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# RELATIONSHIPS BETWEEN BURN SEVERITY AND THE SIMULATED THERMAL PULSES OF VARIOUS NUCLEAR WEAPONS

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## ABSTRACT

Most laboratory data on simulated nuclear weapon thermal pulses can be compared only indirectly with the results from field studies. To overcome this handicap, data of the type which could be obtained in field experiments were sought.

Burns from the following radiant exposure-simulated nuclear weapon pulse combinations were produced:

1. 5 cal/cm$^2$ - 20 KT, 40 KT, 100 KT, 1000 KT
2. 10 cal/cm$^2$ - 20 KT, 40 KT, 100 KT, 1000 KT, 10,000 KT
3. 15 cal/cm$^2$ - 100 KT, 1000 KT, 10,000 KT
4. 20 cal/cm$^2$ - 100 KT, 1000 KT, 10,000 KT

With most of the combinations studied, a moderately wide range of burn severity occurred within the sixteen replications of a single exposure-pulse combination.

Radiant exposures of 10 cal/cm$^2$ resulted in nearly the same depth of damage with thermal pulses simulating 20 KT, 40 KT, 100 KT and 1000 KT weapons. Pulses simulating 100 KT, 1000 KT, and 10,000 KT weapons had little influence on burns produced by exposures of 15 cal/cm$^2$. With the 5 cal/cm$^2$ exposure, maximum damage resulted from the use of a 20 KT pulse. On the other hand, less damage occurred from 20 cal/cm$^2$ with the 100 KT pulse than with either 1000 KT or 10,000 KT pulses. Except for the 5 cal/cm$^2$ exposure, the results are contrary to some earlier predictions of the effects of nuclear weapons.

## INTRODUCTION

Most laboratory studies on the dose-response of skin to radiant energy have been concerned with thresholds at which a given radiant exposure-exposure time combination will, half of the time, produce some standard degree of damage. Although the results of such studies can be used to make reasonable predictions of the types of casualties to be expected from the detonation of various nuclear weapons, such extensive data cannot be confirmed during field tests. Here, burns from only a few different radiant exposures are observed, and any variation due to weapon size may merely be inferred by very indirect comparisons of the results from several field tests. Data for many desired direct comparisons between laboratory and field studies are lacking.

This experiment was designed to accomplish four objectives. Primarily, we wished to establish the range of burn severity which might be expected from a single radiant exposure delivered with a thermal pulse simulating that of one type of nuclear weapon. Secondly, we sought to determine similarities and differences between burns from the same radiant exposure but produced by thermal pulses simulating those of different nuclear weapons. Thirdly, we wished to learn the effect of different exposures delivered with a single pulse. Finally, we hoped to gather some information on the relationship between duration of the simulated nuclear weapon thermal pulse and burn severity. This last point has interested us because it has been demonstrated in this laboratory that with a square pulse, a given exposure is not necessarily most effective when delivered most rapidly.

## METHODS

The heat source was a modified 24 inch Army carbon arc searchlight (1). By means of a rotating, slotted wheel interposed between the diaphragm and the exposure port, exposures were delivered with pulses simulating those of nuclear weapons. Different pulses were simulated by varying the rotation time of the wheel (2 and 3).

Young Chester White pigs, between 8 and 13 kilograms in weight, were used as the experimental animals. They were anesthetized by the intraperitoneal injection of Dial in urethane (Ciba) in a dose of 65 mgm. per kilogram of body weight. The hair was clipped and then shaved with an electric razor, and the skin was washed with a detergent solution.

The following combinations of radiant exposure and simulated weapon yield were investigated:

(1) 5 cal/cm$^2$ at 20 KT, 40 KT, 100 KT and 1,000 KT

(2) 10 cal/cm$^2$ at 20 KT, 40 KT, 100 KT, 1000 KT and 10,000 KT

(3) 15 cal/cm$^2$ at 100 KT, 1000 KT and 10,000 KT

(4) 20 cal/cm$^2$ at 100 KT, 1000 KT and 10,000 KT

The exposure times simulating these weapon yields (4) are:

1.8 secs. - 20 kilotons

2.5 secs. - 40 kilotons

4.0 secs. - 100 kilotons

12.6 secs. - 1000 kilotons

40 secs. - 10,000 kilotons

The 15 treatments to be tested were randomized, and the treatment block was replicated 16 times.*

Twenty-four hours after the burning, severity was estimated by two observers according to the following criteria:

1+ - erythema

2+ - patchy white burn

3+ - uniform white burn

4+ - steam bleb

5+ - carbonization

Each class was further subdivided into mild (m), moderate (M), or severe (S).

Biopsies, which included normal skin on each side of the burn, were then taken, fixed in 10% formalin, and sections were stained with hematoxylin and eosin, and according to Hinshaw's method (5). Those burns which exhibited only epidermal damage by vacuolization, pyknosis of the nuclei, or color change were classified as partial epidermal damage (PED), while if dermal-epidermal separation was also seen they were listed as complete epidermal damage (CED). When the dermal collagen was involved, as evidenced by color change (blue or black according to Hinshaw's method, or increased basophilia with the H & E stain), or by swelling and loss of striations of the collagen fibers, the maximum depth of damage was measured with a ruled ocular. To compensate for shrinkage or edema in the burned

*In 3 combinations less than 16 replications were obtained due to technical difficulties (distortion of the biopsy section or error in the diaphragm setting of the carbon arc searchlight). Therefore at the 5 $cal/cm^2$ - 4.0 sec., 10 $cal/cm^2$ - 4.0 sec. and the 15 $cal/cm^2$ - 40 sec. combinations, 15, 14, and 15 replications, respectively, were obtained.

area, the depth of the remaining normal collagen (if any) was measured, and expressed as a percentage of the depth of dermis in the adjacent normal skin. This was then subtracted from 100%, to give the percentage of the depth of dermal collagen damaged.

The total dermal thickness was defined as in previous experiments (6). The depth of hair follicle damage and the presence or absence of glandular damage was also noted, and the degree of demarcation between damaged and undamaged collagen was graded as poor, fair or good.

## RESULTS

Table 1

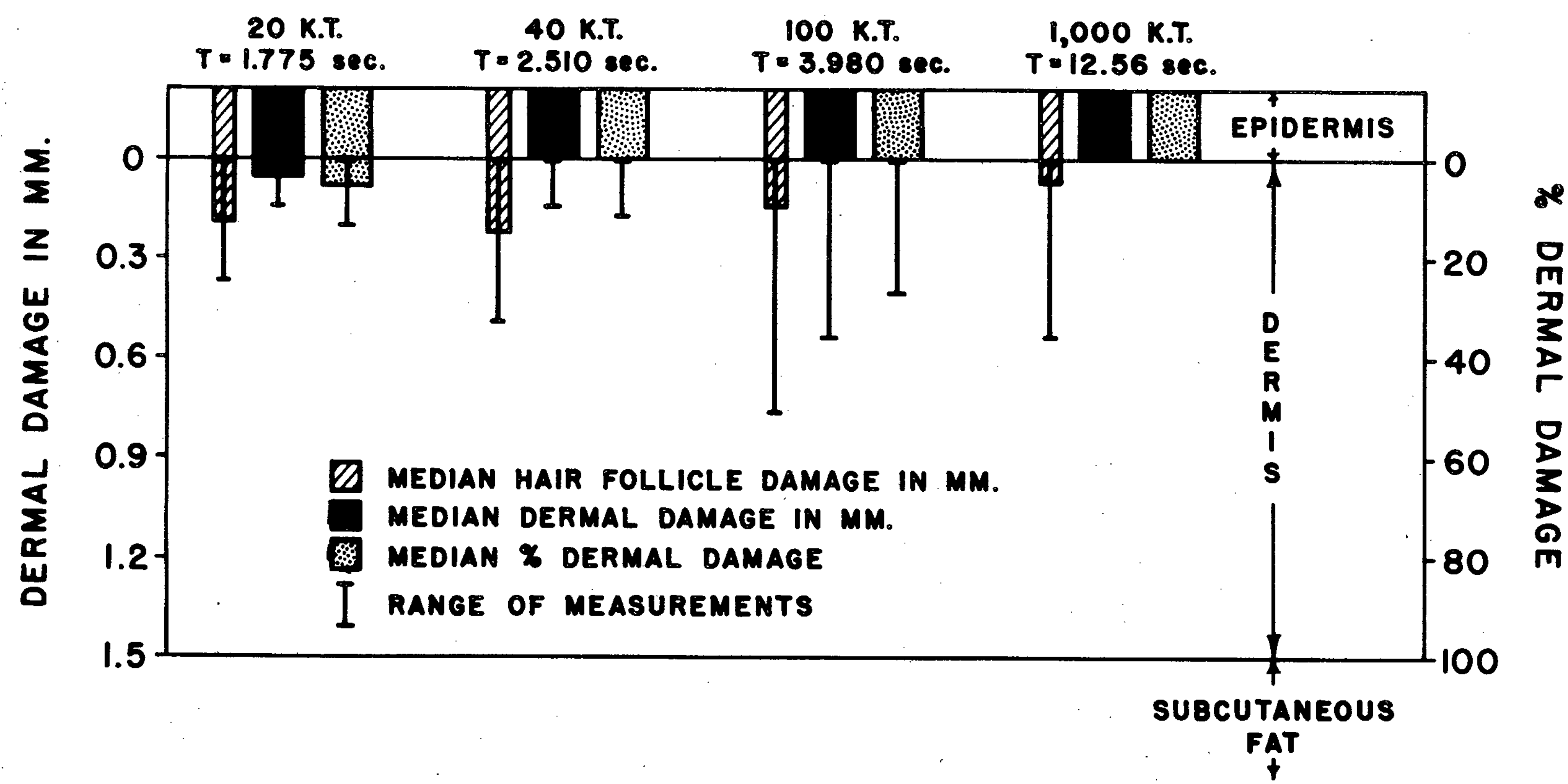
MEDIAN VALUES AT 5 CAL/CM$^2$ RADIANT EXPOSURE

| Exposure Time (sec) | Weapon Yield (KT) | Surface Appearance | Depth of Dermal Damage (mm) | Depth of Dermal Damage % | Hair Follicle Damage (mm) |
|---|---|---|---|---|---|
| 1.8 | 20 | 2+m | 0.055 | 6 | 0.19 |
| 2.5 | 40 | 2+m | 0.00 | 0 | 0.23 |
| 4.0 | 100 | 2+m | 0.00 | 0 | 0.15 |
| 12.6 | 1000 | 1+M | 0.00 | 0 | 0.08 |

At the 5 cal/cm$^2$ radiant exposure level, the burn depth is only mildly influenced by the different exposure times used, and the shortest exposure time results in the greatest damage. The median value for dermal damage is only 6% of total dermal thickness for the shortest exposure time and is 0% at the three other times (see Table 1 and Fig. 1). Most of the burns from the simulated 20 KT weapon show some dermal damage (3% to 14%), but the 40 KT and 100 KT pulses rarely produce dermal involvement. With the 1000 KT pulse none of the burns shows dermal involvement, and in all but one of the sixteen replications the epidermis is only partially

Fig. 1

SCHEMATIC RELATIONSHIP BETWEEN DERMAL DAMAGE AND HAIR FOLLICLE DAMAGE AS COMPAIRED WITH BOMB YIELD (EQUIVALENT EXPOSURE TIME) AT 5 $cal/cm^2$ RADIANT EXPOSURE



damaged (see Appendix I). The depth of dermal damage as measured in millimeters tends to correlate well with the percentage of dermal damage both at this exposure time and at all other times tested (see Figs. 1 to 4). The median surface appearance is 2+ mild for the 20, 40 and 100 KT pulses, and is 1+ moderate for the 1000 KT pulse (see Table 1).

The range of burn severity for each exposure-weapon combination is given in Appendix I.

Table 2

MEDIAN VALUES AT 10 CAL/CM$^2$ RADIANT EXPOSURE

| Exposure Time (sec) | Weapon Yield (KT) | Surface Appearance | Depth of Dermal Damage (mm) | Depth of Dermal Damage (%) | Hair Follicle Damage (mm) | Degree of Demarcation |
|---|---|---|---|---|---|---|
| 1.8 | 20 | 3+M | 0.46 | 30 | 0.62 | Fair |
| 2.5 | 40 | 3+S | 0.35 | 30 | 0.62 | Good |
| 4.0 | 100 | 3+M | 0.46 | 27 | 0.54 | Good |
| 12.6 | 1000 | 3+m | 0.31 | 28 | 0.54 | Fair |
| 40.0 | 10000 | 2+S | 0.07 | 6.5 | 0.31 | Fair to Poor |

With the 10 cal/cm$^2$ radiant exposure, there is no difference in the percentage of dermal damage with the 20, 40, 100 and 1000 KT pulses, the median value being about 30%; while with the longest pulse (10,000 KT) the median percentage of dermal damage is only 6.5%. The median surface appearance is 3+M, 3+S, 3+M, 3+m and 2+S respectively, over the range of exposure times tested (see Table 2 and Fig. 2). Appendix II demonstrates a moderate variation in the severity of the sixteen burns produced by each of the pulses.

Fig. 2

SCHEMATIC RELATIONSHIP BETWEEN DERMAL DAMAGE AND HAIR FOLLICLE DAMAGE AS COMPAIRED WITH BOMB YIELD (EQUIVALENT EXPOSURE TIME) AT 10 cal/cm$^2$ RADIANT EXPOSURE

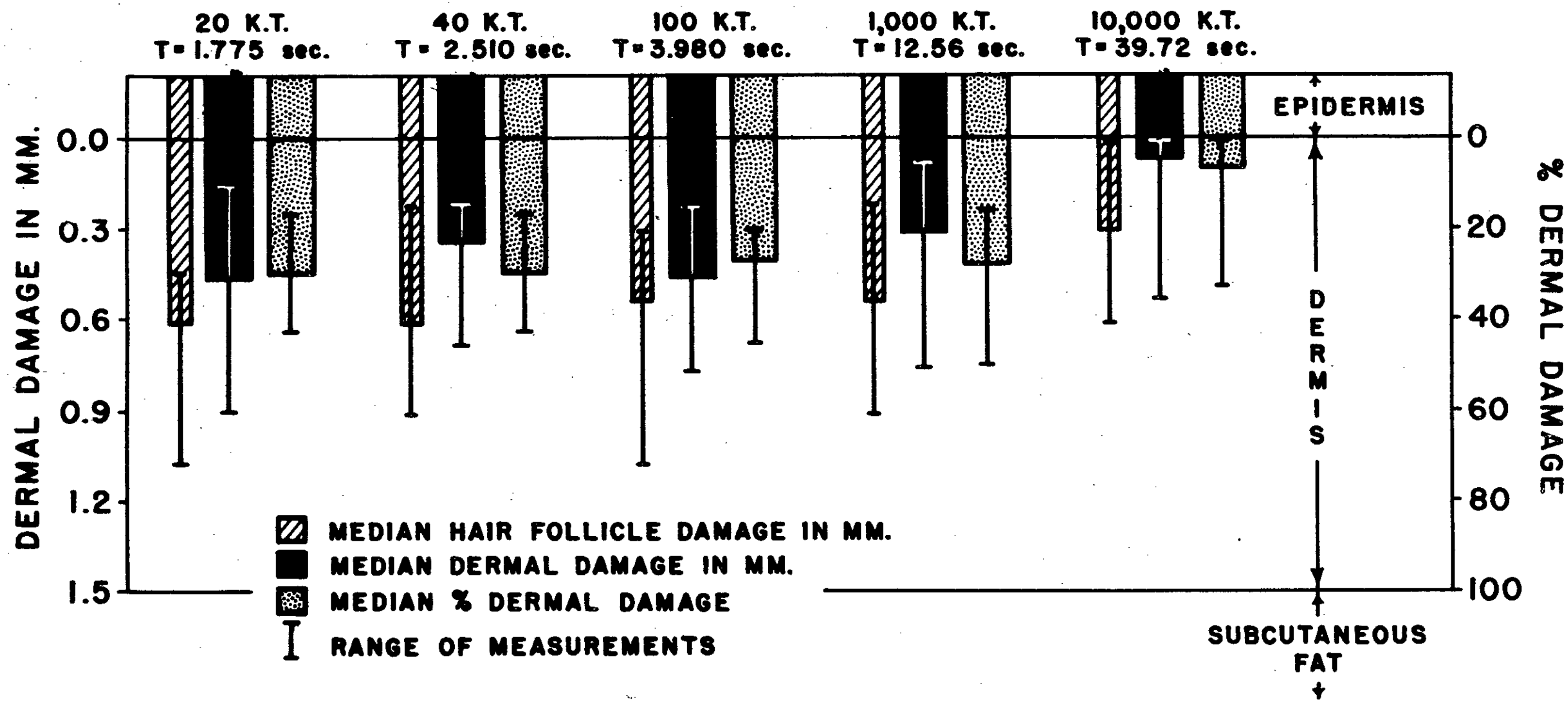


Table 3

MEDIAN VALUES AT 15 CAL/CM$^2$ RADIANT EXPOSURE

| Exposure Time (sec) | Weapon Yield (KT) | Surface Appearance | Depth of Dermal Damage (mm) | Depth of Dermal Damage (%) | Hair Follicle Damage (mm) | Degree of Demarcation |
|---|---|---|---|---|---|---|
| 4.0 | 100 | 3+S | 0.92 | 53 | 1.08 | Fair |
| 12.6 | 1000 | 3+S | 0.85 | 53 | 1.16 | Fair |
| 40.0 | 10000 | 3+S | 0.62 | 50 | 1.04 | Fair |

At 15 cal/cm$^2$, the median percentages of dermal damage for the three pulses tested are practically identical (53%, 53% and 50% at 100, 1000, and 10,000 KT respectively) and the median surface appearance for all the pulses is 3+ severe (Fig. 3 and Table 3). It is also of interest that the range of burn severity is nearly the same for each of the three pulses, and that depth of damage varies from 1/3 the thickness of the skin to full thickness loss (Appendix III).

Table 4

MEDIAN VALUES AT 20 CAL/CM$^2$ RADIANT EXPOSURE

| Exposure Time (sec) | Weapon Yield (KT) | Surface Appearance | Depth of Dermal Damage (mm) | Depth of Dermal Damage (%) | Hair Follicle Damage (mm) |
|---|---|---|---|---|---|
| 4.0 | 100 | 5+m | 1.08 | 89 | 1.08 |
| 12.6 | 1000 | 3+S | 1.39 | 100 | 1.54 |
| 40.0 | 10000 | 3+S | 1.43 | 100 | 1.43 |

At the 20 cal/cm$^2$ exposure, burn damage is often full thickness (100%) at all exposure times tested. Although the median percentage of

Fig. 3

SCHEMATIC RELATIONSHIP BETWEEN DERMAL DAMAGE AND HAIR FOLLICLE DAMAGE AS COMPAIRED WITH BOMB YIELD (EQUIVALENT EXPOSURE TIME) AT 15 cal/cm$^2$ RADIANT EXPOSURE

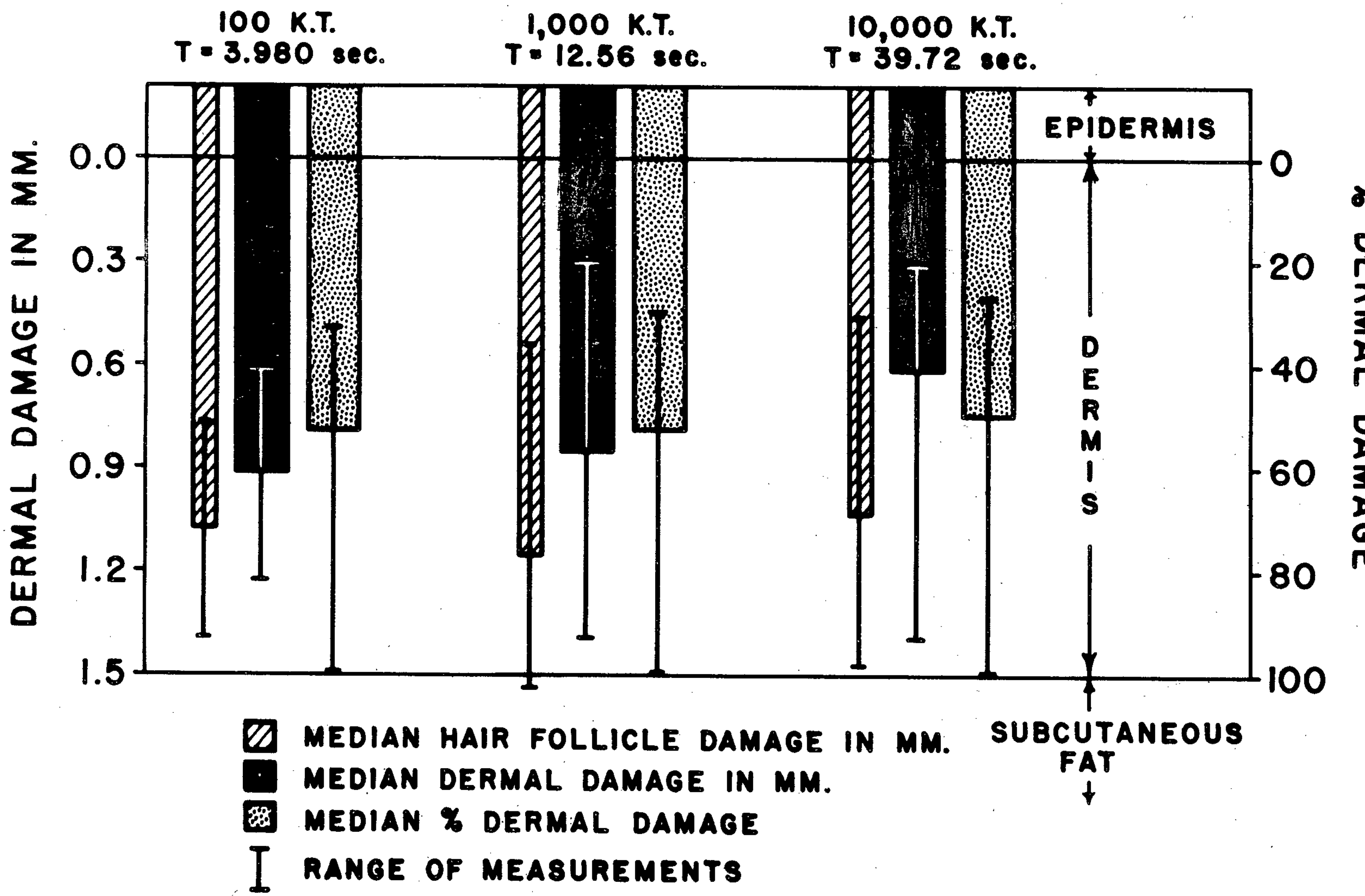
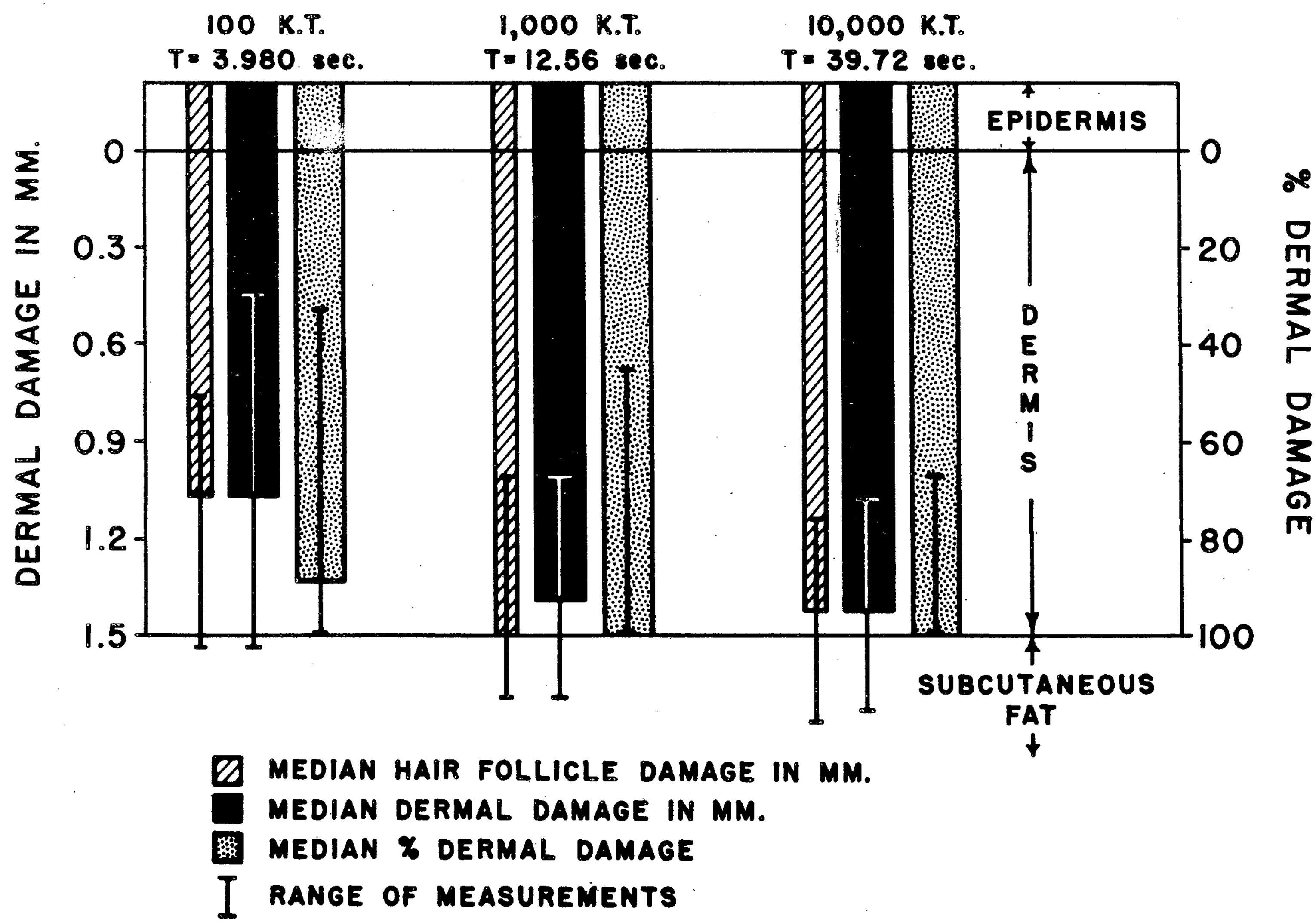


Fig. 4

SCHEMATIC RELATIONSHIP BETWEEN DERMAL DAMAGE AND HAIR FOLLICLE DAMAGE AS COMPAIRED WITH BOMB YIELD (EQUIVALENT EXPOSURE TIME) AT 20 cal/cm$^2$ RADIANT EXPOSURE



dermal damage at 100 KT is 89%, nearly one-half of the replications are full thickness and the others range from 33% to 94% (Appendix IV). The median surface appearance is 3+ severe with 1000 and 10,000 KT pulses, and 5+ mild with the 100 KT pulse (See Table 4 and Fig. 4).

For all combinations tested, the glandular damage was seen to parallel hair follicle damage, and will therefore not be considered further.

An interesting finding, seen only in the long exposure time burns with dermal damage, was the appearance of a zone of what seemed histologically to be undamaged dermal collagen between the superficial burned area and a deeper damaged area. This occurred with the 1000 and 10,000 KT pulses and was most evident with the 10,000 KT pulse at 10 cal/cm$^2$ and 15 cal/cm$^2$ exposures (Appendices II and III).

Finally, the degree of demarcation between damaged and normal collagen, which could be evaluated only at the 10 and 15 cal/cm$^2$ radiant exposures where dermal damage occurred and was not complete, appeared to be best at the shorter exposure times with 10 cal/cm$^2$ exposures (see Tables 2 and 3).

## DISCUSSION

With thermal pulses simulating those of nuclear weapons, the 5 cal/cm$^2$ exposure produces maximum damage at the shortest exposure time tested. As the exposure time is increased, the damage is reduced. This finding is similar to that reported for a square pulse with this radiant exposure (6,7).

With 10 cal/cm$^2$ exposures, only when the exposure time is increased to 40 secs. is there an appreciable reduction in dermal damage. Pulses simulating those of 20, 40, 100, and 1000 KT weapons produce nearly the same range of burn severity. With the 15 and 20 cal/cm$^2$ exposures, burn severity is little influenced by the three pulses (100 KT, 1000 KT and 10,000 KT).

If there is a difference, less damage is produced by 20 $cal/cm^2$ with the 100 KT pulse than with the 1000 and 10,000 KT pulses.

It is possible, therefore, that a critical exposure time (or weapon yield) exists for each radiant exposure just as it does for square pulses. No exact definition of this time is yet possible because of the limited number of exposure times tested.

It was previously reported for square pulses (8, 11) that only 1+ and 2+ surface appearances represent a reasonably predictable depth of injury, and burns graded higher show little correlation with actual depth of damage. With the simulated field pulses used in this experiment there is little correlation between surface appearance — when the grade is 3+ or greater — and burn depth when burns from one type of pulse are compared with those from a different pulse.

A possible explanation of the intervening zone of undamaged collagen might be that it is due to an artefact in the staining process, with this zone of collagen actually being damaged but not taking the differential stain. However, this will require further investigation. That hair follicle damage extends deeper than dermal damage agrees with previous studies.

In 16 replications of the same radiant exposure-pulse combination a moderately wide range of burn severity results from the majority of combinations investigated. Once again this demonstrates that skin is not a passive receiver. It reacts to thermal energy, and the type of reaction influences the severity of the resulting burn.

## CONCLUSIONS

1. When burns are produced by a total radiant exposure of 5 cal/cm$^2$, burn severity decreases with thermal pulses of longer duration. Maximum damage results from a pulse simulating that of a 20 KT weapon, the shortest pulse investigated; 40 KT and 100 KT weapon pulses show similar effects; and the 1000 KT pulse produces less damage.
2. Burn severity is nearly the same from 10 cal/cm$^2$ whether the thermal pulse simulates 20 KT, 40 KT, 100 KT, or 1000 KT weapons. Less damage is caused by 10 cal/cm$^2$ when it is delivered with a 10,000 KT simulated pulse.
3. There is surprisingly little difference in the range of severity of burns from 15 cal/cm$^2$ when the thermal pulse simulates 100, 1000, and 10,000 KT weapons.
4. Most of the burns from radiant exposures of 20 cal/cm$^2$ show complete destruction of the full thickness of dermis. If there is a difference due to the type of thermal pulse, it is that the 100 KT pulse results in less damage than does either the 1000 or 10,000 KT pulse.
5. When the radiant exposure is sufficient to produce some dermal damage but not great enough to destroy the full thickness of the skin, a moderately wide range of burn severity results from each exposure-pulse combination. This again demonstrates that skin is not a passive receiver but reacts to thermal energy. The type of reaction influences the severity of the burn produced.

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# APPENDIX I

## RELATIONSHIP BETWEEN EXPOSURE TIME AND DEPTH OF BURN AT RADIANT EXPOSURE OF 5 $CAL/CM^2$

| Time in sec. (Weapon yield) | Depth of Damage (1) | Depth of Dermal Damage Expressed as Percentage | Depth of Hair Follicle Damage (mm) |
|---|---|---|---|
| 1.8 | CED,CED,CED,CED,0.03, 0.03,0.05,0.05,0.06, 0.08,0.08,0.09,0.09, 0.11,0.12,0.15 | 0,0,0,0,3,4,4,6,6,6, 6,6,8,9,12,14 | 0,0.08,0.15,0.15,0.15, 0.15,0.15,0.15,0.23, 0.23,0.23,0.31,0.31, 0.31,0.31,0.38 |
| 2.5 | CED,CED,CED,CED,CED, CED,CED,CED,0.05,0.06, 0.08,0.08,0.08,0.08, 0.15 | 0,0,0,0,0,0,0,0,0, 5,6,6,6,6,9,12 | 0,0,0.08,0.15,0.15,0.15, 0.23,0.23,0.23,0.23,0.23, 0.31,0.31,0.31,0.31,0.49 |
| 4.0 | PED,PED,PED,CED,CED, CED,CED,CED,CED,0.03, 0.05,0.06,0.12,0.23, 0.54 | 0,0,0,0,0,0,0,0,0, 4,6,12,14,27,27 | 0,0,0,0,0,0,0,0.15,0.15, 0.15,0.23,0.31,0.31,0.38, 0.77 |
| 12.6 | PED,PED,PED,PED,PED, PED,PED,PED,PED,PED, PED,PED,PED,PED,PED, CED | 0,0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0 | 0,0,0,0,0,0,0,0,0.15,0.15, 0.23,0.23,0.31,0.31,0.38, 0.54 |

(1) - numbers represent depth of dermal damage in millimeters
PED - Partial Epidermal Damage
CED - Complete Epidermal Damage

## APPENDIX II

RELATIONSHIP BETWEEN EXPOSURE TIME AND DEPTH OF BURN
AT RADIANT EXPOSURE OF 10 CAL/CM$^2$

| Time in sec. (Weapon yield) | Depth of Damage(1) | Depth of Dermal Damage Expressed as Percentage | Depth of Hair Follicle Damage (mm) |
|---|---|---|---|
| 1.8 | 0.15,0.31,0.31,0.31, 0.31,0.31,0.38,0.46 0.46,0.46,0.54,0.54, 0.62,0.62,0.77,0.92 | 17,20,20,25,25,27,29 30,30,30,30,37,37,40, 44,45 | 0.46,0.46,0.46,0.54,0.54, 0.54,0.54,0.62,0.62,0.62, 0.69,0.77,0.92,0.92,1.00, 1.08 |
| 2.5 | 0.23,0.23,0.31,0.31, 0.31,0.31,0.31,0.31, 0.38,0.38,0.46,0.54, 0.62,0.62,0.69,0.69 | 17,20,20,20,20,22,25, 30,30,33,35,37,40,40, 40,43 | 0.23,0.38,0.46,0.54,0.54, 0.54,0.54,0.62,0.62,0.69, 0.69,0.77,0.77,0.77,0.92, 0.92 |
| 4.0 | 0.23,0.23,0.31,0.31, 0.31,0.38,0.46,0.46, 0.46,0.46,0.62,0.62, 0.77,0.77 | 20,20,20,22,25,25,27, 27,30,40,40,42,43,45 | 0.31,0.38,0.38,0.46,0.46, 0.46,0.46,0.62,0.62,0.69, 0.85,0.92,1.08,1.08 |
| *12.6 | 0.08,0.23,0.23,0.23, 0.31,0.31,0.31,0.31, 0.31,0.31,0.31,0.31 0.38,0.46,0.46,0.77 | 16,17,20,20,23,24,26, 27,29,29,30,30,30,33, 40,51 | 0.23,0.31,0.38,0.38,0.38, 0.46,0.46,0.54,0.54,0.62, 0.62,0.69,0.77,0.77,0.77, 0.92 |
| **40.0 | CED,0.03,0.05,0.05, 0.05,0.05,0.05,0.06, 0.08,0.08,0.08,0.15, 0.15,0.23,0.38,0.54 | 0,4,5,5,6,6,6,6,7,10, 12,16,20,20,30,33 | 0,0.05,0.06,0.15,0.15,0.23, 0.31,0.31,0.31,0.38,0.46, 0.46,0.46,0.54,0.54,0.62 |

(1) - numbers represent depth of dermal damage in millimeters
CED - Complete Epidermal Damage
* 1 out of 16 replications showing intervening zone of relatively undamaged collagen
** 6 out of 16 replications showing intervening zone of relatively undamaged collagen

## APPENDIX III

RELATIONSHIP BETWEEN EXPOSURE TIME AND DEPTH OF BURN AT RADIANT EXPOSURE OF 15 CAL/CM$^2$

| Time in sec. (Weapon yield) | Depth of Dermal Damage (mm) | Depth of Dermal Damage Expressed as Percentage | Depth of Hair Follicle Damage (mm) |
|---|---|---|---|
| 4.0 | 0.62,0.69,0.69,0.69,0.77,0.85,0.92,0.92,0.92,0.92,0.98,1.08,1.08,1.15,1.23,1.23 | 33,37,40,42,47,47,48,50,56,60,62,71,75,82,100,100 | 0.77,0.92,0.92,0.92,1.00,1.08,1.08,1.08,1.08,1.23,1.23,1.23,1.23,1.23,1.23,1.39 |
| *12.6 | 0.31,0.62,0.62,0.69,0.69,0.77,0.77,0.77,0.92,0.92,1.00,1.15,1.23,1.31,1.31,1.39 | 30,32,39,40,40,45,47,50,56,59,60,64,68,80,100,100 | 0.54,0.77,0.77,0.85,0.92,1.00,1.08,1.08,1.23,1.23,1.31,1.31,1.39,1.39,1.54,1.54 |
| **40.0 | 0.31,0.46,0.46,0.46 0.54,0.62,0.62,0.62,0.69,0.77,0.77,0.92 1.00,1.08,1.39 | 27,33,36,37,38,40,47,50,50,57,60,67,67,70,100,-- | 0.46,0.54,0.62,0.77,0.77,0.92,1.00,1.00,1.08,1.08,1.08,1.31,1.39,1.39,1.46,-- |

*3 out of 16 replications showing intervening zone of relatively undamaged collagen
**7 out of 15 replications showing intervening zone of relatively undamaged collagen

## APPENDIX IV

### RELATIONSHIP BETWEEN EXPOSURE TIME AND DEPTH OF BURN AT RADIANT EXPOSURE OF 20 CAL/CM²

| Time in sec. (Weapon yield) | Depth of Dermal Damage (mm) | Depth of Dermal Damage Expressed as Percentage | Depth of Hair Follicle Damage (mm) |
|---|---|---|---|
| 4.0 | 0.46, 0.54, 0.77, 0.77, 0.77, 0.85, 0.92, 1.08, 1.08, 1.08, 1.15, 1.15, 1.23, 1.23, 1.31, 1.54 | 33, 47, 50, 50, 60, 63, 75, 84, 94, 100, 100, 100, 100, 100, 100, 100 | 0.77, 0.77, 0.92, 0.92, 0.92, 1.00, 1.08, 1.08, 1.08, 1.15, 1.23, 1.23, 1.23, 1.31, 1.39, 1.54 |
| 12.6 | 1.00, 1.08, 1.23, 1.31, 1.31, 1.39, 1.39, 1.39, 1.39, 1.39, 1.54, 1.54, 1.54, 1.62, 1.62, 1.69 | 45, 95, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100 | 1.00, 1.15, 1.23, 1.31, 1.39, 1.39, 1.46, 1.54, 1.54, 1.54, 1.54, 1.54, 1.62, 1.62, 1.69, 1.69 |
| 40.0 | 1.08, 1.15, 1.15, 1.23, 1.23, 1.31, 1.39, 1.39, 1.46, 1.46, 1.46, 1.54, 1.77, 1.85, 1.92, 2.15 | 67, 74, 94, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100, 100 | 1.15, 1.15, 1.23, 1.23, 1.23, 1.31, 1.39, 1.39, 1.46, 1.46, 1.54, 1.77, 1.77, 1.85, 1.92, 2.31 |

## APPENDIX V

RELATIONSHIP BETWEEN EXPOSURE TIME AND SEVERITY OF BURNS AS JUDGED BY SURFACE APPEARANCE AT THE FOLLOWING RADIANT EXPOSURES

| Rad. Exp. ($cal/cm^2$) | Exp. Time (sec) | Number of Burns per Classification | | | | | | | | | | | | | | | Total Burns |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1+ | | | 2+ | | | 3+ | | | 4+ | | | 5+ | | | |
| | | m | M | S | m | M | S | m | M | S | m | M | S | m | M | S | |
| 5 | 1.8 | | | 3 | 7 | 5 | 1 | | | | | | | | | | 16 |
| 5 | 2.5 | | | 6 | 4 | 6 | | | | | | | | | | | 16 |
| 5 | 4.0 | | 2 | 4 | 4 | 4 | 1 | 1 | | | | | | | | | 16 |
| 5 | 12.6 | 5 | 6 | 5 | | | | | | | | | | | | | 16 |
| 10 | 1.8 | | | | | | | 1 | 8 | 7 | | | | | | | 16 |
| 10 | 2.5 | | | | | | | | 7 | 9 | | | | | | | 16 |
| 10 | 4.0 | | | | | | | | 10 | 4 | | | | | | | 14 |
| 10 | 12.6 | | | | | | 1 | 7 | 7 | 1 | | | | | | | 16 |
| 10 | 40.0 | | | | | 4 | 11 | 1 | | | | | | | | | 16 |
| 15 | 4.0 | | | | | | | | | 11 | | 1 | 2 | 1 | | | 15 |
| 15 | 12.6 | | | | | | | | | 16 | | | | | | | 16 |
| 15 | 40.0 | | | | | | | | 4 | 12 | | | | | | | 16 |
| 20 | 4.0 | | | | | | | | | | | | 5 | 10 | 1 | | 16 |
| 20 | 12.6 | | | | | | | | | 15 | | 1 | | | | | 16 |
| 20 | 40.0 | | | | | | | | | 15 | | | | 1 | | | 16 |

m - mild
M - moderate
S - severe