Classification of Human Senile Cataractous Change by the American Cooperative Cataract Research Group (CCRG) Method: II. Staged Simplification of Cataract Classification

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One thousand nine hundred and seventy-six cataracts extracted intracapsularly were classified according to the system adopted by the Cooperative Cataract Research Group (CCRG) Consortium. A nine-stage protocol for simplifying the classification data is presented. The method of simplifying the basic CCRG classification emphasizes anatomic similarities among lenses. Simplification is indicated when small numbers of cataracts in any class provide insufficient statistical power to allow detection of scientifically or clinically important differences in rates between comparison groups, if such differences exist; however, simplification unavoidably obscures the anatomic, biochemical, and biophysical features of individual cataracts. Age-specific characteristics of this population of 1976 cataracts are used to demonstrate the effects of the simplification process. The preponderance of mixed cataracts and the relative scarcity of pure cataracts are documented, and the implications of these numbers for cataract research are presented. Invest Ophthalmol Vis Sci 25:166-173, 1984

In 1978,¹ a system of cataract photography and classification was described that provided lens scientists with an opportunity to examine and photograph the lens immediately after extraction and to document objectively, in artifact-free photos, the cataractous change independently of nuclear color. These photographs provided a record of the complexity and variability of cataract anatomy. The system of cataract classification has evolved over the years to its present form,² and in 1980, it was adopted by the American Cooperative Cataract Research Group (CCRG) Consortium for use with all Consortium-sponsored research.

As it became possible to document in increasing detail the anatomic features of each cataract, it also became clear that no two cataracts were morphologically identical. Before analytic data from single whole lenses could be correlated with cataract classification data, a rationale for grouping these morphologically unique entities was needed. It was decided to adopt the classical view of the lens as an organ made up of two distinct zones: the cortex and the nucleus. In the cataract classification system, the cortex was subdivided into six zones: subcapsular anterior, subcapsular posterior, anterior cortical, equatorial cortical, posterior cortical, and supranuclear. The nuclear region was not subdivided. By combining the several zones of cortical opacification, it became possible to simplify the classification data, divide a large population of cataracts into smaller groups, and interpret data from subpopulations of similar but not identical cataracts. It is the purpose of this article to demonstrate the staged system used to simplify the raw classification data from a population of 1976 cataracts. The effect of simplification and grouping on age-specific and nuclear color data from these lenses will be presented. The biostatistical techniques of the PROPHET computer system³ were employed to achieve these ends.

Materials and Methods

An updated description of the techniques used in collecting, photographing, storing, or transporting lenses is described in Part I.² All lenses that are intact
Fig. 1. Stages of simplification of the CCRG cataract classification system. From Stage I to II, subscripts are deleted; from Stage II to III the subcapsular zones (SCA and SCP) are condensed to a single SC class. From Stage III to IV, CXA, CXE, and CXP zones are condensed to a single CXAEP class. From Stage IV to V, the CXAEP and SC terms are collapsed into one class denoting superficial cortical opacities (CXS). From Stage V to VI, the superficial cortical opacities (CXS) are grouped with the SN opacities to form a single group of cortical opacities (CX). From Stage VI to VII, CX and N are condensed to form a single class (I) of immature cataracts. At Stage VIII, H and M are condensed into a single HM class and at Stage IX, all H and I cataracts are grouped into a single class (CAT) of cataracts.

after intracapsular extraction and then atraumatically photographed are available for classification and eventual laboratory analysis.

The classification may contain up to seven of the following terms: H (hypermature), M (mature), I (immature), SCA (anterior subcapsular), SCP (posterior subcapsular), CXA (anterior cortical), CXE (equatorial cortical), CXP (posterior cortical), SN (supranuclear), N (nuclear), and NS (nuclear sclerosis). Subscripts added to the SCA, SCP, CXA, CXE, CXP, SN, and N terms indicate the extent or intensity of involvement in that particular region of the cataract. It is recognized that NS (nuclear sclerosis) is a misnomer and, therefore, not the ideal term to designate nuclear color. However, since “nuclear sclerosis” in the United States is an accepted misnomer used to designate nuclear brunescence, it will be so used in this article. We do not intend to enter the semantic controversy regarding the merits of “nuclear sclerosis” as a useful descriptor of nuclear color in scientific writing and/or thinking.

While admittedly complex, this classification system can be simplified (Fig. 1). Figure 1 presents nine stages of classification (I–IX); these stages represent a progression from the most complex (Stage I) to the simplest (IX). Each stage is more or less useful to the lens scientist, depending on the type of research that is being done. Stages I, II, and III are most useful to those scientists who are able to study the clear and opaque portions of a single lens and who need to correlate their data with measures of the location and/or extent of the cataractous change (ie, electron microscopists, studying the anatomy4,5 or electron dispersivity6 of single lenses, biophysicists studying light scattering,7 and biochemists studying single microdissected cataracts.8–11

In a large population of cataracts classified at Stage I, the number of lenses with identical classifications is extremely small, particularly if pure forms (cataracts with only one opaque region) are eliminated. At Stage II, while there are likely to be more lenses with identical classifications, the number of possible classifications employing seven or fewer of the terms is 127. This is calculated by summing the number of unordered combinations of classification terms (7C7 + 7C6 + 7C5 + 7C4 + 7C3 + 7C2 + 7C1 = 127).

At Stage III, the number of terms has been reduced to six and the number of unordered combinations for six or fewer terms reduced to 63. At Stage III, the CXA, CXP, and CXP terms have been condensed to CXAEP, the number of terms reduced to four, and the number of unordered combinations reduced to 15. It is at this stage that many populations of cataracts can be subdivided and classes compared. Stages V–VII represent further condensations of terms within the classification of immature cataracts. At Stage VII all immature cataracts are grouped together in a single
Table 1. Stage IV of the Classification Simplification Scheme applied to 1976 immature cataracts extracted intracapsularly

<table>
<thead>
<tr>
<th>Combination of terms</th>
<th>Number of lenses</th>
<th>% of total</th>
<th>Mean age (yrs)</th>
<th>Standard deviation</th>
<th>Mean NS index</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>214</td>
<td>10.83</td>
<td>70.48</td>
<td>11.04</td>
<td>4.50</td>
<td>1.24</td>
</tr>
<tr>
<td>SC</td>
<td>25</td>
<td>1.27</td>
<td>57.60</td>
<td>9.39</td>
<td>2.96</td>
<td>1.17</td>
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<tr>
<td>CXAEP</td>
<td>12</td>
<td>0.61</td>
<td>67.25</td>
<td>12.41</td>
<td>3.83</td>
<td>1.59</td>
</tr>
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<td>SN</td>
<td>6</td>
<td>0.30</td>
<td>70.33</td>
<td>7.79</td>
<td>3.67</td>
<td>1.03</td>
</tr>
<tr>
<td>N+SC</td>
<td>51</td>
<td>2.64</td>
<td>68.63</td>
<td>9.37</td>
<td>4.38</td>
<td>1.39</td>
</tr>
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<td>201</td>
<td>10.17</td>
<td>70.82</td>
<td>9.87</td>
<td>4.71</td>
<td>1.43</td>
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<td>N+SN</td>
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<td>5.16</td>
<td>75.00</td>
<td>9.04</td>
<td>4.49</td>
<td>1.30</td>
</tr>
<tr>
<td>SC+CXAEP</td>
<td>24</td>
<td>1.22</td>
<td>59.00</td>
<td>10.01</td>
<td>3.29</td>
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<td>1.27</td>
<td>65.04</td>
<td>13.27</td>
<td>3.16</td>
<td>1.18</td>
</tr>
<tr>
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<td>68</td>
<td>3.44</td>
<td>73.19</td>
<td>8.67</td>
<td>3.53</td>
<td>1.31</td>
</tr>
<tr>
<td>N+SC+CXAEP</td>
<td>300</td>
<td>15.18</td>
<td>69.80</td>
<td>9.97</td>
<td>4.72</td>
<td>1.49</td>
</tr>
<tr>
<td>N+CXAEP+SN</td>
<td>236</td>
<td>11.94</td>
<td>75.15</td>
<td>9.09</td>
<td>4.29</td>
<td>1.22</td>
</tr>
<tr>
<td>N+SC+SN</td>
<td>121</td>
<td>6.12</td>
<td>71.86</td>
<td>10.13</td>
<td>4.27</td>
<td>1.32</td>
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<tr>
<td>SC+CXAEP+SN</td>
<td>111</td>
<td>5.62</td>
<td>68.86</td>
<td>10.93</td>
<td>3.80</td>
<td>1.29</td>
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<td>N+SC+CXAEP+SN</td>
<td>380</td>
<td>19.23</td>
<td>74.15</td>
<td>8.30</td>
<td>4.51</td>
<td>1.21</td>
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<tr>
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<td></td>
<td>69.10</td>
<td></td>
<td>4.01</td>
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<tr>
<td>Total</td>
<td>1976</td>
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</tbody>
</table>

At Stage IV there are four basic classification terms (SC, CXAEP, SN and N). There are 15 possible 1, 2, 3 and 4-term combinations of these terms and the number of lenses in each of these 15 classes with its mean age, mean NS index and standard deviation are tabulated.

class I. At Stage VIII the hypermature and mature classes are condensed into a single HM class, and at Stage IX all cataracts are grouped together in a single class labeled “CAT.” In this class there is no differentiation among the different stages or types of cataract. Since there are no widely used subdivisions of the class of nuclear senile cataracts, simplification or condensation of this class is unnecessary.

The scheme in Figure 1 regroups lenses and condenses the classification by recognizing that certain terms denote only a portion of a larger zone of the crystalline lens. The definition of these new terms is as follows:

\[
\begin{align*}
CX &= SN \pm (CXA \pm CXE \pm CXP) \pm (SCA \pm SCP) \\
CXS &= (CXA \pm CXE \pm CXP) \pm (SCA \pm SCP) \\
CXAEP &= (CXA \pm CXE \pm CXP) \\
SC &= (SCA \pm SCP)
\end{align*}
\]

Each of the above condensed classes (II–IX) contains data from similar but not necessarily identical cataracts. Whereas in a large population of cataracts, there might be only a few lenses with involvement exclusively in the CXA region, there may be many with opacification in CXA ± CXE ± CXP, and, by grouping these lenses together, one can construct a larger group of cortical cataracts (although not of pure anterior cortical cataracts) and compare it with other groups of cataracts. In this example, the new variable becomes CXAEP, a term used to represent all possible combinations of the three cortical areas.

A scientist with data from the analyses of a population of classified cataracts can derive the simplified classifications of each cataract by following the progression through the stages in Figure 1. At each stage the population can be subdivided into the number of subgroups corresponding to the number of combinations of terms at that stage and select the stage that gives him reasonable numbers, means, and standard deviations in each class. Tests for the normality of the distribution of data in each class can be made and appropriate parametric or nonparametric statistics used to assess the significance of observed differences. If the number of lenses in each class is too small and/or the standard deviation too large to provide enough power to be able to detect scientifically or clinically important differences in rates between comparison groups and if such differences exist, the data should be reorganized and analyzed at the next higher stage of simplification (ie, IV —> V, V —> VI). Power calculations can be done to estimate the number of lenses necessary to achieve a desired level of significance given a known mean, standard deviation, and population size. The specific steps by which PROPHET (or any other computer with appropriate software) can automatically regroup raw classification data into simpler arrangements are available as an appendix from the first author.

Results

The simplification technique has been applied to 1976 immature cataracts and is presented in Tables 1–4.
Table 2. Stages V and VI of the Classification Simplification Scheme applied to 1976 immature cataracts extracted intracapsularly

<table>
<thead>
<tr>
<th>Combination of terms</th>
<th>Number of lenses</th>
<th>% of total</th>
<th>Mean age (yrs)</th>
<th>Standard deviation</th>
<th>Mean NS index</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>214</td>
<td>10.83</td>
<td>70.48</td>
<td>11.04</td>
<td>4.50</td>
<td>1.24</td>
</tr>
<tr>
<td>CXS</td>
<td>61</td>
<td>3.09</td>
<td>60.05</td>
<td>10.74</td>
<td>3.26</td>
<td>1.42</td>
</tr>
<tr>
<td>SN</td>
<td>6</td>
<td>0.30</td>
<td>70.33</td>
<td>7.79</td>
<td>3.67</td>
<td>1.03</td>
</tr>
<tr>
<td>N+CXS</td>
<td>652</td>
<td>33.00</td>
<td>69.89</td>
<td>9.76</td>
<td>4.64</td>
<td>1.46</td>
</tr>
<tr>
<td>N+SN</td>
<td>102</td>
<td>5.16</td>
<td>75.00</td>
<td>9.04</td>
<td>4.49</td>
<td>1.30</td>
</tr>
<tr>
<td>CXS+SN</td>
<td>204</td>
<td>10.32</td>
<td>69.84</td>
<td>10.84</td>
<td>3.63</td>
<td>1.23</td>
</tr>
<tr>
<td>N+CXS+SN</td>
<td>737</td>
<td>37.30</td>
<td>74.11</td>
<td>8.93</td>
<td>4.40</td>
<td>1.23</td>
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<td>Mean of Total</td>
<td></td>
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<td>69.93</td>
<td></td>
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<tr>
<td>Total</td>
<td>1976</td>
<td>100.00</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

At Stage V there are three basic classification terms (N, CXS, SN). There are seven possible 1, 2 and 3-term combinations of these terms. At Stage VI there are 2 basic classification terms (N and CX) and three possible 1 and 2-term combinations of these terms. The number of lenses in each of these classes, its mean age and standard deviation and mean NS index and standard deviation are tabulated.

Table 1 contains the 15 combinations of condensed terms at Stage IV of Figure 1. Each contains some lenses whose distribution of cataractous change is described exclusively by that combination. The relative scarcity of pure cataracts (those in which only one zone is opaque) should be noted. Arranged in increasing frequency, they are: SN, CXAEP, SC, and N. While a study of pure nuclear cataracts may be feasible, since they constitute 10.83% of the total population, large studies of pure SN, CXAEP, and SC cataracts will be nearly impossible. While CX makes up the largest single-region-group (13.7% of the total, Table 2), it is not in fact as homogenous a class as is N. The CX class contains all forms and degrees of cortical opacification SCA, SCP, CXAEP, and SN, and it may be regarded as a pure class only because it does not contain any nuclear opacities.

If one analyzes the mean age data for the 15 classes in Table 1 and conducts a one-way analysis of variance, the F statistic is 16.093 and the P value = 0.0001. The inference is that there are significant differences among the mean ages in the classes in Table 1. To find out...
where the significant differences occur, Table 3 contains the
(P < 0.05 or P < 0.01) differences in mean ages. The inclusion of
SC opacification in the class frequently renders the
mean age of that class significantly different from the
mean age of classes in which there is no SC opacification
(ie, N vs. SC; N + SC vs. SC + SN; N + SC vs. CXAEP + SN; N + SC
vs. N + CXAEP + SN, etc). Since age is an acknowledged primary factor in human senile
cataractogenesis, it is reassuring to see the cataracts at
Stage IV separate into significantly different classes by
mean age.

In only pure SN is there no significant difference
between the mean age of this and other classes; however,
this may simply reflect the small numbers of lenses (6/1976) in this class. This may also explain the
similar result for pure CXAEP cataracts (12/1976).
However, that pure SC cataracts show such significantly
different mean ages from those of other classes when
the number of cataracts studied (25/1976) is so small,
suggests strongly that this class is unique—one in which
age is a much more significant etiologic factor.

In Table 4 the NS indices of the 15 classes in Stage
IV are compared and a P value calculated for each
comparison. Significance of differences tends to hinge
on the presence or absence of nuclear opacification.
Those comparisons with significant differences in
nuclear color as expressed by the NS indices2 usually
contain only one class in which nuclear (N) opacification
is present (ie, N vs. SC; N vs. SC + SN; N vs.
CXAEP + SN; N vs. SC + CXAEP + SN; N + SC
+ CXAEP vs. CXAEP + SN; N + CXAEP + SN vs.
CXAEP + SN, etc). These results suggest that there
are no significant differences in the shade or intensity
of nuclear yellowing among the different types of cor-
tical cataract. In contrast, the appearance of nuclear
opacification is associated with significantly greater
nuclear yellowing than pure cortical (SC, CXAEP,
CXS, SN) cataracts. This finding will be explored in
much greater detail in Part III.12 That the Kruskal-
Wallis One-Way Analysis of Variance Statistic equals
143.60, with a P = 0.0001 (Table 1) suggests that the
significant differences in NS indices among the 15
classes are really due to the differences in nuclear color
among pure cortical (CXAEP, SC, and SN), pure nu-
clear (N), and the mixed cortico-nuclear cataracts.

By arranging the mean age and NS index data for
pure cataracts from the most superficial (SC) to the
deepest (N), it is interesting to note the increasing mean
ages and NS indices with the increasing depth of the
opaque zone.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Mean age (yrs)</th>
<th>SC</th>
<th>CXAEP</th>
<th>SN</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age index</td>
<td>2.96</td>
<td>3.83</td>
<td>3.67</td>
<td>4.50</td>
<td></td>
</tr>
</tbody>
</table>

These data suggest that in addition to the uniqueness of
the morphology of these pure cataracts, there is a
characteristic age at which the opacity becomes visually
disabling, ie, the deeper the cataract in the lens, the
greater the age. The NS index data show an increasing
darkening of the lens nucleus with age; a more detailed
study of this relationship has been made.12 If one com-
pares mean ages of N and CX groups (70.48 years vs.
67.65 years, P < 0.01) one sees that the cortical cat-
aracts are from a younger population; consistent with
this is the finding of less yellowing of the nuclear zone
(NS in CX = 3.55 vs. 4.50 in pure N cataracts, P < 0.01). The SC group has the youngest mean age

Table 4. Stage IV. Classification simplification procedure—comparison of NS index data from Table 1

<table>
<thead>
<tr>
<th>N</th>
<th>SC</th>
<th>CXAEP</th>
<th>SN</th>
<th>N+SC</th>
<th>+CXAEP</th>
<th>N+SN</th>
<th>+CXAEP</th>
<th>N+CXAEP</th>
<th>+SN</th>
<th>+CXAEP</th>
<th>+SN</th>
<th>N+CXAEP</th>
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<th>+SN</th>
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<th>+CXAEP</th>
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Null hypothesis: The populations compared are equal. Reject hypothesis at
P < 0.05 or P < 0.01. Only significant differences are presented.

Statistical analyses of data at Stage VI of the Classification Simplification
Scheme as applied to 1976 immature cataracts extracted intracapsularly. Due

(57.60 years); this is consistent with the clinical impression that this is the most visually disabling cataract and, therefore, the most likely to be removed first.

Data in Table 1 also confirm the clinical impression that increasing age is associated with increasing opacification of the lens (ie, more regions become opaque as age increases). If one organizes the classes centrifugally, with nuclear opacification as central and extending out into the cortex, one sees a trend of pure nuclear opacification occurring in younger lenses and nuclear plus cortical opacification occurring with advancing age.

Cataract class(es) N N+SN N+SN+CXAEP N+SN+CS
Mean age (yrs) 70.48 75.00 75.15 74.11

If one then organizes the classes centripetally with the cataract occurring in the most superficial zone and looks at mean ages of classes of more extensive cataracts, one sees:

Cataract class(es) SC SC+CXAEP CXS CX N+CS
Mean age (yrs) 57.60 59.00 60.05 67.65 72.24

It is clear that in both nuclear and cortical opacification there is an increase in complexity of the opacity with increasing age; although for the cortical cataract the complex changes appear to be inward, while for the nuclear cataract they appear to be outward.

If the 1976 immature cataracts are divided into the subgroups specified for Stages V and VI, and the data are tabulated as shown in Table 2, the number of subgroups at Stage V is seven; at Stage VI it is three. Although the condensation has simplified the manipulation of the 1976 cataracts (ie, at Stage V one is forced to deal only with 7 rather than the 15 subgroups of Stage IV), it has obscured, to some degree, the characteristics of individual classes. Stated more simply, an unavoidable result of simplifying the classification data is a complication of the age and NS data. Since age is known to be a major factor in senile cataractogenesis and nuclear brunesence, the simplification of the classification obscures the age-specific contributions to individual cataracts or classes of cataracts. As an extreme example of this, look at the mean age (57.60 years) and mean NS index (2.96) of SC cataracts; at Stage II this strikingly young age and low NS index are clearly different from the total population means (69.10 years and 4.01). However, when SC cataracts are classified "CX" at Stage VI, the mean age (67.65 years) and NS index (3.55) are not as different from those of the total population (69.10 years and 4.01, respectively). Just as age-specific contributions to one form of cataract may be obscured by the simplification process, biochemical and biophysical specificity for certain cataract classes may be similarly obscured.

Discussion

Our sample of 1976 immature cataracts is derived from adults greater than 40 years of age. Most of the patients undergoing cataract surgery came from the Boston–New England area. It was not possible to characterize this population with regard to racial or socioeconomic factors. Analyses of these lenses are not meant to elucidate the nature of cataracts prior to extraction, nor are they meant to represent cataracts as they occur in vivo. The classification system simply enables the laboratory scientist to study individual cataractous lenses, and to the extent possible, group the cataracts according to their anatomic similarities for the purpose of comparing laboratory data from one group with those from another.

Of the 1976 immature cataracts analyzed to date, only 12.39% of the immature forms are pure (ie, having only one zone of the lens opaque). The implications of these numbers are significant: if the CCRG Consortium is to study single, intracapsularly-extracted, human cataracts, it must employ a classification system and statistical methods capable of dealing with the complexities of cataract anatomy. It must also develop a system of harvesting large numbers of cataracts.

The distribution of pure and mixed forms suggests that the following guidelines will apply and to some degree restrict the nature of human cataract research.

1. The classification system employed must be able to catalog the individual features of mixed (complex) cataracts.

2. The biostatistical techniques applied to analyze these data must include contingency table making and multivariate analysis.

3. Due to the large size of the data base and the large number of variables, the computer system chosen must be rapid, and inexpensive. PROPHET* meets most of these requirements.

4. Except for nuclear cataracts which make up 10.83% of all immature cataracts, it is unlikely that the other forms (SCA, SCP, CXAEP, and SN) will ever be available in numbers sufficient to support studies about their physiology and metabolism. Anatomic studies, which require comparatively little tissue, will probably not be restricted by the short supply. Photography of lenses immediately after cataract extraction can detect these pure forms and promptly direct them into the appropriate study.

5. Even with the sophisticated multivariate biostatistical techniques that are available through PROPHET, the small numbers of lenses in certain classes may make it impossible to separate discriminant
variables from the many that are present. In human cataract research, paired lenses are rarely available and never identical. Therefore, one does not have a control lens for each experimental lens as one does in research on animal lenses. The complexity of dealing with individual cataracts, each of which is morphologically unique, requires the use of a complex classification system such as has been adopted by the CCRG.

The results strongly suggest that analytic studies with numbers of cataracts sufficiently large to allow analysis at Stages II–IV are more likely to uncover the biochemical/biophysical individuality of a particular type of cataract than studies at Stages V–IX. In order to work at Stages II–IV, large numbers of cataracts must be available to the laboratory scientist. However, if the number of lenses available does not permit working at Stage II or III of the simplification scheme, one must give up the hope of identifying specific characteristics of a certain cataract in exchange for knowledge about a more general class of cataracts. This type of compromise affects the correlation of laboratory with classification data at all stages except Stage I.

The complexity of the statistical analysis should force us to consider rapid development of techniques for microdissecting a cataract into clear and opaque zones, so that once again each lens will provide its own control. It is imperative that microtechniques capable of analyzing separately the opaque and clear parts of a single cataract be developed rapidly. Progress by Harding, Horwitz, Tanaka, and Bettelheim in developing these techniques has been most encouraging. Even if multivariate analysis is successful in identifying a single discriminant variable in a particular type of cataract formation, such direct analyses will be needed to confirm the statistical inferences.

6. The data in Table 1 have important implications for in vivo studies of human cataractogenesis; techniques will be needed to accurately and objectively document cortical cataractous change. There may be cortical opacification nearly seven times as frequently as pure nuclear opacification. Hockwin and Dragomirescu have proposed the Topcon Lens Densitograph as a camera suitable for documenting all forms of cataractous change. This is certainly an excellent technique for documenting nuclear opacification, since the nuclear opacity usually has polar symmetry. However, the cortical cataract has unpredictable asymmetry, and its features cannot be captured with a single slit view. If, as Hockwin suggests, one attempts to take several slit photographs at points around the hemicircle of the lens, one begins to generate an unmanageably large data mass. For these reasons, the Topcon camera may not be the best instrument to document and follow the progress of cortical cataractous change. A potentially superior technique is described by Kawara and Obazawa. In spite of the availability of these techniques, only two reports have appeared in which there has been a prospective study of cataract formation employing these objective photographic techniques.

The data in Table 1 also suggest the importance of in vivo techniques to progress in research on the early stages of human senile cataract formation. Table 1 demonstrates the scarcity of the single-region opacities among all cataracts extracted intracapsularly. The increasing popularity of extracapsular cataract surgery will further reduce their availability. To offset this disadvantage, techniques for studying cataracts in vivo may have their greatest impact on the study of early or single-region forms of human cataract.

Key words: Cooperative Cataract Research Group, classification, simplification, PROPHET

Acknowledgments

The authors would like to acknowledge the excellent support and cooperation of the nurses and surgeons in the operating rooms of the Massachusetts Eye and Ear Infirmary, and the support and advice of Drs. Bernard Ransil and Raymond Neff.

References


