [8] the rPIF is based on retrograde flow within the posterior interosseous artery (PIA) which exists as a branch of the common interosseous artery (CIA) and most often possesses a distal anastomosis with the anterior interosseous artery (AIA). Surgically the PIA is encountered proximally as it emerges from under the supinator muscle and descends on the proximal muscle bellies of abductor pollicus longus (APL) and extensor pollicis longus (EPL) muscles (Fig. 1). The PIA to AIA anastomotic branch dives deep to the extensor indicis muscle penetrating the interosseous membrane. Most commonly the PIA supports three branches supplying the supinator, APL and EPL muscles. Strauch and Yu report absence of the AIA to PIA anastomotic branch (2–3%) or a robust retrograde PIA without a large recurrent AIA branch (5.7%) [12]. The consequences of these variations are obvious and preclude the use of the rPIF.

Typically the posterior interosseous nerve (PIN) lies deep and lateral to the PIA with the extensor carpi ulnaris (ECU) motor branch crossing deep to the PIA. There are, however described variants where the ECU motor branch of the PIN crosses superficial to the PIA.

2.2. *Surgical technique*

A line is drawn from the lateral epicondyle to the distal radioulnar joint while the arm is in resting elbow flexion, corresponding to the axis of the PIA. Construction of the skin paddle is completed along this axis and is based from the middle third of the forearm so as to include sufficient pedicle length for rotation. This flap may be designed as an island pedicle flap or with the inclusion of a skin bridge. Preoperative doppler ultrasound aids in detection of perforators. The flap is raised from the ulnar border incorporating the deep fascia in the flap. Caution is warranted as the surgeon's dissection reaches the radial border of the extensor carpi ulnaris (ECU) to include the fascial attachments from the pedicle to the fascia. Once the pedicle is identified, the radial incision is made and the muscle belly of the extensor digiti minimi (EDM) identified. EDM is then retracted radially, the ECU ulnarly and attention is turned to identifying and preserving the PIN to include its ECU motor branch proximally. The PIA is dissected, taking care capture all perforators feeding the skin paddle. The proximal PIA and venae comitantes may be ligated and divided early to facilitate flap dissection. Once sufficient pedicle length is achieved, the flap is rotated into place, and the resulting donor defect is covered with split-thickness skin graft. Splint to keep the wrist in slight extension is advisable but it is important to avoid pressure on the pedicle.

2.3. *Flap monitoring*

Once inset, the flap can be monitored similarly to any pedicled flap. Congestion or insufficiency will manifest with