Relationship between the size of skin excision and wounds in the dog: comparison of full-thickness and partial-thickness skin excisions

D. PIN1*, T. CACHON2, C. CAROZZO2

1 Department of Dermatology, Ecole Nationale Vétérinaire de Lyon, 1, Avenue Bourgelat, 69280 Marcy l’Etoile, FRANCE.
2 Department of Surgery, Ecole Nationale Vétérinaire de Lyon, 1, Avenue Bourgelat, 69280 Marcy l’Etoile, FRANCE.

*Corresponding author: Tel: +33 4 7887 2777; E-mail: d.pin@vet-lyon.fr

SUMMARY

The aim of this study was to compare the size of planned skin excisions and obtained wounds with two techniques of excision: full-thickness skin excisions using a scalpel and partial-thickness skin excisions using a dermatome (Aesculap). Four adult Beagle dogs with normal skin were used and on each dog, full-thickness skin excisions were performed with a No. 22 scalpel blade mounted on a scalpel handle down to the hypodermis and a dermatome (Aesculap) was used to realize the 0.8 mm deep partial-thickness skin excisions. The length and width of the wounds were measured one, 10, and 30 minutes after excision. An increase in size occurred in all full-thickness skin excision sites, 1, 10, and 30 minutes after excision and the wound area of the full-thickness excision sites was on average 58 to 51 per cent, 70 to 63 per cent, and 93 to 67 per cent, greater than the planned excision area (800 or 1500 mm square), respectively. The increase in size of the different full-thickness skin excision sites was statistically significant (P lower than 0.05) and 30 (P lower than 0.05) minutes after excision. On the contrary, no change in size occurred in the partial-thickness skin excision sites any time after excision. This study has shown that the difference between the size of the planned full-thickness skin excision and obtained wound is significant in the dog but no change in size occurs in partial-thickness skin excision. These data are relevant in experimental grafting of skin substitutes or therapeutic grafting of skin pieces, in which the use of a dermatome means it is possible to predict the size and shape of the wound.

Key-words: Skin, wound, surface, full-thickness, partial-thickness, dermatome, graft.

RÉSUMÉ

Etude comparative, chez le chien, de la variation de la taille des plaies cutanées intéressant toute ou partie de l’épaisseur de la peau

Le but de cette étude était de quantifier, chez le chien, la variation de la surface d’une plaie cutanée intéressant la totalité de l’épaisseur de la peau dans les 30 minutes qui suivent sa réalisation et de la comparer avec celle d’une plaie intéressante unie partie seulement de l’épaisseur cutanée, obtenue en utilisant un dermatome (Aesculap). Sur quatre Beagle adultes indemnes de toute lésion cutanée, ont été effectuées des plaies cutanées intéressant la totalité de l’épaisseur de la peau en utilisant un manche de scalpel et une lame No. 22 et des plaies cutanées n’intéressant qu’une partie de l’épaisseur de la peau (0.8 mm exactement) à l’aide d’un dermatome (Aesculap). La longueur et la largeur de chacune des plaies ont été mesurées une, 10, et 30 minutes après sa réalisation, la surface correspondante calculée et l’évolution de cette surface étudiée. Toutes les plaies cutanées intéressant la totalité de l’épaisseur de la peau ont vu leur surface augmenter après leur réalisation. L’augmentation de surface était de 51 à 58 pour cent pour une minute, 63 à 70 pour cent à 10 minutes et 67 à 93 pour cent à 30 minutes, que la plaie ait été de 800 ou de 1500 mm² et l’augmentation était statistiquement significative à 1 (P inférieur à 0.05) et 30 (P inférieur à 0.05) minutes. Par contre, aucune variation de taille n’a été observée pour les plaies cutanées n’intéressant qu’une partie de l’épaisseur de la peau. Cette étude a montré que les plaies cutanées intéressant la totalité de l’épaisseur cutanée voient leur taille augmenter, de manière significative, dans les 30 minutes qui suivent leur réalisation, alors que des plaies cutanées n’intéressant qu’une partie de l’épaisseur de la peau ne subissent aucune variation de taille. Ainsi, lors de greffe, expérimentale ou thérapeutique, de lambeaux de peau ou de substituts cutanés, il est possible, en utilisant un dermatome, de prévoir exactement la surface de la plaie obtenue ou du lambeau prélevé.

Mots-clés : Peau, plaie, surface, épaisseur, totale, partielle, dermatome, greffe.

Introduction

Wounds differ in size and shape after excision and the excised skin shrinks when removed, and after fixation [3]. This phenomenon is widely recognized and has been quantified in humans showing that significant differences between planned excision and wound sizes exist [4]. The effect of routine histologic processing on the size of skin samples obtained from dogs has been evaluated [6] but, to our knowledge, the difference between the size of the planned skin excision and obtained wound has never been quantified in the dog.

Although traditionally described skin flaps and grafting techniques are usually adequate for wound closure, because of the extensibility of canine skin [1], if substantial differences exist between the planned and actual wound size and shape, the closure technique cannot be predicted with precision before lesion excision [4]. Furthermore, the exact size and shape of the wound must be predicted in experimental grafting of skin substitutes [8] or therapeutic grafting of full- or partial-thickness skin pieces. Partial-thickness skin pieces are commonly obtained by using a dermatome [2, 5, 7].
The first goal of this study was to quantify the difference between the size of the planned skin excision and obtained wound. The second goal of this study was to compare the change of full-thickness and partial-thickness skin wounds obtained using a scalpel or a dermatome, respectively.

**Materials and Methods**

Four adult Beagle dogs, two male and two female, were included in the study. They were free of any skin lesions. They were used in a teaching program unrelated to this study and were to be euthanised. Each dog was anesthetised: premedication with morphine (0.3 mg/kg) and acepromazine (0.05 mg/kg), induction with thiopental (10 mg/kg) and anesthesia was maintained by use of inhaled isoflurane. The dogs were placed in ventral recumbency and 4 bilateral areas (ie, 8 areas/dog) were clipped, the top of the head, the shoulder, the dorsal abdomen and the lateral aspect of the thigh.

All the planned excision pieces were rectangular in shape and were traced, upon the skin in a physiological position with no fold, using a skin marker and a preformed model of 40 x 20 mm on the head and of 50 x 30 mm on the other sites. The longer axis was oriented parallel to the sagittal plane over the head and the dorsal abdomen, and in the proximal-distal direction over the shoulder and the thigh. On dogs A and B, only full-thickness skin excisions were performed and on dogs C and D, full-thickness and partial-thickness skin excisions were realized as follows: on dog C, full-thickness excisions sites were on the right side of the body on the head and the dorsal abdomen, and on the left side of the body on the shoulder and the thigh, and the other sites were partial-thickness excisions sites. The sites were inversely assigned to dog D compared to dog C.

Full-thickness skin excisions were performed with a No. 22 scalpel blade mounted on a scalpel handle down to the hypodermis then separated from the subcutis with surgical scissors. A dermatome (Aesculap®) was used to realize the 0.8 mm deep partial-thickness skin excisions. The depth of 0.8 mm was chosen because it is just beneath the level of the bulbs of the hair follicles and just above the dermo-hypodermal junction, as shown in a previous study [9]. The excision took approximately one minute. The length and width of the wounds were measured with a millimetre ruler by the same individual one (time T1), 10 (time T10), and 30 (time T30) minutes after excision. Practically, three successive measurements of the medians of each rectangular wound were collected and an average of the lengths and widths and the area of each wound were calculated.

**Results**

An increase in size occurred in all full-thickness skin excision sites, 1, 10, and 30 minutes after excision (Figures 1-4). The shape of the wounds did not notably change after excision.

The mean wound area of the 50x30 full-thickness skin excision sites on dog A or on dog B increased significantly 1 (P<0.05) and 30 (P<0.05) minutes after excision. Although an individual dog’s impact can not be statistically eliminated, this impact is likely to be minor, particularly 30 minutes after excision, since the mean area of the 50x30 full-thickness excision sites of the different dogs were quite similar (Figures 1 to 4 and Table 1). Wound area of 40x20 full-thickness excision sites (n = 6) was on average 58% (1264.5 mm²), 70% (1365 mm²), and 93% (1542 mm²) greater than the planned excision area (800 mm²), 1, 10, and 30 minutes after excision, respectively (Table I). Wound area of 50x30 full-thickness excision sites (n = 18) was roughly 51% (2265.05 mm²), 63% (2443.11 mm²), and 67% (2502.44 mm²) greater than the planned excision area (1500 mm²), 1, 10, and 30 minutes after excision, respectively (Table I). The mean wound area of all the 50x30 full-thickness skin excision sites increased significantly 1 (P<0.05) and 30 (P<0.05) minutes after excision and the mean wound area of all the 40x20 full-thickness skin excision sites also increased significantly 1 (P<0.05) and 30 (P<0.05) minutes after excision.

**FIGURE 1:** Size of the wounds 1, 10, and 30 minutes after excision on dog A. Each wound is represented by a different spot as follows: R and L are used to design the sites on the right and the left parts of the body, respectively and 1 is used for the head, 2 for the shoulders, 3 for the back and 4 for the thighs.

**FIGURE 2:** Size of the wounds 1, 10, and 30 minutes after excision on dog B. Each wound is represented by a different spot as follows: R and L are used to design the sites on the right and the left parts of the body, respectively and 1 is used for the head, 2 for the shoulders, 3 for the back and 4 for the thighs.
FIGURE 3: Size of the wounds 1, 10, and 30 minutes after excision on dog C. Each wound is represented by a different spot as follows: R and L are used to design the sites on the right and the left parts of the body, respectively and 1 is used for the head, 2 for the shoulders, 3 for the back and 4 for the thighs.

FIGURE 4: Size of the wounds 1, 10, and 30 minutes after excision on dog D. Each wound is represented by a different spot as follows: R and L are used to design the sites on the right and the left parts of the body, respectively and 1 is used for the head, 2 for the shoulders, 3 for the back and 4 for the thighs.

<table>
<thead>
<tr>
<th>Wound area (mm²)</th>
<th>Planned</th>
<th>1'</th>
<th>10'</th>
<th>30'</th>
</tr>
</thead>
<tbody>
<tr>
<td>40x20 full-thickness excision sites (n = 6)</td>
<td>Mean area</td>
<td>800</td>
<td>1264.5</td>
<td>1365</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>+58.06</td>
<td>+70.62</td>
</tr>
<tr>
<td>40x20 partial-thickness excision sites (n = 2)</td>
<td>Mean area</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>50x30 full-thickness excision sites (n = 18)</td>
<td>Mean area</td>
<td>1500</td>
<td>2265.05</td>
<td>2443.11</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>+51</td>
<td>+62.87</td>
</tr>
<tr>
<td>50x30 partial-thickness excision sites (n = 6)</td>
<td>Mean area</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE 1: Mean area of all 40 x 20 mm and all 50 x 30 mm, full-thickness or partial-thickness skin, planned wounds and percentage of expansion, 1, 10, and 30 minutes after excision.

<table>
<thead>
<tr>
<th>Wound area (mm²)</th>
<th>Planned</th>
<th>1'</th>
<th>10'</th>
<th>30'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder (n=6)</td>
<td>Mean area</td>
<td>1500</td>
<td>2379.5</td>
<td>2490.16</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>+58.63</td>
<td>+66.01</td>
</tr>
<tr>
<td>Back (n=6)</td>
<td>Mean area</td>
<td>1500</td>
<td>2249.83</td>
<td>2483.83</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>+49.99</td>
<td>+65.59</td>
</tr>
<tr>
<td>Thigh (n=6)</td>
<td>Mean area</td>
<td>1500</td>
<td>2165.83</td>
<td>2355.33</td>
</tr>
<tr>
<td></td>
<td>Expansion (%)</td>
<td>-</td>
<td>+44.39</td>
<td>+57.02</td>
</tr>
</tbody>
</table>

TABLE 2: Mean area of the 50x30 full-thickness excision sites and percentage of expansion on the different body regions, 1, 10, and 30 minutes after excision.
The percentages of expansion of 50x30 full-thickness skin wounds, 1, 10, and 30 minutes after excision, were roughly 59%, 66%, and 72% on the shoulder, 50%, 65%, and 68% on the dorsal abdomen, and 44%, 57%, and 61% on the thigh, respectively (Table II).

On the contrary, no change in size occurred in the wounds of the partial-thickness, 40x20 or 50x30, skin excision sites, 1, 10 or 30 minutes after excision.

**Discussion**

This study shows that an increase in size occurred in all full-thickness skin excision sites, a significant difference exists between planned excision and the actual full-thickness wound in the dog (Figure 5) and that the expansion rate may vary with the dog, the site, and the area of the planned wound from 61% to 93%. This increase in size has to be taken into account for skin lesions excisions to determine the wound closure technique.

The wounds were observed for longer time than 30 minutes and no more change in size was noted. Furthermore, 30 minutes is the time used to realize the haemostasis of the wound and to put in place a graft.

In humans, Hudson-Peacok et al. found that although an increase in size occurred in a majority of wounds, some remained unchanged or were actually smaller, that wound area (mean, 285 mm²) was on average 20% greater than the planned excision area (mean, 237 mm²). Finally there was a strong age effect in the limb and trunk groups, but there was no age effect on the head and neck sites. We found no data in the veterinary literature about the effect of age or sex or the body region on the size of the wounds in the dog. These effects can not be investigated in our study because there were only two male and two female, all were adult and the number of wounds on each site was too small. Similar studies should be pursued with dogs of both sexes and different ages and breeds.

Conversely, no change in size occurs between the planned and the actual wound when a partial-thickness skin excision is performed with a dermatome (Figure 5). The difference in change of size between partial- and full-thickness skin excisions is probably due to the persistence of a layer of deep dermis in the partial-thickness skin excision wound bed, as shown in a previous study [9].

This has direct consequences on experimental grafting of skin substitutes when the size of the receiving bed can be adapted to the size of the graft, and on therapeutical grafting for wound closure when the size of the graft can be determined according to the size of the wound to close, by the use of a dermatome to perform the excision.

**References**