

# Sun Protection by Families at the Beach

June K. Robinson, MD; Alfred W. Rademaker, PhD

**Background:** During the last decade, results of surveys of adults showed an increase in sun protection knowledge, a slight decline in the attitude that having a tan was healthy, widespread sunscreen use as the principal method of solar protection, and an increase in sunburning.

**Methods:** During the summer of 1996, observers recorded the sun protection activities of 352 family groups as they arrived at the beach and did concurrent interviews.

**Results:** Ninety-eight percent of families using sunscreen applied it after arrival at the beach and it was the dominant form of sun protection used. Usually, the adult woman provided the sunscreen and applied it to a child before applying it to herself. The median delay in application from arrival at the beach to application to the last

family member was 51 minutes. Wearing either a hat, shirt, or sunscreen by 1 adult was associated with wearing the same item by at least 1 child in the family group (hat,  $P < .001$ ; shirt,  $P < .001$ ; sunscreen,  $P < .001$ ). Children's sunscreen use was associated with having fair skin and a parent who used it.

**Conclusions:** Because those with fair skin type are more likely to use sunscreen and to burn after short periods of exposure, delay in sunscreen application may cause sunburns. While solar protection has become part of routine beach behaviors for most families, there is room for improvement with better application of sunscreen; more use of clothing, especially hats; and seeking shade.

*Arch Pediatr Adolesc Med.* 1998;152:466-470

**Editor's Note:** A very important point not known to many parents (not to mention clinicians) is that sunscreens require at least 15 minutes after application to be effective. Keep that in mind the next time you apply that high-powered stuff as you stand in the sun.

*Catherine D. DeAngelis, MD*

*From the Division of Dermatology, Loyola University School of Medicine, Skin Cancer Clinical Program, Cardinal Bernardin Cancer Center, Maywood, Ill (Dr Robinson); and the Biometry Section, Robert H. Lurie Cancer Center, Northwestern University Medical School, Chicago, Ill (Dr Rademaker).*

**D**URING THE last decade, programs sponsored by the American Academy of Dermatology and other public health organizations have informed the public of the hazards of sun exposure. Excessive sun exposure during childhood has been associated with subsequent development of skin cancers.<sup>1,2</sup> Implementing "safe sun" behaviors in the population may reduce skin cancer incidence and mortality.<sup>3</sup> These behaviors include limiting exposure to UV radiation between 10 AM and 4 PM; wearing protective clothing (wide-brimmed hats, sunglasses, long-sleeved shirts and long pants); using sunscreens with solar pro-

tection factors of 15 or greater and lip balm; avoiding artificial tanning devices; and using hats, clothing, and shading for children younger than 6 months. For sunscreens to be effective, they must be applied prior to sun exposure and over the entire exposed body surface in adequate amounts to reach the specified sun protection factor and reapplied every 2 hours.<sup>4-8</sup> While the amount of time required before a sunscreen is effective varies among sunscreens, it is in the range of 15 to 20 minutes to allow adequate drying and complete binding to the skin surface before the sunscreen-treated skin is rubbed by clothing or becomes wet.<sup>9,10</sup>

Sun protection methods have been studied by telephone surveys,<sup>11-16</sup> interviews of beach-going people,<sup>17</sup> and a New Hampshire study combining direct observation with concurrent interviews.<sup>18</sup> The potential bias of self-reported behavior<sup>19</sup> and reported parental sunscreen use in their children<sup>20</sup> influenced the design of this study of families at a beach with maximum sun exposure.

## SUBJECTS AND METHODS

During summer 1996, observers monitored the weekend sun protection behavior of family groups at a single Lake Michigan beach location in Chicago, Ill, and did concurrent parent or adult caregiver interviews. The beach was readily accessible by public transportation, walking from the adjacent community, or private car. A line of trees provided shade at one edge of the beach area. The observation was done on weekends and holidays from Memorial Day (end of May) to Labor Day (early September) between 10 AM and 4 PM on days with at least partial sun. For the purposes of this study, a family group was defined as at least 3 people, where at least 1 of the group was an adult and at least 1 was a child.

During pilot studies in 1994 and 1995, the beach was more often used by families on weekends than weekdays; thus, weekends were selected for the 1996 study. Sun protection behaviors used by at least 10% of the population in the pilot studies were used to collect data in the 1996 study. Because no children or adults were observed to wear long-sleeved shirts or pants in pilot studies, this was not included on the data sheet. Pilot studies demonstrated that 4% of people sought shade under the trees to cook food and place baby carriages and no groups brought beach umbrellas.

The observers/interviewers received extensive training, demonstrated high interrater reliability before entering the field, and had periodic quality checks. Observers sat at the beach entrance and selected every other group entering the area to collect data concerning the number of adults and children approximately between 1 and 10 years old, the type of sun protection worn to the beach and provided after arrival, and who used it. Familial sunscreen use was recorded as 1 bottle or more than 1 bottle, and the method of distributing it as 1 bottle passed around among

people, squirts of sunscreen given to people from the bottle by 1 or more than 1 person, and/or 1 person used 1 bottle to apply it to others. Data were collected on 2 adults in the family group. If one adult was observed to be involved with providing care for the children and the other was not engaged, then the one participating in care was selected for data collection. When there were more than 3 children in the family group, data were recorded on the youngest, a randomly selected middle child, and the oldest child who appeared to be younger than 10 years. If after 60 minutes (the length of time commonly used to quantitate ease of burning) of arrival at the beach the family did not initiate sun protection measures, observation ceased and the care-taking adult was interviewed.

The interviewer approached the adult, described the study, and requested consent to participate. If consent was granted, eligibility was determined; eg, adult was a parent and the children under their care were between the ages of 1 and 10 years. In some instances, these family groups included children who were relatives or friends. Parents were interviewed regarding the age and sex of the children, their skin type, their ethnic/racial group, and the use of sunscreen prior to arrival at the beach. Interviewers read the label on the bottle of sunscreen that the family was using.

Data were analyzed using the  $\chi^2$  test. Statistical significance was indicated if  $P < .05$ . For **Table 1**, one  $\chi^2$  test with 2 *df* was done for each type of sun protection. In **Table 2**, a Fisher exact test was used for the 2×3 table, which excluded the data points where sunscreen was first applied to the partner. In **Table 3**, a Fisher exact test was done for each of the protective behaviors.

Logistic regression analysis explored the factors of skin type of child, use of sunscreen by parent, and age and sex of child with the child's use of sunscreen. Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. The SAS software (SAS Institute Inc, Cary, NC) was used in conducting analysis.<sup>21</sup>

Our study sought to understand familial patterns of sun protection as well as the role of parents as models for the use of sun protection by their children. The results of this study could provide focused sun prevention advice to families and aid in developing realistic public education messages.

## RESULTS

### DESCRIPTION OF THE FAMILY GROUPS

Three hundred eighty-five family groups were observed and 352 had both a parent who agreed to be interviewed and children between the ages of 1 and 10 years. More adult women participated (302) than men (221). One hundred one families were composed of 3 people, 119 of 4 people, 102 of 5 people, and 30 of 6 people or more. Thirty-eight of these family groups contained 1 child between the ages of 1 and 10 years, 140 had 2 children, 125 had 3 children, 37 had 4 children, and 12 had 5 children (Table 1). The sex and age of the 840 observed children are more representative of the younger ages; eg, 319 children were aged 1 to 4 years, 337 children were aged

5 to 7 years, and 184 children were aged 8 to 10 years. The observed children were 74% white, non-Hispanic; 12% Hispanic; and 14% African American.

### TYPE OF SUN PROTECTION WORN

The type of sun protection worn to the beach is summarized in Table 2. Because sometimes an adult or child used 1 or more forms of sun protection, eg, sunscreen, hats, sunglasses, and/or T-shirts, the total number of observed behaviors exceeds the number of subjects.

The population was analyzed for sex preference in sun protection worn at the time of arrival at the beach. Women and children wore more sunscreen than men ( $P < .001$ ). Men and children wore hats more than women ( $P < .001$ ); however, most of the children wearing hats were between 1 and 4 years old (1-3 years, 97%; 5-7 years, 3%). Women wore sunglasses more than men and children ( $P < .001$ ), but children wearing sunglasses were mostly 8 to 10 years old (1-3 years, 0%; 5-7 years, 8%; 8-10 years, 92%). There was no difference in wearing T-shirts among men, women, and children.

**Table 1. Frequency of Family Groups by Number of Adults and Number of Children**

No. of Children	No. of Adults					Total No. of Families
	1 F	1 M	2 F	2 M	1 F and 1 M	
1	0	0	9	4	25	38
2	49	14	17	18	42	140
3	30	12	26	0	57	125
4	12	7	0	0	18	37
≥5	10	2	0	0	0	12
Adults participating in child care						
F	101	0	59	0	142	302
M	0	35	0	44	142	221

### PATTERNS OF SUNSCREEN USE AND METHOD OF DISTRIBUTION

The most often observed sun protection carried and provided to other family members was sunscreen (Table 2). In 310 families, the sunscreen was applied after arrival at the beach. Adult women initiated sunscreen application more often than adult men or children. In 15 family groups, the adult man began the application and in 40 the older child initiated sunscreen application (Table 3). Six family groups (2% of the study group) applied sunscreen prior to arriving at the beach; therefore, they were not observed applying it. Thus, 316 of the 352 families used sunscreen. Thirty-six family groups had adults who did not use sunscreen, but 25 of these groups used it on at least 1 child. There was a significant association between the person initiating sunscreen application and the person to whom sunscreen was first applied ( $P < .001$ ). If the adult woman applied the sunscreen, there was a greater likelihood that it was first applied to a child. If either the adult man or the child applied the sunscreen, then it was most likely applied to themselves first. All other forms of sun protection, either alone or in combination with another, were less frequently provided after arrival at the beach; sunglasses alone (2 groups), hat alone (6 groups), and sunscreen and one of the others (19 groups).

After arriving at the beach, there was a median delay of 9 minutes before sunscreen was applied to the first person. There was a median delay of 42 minutes in application from the first to the last person, with a range of 15 to 56 minutes. Thus, there was a 51-minute median delay in sunscreen application from arrival at the beach until application to the last family member.

All family groups used 1 bottle of sunscreen distributed to members with no single predominate style of application. In 35% of families, the bottle was passed from one to another family member. In 40% of families, the sunscreen was squirted by 1 person onto the extended hand of various family members. Some of these families used a combination of passing the bottle around and having various members place dabs onto the hands of family members. Twenty-five percent of families had one member apply it to all others. Interviewers confirmed that the bottle observed being passed among the family mem-

**Table 2. Type of Sun Protection at the Beach by Family Members\***

Type of Sun Protection	Adult Women (n = 302)	Adult Men (n = 221)	All Children (n = 840)	P
Sunscreen	214 (71)	102 (46)	638 (76)	<.001
Hat	6 (2)	42 (19)	100 (12)	<.001
Sunglasses	223 (74)	42 (19)	75 (9)	<.001
T-shirt	78 (26)	51 (23)	218 (26)	.67

\*All data are expressed as number (percentage) unless otherwise indicated.

**Table 3. Person Initiating Sunscreen Application and the First Recipient\***

Sunscreen	Application Initiator		
	Adult Women (n = 255)	Adult Men (n = 15)	Other Child (n = 40)
First recipient			
Self	3 (1)	11 (73)	40 (100)
Child	250 (98)	4 (26)	0 (0)
Adult partner	1 (1)	0 (0)	0 (0)

\*All data are given as number (percentage).

bers was sunscreen. All sunscreen observed in use had a sun protection factor of 15 or greater.

Children having fair or very fair skin (OR, 2.1; 95% CI, 1.8-3.6) and those whose parents used sunscreen (OR, 2.3; 95% CI, 1.5-3.2) were more likely to have sunscreen applied. After controlling for skin type and parental use of sunscreen, the age and sex of the child were not associated with the likelihood of sunscreen use.

### PARENTS AS ROLE MODELS

The possible role of parents in serving as a model for the use of sun protection by children was analyzed by family groups in which there was 1 adult wearing sunscreen, a hat, sunglasses, or shirt and in which at least 1 child wore the same item. In 36 families no adult wore sunscreen, but at least 1 child in 25 (69%) of those same families wore sunscreen. In all 316 families where at least 1 adult wore sunscreen, the child also wore sunscreen ( $P < .001$ , 69% vs 100%, ). Similarly, in 295 families no adult wore a hat and 45 (32%) of those families had at least 1 child wear a hat. In 57 families, at least 1 adult wore a hat and in 51 (89%) of those same families at least 1 child wore a hat ( $P < .001$ , 32% vs 89%). In 223 families no adult wore a T-shirt and 85 (38%) of those had at least 1 child wear a T-shirt. In 129 families at least 1 adult wore a T-shirt and 123 (95%) of those families had at least 1 child wear a T-shirt ( $P < .001$ , 38% vs 95%). Wearing sunglasses in adults and children did not achieve statistical significance.

### COMMENT

In response to the rise in skin cancer in the United States, mass media campaigns were developed to raise skin can-

**Table 4. Burning Time for People With Unprotected Fair Skin**

UV Index Value	Exposure Level*	Burning Time
0-2	Minimal	Up to 1 h
3-4	Low	30-60 min
5-6	Moderate	20-30 min
7-8	High	13-20 min
10+	Very high	<13 min

\*Exposure level may be influenced by cloud cover and partial shade provided by trees; however, beach locations usually have high or very high exposure levels because of the UV reflection from water and sand. Adapted from Long et al<sup>25</sup> and the Environmental Protection Agency.<sup>26</sup>

cer awareness, demonstrate preventive behavior, and present sun protection behavior as fashionable, particularly to young people. In Australia, where mass media campaigns predate the American effort, there has been a substantial attitudinal shift during the years of the campaign, an increase in hat wearing and sunscreen use, and a significant reduction in the number of sunburns.<sup>22</sup> Following a decade (1986-1996) of such efforts in the United States media, having a tan was viewed slightly less favorably and there was a remarkable increase in sunscreen use (35%-53%) but also an increase in reported sunburning (30%-39%).<sup>23</sup> Parents and their children are part of this disturbing paradox of increasing reported sunscreen use and increasing sunburning; 30% of parents with children younger than 13 years reported that their children had a sunburn during the summer of 1995.<sup>24</sup> The same parents also reported having had a sunburn themselves.

This study found that in spite of the inconvenience, cost, and messy application of sunscreen, it is usually the sole form of sun protection used. Sunscreen use was observed by 71% of women, 46% of men, and 76% of children, which exceeds the 54% self-reported sunscreen use in the 1996 national survey.<sup>24</sup> The beach conditions of this study were selected to promote use of sun protection and provide information about familial patterns of sun protection. Usually, an adult woman provided the sunscreen and applied it to a child before applying it to herself. Ninety-eight percent of families applied sunscreen after arrival at the beach, with a median delay in application from the first to the last family member of 42 minutes and a delay of 9 minutes before application to the first person, who was usually the youngest child. Depending on the intensity of the UV radiation as reported by the UV index and the exposure level experienced, a person with fair skin may burn in less than 13 minutes without sunscreen (**Table 4**). Certainly the 51-minute delay in sunscreen application from arrival at the beach to applying it to the last family member, usually the adult woman, was sufficient for fair-skinned individuals to burn even at low to moderate exposure. The sunscreen application delays found in this observational study may account for some of the self-reported sunburns by people with fair skin who were surveyed in a 1996 nationwide survey with 39% of adults having a sunburn during the summer in 1996.<sup>23</sup> The survey did not record which skin surface areas were covered with

sunscreen; hence, no information was provided about sunburns in those areas not commonly covered by sunscreen or clothing.

The beach site used in this study aided in selecting a population with younger children, to determine behavior during a time of life with stronger parental influence on solar protection behaviors. Wearing either a hat, shirt, or sunscreen by 1 adult was associated with wearing the same item by at least 1 child in the family group (hat,  $P < .001$ ; shirt,  $P < .001$ ; sunscreen,  $P < .001$ ). Children's sunscreen use was associated with having fair skin and a parent who used it.

Surveys of American adults<sup>15,23</sup> and teenagers<sup>11,16</sup> have shown increased knowledge but a continuation of sunburning that places them at risk for future development of melanoma. The sun protection message has begun to reach families. Most children were observed to have some protection. Providing counseling and skills training to modify an existing sun protection behavior by those who are already providing sun protection for the family may prevent sunburning. Adult women provided sunscreen for the family members and applied it to the children before applying it to themselves. Since women's sunscreen compliance<sup>12,13,27-30</sup> was generally higher than men's, encouraging women to apply sunscreen before leaving home may eliminate the delay in applying it. In this study, 1 bottle of sunscreen was used by family members. Since the average adult needs approximately 30 g (1 oz) of sunscreen to achieve protection,<sup>6</sup> a family of 4 needs about 4 oz of sunscreen, or about half a bottle. Because women provided the sunscreen for the family, messages to women about adding a new bottle to the beach bag after a trip to the beach could aid in having adequate quantities available to reapply after swimming.

Unfortunately, the public receives mixed messages about sun protection from the mass media, the American fashion industry, and sunscreen manufacturers, who promote sun exposure by promising sun protection with the use of sunscreen while depicting tanned, sunbathing models who are not seeking shade or wearing hats.<sup>31</sup> Wearing sunglasses, as widely depicted in magazines, was not associated with other visual evidence of use of photoprotective factors (lighter tan, hat wearing, and seeking shade). Adult women in this beach study wore sunglasses and sunscreen but did not wear hats, which is similar to the association between wearing sunglasses and a high degree of skin sun exposure noted in the Australian population.<sup>32</sup> Young children in Australia who did not wear sunglasses did wear a hat to shade the eyes.<sup>32</sup> In this study, hats were worn by young children but most hats were baseball caps that provide poor neck and ear coverage. Hat use could be promoted by encouraging parents to wear a hat as an example to their children, especially to shade the eyes.

Parents in this study served as role models for sunscreen, hat, and T-shirt wearing by their children. Parental experience with sunburn and a desire to prevent acute sunburn in fair children influenced children's sunscreen use.<sup>17,20</sup> Teenage sunscreen use was also heavily influenced by parents who insisted on its use when the teenagers were children.<sup>11</sup> Thus, learning to use sun protection as children may extend into the teenage years.

Adult family members provided the initial learning environment and served as a role model for children. Members of the family provide high levels of social support for each other and may assist each other with incorporation of new behaviors and reinforce use of a particular behavior. Learning by children within the family unit is especially relevant to skin cancer prevention because sun protection efforts in children could lower the total cumulative lifelong sun exposure responsible for nonmelanoma skin cancer as well as episodic intense recreational sun exposure leading to blistering sunburns that may be more responsible for melanoma.<sup>33</sup> While solar protection has become part of routine beach behaviors for most families, there is room for improvement with better application of sunscreen; more use of clothing, especially hats; and seeking shade.

Accepted for publication December 1, 1997.

This work was supported by the generous contribution of A. E. Staley III.

Reprints: June K. Robinson, MD, Loyola University Medical Center, Cardinal Bernardin Cancer Center, 2160 S First Ave, Maywood, IL 60153.

## REFERENCES

1. Goldsmith L, Koh HK, Bewerse B, et al. Proceedings from the national conference to develop a national skin cancer agenda. *J Am Acad Dermatol.* 1996;34:822-823.
2. Weinstock MA, Colditz GA, Willett WC. Nonfamilial cutaneous melanoma incidence in women with sun exposure before 20 years of age. *Pediatrics.* 1989;84:199-204.
3. Stern RS, Weinstein MC, Baker SG. Risk reduction for nonmelanoma skin cancer with childhood sunscreen use. *Arch Dermatol.* 1986;122:537-545.
4. Bech-Thomsen L, Wulf HC. Sunbathers application of sunscreen is probably inadequate to obtain the sun protection factor assigned to the preparation. *Photodermatol Photoimmunol Photomed.* 1993;9:242-244.
5. Long CC, Finlay AY. The finger-tip unit: a new practical measure. *Clin Exp Dermatol.* 1991;16:444-447.
6. Long CC, Finlay AY, Averill RW. The rule of hand: 4 hand areas=2 FTU=1 g. *Arch Dermatol.* 1992;128:1130.
7. Sayre RM, Powell J, Rheims LA. Product application technique alters the sun protection factor. *Photodermatol Photoimmunol Photomed.* 1991;8:222-224.
8. Sternberg C, Larko O. Sunscreen application and its importance for the sun protection factor. *Arch Dermatol.* 1985;121:1400-1402.
9. Friedlander J, Lowe NJ. Sunscreens. In: Arndt KA, Le Boit PE, Robinson JK, Wintroub BU, eds. *Cutaneous Medicine and Surgery.* Philadelphia, Pa: WB Saunders Co; 1996:751-757.
10. Lowe NJ. SPF: comparative techniques and selection of UV sources. In: Lowe NJ, ed. *Physician's Guide to Sunscreens.* New York, NY: Marcel Dekker; 1991:161-175.
11. Banks BA, Silverman RA, Schwartz RH, Tunnessen WW. Attitudes of teenagers toward sun exposure and sunscreen use. *Pediatrics.* 1992;89:40-42.
12. Berwick M, Fine JA, Bologna JL. Sun exposure and sunscreen use following a community skin cancer screening. *Prev Med.* 1992;21:302-310.
13. Johnson EY, Lookingbill DP. Sunscreen use and sun exposure. *Arch Dermatol.* 1984;120:727-731.
14. Kirkpatrick CS, Lee JA, White E. Melanoma risk by age and socioeconomic status. *Int J Cancer.* 1990;46:1-4.
15. Mawn VB, Fleischer AB. A survey of attitudes, beliefs, and behavior regarding tanning bed use, sunbathing, and sunscreen use. *J Am Acad Dermatol.* 1993;29:959-962.
16. Robinson JR, Rademaker AW, Sylvester J, Cook B. Summer sun exposure: knowledge, attitudes, and behaviors of Midwest adolescents. *Prev Med.* 1997;26:364-372.
17. Maducdoc LR, Wagner RF, Wagner KD. Parents' use of sunscreen on beach-going children. *Arch Dermatol.* 1992;128:628-629.
18. Olson AL, Dietrich AJ, Sox CA, et al. Solar protection of children at the beach. *Pediatrics.* 1997;99:860.
19. Rampen FHJ, Fleuren BAM, De Boo TH, Lemmens AJE. Unreliability of self reported burning tendency and tanning ability. *Arch Dermatol.* 1988;124:885-888.
20. Zinman R, Schwartz S, Gordon K, et al. Parental use of sunscreen is key in determining whether they will use it on their child: sunscreen use by parents on children is probably related more to experience with sunburn than with concerns about skin cancer. *Arch Pediatr Adolesc Med.* 1995;149:804-807.
21. *SAS/STAT User's Guide, Release 6.03.* Cary, NC: SAS Institute Inc; 1988.
22. Frittschi L, Green A, Solomon PJ. Sun exposure in Australian adolescents. *J Am Acad Dermatol.* 1992;27:25-28.
23. Robinson JK, Rigel DS, Amonette RA. Trends in sun exposure knowledge, attitudes, and behaviors: 1986 to 1996. *J Am Acad Dermatol.* 1997;37:179-186.
24. Survey of sun exposure behaviors shows parents and children are burning. In: American Academy of Dermatology and Opinion Research Corporation. *Sun Exposure.* Princeton, NJ: Opinion Research Corp; 1996.
25. Long CS, Miller AJ, Lee HT, Wild JD, Przywart RC, Hufford P. Ultraviolet index forecasts issued by the National Weather Service. *Bull Am Meteorological Soc.* 1996;77:729-748.
26. Environmental Protection Agency. *Technical Appendices to the Experimental UV Index Fact Sheet.* Washington, DC: Environmental Protection Agency; 1994. EPA 430-F-94-019.
27. Cockburn J, Hennrikus D, Scott R, Sanson-Fischer R. Adolescent use of sun-protection measures. *Med J Aust.* 1989;151:136-140.
28. Hill D, White V, Marks R, Borland R. Changes in sun-related attitudes and behaviours, and reduced sunburn prevalence in a population at high risk of melanoma. *Eur J Cancer Prev.* 1993;2:447-456.
29. King PH, Murfin GD, Yanagisako KL, et al. Skin cancer/melanoma knowledge and behavior in Hawaii: changes during community-based cancer control program. *Prog Clin Biol Res.* 1983;130:135-144.
30. Robinson JK. Behavior modification obtained by sun protection education coupled with removal of a skin cancer. *Arch Dermatol.* 1990;126:477-481.
31. George PM, Kuskowski M, Schmidt C. Trends in photoprotection in American fashion magazines, 1983-1993. *J Am Acad Dermatol.* 1996;34:424-428.
32. Threlfall TJ. Sunglasses and clothing: an unhealthy correlation? *Aust J Public Health.* 1992;16:192-196.
33. Elwood JM. Melanoma and sun exposure: contrasts between intermittent and chronic exposure. *World J Surg.* 1992;16:157-165.