RGP EDGES: CAN PRACTITIONERS ASSUME THE LABS ARE COMPLIANT? A CASE FOR IN-OFFICE MODIFICATION.

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Abstract

Thirty-six RGP lenses were examined with a modified radiuscope edge analyzer to determine whether or not they needed modification. The sample was made up of four trial sets: Envision 9.6, Fluorocon 9.5, Regional Silicone-acrylate 9.5, and a Regional Silicone-acrylate 9.0. The lenses were evaluated by a pass/modify criteria based on the clinical relevance of apex position, front taper, and edge uniformity. This study showed that 83% of the lenses examined needed modification. In addition, 22% of the lenses failed in every criteria. Lack of anterior taper, resulting in thick lenses, was the single most consistent flaw found among the test sample. The pass rate (6/36) was so low in this study that comparisons between materials and/or different overall diameters from the same lab are inconclusive at best. A good edge appears to be almost a random phenomenon. This study is contrasted with Andrasko's study (74% of lab edges are acceptable) to show how different definitions can bring significantly different conclusions about edge quality. Finally, a strong case is made for routine in-office modification.

Key words: rigid gas permeable, edge, lens analyzer, modification.

INTRODUCTION

It is observed clinically that many patients with well-fit rigid gas permeable (RGP) lenses are unable to successfully wear their lenses because of discomfort. The source of discomfort is often an enigma to the practitioner who wonders why similiar lenses can be worn successfully by one patient and unsuccessfully by another. Often a practitioner places the blame for lack of success on the patient and characterizes the unsuccessful patient as overly sensitive or a poor candidate while assuming that the lenses received from the lab are perfect. A recent article by Andrasko pointed out that in his sample only 4% of the lenses exhibited the negative edge characteristics of an anterior apex position combined with inadequate anterior tapering (1). With data such as this it seems reasonable that a practitioner can assume that 1990's technology has solved the problem of the poor edge.

As an optometry student, I have been disconcerted with how easy it is to verify overall diameter, base curve, thickness, and optic zone, but how difficult it is to consistently evaluate an edge. Nevertheless, Mandell said, "evaluation of the contact lens edge represents the most difficult but most important part of the inspection routine" (2). It is indeed interesting that for such an important task no standard verification procedure has been developed. Instead, many different instruments/procedures are available to evaluate the edge including: subjective response, stereomicroscopes, projection magnifiers, modified radiuscopes, and even the palm technique (3). My own experience with these techniques has been frustrating and inconsistent. For this reason, I was very impressed when I read Caroline and Norman's success with a modified radiuscope known as an edge analyzer(4). This instrument appeared to give consistent results and was easy to use. During the summer, I purchased an edge analyzer and decided to use it on this research project to compare edges from different trial sets.

METHODS

I selected 36 RGP lenses for examination with my edge analyzer to determine whether or not they needed modification. The sample was made up of three trial sets (9 lenses each) that had the same overall diameter(9.5/9.6mm), power (-3.00 diopters), and base curves(7.4-8.2mm). The trial sets consisted of: Envision, Fluorocon, and a Regional Silicone-acrylate. The Regional Silicone-acrylate(RSA) has a dk of 28 and is approved for daily wear. In addition, a Regional Silicone-acrylate with an overall diameter of 9.0 mm was evaluated. I was interested in whether or not there were edge differences between the different materials and if edge differences existed between the two RSAs made by the same lab.

The lenses were evaluated by a pass/modify criteria based on the clinical relevance of the various edge parameters. For clarification, the five parameters of an RGP edge are: edge thickness, apex position, taper of the anterior surface of the edge, rounding of the posterior surface of the edge, and edge shape. Of these five components, "a centrally located apex and adequate anterior taper have the greatest positive influence on comfort" (1). Other factors such as edge thickness, shape, and rounding of the posterior surface play a lesser but important role in lens comfort. In addition, Mandell stated, "patients are also very critical of edges that are not uniform around their entire circumference" (2). For these reasons, I chose apex position, anterior tapering, and lens uniformity as the clinically relevant criteria for pass/modify evaluation. Most importantly, these factors represent edge parameters that can easily be altered by in-office modification procedures. Each of these pass/modify criteria will be explained in detail.

The edge apex was evaluated using the boxing system described by Mandell (2). The apex position is given a number relative to its position to the total lens thickness at 50 microns in from the apex. The ideal apex position has been described by Mandell to be slightly posterior to the center of the edge (2). Aditionally, the apex should be rounded to provide the best initial comfort. Andrasko's study defined the ideal edge to be 33%-48% of the way from the back to the front of the lens (1). For this study, I felt a range of 30%-45% was more desireable, thus avoiding the borderline area between 46%-51%. It is important to remember that I am making my evaluations the way that a clinician would. I am not sectioning or molding lenses but rather looking into the edge analyzer, forming the box in my mind and estimating the apex 50 microns in. I performed this exercise 20 times before beginning this study and compared my results with those obtained by detailed measuring. I found that my estimation method was within 5% of the values I found when directly measuring.

The anterior taper of the lens was evaluated subjectively based on whether or not it was present or absent. Anterior lens tapering is easily recognizable and is demonstrated in figure 6. This lens parameter results in significantly more comfortable lenses than those with square or thick edge profiles (1). Lack of anterior tapering results in a thick or square edge and has been cited by Mandell as the most common reason for an uncomfortable edge (2). Lenses were subjectively passed if they had anterior taper and were designated needing modification if the anterior surface lacked tapering and consequently had the appearance of a straight line.

Edge uniformity is essential to patient satisfaction. Edges that sometimes feel good and other times feel bad may be indicators of this problem. To evaluate uniformity, the lens is evaluated at an initial edge point (0 degrees) and re-evaluated after rotating the lens 180 degrees. If the edge presented at both points has essentially the same shape, rounding, and thickness, then it passed. If it deviated from these parameters, then it needed modification. This is an easy task to subjectively evaluate.

In conclusion, an overall pass/modify assessment was given to a lens if it passed all of these criteria. Failure in any area constitutes failure of that lens. Since modification is such an easy in-office procedure, this study wants to identify all lenses that will not meet the requirements of patient satisfaction.

RESULTS

Figure 5(top) shows an edge profile of a lens with an unacceptable forward apex (see arrow). This type of edge was found in 52% (19/36) of my sample. Figure 1 shows the results of my evaluation of apex position. It was interesting to note that 8% (3/36)of my sample had a front apex position greater than 55% of the way from the back of the lens. Even more interesting, was the clustering of apex positions at the center of the lens. Sixteen of the 36 lenses I evaluated had an apex position right at 50%. In figure 5 (bottom) note the decreased thickness of the edge following modification and the more desireable, posterior to the center of the lens, position of the apex.

Figure 6 (top) shows an edge of a lens with no anterior tapering. This was the most common flaw found among all the lenses I examined. Figure 6 (bottom) shows the same lens after modification. Note the ideal anterior tapering on this lens. Figure 2 shows the results of my evaluation of anterior tapering. Eighty-three percent of my sample (30/36) required modification of the anterior surface. This critical parameter for lens comfort was vastly ignored by the laboratories who edged the lenses in my sample.

Figure 7 shows an edge profile of a lens with a square edge. This same lens is rotated 180 degrees and re-photographed. Note the differences in shape between the two photographs indicating a lack of edge consistency. Figure 3 shows the results of my evaluation of edge uniformity. This parameter had a 78% (28/36)success rate and was clearly the most consistent lab result. It is interesting to note that the 22% (8/36) of the lenses that failed edge uniformity also failed apex position and front taper.

As you can see in figure 4, eighty-three percent (30/36) of the lenses I evaluated needed modification. Envision had the highest pass rate (33%) while RSA 9.5 had no lenses that passed. Interestingly, the regional lab did produce the second highest overall rating with the RSA 9.0 passing at a 22% rate. Figures 6 and 8 (bottom) both show examples of excellent overall edges. These are the edges you expect to get from the laboratory, but instead you may receive the edges found in figures 6 and 8 (top).

DISCUSSION

My research sample indicates that RGP edges received from contact lens laboratories are in need of in-office modification. Eighty-three percent of the lenses I examined could be made more comfortable to the patient by in-office modification of the anterior edge surface. I also found that the edge analyzer is an efficient and easy to use tool that brings consistency to the difficult task of edge evaluation.

In this study, the apex position (of all 36 lenses) was critically evaluated. I found 52% of my sample had a central or forward apex. This is not an optimal situation. Mandell points out that the apex of the lens must be near the posterior surface to prevent the upper lid from catching the apex and creating uncomfortable sensations (2). My 52% failure rate is significantly different from that found by Andrasko. In his study, using a definition that centered lenses are acceptable, he failed only the 15% of his sample that had a definite front taper (5).

The most significant clinical pearl I learned from this study is that a lack of anterior taper, resulting in a thick lens, is the single most consistent flaw in lenses manufactured by laboratories. This is consistent with the findings by Mandell (2). My study showed that good anterior tapering was present in only 15% of the lenses. This is in contrast to Andrasko who found 34% (1). This could be explained by Andrasko's use of sectioning lenses compared to my use of a lens analyzer, but it is better explained by the differing definitions used in his study when compared to mine. Consequently, Andrasko passes lenses in his study that he considers to be fair (51%), while I only passed a lens if it had good edge quality.

Edge uniformity, often overlooked, was the last parameter evaluated. This study showed that 78% of the lenses evaluated had good edge consistency. Nevertheless, 22% failed in this area. Consider the example as shown in figure 7. Would you want to be wearing that lens when the square edge is up? It is interesting to note that the 22% that failed edge uniformity also failed apex position and front taper. This represents a large pool of lenses that are totally unacceptable and represents a significantly larger number than the four percent reported by Andrasko (1).

This study is contrasted with Andrasko's study to show how different definitions can bring significantly different conclusions. Andrasko found that 74% of the lenses he inspected were acceptable. In my study, I found that 83% of the lenses I inspected could be made more comfortable to the patient by in-office modification. For this reason, my study was concerned with insuring that the patient received good quality edges and Andrasko's study was concerned with laboratories providing acceptable edges.

In-office modification of the anterior surface of the lens, including the lens apex, is an easy task requiring less than 45 seconds to complete. I recommend using an edge analyzer and a modification unit that includes a 60 degree velveteen covered cone tool and a 90 degree velveteen covered cone tool. All of the modified lenses shown in the photographs were performed by me in less than one minute--thus demonstrating how easy and effective it is to modify RGP edges.

In conclusion, with only six of the thirty-six lenses passing this edge analysis, the level of success is so low that comparisons between materials and/or different overall diameters from the same lab are inconclusive at best. A good edge appears to be almost a random phenomenon. After a thorough analysis of four trial sets, I conclude that the best assumption a practitioner can make about a new lens is that it probably needs modification before a patient will be comfortable wearing it.

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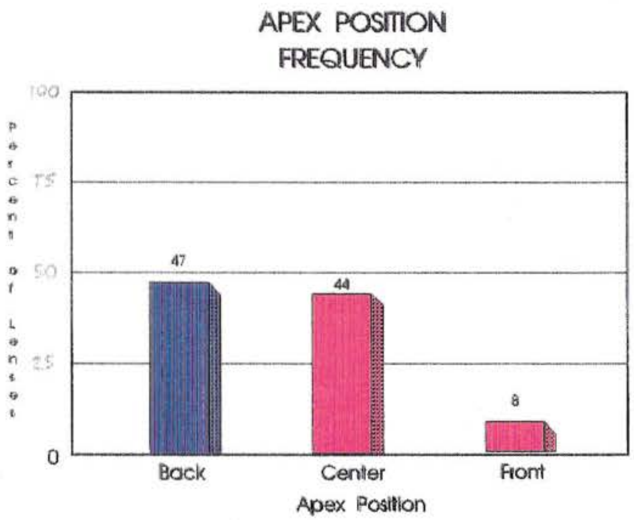

Figure 1

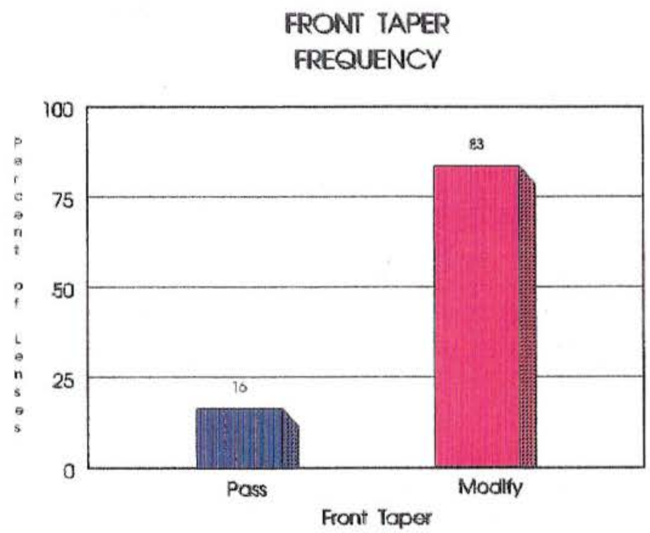

Figure 2

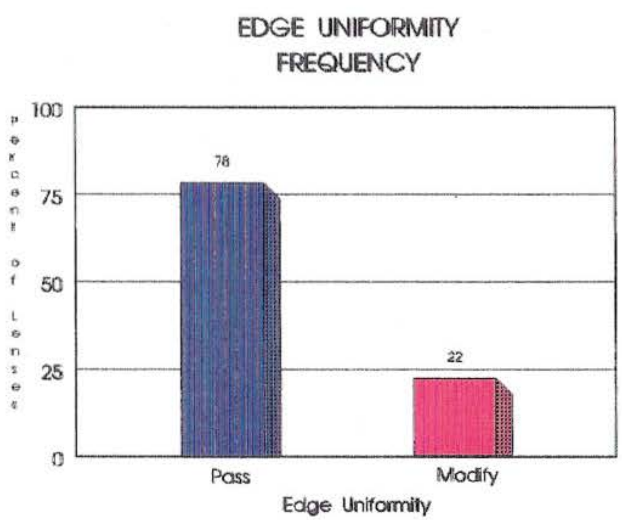

Figure 3

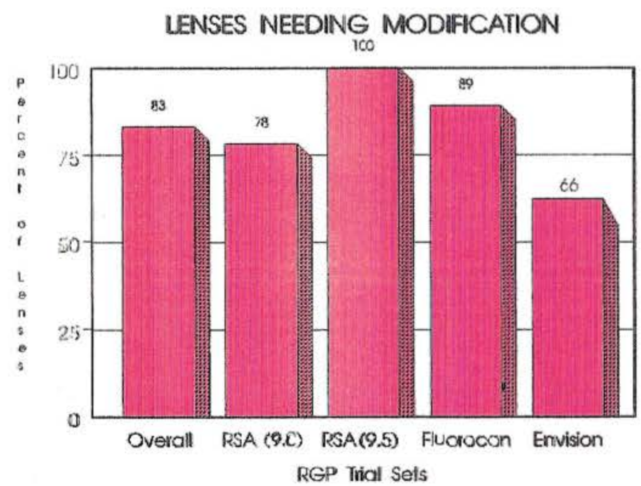

Figure 4

PASS MODIFY

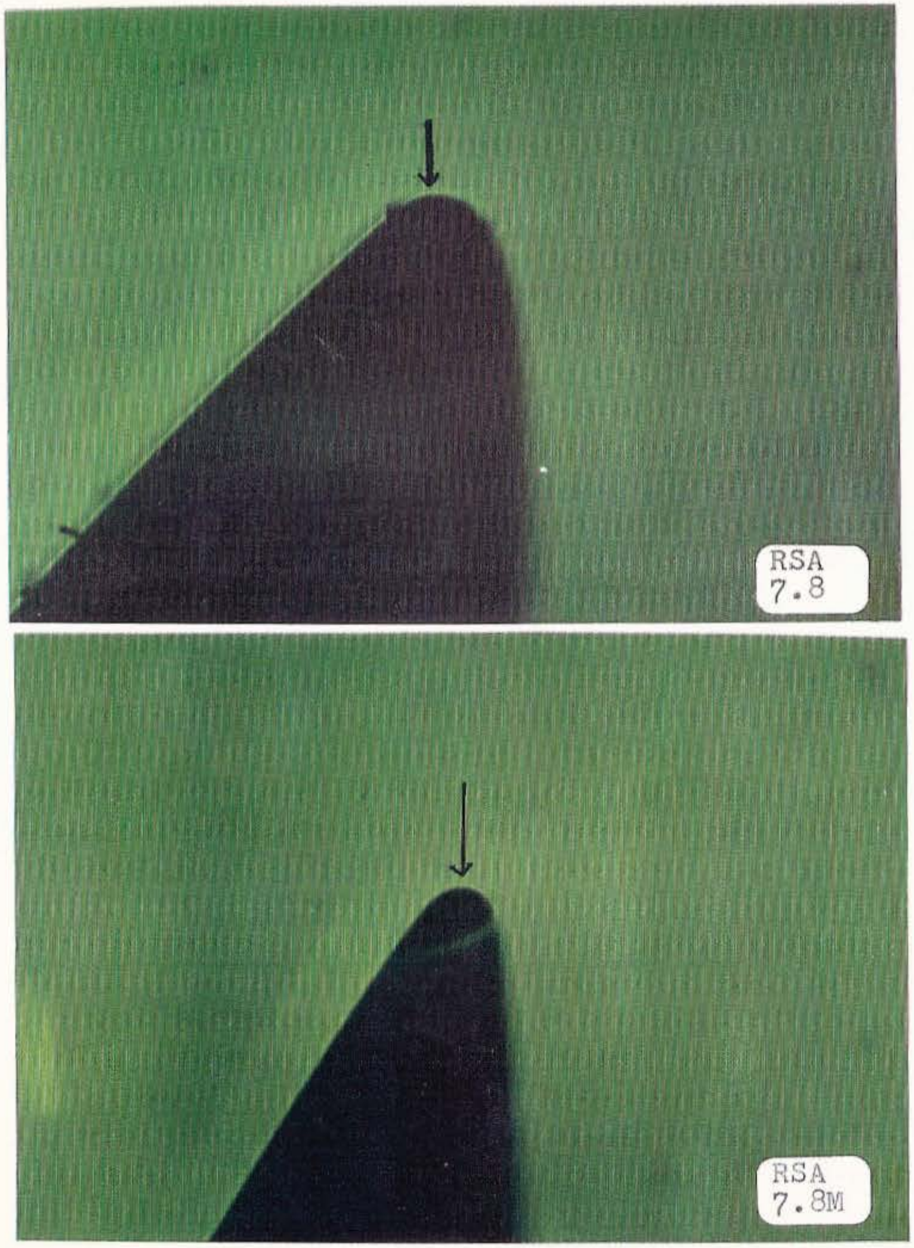

Figure 5: Edge profile of a lens with unacceptable forward apex (top). The bottom photograph shows this same lens after modification.

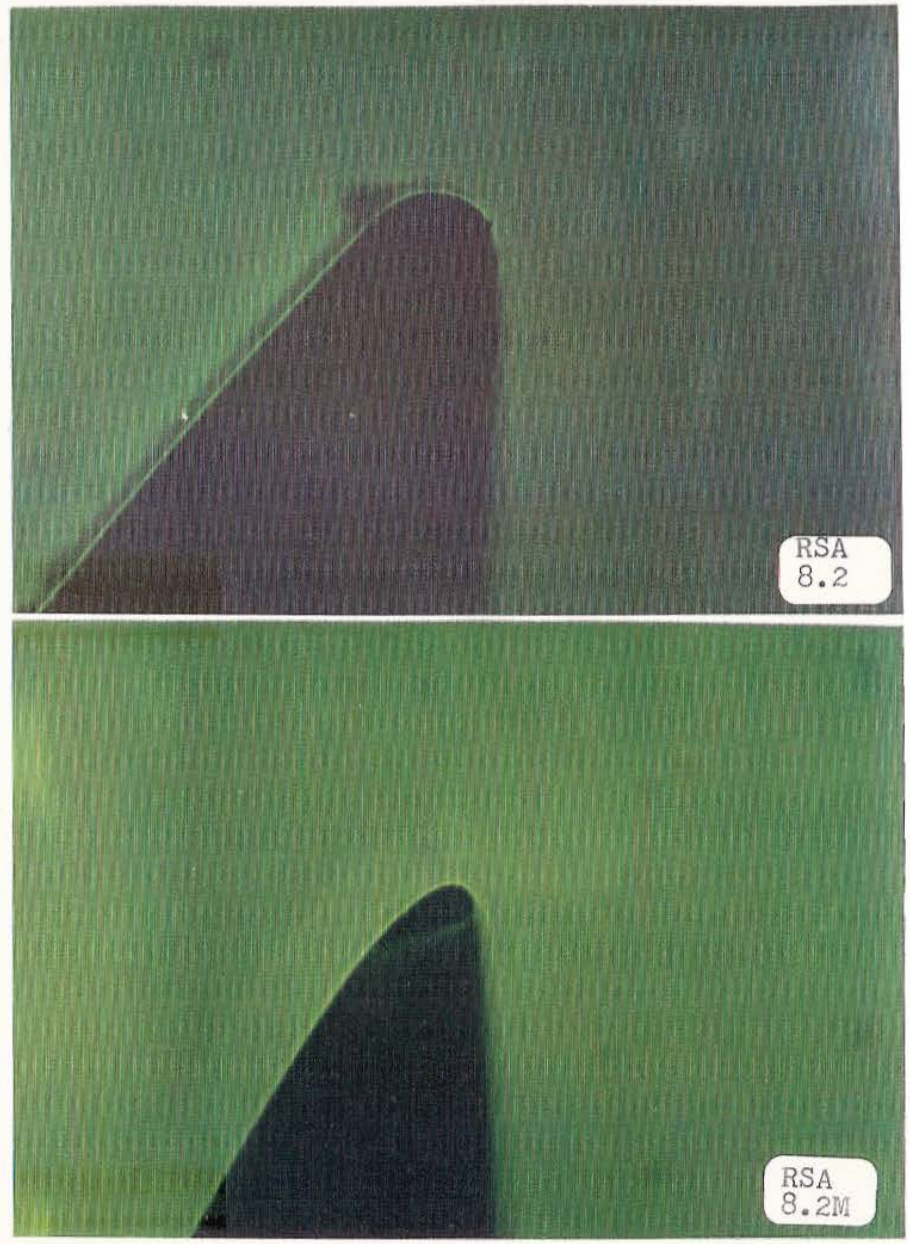

Figure 6: Edge profile of a lens with virtually no anterior tapering (top). The bottom photograph shows this same lens after modification.

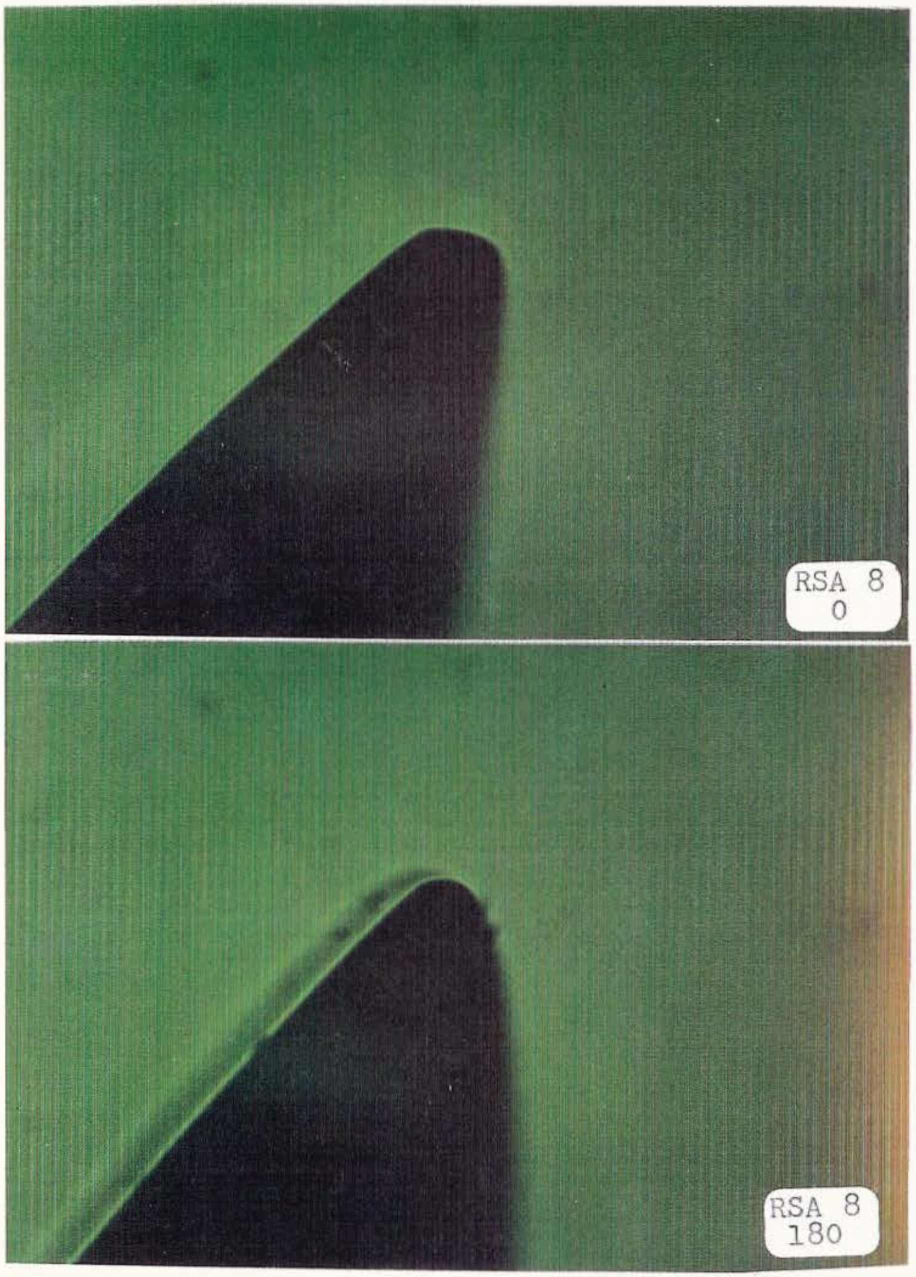

Figure 7: Edge profile of a lens showing a square edge(top). This same lens is rotated 180 degrees and re-photographed (bottom).

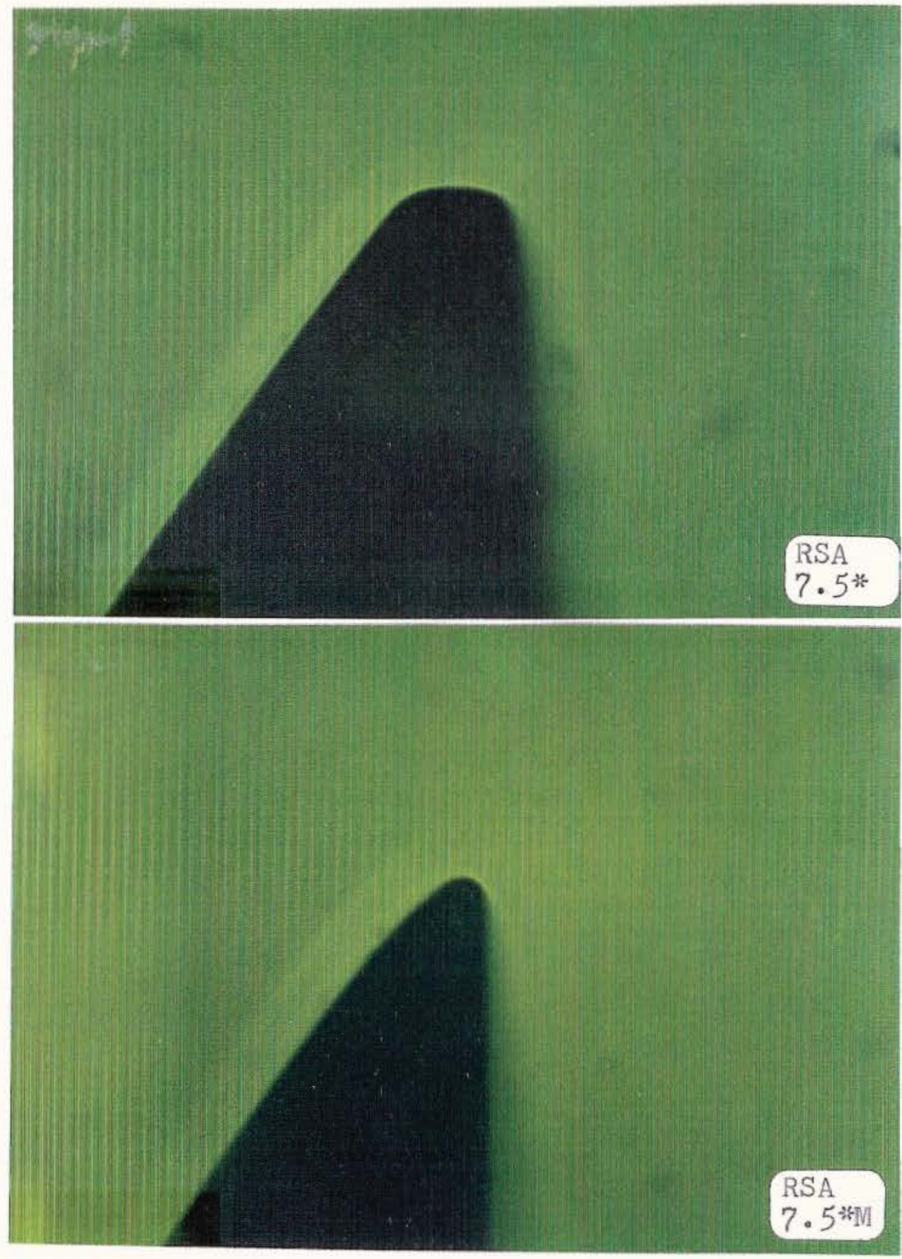

Figure 8: Edge profile of a lens that has a very square edge(top). The bottom photograph shows this same lens after modification--an ideal edge.