

Maximum Extension of the Greater Omental Flap by Subcutaneous Tunneling in Felines

Maiara Bernardina de Carvalho , Eloisa Martineli Galuch , Kamyla Alves da Cruz ,
João Victor Fernandes Peres Gutierrez , Gabriel Aguiar Pavilak ,
Bruna Letícia Domingues Molinari  & Leonardo Martins Leal 

ABSTRACT

Background: The omentum is a vascularized organ with angiogenic and absorptive properties, making it valuable in veterinary surgery for tissue repair, infection control, and revascularization. In dogs, omental flaps have been extended to limbs and the brain, while in humans cadaveric studies demonstrated its reach to thoracic and limb regions. In cats, anatomical constraints such as omental length and mobility have limited its use in distant body regions. The objective of this study was to determine the maximum extension of the greater omentum flap in feline cadavers and evaluate its reach to pelvic and thoracic limbs, head, and tail using subcutaneous tunneling.

Materials, Methods & Results: Sixteen feline cadavers of varied age, weight, and body length were used, allowing assessment in a heterogeneous sample. The animals were obtained from natural deaths unrelated to this study. A pre-retro-umbilical median celiotomy was performed to access the omentum, which was exteriorized. From this structure, a single-layer “L”-shaped flap was created by incising 1/3 of its width while preserving the vascular pedicle. Subcutaneous tunnels were established toward target regions by blunt dissection between skin and musculature, with small incisions when necessary. The omentum was kept moist with saline throughout the procedure. Measurements were taken at each stage of flap creation and extension, including double-layer, single-layer, and post-tunneling lengths. The cadavers were divided into 4 groups according to the target region: pelvic limb, thoracic limb, head, and tail. In all cases, the greater omentum reached the proposed anatomical regions. Flap lengths ranged from 30 cm to 85 cm, with larger animals consistently exhibiting longer extensions, confirming correlation between body size and omentum length. Passage required wider tunnels in cadavers with higher fat content, and tunneling to the head proved more challenging in heavier animals due to the greater distance from the origin. Nevertheless, the technique remained feasible even in cadavers with a history of abdominal surgery, indicating that prior procedures did not necessarily compromise extension or vascular integrity.

Discussion: These findings show that subcutaneous tunneling allows the greater omentum to reach distant anatomical regions in cats while maintaining vascular integrity. The versatility of the flap highlights its potential use in reconstructive procedures, chronic wound management, and enhancement of local blood supply. Its surface area, flexibility, and vascularization make it suitable for wound healing in anatomically challenging areas, particularly distal limbs and cranial regions. Limitations must be considered: laparotomy creates communication between sterile and non-sterile areas, increasing contamination risk, and excess fat can complicate tunneling, requiring wider dissection and longer surgical time. Despite these challenges, the technique proved reproducible and safe in cadavers, supporting clinical application. Overall, the study confirmed the feasibility of the “L”-shaped omental flap in feline patients, providing a method to extend the omentum to previously inaccessible sites. These results reinforce the translational relevance of the technique, as similar approaches have been reported in canine and human models. Future studies are warranted to evaluate long-term outcomes, particularly in wound healing, bone vascularization, and management of chronic infections, supporting broader application in veterinary practice.

Keywords: cat, omentalization, pedicle, subcutaneous tunneling.

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Department of Veterinary Medicine, Ingá University Center (UNINGA), Maringá, PR, Brazil. CORRESPONDENCE: L.M. Leal [prof.leonardoleal@uninga.edu.br]. Department of Veterinary Medicine - UNINGA. Rod. PR 317 n. 6114. Parque Industrial 200. CEP 87035-510 Maringá, PR, Brazil.

INTRODUCTION

The omentum is an anatomical structure recognized for its vascularization, flexibility, and absorptive capacity, which makes it widely applicable in surgical procedures for tissue repair, infection control, and reconstruction of abdominal and thoracic walls [3,7,9]. It can serve as a vascular pedicle to extend blood supply to distant sites [3]. In dogs, omental flaps have been used to reach limbs and the brain via subcutaneous tunneling, maintaining vascular efficiency, and L shaped flaps can extend to distal metaphyses of long bones [5,6,8]. In human cadavers, the omentum reaches thoracic and limb regions, though distal extremities remain limited [1]. In cats, omental pedicles have improved chronic wound healing while protecting the pedicle and peritoneal cavity [2,10,11]. Therefore, the aim of this study was to determine the maximum extension of the omental flap in feline cadavers, targeting distant anatomical structures such as limbs, head, and tail.

MATERIALS AND METHODS

Animals

Sixteen fresh or previously frozen feline cadavers were used in this study. Cadavers were obtained from animals that had died from causes unrelated to the experimental procedures. Breed, weight, and age were not standardized, allowing assessment of the greater omentum flap in a heterogeneous sample. The animals were divided into 4 experimental groups according to the target region of the omental flap: Group I, pelvic limb; Group II, thoracic limb; Group III, head; and Group IV, tail.

Omental flap creation

A pre-retro-umbilical median celiotomy was performed, followed by exteriorization of the spleen, stomach, and double-layer greater omentum [4]. The dorsal omental layer was separated from the pancreas and extended caudally to form a single-layer flap. An inverted "L"-shaped incision was made, beginning on the right side below the gastrosplenic ligament and extending transversely across the omentum. Approximately 1/3 of the omentum's width was incised, with ligation and sectioning of the omental vessels, and the incision then continued caudally, parallel to the omental vessels, with the longitudinal cut extending along approximately 2/3 of the omentum's length (Figure 1). The right portion of the omentum was rotated 180° caudally until the pedicle was fully extended toward the intended region.

Measurements

The length of the greater omentum was measured at each stage of flap creation using a measuring tape¹. Measurements were obtained from the margin of the greater curvature of the stomach to the distal edge of the extended omentum, with the measuring tape positioned perpendicular to the stomach and parallel to the animal's longitudinal axis (Figure 2). Additional measurements were recorded after the omental flap reached the distal metaphyses of the evaluated bones. The same omental flap was used to assess its reach to the pelvic and thoracic limbs, head, and tail.

Subcutaneous tunneling

Subcutaneous tunnels were created by blunt dissection between the skin and the underlying musculature. In Group I (pelvic limb), tunneling began at the caudal edge of the umbilical incision, followed the rectus abdominis muscle, continued through the inguinal region with an auxiliary 3 cm skin incision to facilitate passage, and extended through the cranial region of the quadriceps muscle to reach the distal metaphyses of the femur and tibia (Figure 3). In Group II (thoracic limb), tunneling began at the cranial edge of the celiotomy and extended over the sternum and superficial pectoralis muscle, with a small incision in the xiphoid region to facilitate passage, continuing over the humerus and extending to the distal metaphyses of the humerus, radius, and ulna (Figure 4). In Group III (head), tunneling extended dorsally from the celiotomy toward the lumbar and nuchal regions, with auxiliary dorsal incisions, reaching the skull at the level of the incisor bone (Figure 5). In Group IV (tail), tunneling proceeded dorsally and caudally from the celiotomy to the caudal vertebrae, reaching the tail at the level of the 5th caudal vertebra (Figure 6). In all groups, the omental flap was kept moist with saline solution³ to facilitate passage, reduce resistance, and prevent tearing.

Flap fixation and closure

The omentum was sutured to the edges of the terminal wounds corresponding to the pelvic limb, thoracic limb, head, and tail using 4-0 polyglecaprone⁴ in a simple interrupted pattern, ensuring complete coverage of the wound surface. Skin closure was performed with 3-0 nylon⁴, also using a simple interrupted pattern. After fixation, the limbs, head, and tail were manually articulated to assess range of motion and verify the integrity of the omental flap.

Data recording

Measurements were recorded individually for each cadaver and are presented in Table 1. Data were described quantitatively without statistical manipulation

to preserve the original measurements. Potential complications related to tunneling and flap passage, such as resistance or tearing, were minimized by maintaining constant moisture of the omentum with saline solution.



Figure 1. Photographic image of the inverted "L" flap, with the incision initiated below the gastrosplenic ligament and transversely across the omentum.

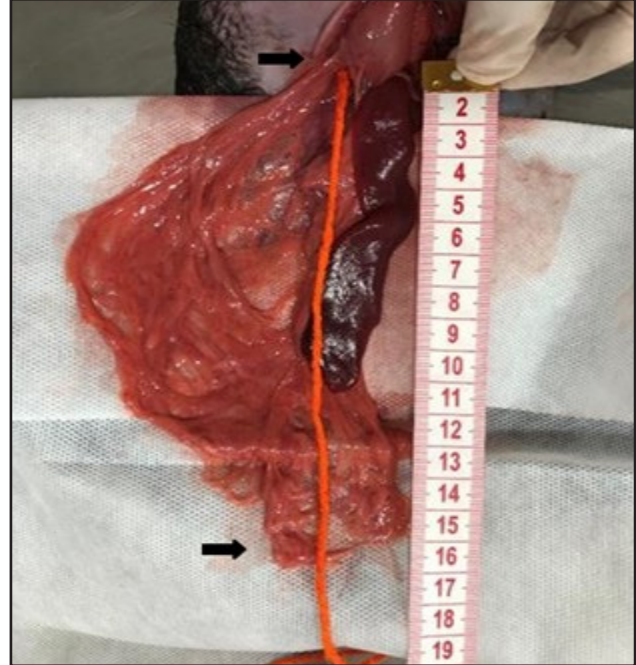


Figure 2. Photographic image demonstrating the measurement points, which were the margin of the greater curvature of the stomach and the margin of the extended omentum.



Figure 3. Photographic image demonstrating the path of the subcutaneous tunnel to the pelvic limb, with only 3 skin incisions made: in the inguinal region, at the distal metaphysis of the femur, and at the distal metaphysis of the tibia.



Figure 4. Photographic image of the subcutaneous tunnel performed for the thoracic limb, with three skin incisions: in the xiphoid cartilage region, the distal metaphysis of the humerus, and the distal metaphysis of the radius and ulna.



Figure 5. Photographic image demonstrating the path of the subcutaneous tunnel performed for the head, with the tunnel advancing to the level of the incisor bone, involving 3 skin incisions: in the dorsal region near the 1st lumbar vertebrae, in the nuchal region (C6 vertebra), and at the level of the incisor bone.



Figure 6. Photographic image of tunneling to the tail, after the passage of the omentum to the caudal vertebrae, with 3 skin incisions made: in the dorsal region near the last lumbar vertebra, in the 1st caudal vertebra, and at the level of the 5th caudal vertebra.

Table 1. Measurements acquired from the omentum flap and the body values of feline's cadavers.

	Animal	Corpse weight (kg)	Corpse height (cm)	Corpse length (cm)	Layer double (cm)	Layer simple (cm)	"L" flap (cm)	Spare (cm)
Group I	1	2.85	28	79	13	24	50	26
	2	3.2	30	84	19	29	61	21
	3	3.6	25.5	80	11	21	46	22
	4	3.2	35	75	20	45	40	50
Group II	5	6.1	33	77	18	39	85	55
	6	4.1	28	77.5	14	17	39	7
	7	5.95	30	74	21	35	61	18
	8	2.85	79	29	14	21	33	15
Group III	9	2.90	27	70	15	20	30	0
	10	3.50	34	84	18	34	50	10
	11	3.75	30	74	23	43	53	24
	12	4.15	30	79	12	24	42	12
Group IV	13	3.0	31	81	16	21	47	13
	14	5.85	35	81	19	39	68	30
	15	3.20	25	82	22	34	57	22
	16	5.70	31	81	13	22	47	22

Source: Maiara Bernardina de Carvalho.

RESULTS

In the present study, frozen feline cadavers were used, following the methodology of Moura [13], without affecting the procedural outcomes related to the tensile strength of the omentum. Throughout the procedures, the omentum was carefully moistened with saline solution to prevent drying and tearing.

The cadavers were not euthanized for this study. They were used randomly, with varying causes of death, ages, weights, and body lengths. This variability allowed for the assessment of the extent of the “L”-shaped omentum flap in a heterogeneous sample.

In all evaluated cases, the omentum successfully reached the anatomical targets proposed in this study: the pelvic limbs, thoracic limbs, head, and tail. Measurements of the double-layer omentum, single-layer omentum, “L” flap, and additional tissue length after reaching the target regions are presented in Table 1. The cadavers’ weight, height, and body length - used to correlate the omentum size with animal dimensions - are also shown in Table 1.

Data were described individually, without statistical manipulation, to preserve the originality of the measurements.

DISCUSSION

In this study, variability was observed in the length of the “L”-shaped omental flap, with larger animals generally presenting longer flaps. This result is consistent with the findings of Ito *et al.* [8], who concluded that the length of the “L” flap is directly proportional to the animal’s weight, regardless of sex. The data obtained here support this conclusion, as larger animals tended to have longer flaps, facilitating the extension of the omentum to more distant body regions.

Similarly, the omentum in dogs could be extended to various anatomical sites, supporting its use in multiple regions of the feline body [14]. Also, it was observed the feasibility of extending the omental flap via subcutaneous tunneling to the distal limbs of cats [13]. This outcome was successfully replicated in the present study for the pelvic, thoracic, head, and tail regions.

The results suggest that the omentum can reach all of the regions evaluated, regardless of the animal’s sex, age, or size. However, some difficulty was noted in Group III (head), particularly in larger animals, due to the greater distance from the omental origin. This finding aligns with Moura’s [13] report, which high-

lighted the head as one of the most challenging regions to access due to anatomical limitations.

Regarding sex-related variation, no significant differences were observed in flap creation or measurement, despite most cadavers being male. Two female cadavers (numbers 9 and 14) were included, and their presence did not affect the results, indicating that sex does not substantially influence the length of the “L” flap.

Animals with higher body weight and greater fat content in the omentum presented more difficulty during the procedure. These individuals required wider subcutaneous tunnels to allow passage of the omentum without tearing. This observation is consistent with Moura [13], who noted that excess fat can complicate tunneling and increase surgical time.

The advantages of using the omentum in this context should be emphasized. Its large surface area, flexibility, and intrinsic vascularization make it an ideal option for wound healing in anatomically challenging areas. The omentum can enhance blood supply to injured tissues, thereby promoting healing [8]. This property was confirmed in the present study, as the omentum was successfully extended to multiple anatomical regions, demonstrating its versatility in clinical applications.

However, the use of the omentum flap has certain limitations. The procedure requires a laparotomy, which creates communication between sterile and non-sterile areas, potentially increasing the risk of contamination [12]. This risk was not evaluated in the present study due to the use of cadavers. Additionally, previous abdominal surgeries may compromise omental integrity, a concern raised by López-Monjardin *et al.* [12]. In this study, 1 female cadaver with a history of abdominal surgery (castration) showed no procedural interference, suggesting that the omentum can still be viable in such cases.

In conclusion, this study reinforces the potential of the omental flap - delivered via subcutaneous tunneling - as a viable surgical technique for reaching various body regions, including the pelvic, thoracic, head, and tail. The findings are in line with previous research, supporting the use of the omentum as an effective tool in veterinary procedures, especially for enhancing bone healing and managing chronic wounds, as demonstrated by Ferrigno *et al.* [3] in dogs and Falcão *et al.* [2] in cats. Future studies should explore the long-term clinical outcomes of using omental flaps to better understand their viability *in vivo*.

CONCLUSION

In conclusion, this study demonstrated that the omentum successfully reached all proposed anatomical regions - pelvic limbs, thoracic limbs, head, and tail - in all feline cadavers evaluated. The extension of the “L”-shaped omental flap through subcutaneous tunneling was feasible even in a highly heterogeneous sample. Flap length was directly related to body weight, with larger animals exhibiting longer flaps. In cases where the flap was directed toward the head, a smaller amount of excess tissue was observed compared to other groups.

The technique proved viable even in animals with a history of abdominal surgery, supporting the recommendation to consider the “L” flap approach in similar clinical scenarios. Overall, the study confirmed the feasibility of this method in felines, highlighting its potential to reach distant body regions, promote healing, and enhance blood flow to affected areas.

MANUFACTURERS

¹Brasfort Indústria e Comércio Ltda. Cambé, PR, Brazil.

²Kalmedica Produtos Médicos Ltda. Aracaju, SE, Brazil.

³Fresenius Kabi Brasil Ltda. Barueri, SP, Brazil.

⁴PolySuture Indústria e Comércio Ltda. São Sebastião do Paraíso, MG, Brazil.

Ethical approval. The study was approved by the Ethics Committee on the Use of Animals (CEUA) of Centro Universitário Ingá (Uningá), Maringá, Paraná State, Brazil, under protocol PM82/2019. All procedures were conducted in accordance with the ethical principles recommended by the Colégio Brasileiro de Experimentação Animal (COBEA) and the International Guiding Principles for Biomedical Research Involving Animals (CIOMS/WHO).

Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of paper.

Artificial intelligence statement. The authors declare that no Artificial Intelligence (AI) was used in this study. The authors are solely responsible for all aspects of the work.

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