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Fasciocutaneous flaps based on a doppler detected perforator, an illustrative series as used for burn contracture reconstruction☆

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Summary Perforator flaps are well established as a versatile option in reconstructive surgery that provide thin, pliable cutaneous or fasciocutaneous tissue. They are particularly useful in the reconstruction of large shallow defects, such as after the release of a burn contracture, however there are situations where the additional time spent islanding these flaps may be unnecessary, and the flap is then essentially a fasciocutaneous flap based, but not islanded, on a perforator artery. This paper documents a series of 22 severe burn contractures in 17 patients reconstructed with fasciocutaneous flaps in this way. The arteries were all located pre-operatively with a hand held Doppler probe, around half at the site of a known perforator and half by systematic scanning of the surrounding skin for an ad hoc perforator. All patients achieved a good functional range of motion. There were three cases of partial superficial flap necrosis treated with split skin grafting. The functional and aesthetic outcomes were far better then those expected with split skin grafting, and published series show that contractures treated with perforator flaps are unlikely to ever need further surgery. Without islanding the flap it becomes a feasible option for reconstructing these patients even in the extremely resource poor environment in which they often present, and is an option for all plastic surgeons to consider in the reconstruction of large superficial defects.

Introduction

In deep burns over most large joints a full range of motion can be preserved with antideformity splinting, usually holding the joint in neutral. In the neck and axilla this is difficult because the antideformity position is uncomfortable for the patient to maintain and prevents them from carrying out their activities of daily living. At these sites

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contractures can be a problem even with the intense multidisciplinary approach that is used in developed nations for acute burn care.[1] In resource poor countries burn contractures are a formidable problem. The lack of safe heating and cooking facilities are compounded by inadequate acute burn care. Consequently, burn contractures are more common and more severe. Reconstruction of these deformities is demanding and frequently involves prolonged splinting and multiple operations.[2] The ideal procedure to correct a burn contracture would be a single stage operation that provides a full release and reconstructs the defect with robust, flexible, and aesthetically pleasing tissue cover that does not need prolonged post-operative splinting.

This series documents 22 severe burn contractures in 17 patients that were treated with fasciocutaneous flaps over a period of 18 months, by a single surgeon working in Nepal. It illustrates that this provides a quick and less technically demanding option than a free flap, with results that are superior, both functional and aesthetically, than the alternative of split skin grafting.

Surgical technique

Twenty two burn contractures were treated with pedicled fasciocutaneous flaps based on a Doppler detected perforator vessel during the period from January 2007 to June 2008 at Green Pastures Leprosy and Rehabilitation Centre in Pokhara, Nepal. Ten of these were in the neck, five in the axilla, five at the elbow, and one each in a hand and the upper back. A single surgeon carried out all of the operations. In each case a perforator artery was mapped pre-operatively with a hand held Doppler probe, either by locating a known perforator, or by systematically scanning the adjacent area for a Doppler signal. The burn was released by means of an incision across the contracture until the effected joint had a full range of motion. Burn scar was only excised if this was necessary to gain a full range of motion or if the scar tissue had been undermined in the process of releasing the joint. Thus the minimum defect required for full release was used, with the defect over the most critical part of the contracture so that reconstruction of the created defect with thin pliable tissue would maintain a full range of motion. The flap was then designed to fill the defect, either using a flap based on a known perforator with regard to any described axiality, or on the basis of an ad hoc Doppler positive perforator accepting that this would support a smaller flap but with no need to consider axiality. The flap shape therefore depended on the defect, but was designed so that the pivot point was over the Doppler positive vessel with a flap base at this point of at least 3 cm irrespective of the width of the rest of the flap. The flap was raised from the end distal to the perforator raising it at the level of the deep fascia and stopping just short of the doppler detected perforator. In this population this results in a flap of around 6 mm in thickness due to the poor nutritional state of these patients, and therefore thinning was not necessary. With the level of lighting available in the theatre the vessel was not always seen, but it was protected from harm by this method and the resulting pedicle was a 3 cm fasciocutaneous bridge with a perforator flap within it. The flap was inset, and the area splinted with plaster of Paris until wound healing had occurred.

In around half of the cases there was a described perforator flap available locally, which was utilised as a pedicled fasciocutaneous flap. In axillary defects the circumflex scapular artery and thoracodorsal artery are a rich source of flaps. The circumflex scapular artery bifurcates into transverse and descending branches, one or other of which will give off a perforator branch within 1—1.5 cm of the bifurcation.[3] This perforator can support a flap of up to 16 by 8 cm^2. The surface markings for this are 2 cm lateral to the lateral border of the scapula at the level of the lower border of the posterior axillary fold. The thoracodorsal artery gives a mean of four reliable perforators, of which the largest and most consistent is the first perforator in the lateral zone.[4] The surface marking for this is approximately 8 cm (range 5—15 cm) below the posterior axillary fold, 2—3 cm posterior to the lateral free border of the latissimus dorsi muscle.[5] Flap sizes of up to 27 by 15 cm with their long axis parallel to the lateral border of the latissimus muscle have been documented.[2,6]

Burned skin is not a contra-indication to the use of pedicled flaps as there have been several reported cases of successful outcomes despite burn scars in perforator flaps.[6] However, it has also been noted that flaps with normal skin continue to stretch post-operatively, giving on-going improvement in the range of motion attained.[7] In this series unburned skin was used in preference to burned skin in all cases in order to benefit from the elasticity inherent in normal skin. In one case of axillary contracture (see Case 3 below) the territories of the perforator flaps arising from the circumflex scapular artery and the thoracodorsal artery were all involved in the burn. Therefore in this case it was necessary to use the transverse cervical artery perforator to obtain a flap that was surfaced with normal skin. This option was also used in three of the cases of neck contracture. The transverse cervical artery has a reliable musculocutaneous perforator branch that emerges through the upper region of the trapezius muscle. This has been used to support a perforator flap, both pedicled and free, with a vertically orientated paddle parallel to the spinous processes of the first to the sixth thoracic vertebrae.[8] In an adult a flap of up to 35 cm long and 14 cm wide can be raised, but the width should be limited to 10 cm if primary closure is to be obtained in a one stage procedure.[9]

The term ad hoc perforator flap was coined by Waterston and Quaba for the technique of raising a cutaneous or fasciocutaneous flap based on a perforator, either mapped pre-operatively with a Doppler or found on preliminary exploration.[7] The rest of the cases in this series were done in a similar manner to the technique of Waterston and Quaba except that they were not islanded. The main reason for this was that the lighting in the operating theatre was not adequate to allow such a dissection, and also to save the 15 or so minutes of extra operating time required to fully island a perforator flap.

Cases

Case 1

This 26 year old man was burned across his upper back and left arm in infancy. This resulted in a thick plaque of