PROCEEDINGS OF THE
NORTH AMERICAN VETERINARY CONFERENCE
VOLUME 20

JANUARY 7-11, 2006
ORLANDO, FLORIDA

SMALL ANIMAL EDITION

Reprinted in the IVIS website (http://www.ivis.org) with the permission of the NAVC. For more information on future NAVC events, visit the NAVC website at www.tnavc.org
PRACTICAL PATCHES FOR WORRISOME WOUNDS: SUBDERMAL PLEXUS FLAPS

David Fowler, DVM, MVetSc, Diplomate ACVS
Western Veterinary Specialist Centre
Calgary, Alberta, Canada

Small animal surgeons have an advantage over their large animal and human counterparts in that skin in dogs and cats is very elastic with loose attachments to underlying tissues. The result is that large wounds which would require more advanced reconstructive procedures can be closed directly in dogs and cats through the use of various tension relieving techniques. Techniques for the relief or redistribution of tension can involve movement of local tissues via undermining and suturing, relaxing incisions or “plasties,” and tissue expansion or skin stretching. Many larger wounds, or wounds located near structures that do not tolerate tension or deformation (such as the eye) require more advanced reconstructive techniques. Subdermal plexus flaps (also referred to as random pattern or local flaps) are commonly used in these instances.

By definition, a skin flap is differentiated from a skin graft by virtue of the fact that it maintains at least one attachment to the donor site. The flap retains a vascular supply through its donor site attachment and is, thus, not dependent upon revascularization from the recipient bed as is the case with skin grafts. Skin flaps have a number of advantages over skin grafts in reconstruction. Since they maintain a vascular supply they may be used to reconstruct defects overlying avascular tissues such as exposed bone, cartilage and tendon. They are more tolerant of uneven surfaces, contamination and infection, mobility, and fluid accumulation at the recipient site. Disadvantages of skin flaps, as compared to skin grafts, include greater difficulty in matching skin color, length and direction of growth and potentially more extensive dissection for surgical harvest.

CLASSIFICATION OF SKIN FLAPS

Subdermal plexus flaps may be classified according to their vascular supply, location in relation to the recipient site, and direction or method of movement.

Skin in dogs and cats receives its primary blood supply via numerous direct cutaneous arteries. These vessels arborize into a relatively randomly oriented subdermal plexus. Flaps which incorporate a direct cutaneous artery in their donor site attachment and which are elevated along the course of the direct cutaneous vessel are termed axial pattern flaps. Skin flaps which do not include a direct cutaneous vessel are dependent upon a vascular supply derived from the subdermal plexus and are termed random pattern or subdermal plexus flaps. The subdermal plexus lies within the deep subcutaneous layer, and is supported by vasculature deep to the cutaneous musculature (panniculus and platysma muscles) where present. Subdermal plexus flaps have a less reliable vascular supply as compared to axial pattern skin flaps. While axial pattern skin flaps need only maintain a pedicle consisting of the direct cutaneous artery and vein, subdermal plexus flaps must maintain a relatively broad base of intact skin at the donor site. Length to width ratios are unreliable in predicting survival of subdermal plexus flaps. As a general rule the surgeon should maintain as broad a base as possible, and limit the length of flap dissection as much as possible.

Subdermal plexus flaps may be classified as local or distant depending on their proximity to the recipient site. Local flaps are harvested from areas of loose skin adjacent to the wound. The flap is moved into the wound for direct, one-stage reconstruction, and the donor site is closed primarily. For local flaps to be used the defect must be situated near a suitable donor site. Local flaps are, therefore, used to reconstruct defects involving the head, neck and upper extremities. Distant flaps are constructed at a donor site distant from the recipient site and are advanced to the wound using multi-staged, direct or indirect transfer procedures. Simpler single-stage procedures (skin grafts, axial pattern flaps) for reconstruction of such defects are nearly always available making the use of distant flaps rarely necessary.

Subdermal plexus flaps are most commonly characterized by their method of transfer. Advancement flaps are advanced into a defect by sliding in a forward direction. Advancement flaps are used most often to distribute tension away from an easily deformed and critical structure such as the eyelid or lip. Advancement flaps may be either single pedicle (one donor site attachment) or bipedicle (two donor site attachments). Advancement flaps should be harvested perpendicular to lines of tension to facilitate sliding of the flap into the defect with minimal tension.

Rotation flaps are raised from an arc shaped incision extending from the border of an irregular or triangular defect. As with advancement flaps, rotation flaps are used most often to distribute tension away from the wound margins. Once the flap is raised, it is moved into the defect by rotating along the arc shaped incision. The length of the arc incision should be approximately 4X the length of required movement.

Transposition flaps are elevated as rectangular flaps with one edge bordering on the defect and which lie within a 90° arc of rotation to the wound. Once the flap is raised it is transposed into the defect and the donor site sutured primarily. Flap length is determined by measuring from the pivot point of the flap to the most distant portion of the defect, with flap length equal or slightly greater than this length.

The inguinal and axillary skin folds are roughly triangular folds of skin with four anatomic regions of attachment – the lateral body wall, the medial body wall, the lateral proximal extremity, and the medial proximal extremity. Three of these four points of attachment can be incised, leaving one point of attachment intact. The triangular skin fold can then be ‘unfolded,’ providing a very large subdermal plexus flap.
Skin fold flaps are extremely useful for reconstruction of large trunk or proximal extremity wounds that are adjacent to these regions. The point of attachment maintained is determined by the required movement of the flap. The relative vascular supply provided by each region of attachment has not been well studied, and probably varies. It has been my experience that the lateral body wall attachment for both the inguinal and axillary skin fold flaps is superior in ensuring flap survival. Therefore, this region of attachment is recommended whenever possible.

TECHNICAL CONSIDERATIONS

Several technical points should be considered to ensure flap survival. Flaps should be planned meticulously in advance of the surgical procedure. The donor site should be mapped carefully to ensure availability of adequate tissue and ability to primarily close the donor site. A template can be fashioned from the recipient site by placing an absorbent material (gauze sponges work well) over the defect until it becomes blood or fluid stained. The template can then be trimmed to the exact proportions of the defect. The template is subsequently placed over the proposed donor site and, while fixing the template at the proposed point of flap rotation, it is transposed into the defect. Template size and configuration can then be adjusted accordingly to allow tension free flap transposition. The outline of the proposed flap is then drawn onto the skin at the donor site. A simple test to check for adequacy of tissue to achieve primary closure is to pinch the margins of the proposed flap together. If the margins can be pinched into apposition with little tension then primary closure of the donor site should not be a problem.

Attention to vascular anatomy is important during flap elevation. In areas where cutaneous musculature (panniculus muscle, platysma muscle) is present dissection should be performed deep to this muscle layer. In areas devoid of cutaneous musculature dissection should be performed in the deep subcutaneous plane. This will ensure maximum preservation of vascular supply to the flap. Remember to maintain a broad donor site attachment and limit flap dissection as much as possible to avoid distal flap necrosis.

Once the flap is elevated from the donor site it is moved into the recipient wound bed. The flap is first sutured at its most distant point. Remaining sutures are then distributed to limit formation of dog ears and to spread tension along the length of the flap. Subcutaneous sutures along the edge of the closure are acceptable to help reduce tension on the skin edges. Walking type sutures (sutures between the deep surface of the flap and the surface of the wound bed) should be avoided when performing subdermal plexus flaps since these have the potential to embarrass blood supply to distal regions of the flap. Dead space beneath subdermal plexus flaps can be managed with passive or active drains, if necessary.

RECOMMENDED FLAPS: HEAD AND NECK

Wounds superior to the upper eyelid are easily reconstructed using a single pedicle advancement flap from the temporal region. Wounds adjacent to the lateral canthus are most easily reconstructed using a rotation flap elevated from elastic tissue overlying the cheek. Maxillary defects can be reconstructed using rotation flaps from the cheek as well. Oral mucosa can be included during flap dissected and used to resurface the nasal cavity for reconstruction following partial maxillectomy. Full thickness defects of the lips are best reconstructed using full thickness advancement flaps from adjacent lip margins.

RECOMMENDED FLAPS: PREPUCE AND ANUS

These areas are most amenable to reconstruction using rotation flaps. Rotation flaps can be based in any direction, depending on elasticity of surrounding tissues. Large defects in the caudal abdominal region can also be reconstructed using inguinal fold flaps.

RECOMMENDED FLAPS: PROXIMAL EXTREMITIES

Extremity wounds must be evaluated relative to elasticity of surrounding tissues. There is no single type of flap that is best suited to these wounds, and the surgeon must make decisions based on the specific location of the wound and the availability of surrounding skin. This can vary tremendously between breeds and individuals, to the point that subdermal plexus flaps may not be feasible in certain instances.