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CLINICAL APPLICATION AND OUTCOME OF SUB-DERMAL PLEXUS SKIN FLAPS, AXIAL PATTERN FLAPS AND A SKIN GRAFT TO REPAIR EXTENSIVE CUTANEOUS DEFECTS IN DOGS AND CATS: 22 CASES

D. M Siriwardane*
Pet Vet Clinic, No. 98/4, Havelock Road, Colombo 05

SUMMARY: Skin flaps and grafts are widely used in veterinary practice to achieve closure of skin defects where primary wound closure is not possible. They can be used when addressing large cutaneous defects secondary to traumatic injury or following tumour resection. The objective of the study was to retrospectively evaluate the clinical indications, complications and outcomes associated with skin flaps and a graft in animals that underwent extensive cutaneous defect restoration. Data was collected from the medical records of 22 animals (12 dogs and 10 cats), which included 16 Sub-dermal Plexus Skin Flaps (SPSF), 5 Axial Pattern Flaps (APF) and one free skin graft. The outcome of skin reconstruction was subjectively evaluated based on the comparison of the surviving skin postoperatively to the original skin transposition. There were minor or moderate complications observed in SPSFs. In the five animals with APFs, one animal had moderate complications, while in one case, the flap completely failed due to occlusion of the blood supply. The full-thickness skin graft of the dog's distal forelimb healed with complete graft uptake. All wound complications were managed conservatively. A higher proportion of extensive wounds observed in cats (75%) were in intact males due to trauma. In most of the dogs (83.3%), wounds were found following tumour resection. Twenty one out of the 22 animals recovered well postoperatively. Results suggested that large cutaneous defects can be repaired with excellent cosmetic and functional outcomes using skin flaps and grafts. Although postoperative complications are expected, standard wound management techniques can resolve them. Careful planning, meticulous surgical procedures and post-operative management are key for a successful outcome.

KEYWORDS: skin flaps, cutaneous, skin graft, resection, transposition

INTRODUCTION

The skin of dogs and cats is loose and abundant in most parts of the body, especially on the neck and trunk, but is less pliable on the limbs, tail, around the nose-bridge and nasal planum (Williams and Moores, 2009). Cats have highly elastic skin that can be mobilised to cover larger defects than in a dog (Williams and Moores, 2009). The location of the wound, elasticity of surrounding tissue, regional blood supply and character of the wound bed should be considered when planning reconstruction surgery. The vascular network (Figure 1) supporting the skin is the sub-dermal plexus. The vessels of this plexus arise from the direct cutaneous artery and travel parallel to the skin, deep and superficial to the panniculus muscle layer (Kirpensteijn and Haar, 2013).

Sub-dermal Plexus Skin Flaps (SPSF) are random flaps derived from these sub-dermal plexuses, and survival relies on collateral circulation from the remaining cutaneous attachment and its vasculature. Therefore, it limits the size of the flap. Although increasing the width of a flap does not increase its survival length, exceedingly long flaps can undergo necrosis (Ragni and Moore, 2008). Therefore, width to length ratio 1:2 is advisable (Ragni and Moore, 2008). When a larger flap is required two smaller flaps are preferable.

Axial Pattern Flaps (APF) are pedicle grafts that incorporate a direct cutaneous artery and vein (Figure 2) at their base (Kirpensteijn and Haar, 2013). They are larger flaps with clearly defined perfusion areas, which have a higher survivability rate than SPSF (Pavletic, 1990). APFs can be rotated up to 180 degrees at their base (Tobias and Johnston, 2012). Flaps appear shorter and narrower after elevation due to skin elastic recoil but they can be stretched back to the original size. Most APFs are rectangular or modified L- shaped but in some, an island of tissue (preserving direct cutaneous artery and vein) makes rotation easier. If the recipient bed is not directly adjacent to the donor site, a bridging incision is made throughout the skin between the donor and recipient beds (Tobias and Johnston, 2012). Specific Axial Pattern Flaps have been identified in dogs with clearly identified boundaries (Kirpensteijn and Haar, 2013).

A skin graft is a segment of epidermis and dermis that is completely removed from one anatomic location and transferred to a recipient site which survives on re-establishment of a vascular supply from the graft bed (Kirpensteijn and Haar, 2013). In dogs and cats primarily skin grafts are indicated for loss of skin on distal limbs where there is not much loose skin to cover the defect by mobilisation with the skin flaps. (Tobias and Johnston, 2012). The most common donor site is the cranial lower lateral thoracic area.

Corresponding author. M. Siriwardane, E-Mail: dayanimilna@yahoo.com

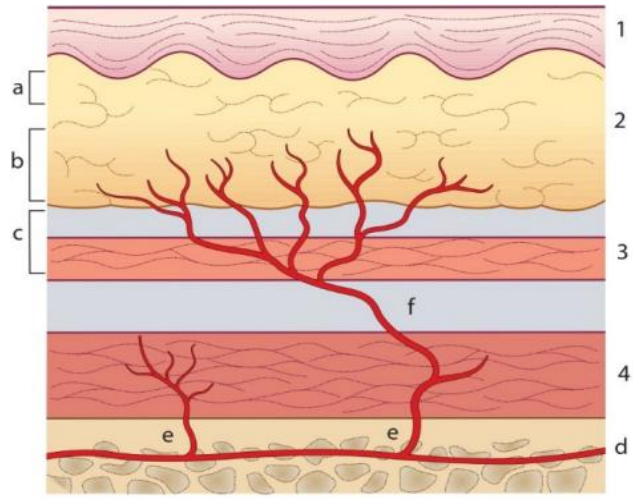

Figure 1. A sketch diagram depicting the unique vascular supply to the skin and underlying tissues of animals (feline and canine). 1. Epidermis; 2. Subcutis; 3. Panniculus muscle; 4. Skeletal muscle; a. Superficial plexus; b. Middle plexus; c. Deep or subdermal plexus; d. Segmental artery; e. Perforator artery; f. Direct cutaneous artery. The perforator arteries supplying the skeletal muscle terminate as small musculocutaneous arteries that run perpendicular to the skin, after their direct cutaneous arteries branch to form deep, middle, and superficial plexuses.

Source - J. Kirpensteijn, G. T. Haar (2013). Text book of Reconstruction surgery and wound management

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Figure 2. Topographical anatomy of the superficial arteries of the canine skin used in axial pattern flaps. 1. facial; 2. superficial temporal; 3. caudal auricular; 4. superficial cervical branch of omocervical; 5. cutaneous branch of thoracodorsal; 6. lateral thoracic; 7. superficial brachial; 8. cranial superficial epigastric; 9. caudal superficial epigastric; 10. deep circumflex iliac; 11. cutaneous branches of superficial lateral coccygeal; 12. medial genicular; 13. Saphenous

Source - J. Kirpensteijn, G. T. Haar (2013). Text book of Reconstruction surgery and wound management

Figure 3. Skin tension lines of the head, neck, trunk and limbs in the dog. The tension lines of the head and neck region resemble the orientation of the underline muscles, while those of the trunk are perpendicular to the body axis. The tension lines of the limbs are generally parallel to the long axis of the limb on the cranial surface an, but perpendicular to the long axis of the limb laterally and caudally.

Source - J. Kirpensteijn, G. T. Haar (2013). Text book of Reconstruction surgery and wound management

Direction of the skin tension lines (Figure 3) are fixed in dogs and cats in which lines are formed by the predominant pull of the fibrous tissue within the skin (Kirpensteijn and Haar, 2013). Incisions and wounds along tension lines heal better, faster and with aesthetically pleasing cosmetic appearance whereas those made across tension lines tend to gape (Kirpensteijn and Haar, 2013).

Therefore, the location of the wound considerably affects the tension. Wounds on the distal limbs are challenging to close. Wounds located over the joints have significant motion, and tension varies with the joint movement (Williams and Moores, 2009). Also, wound geometry can affect the tension (Tobias *et al*., 2012). Excessive tension can lead to dehiscence, excessive scar tissue formation and increased post-operative pain, which are unfavourable effects of high-tension wound closure (Tobias and Johnston, 2012).

Skin flaps and grafts are designed to overcome these detrimental effects and maintain durable skin coverage with decent cosmetic outcomes. However, despite the major advantages, complications such as suture dehiscence, seroma formation, distal flap necrosis, flap failure, flap oedema and infections are encountered.

Objective

The objective of this retrospective study is to evaluate the clinical indications, complications and outcomes associated with flaps and grafts.

MATERIALS AND METHODS

Electronic medical records between the years 2020 and 2024 at Pet Vet Clinic were reviewed. Signalment, history, physical examination, pre-surgery wound management, surgical procedure including flaps or grafts used, post-operative management, flap and graft long-term survival (major and minor) were recorded. Flap survival was estimated by comparing the surviving skin surface area to the entire flap surface area following transposition. In-depth discussions took place before undertaking the surgical procedure to educate the client about the gravity of the surgical complications, long post-operative care, flap or graft survival and financial capacity.

Before the reconstructive surgery, traumatic wounds were managed until a healthy granulation bed was achieved. At presentation, patients were anaesthetised or sedated for initial surgical wound debridement. A culture swab was collected for bacteriology following initial lavage (with 0.9% saline or Lactated Ringer's solution) and debridement. Post-debriding dressings (wet-to-dry and tie over dressing) were used as appropriate with multiple sedations or anesthesia. Reconstructive surgery was planned thereafter.

A wide area of the skin was clipped, disinfected and prepared for mobilisation. Based on the location and size of the wound, the estimated flap area was selected and marked on the prepared site. A sterile paper was used as a template during surgery to obtain the estimated length and width of the flaps for the donor site. Flap shortening was expected during rotation, therefore, larger width and length were harvested for the APFs and skin graft. The distal end of the flaps was held using a suture material to minimise trauma during handling and rotation. The donor site was closed as a primary closure.

In the traumatic wounds, the skin border was removed using a sharp scalpel blade before the flap or graft bed was transposed. The subcutaneous marginal layer was closed in an interrupted pattern using 3/0 PDS, and the skin was closed in either an interrupted or cruciate pattern with 3/0 Ethilon.

Other reconstruction techniques, such as undermining, walking sutures, and tension-relieving sutures, were combined to close the defects. In some cases, passive drains were used to prevent seroma formation.

In the full-thickness skin graft, the donor skin was harvested from the lateral thorax. The graft was prepared to remove all hypodermal tissue, leaving a thin strip of dermis only. The graft was meshed using a fresh scalpel blade. The wound bed was prepared by gently scraping the fresh granulation bed. The graft was sutured to the edges of the skin defect using 3/0 Ethilon. Non adhesive dressing layer was used to cover the graft bed, which was changed weekly.

Almost all animals were wearing Elizabethan collars or body suits during the post-operative period. Post-operative flap or graft viability was observed subjectively by the skin colour, capillary perfusion, digital temperature, wound discharge and cosmetic appearance.

Analgesia was maintained with a combination of morphine, meloxicam and ketamine. Some animals with long painful procedures were treated post-surgically with six-hourly morphine therapy for 24 hours. Cefuroxime was administered pre-operatively which was continued post-operatively in most animals. In the animals where previous traumatic wounds were present, antibiotic was selected based on wound culture and sensitivity.

To determine the complications, patients' records were observed during the period of hospitalisation or on subsequent visits during the post-operative period. Wound complications were defined as flap necrosis, dehiscence, seroma formation and infection during the post-operative period. Any wound complication was managed conservatively.

Complications were defined as major if there was more than 50% flap necrosis, moderate if surgical debridement was needed with more than 50% flap survival, and minor if seroma formation, wound discharge and treatable infections were present.

Patient information

Twelve dogs and ten cats were included in the study, with ages ranging from 6 months to 14 years. Out of ten cats, two were Persians, and the others were crossbred cats. Out of the twelve dogs, there were two crossbred street dogs, three Labrador Retrievers, one Doberman, one Cocker spaniel, one Dalmatian, one Japanese Spitz, one Dachshund, one Dachshund-cross and one Rottweiler-cross.

In the cat population, there were eight males and two females, while in the dog population, there were nine males and three females (Table 1).

Table 1. Sex of the animals

Sex	Male cats	Female cats	Male dogs	Female dogs
Intact	6		9	1
Neutered	2	2		2
Total	8	2	9	3

RESULTS

Locations of the wounds (trunk, limbs, eyelids, forehead, nasal planum, lips, elbow and rump) and pre-operative management prior to the reconstruction surgery are summarised in Table 2.

Table 2. Location of the wounds and the methods of pre-operative management

Variable		Cats	Dogs	Total
Location of the wound	Rump	1		1
	Ventral and lateral thorax	1	3	4
	Hind limb	3		3
	Inguinal region	1		1
	Nasal planum	1		1
	Elbow		1	1
	Lip		3	3
	Eyelid		2	2
	Forehead	1		1
	Ventral and lateral abdomen	1	2	3
	Fore limb		1	1
	Mid Trunk	1		1
Pre-operative management*	Open wound management	1	1	2
	Surgical debridement	6	1	7
	Wet to dry dressings	8	2	10
	No management	2	9	11

***** In some cases, a combination of two or three methods have been used

Diverse forms of reconstruction methods used, indications of the wounds and complications are summarised below (Table 3).

Table 3. Type of reconstruction, type and location of the wounds, and complications in dogs and cats

Type of Reconstructions		**Variable**			**Total**
SPSFs	**Indication in cats**	**Complications in cats**	**Indication in Dogs**	**Complications in dogs**	
Advancement	2 Cat-bite wounds	Moderate	1 Fibrosarcoma on lip	Nil	3
	1 Traumatic wound unknown reason	Moderate	2 eyelid Melanomas	Nil	3
			1 Melanoma on lip	Nil	1
			1 Mast Cell Tumour	Nil	1
			1 Lipoma	Nil	1
Rotation	1 Squamous Cell Carcinoma (SCC) on nasal planum	Nil			1
Plasty- (H- Plasty)			1 Mast Cell Tumour	Moderate	1
Flank fold	1 Mammary Carcinoma and 1 non-healing wound	Moderate	1 Mammary Carcinoma	Nil	3
Elbow fold	1 Traumatic wound (RTA)	Moderate	1 Mast Cell Tumour	Nil	2
APFs					
Caudal superficial epigastric	1 Traumatic wound (inguinal region)	Nil			1
	1 Traumatic injury (RTA) skin wound over the stifle	Moderate			1
Thoraco – dorsal			1 Traumatic wound (RTA)	Major	1
Caudal Auricular			1 SCC on the upper and lower lip	Minor	1
Superficial Temporal	SCC on the left forehead	Nil			1
Full-thickness skin graft			1 Traumatic wound on distal fore limb (RTA)	Nil	1
					22

Four animals had traumatic wounds (three cats and one dog) due to road traffic accidents, and in the other two the cause of the wounds was unable to be defined. Two cats had necrotic skin wounds after multiple cat bite wounds. Twelve animals underwent surgery for tumour resection, out of which there were 10 dogs and 2 cats.

The selection of the type of flap or graft was based on the wound location and size. Sixteen animals underwent SPSFs, while four animals underwent APFs. The types of SPSFs used in animals were Advancement (9 cases), (Figure 4-7), Flank fold (3 cases), (Figure 8), Plasty (1 case), (Figure 9), and Rotation (1case) (Figure 10), elbow fold (2 cases).
There were four types of APFs used in five animals. The APFs were based on the caudal superficial epigastric artery (Figure 11), thoracodorsal artery (Figure 12), caudal auricular artery (Figure 13), and superficial temporal artery (Figure 14). A passive drain was placed for 2-4 days in ten animals post-surgically. Serosanguineous drainage was observed in those animals.
One dog had a full-thickness skin graft (Figure 15) on the distal forelimb and had a shearing injury following a road traffic accident.

- **Subdermal Flaps**

a) i . *Advancement Flap – 1*

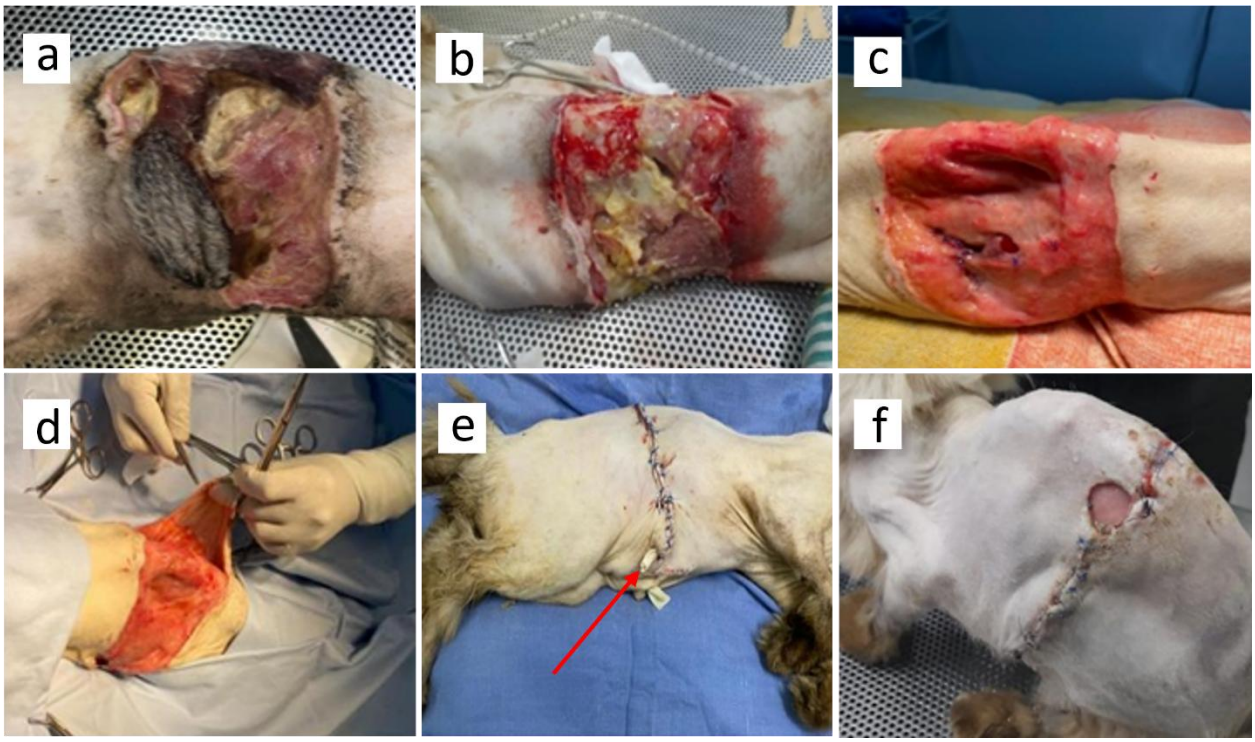

Figure 4: a.& b. A Persian cat with a bite wound resulting in necrotic skin and subcutaneous tissue; c. Well-formed granulation bed; d. Undermining of the skin; e. Complete advancement flap with a Penrose drain (red arrow); f. Two weeks after the surgery

ii. *Advancement flap - 2*

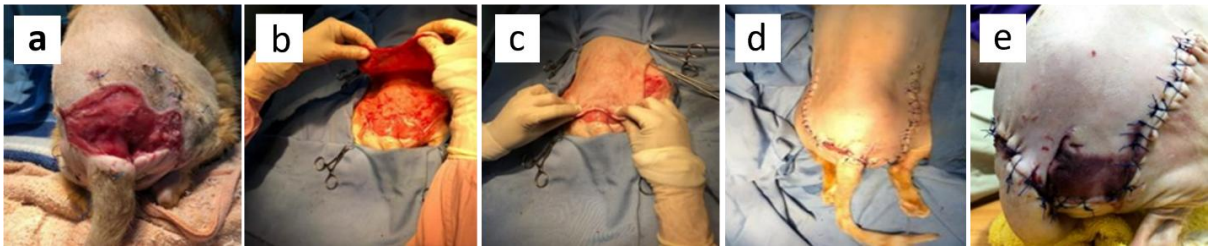

Figure 5. a. Cat with Traumatic wound with good granulation tissue; b. Undermined skin to create the advancement flap; c. Transposition of the flap; Completed flap after suturing; e. Partial flap necrosis after 1 week

iii. *Advancement flap - 3*

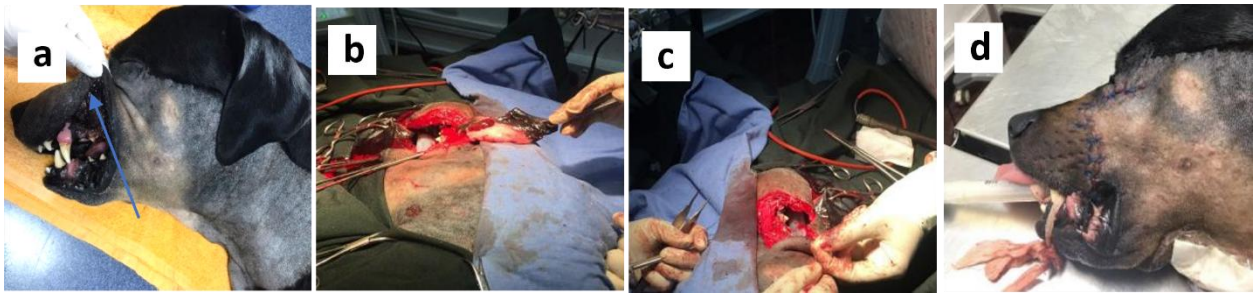

Figure 6. a. Melanoma on the left upper lip of a Dog. (Blue arrow points to the tumour mass); b. Resection of the lip and tumour with the wide margins; c. Creating the flap by undermining the skin; d. Complete advancement flap

iv. *Advancement flap – 4*

Figure 7. a. A large tumour (more than one-third) of the eyelid; b. Creation of an advancement pedicle flap by extending the incision after resecting the tumour with a 2 mm margin - two triangles at the base were removed to get a better apposition; c. The closed defect with the advanced flap up to the lid margin.

b). *Flank fold flap*

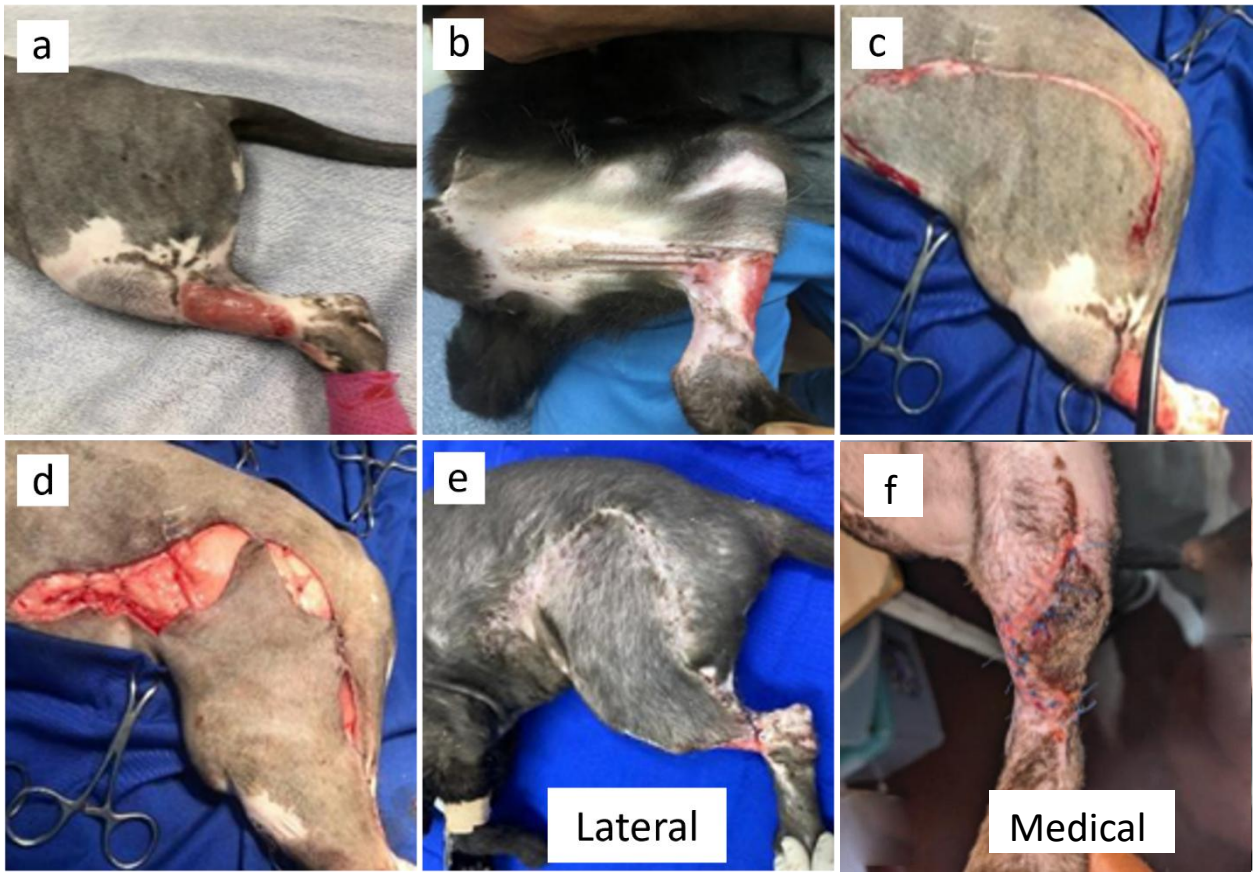

Figure 8. a & b. Chronic non-healing wound of a cat with excess skin contraction and limited range of motion of the limb; c. Creating the flap above the flank fold; d. Rotation of the flap using the flank fold skin; e & f. Healing flap, 2 weeks post-surgery

c) *H-Plasty*

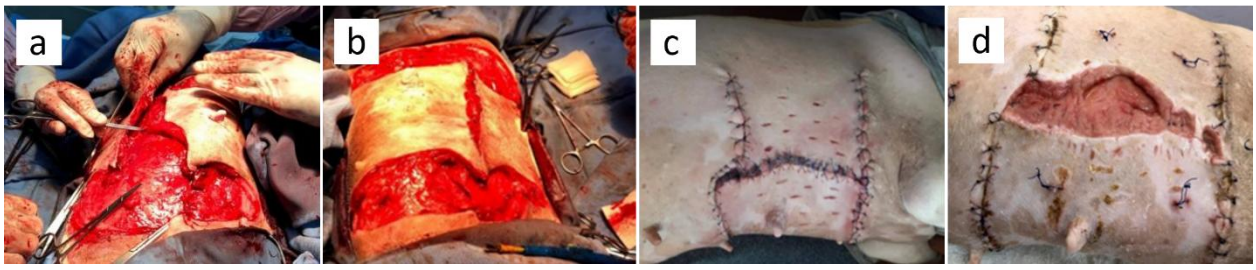

Figure 9. a. Following a large Mast cell tumour resection on the lateral thorax of a dog; b. parallel incisions were created to oppose the skin; c. Sutured flap with H configuration and multiple short relaxing incisions; d. Ten days post-surgical wound. There is middle suture dehiscence, which was resolved later with conservative management.

d) *Rotation flap*

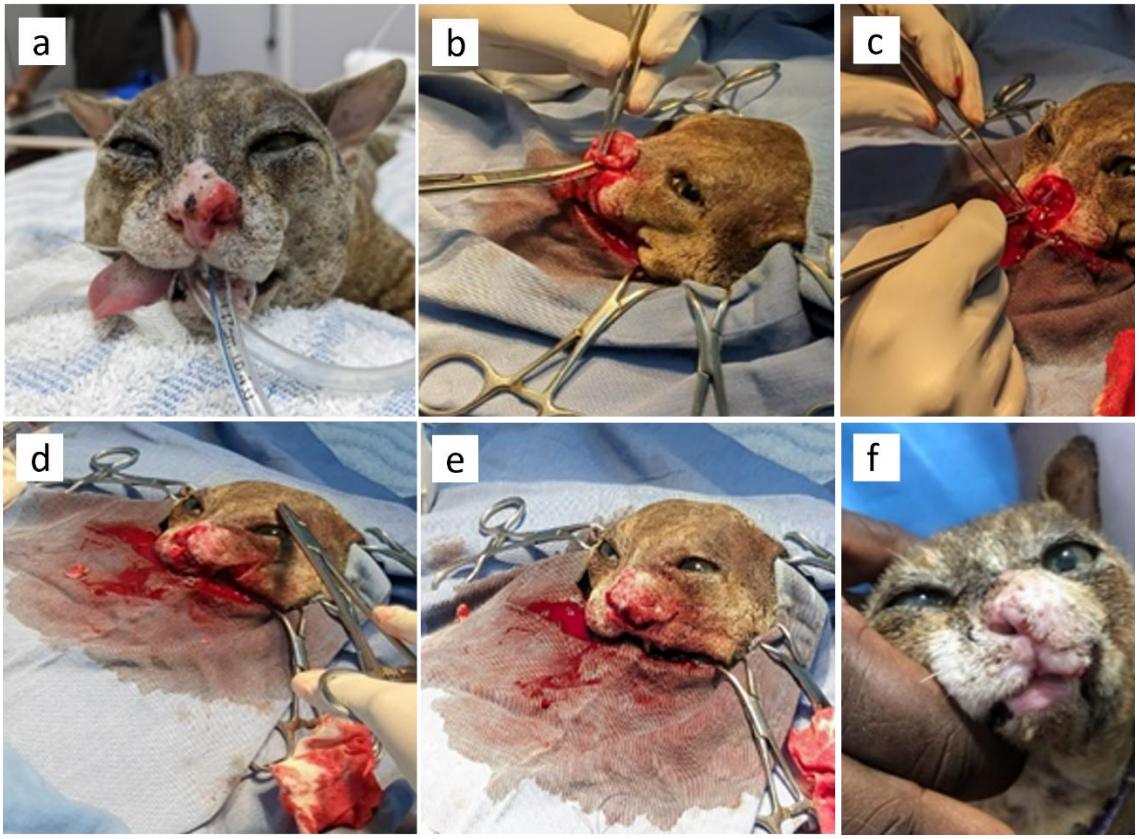

Figure 10. a. Unilateral squamous cell carcinoma (SCC) on the nose of a cat; b. Wide resection of the nasal plenum; c. Temporary placement of a tube (arrow) to maintain nostril patency; d. Incision made along the rostral lip and rotated upward; e. Transposition of the flap to cover the defect with the mucosal layer underneath; f. Two weeks after surgery

- **Axial flaps**

i. *Caudal superficial epigastric flap*

Figure 11. a. Traumatic wound over the stifle of a cat; b. Creating the flap along the ventral abdominal midline and parallel to midline on the left side. Length up to 1-2 cranial mammary gland. Arrow points to the origin of the direct cutaneous artery at the inguinal ring; c. Undermine the skin and pedicle elevation with suture material to avoid ischemia during rotation; d. Rotate the flap from pivot point to the defect over the stifle. A bridging incision is made between the pedicle and the defect. e. Ten days post-surgery, distal partial flap necrosis; f. Recovery after 4 weeks.

ii. *Thoraco dorsal flap*

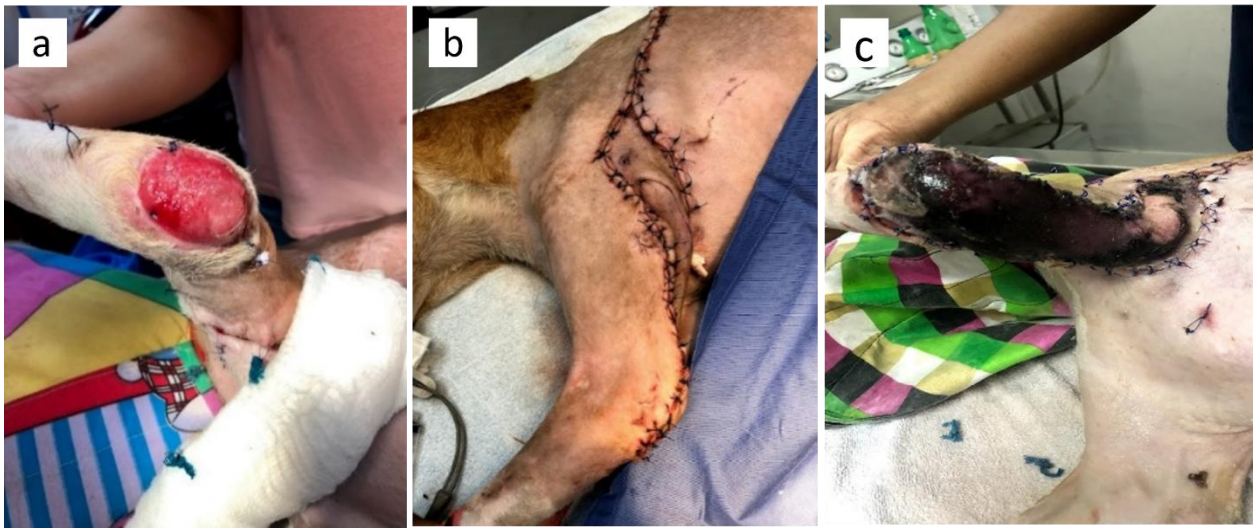

Figure 12. a. Elbow skin defect; b. The Thoraco-dorsal flap repaired the skin defect which discoloured within 24 hours; c. Flap necrosis

iii. *Caudal auricular flap*

Figure 13. a. Squamous Cell Carcinoma of a dog on the left upper and lower lips; b. Tumour extending towards the maxillary lining; c. Resection of the tumour with extensive lip margins; d. Partial removal of alveolar bone and the teeth using an oscillating saw; e. Creation of Caudal-auricular flap. The landmark is from the base of the vertical ear canal up to the scapular region; f. Left maxilla and mandible after removal of the tumour margins. Note that both maxillary and mandibular teeth are also removed; g. Rotation of flap upwards to cover the skin defects of the maxilla and mandible; h. Completion of Caudal- auricular flap. An oesophagal tube was placed to feed the dog; i. The dog is after full recovery, 2 months post-surgery.

iv. *Superficial temporal axial pattern flap*

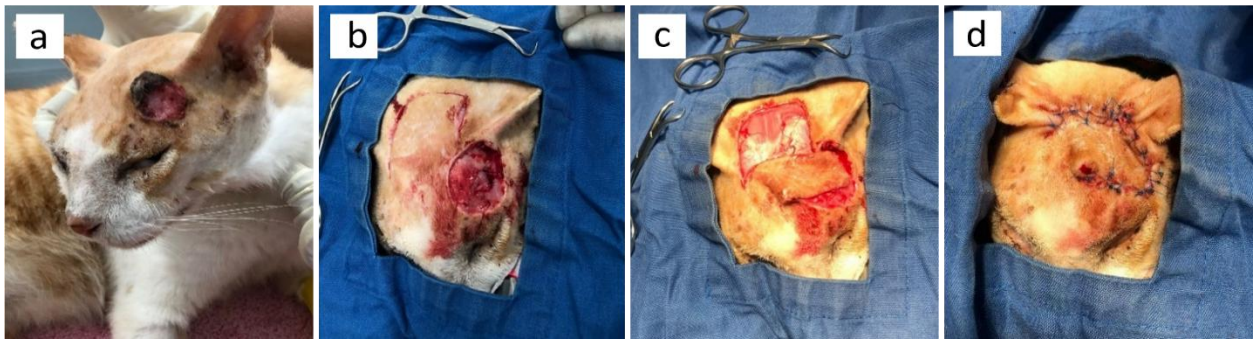

Figure 14. a. A Squamous cell carcinoma (SCC) on the left forehead of the cat; b. Flap was created dorsally; c. A flap rotated to cover the defect, incorporating blood supply from the Right superficial temporal artery; d. Completed flap

Free skin graft

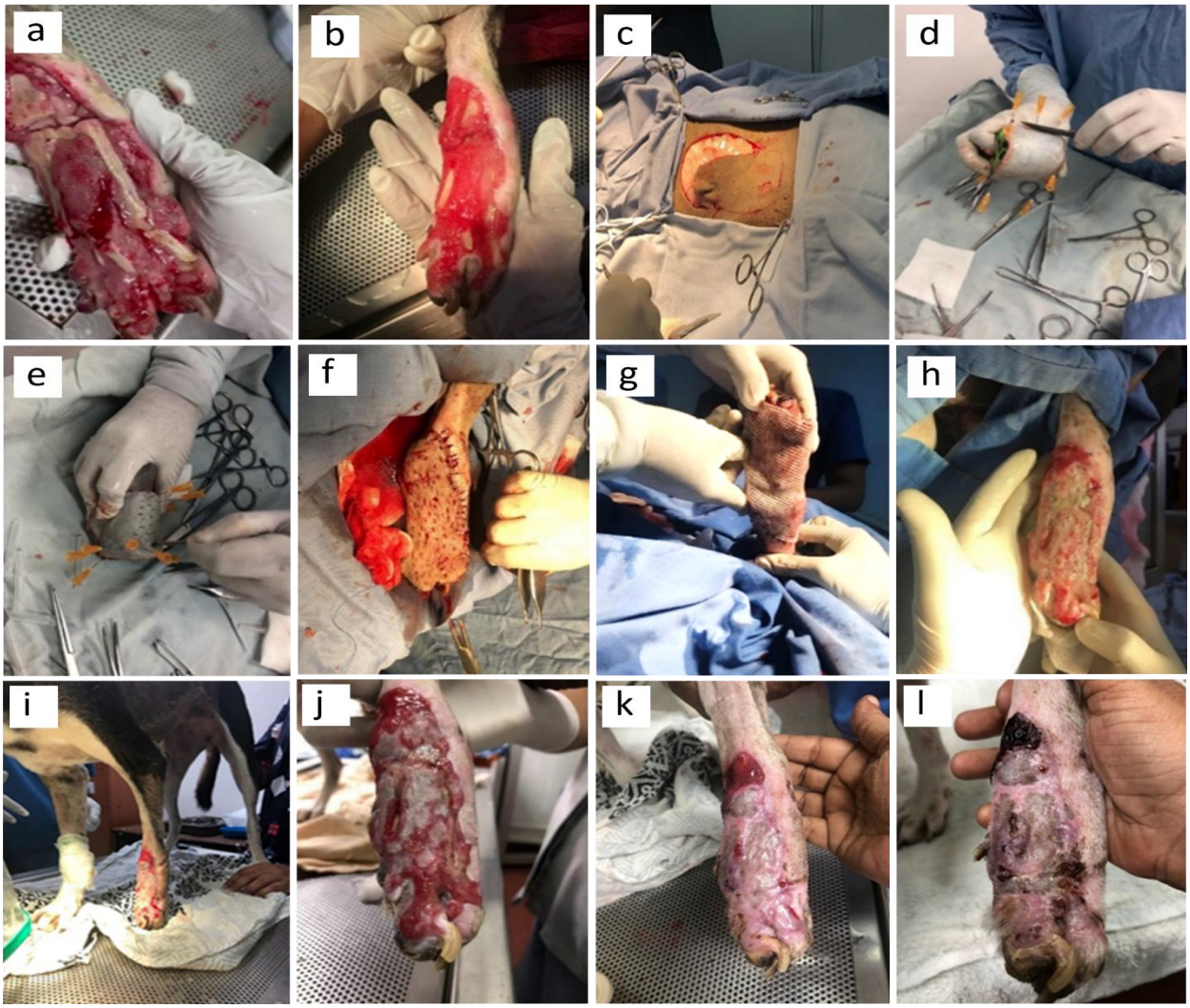

Figure 15. a. Badly sheared wound on the distal fore limb of a dog; loss of tissue, bones and tendons; b. Fresh granulation tissue bed post open wound management; c. Harvesting the donor skin from the lateral thorax; d. Graft preparation: draping the skin around a sterile roll and removing the hypodermal tissue using a scalpel blade; e. Stab incisions are being made with a sharp blade to make a mesh graft; f. Expanded graft used to cover the wound; g. Dressing the graft with a sterile paraffin layer followed by a foam layer: h. First week post surgery. (Weekly dressing change done) i. Second week post surgery; j. Third week post-surgery; k. Fourth week post surgery; l. Sixth week post-surgery

Post-operative complications

Distal flap necrosis was observed in 5 animals, out of which 3 were SPSFs (two Advancement, one rotational) and 2 were APFs (Caudal Superficial epigastric and Caudal Auricular). Skin discolouration was noticed after 24 hours, and skin necrosis developed within 4-6 days. Three animals had moderate flap necrosis which needed surgical debridement, while in two animals it was minor. All were managed with conservative wound management. Partial suture dehiscence in four SPSFs animals (one advancement, one elbow fold, one bilateral flak fold and one plasty) were managed conservatively. Bacterial cultures and sensitivity tests were performed in four animals in which infection was suspected. Cultures were positive in all four animals and were treated with antibiotics according to the sensitivity. One cat who had a cat bite wound showed positive culture for MRSA, which was also treated according to the culture and sensitivity. Ten animals did not have complications or were minor complications such as oedema, minor suture dehiscence which resolved without intervention. The dog with the full thickness skin graft included in this group did not encounter complications. The hospitalised period of the animals varied from a minimum of 48 hours to 3 months. All SPSFs and the full-thickness skin graft survived without further complications during the three months. Four out of the APFs survived with long-term skin coverage and cosmetic effects. One APF (Thoraco- dorsal) failed with complete necrosis.

DISCUSSION

This retrospective study discusses the indications, evaluation, and outcomes of the diverse forms of flaps (16 SPSFs and 5 APFs) and one full-thickness graft used in 22 animals with extensive cutaneous defects. To the authors' knowledge, this is the first study published on extensive cutaneous defect repair in dogs and cats in Sri Lanka using skin flaps and free skin grafts.

A higher proportion of traumatic wounds were observed in cats than in dogs in this study. Out of ten cats, seven presented with traumatic wounds. Most owners had not observed any skin wounds in their cats but perceived changes in behavior, inappetence, limping, and pain to touch. Cats are clever at masking pain; therefore, it is challenging to diagnose the definite problem. As a result, traumatic wounds were more chronic than acute upon presentation. In the study, 75% of the cats were intact male household pets. The roaming behavior of intact cats makes them more vulnerable to traumatic wounds. Cat bite wounds had deep-seated infections and required repeated wound cultures and surgical debridement before reconstruction.

Two dogs who had trauma due to road traffic accidents were roaming intact males. Although the number of accidents involving roaming dogs is high, veterinary treatment, including extensive surgery or care, is often lacking due to limited financial resources and commitment.

In this study, of the 22 animals, 16 underwent SPSF procedures. The most common indication for SPSF in dogs (9 out of 16) was following extensive tumour resection, while in cats (7 out of 16), the procedure was primarily performed for traumatic wound repair in 4 cases. The number of cats presented with tumours in the study was less in comparison with dogs. A possible reason for this could be that the cat population presented to the hospital may be in lower numbers than dogs. There was one cat presented with SCC at an early stage that proved to have successful results. At an early stage, extensive tumour resection to obtain tumour-free margins with reconstruction has appreciated outcomes, especially in Sri Lanka, where the cats with nasal SCC are not treated with chemotherapy or radiation therapy.

Moderate complications in SPSFs were observed in the 4 traumatic wound repairs in cats. It is a possibility, as all those animals had wound infections before the reconstructive surgery. Open chronic wounds are difficult to prepare for aseptic surgery and may also have changes in the skin flora. APFs were developed deep to the level of the cutaneous muscles. Out of five animals, two cats had caudal superficial epigastric flaps, while one cat had a superficial temporal flap. One dog had thoracodorsal, and another dog had caudal auricular flaps. In these 4 animals passive drains were placed to prevent seroma formation between the donor and recipient site for 3-4 days. Moderate complication with distal flap necrosis was noticed on the caudal superficial epigastric flap, which had seroma formation post reconstruction and was resolved with routine wound management. Thoracodorsal flap discoloration started within 24 hours of transposition on the elbow. Eventually, it completely failed, with necrosis setting in. The possible cause could be direct cutaneous arterial occlusion during surgery, which was a surgical error. The dog with the caudal auricular flap underwent extensive surgery (SCC) with wider margins, which required the removal of maxillary and mandibular teeth, along with part of the alveolar bone. The Caudal auricular flap is a robust flap with a good blood supply and remained with minor complications. Recovery was excellent in this dog with opioid therapy pre and post-surgically, despite the extensive, lengthy, painful surgical procedure.

In the present study, there was a single case with skin graft reconstruction, which was a shearing injury located on the distal one-third of the forelimb. Reconstruction of the limbs is challenging with flaps as the mobilisation is prevented due to lack of adjacent skin. Therefore, the distal limb is a common

site for grafts. The primary layer is thought to be an important determinant of the graft outcome. In this study, a sterile, non-adherent paraffin gauze layer was applied as the primary layer over the graft. Another hydro-cellular foam layer was applied over the latter, which had lesser adherent properties. Over 6 weeks, the dog was kept hospitalised, and the bandage was changed weekly. Except for the minor graft necrosis along the medial edge, no significant change was observed in the graft bed. The graft was a successful procedure in this study with the functional limb. Nevertheless, the choice of grafts is less desirable by the clients due to the high cost. Therefore, the sample size with grafts is low based on the author's experience at our practice.

Clients played an important role in the decision making and aftercare of animals postoperatively. Not all patients required hospitalisation during the post-surgical period. Some of the SPSF animals were manageable at home with an Elizabethan collar and a body suit. APFs and skin grafts needed considerable attention for survivability; therefore, those animals needed to be immobilised. Such animals were hospitalised for a minimum of 10 days to 3 months.

All animals except one recovered well without compromising their mobility and with good cosmetic appearance.

CONCLUSION

This study shows that 95% of the patients recovered well with excellent outcome. Minor and moderate wound complications were managed successfully with conservative management. Careful surgical planning, gentle tissue handling to minimise trauma, maintaining good blood supply are key to the success of reconstructive surgery. Surgical knowledge and experience maximize the above successes. Reconstructive surgery with flaps and grafts is challenging yet essential surgical modalities in companion animals

One limitation of the study is small volume of data in the retrospective nature on each type of reconstruction procedures. More data is needed to do the statistical analysis of different types of flaps and grafts in the future studies.

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