Orthokeratology: An Academic Perspective

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Various methods of correcting and/or preventing myopia through manipulation of ocular structures and/or exercises have been reported over the last 300 years. With the introduction of PMMA corneal contact lenses, eye care practitioners began to notice that many young myopic contact lens wearers seemed to have some improvement in their vision, a reduction in their myopic progression, or both.[1–16] In 1962, George Jessen became the first clinician to report on attempts to deliberately alter corneal curvature with PMMA contact lenses using his "orthofocus" techniques, which later became known as "orthokeratology."[17] In 1970, Grant and May[18] reported on a fitting method using larger diameter lenses and maintaining the contact lens base curve at 0.12 D to 0.50 D flatter than the flat keratometry reading. Their techniques were emulated by other orthokeratologists for many years. Over the next 25 years, a multitude of reports on the results obtained through orthokeratology were published.[19–34] Unfortunately, most of these "studies" were uncontrolled and anecdotal in nature with extremely variable results. There were four prospective investigations with some controls that were conducted from 1973 to 1984.[35–48] Based on these studies, conventional orthokeratology fell into disfavor among most eye care practitioners and was declared not to be a viable option for the correction of myopia in the optometric and ophthalmological literature.[49–57] It was during this period that most schools/colleges of optometry barely mentioned orthokeratology or did so in a negative way. Nevertheless, clinicians who advocated orthokeratology continued to refine the technique and improve lens designs until the first reverse geometry lens design in a high Dk material was introduced in 1989, creating a renewed interest among clinicians.[58–69] However, it was not until 2002, when the first Food and Drug Administration (FDA) approval for overnight corneal reshaping was obtained by Paragon Vision Inc. (Mesa, Az) for its CRT lens design that the schools or colleges began to provide more instruction in this area. FDA approval of the B+L VST procedure for orthokeratology was also granted in 2004, which provided even more options to the practitioner.

Over the last 10 to 12 years, there has been an increasing emphasis on understanding and preventing myopia progression, which has paralleled the development of orthokeratology. This is largely due to the increase in the prevalence of myopia in the United States from 25% (1971–1972) to 46% (1999–2004)[70] and promising results in myopia research.[71–81] Historically, management options have been limited as compared with the increasingly accepted forms of treatment today.[82] Orthokeratology, soft multifocal contact lenses, and atropine therapy are currently an essential part of the clinician's armamentarium for attempting to decrease myopic progression. So, how are future optometrists being educated on these options? What fitting modalities are being used in optometric education today? And is it enough?

SURVEY DESIGN

To address these questions, 23 schools/colleges of Optometry in North America and Puerto Rico were surveyed using a customizable web-based survey company called SurveyMonkey (www.surveymonkey.com). The participants surveyed were principal faculty involved in the didactic and clinical instruction in the area of contact lenses. The survey was designed with multiple choice and free text, "open-ended" questions to allow each participant to choose one of the answers or customize the response when the appropriate answer was not available. The free text option also allowed participants to provide additional commentary when necessary. Of the 23 schools/colleges that were polled, 20 responded, an 87% response rate.

RESULTS

This article summarizes the survey data in the areas of didactic and clinical instruction as well as the prescribing practices for orthokeratology and "myopia control" that are being recommended to future optometrists.

To know how much orthokeratology exposure students have in an optometric program, we focused on the total number of lectures within a required course (actual hours of instruction), additional specialized instruction within an elective course and laboratory instruction. It is important to note that every school reported giving one to two orthokeratology lectures within a required contact lens course. When evaluating the number of didactic hours of instruction each school offers, the survey results showed that 11

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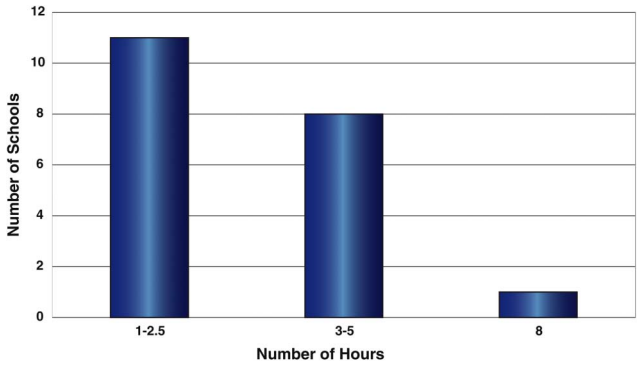

FIG. 1. Number of clock hours of orthokeratology instruction within a required course(s) at the schools/colleges of optometry. full color online

of the schools teach 1.0 to 2.5 hrs, eight schools teach three to five hrs, and one school teaches eight hrs of orthokeratology in the classroom (Fig. 1). These data represent the total number of "clock" hours that are dedicated to orthokeratology instruction within a required course(s) in the curriculum.

Of the 20 schools that responded, 65% have a corresponding laboratory course, 25% of the schools offer a separate orthokeratology course elective, and 10% have orthokeratology instruction within a general contact lens elective or seminar course. Laboratory courses provide supplemental content on contact lens design, fitting concepts as well as provide a "hands on" experience for students to evaluate fluorescein patterns and to troubleshoot orthokeratology lens fits.

It is promising to see that every schools/colleges of optometry has faculty who lecture in the classroom and also see patients in the clinics (Fig. 2). The number of didactic faculty that lecture versus teach in the clinic varies depending on the school. There are certain schools that have more faculty teaching didactically, and others that have more faculty teaching in the clinic. However, when removing the major outliers, these data are overall somewhat balanced. One confounding factor to note is that the same faculty is represented in both sets of data. Said differently, there are faculty who teach in the classroom as well as the clinic and are reflected in these data. This demonstrates that at certain schools, there is continuity from what is being taught in the classroom to how it is being applied in the clinical setting. Another point to consider from Figure 2 is that although seven schools (35%) do not offer a laboratory course and 13 (65%) schools do not offer an elective course, the students at those schools have the potential to gain experience with orthokeratology in their clinics.

In determining when students first learn about orthokeratology, we asked the schools to report at what point orthokeratology is being introduced during the optometry professional program. Most of the schools, 17, introduce orthokeratology into the curriculum early or midway through the students' third academic year, and two schools introduce it later in the third year, whereas three schools introduce it early on during their second year (Fig. 3).

This timing typically correlates, depending on the schools/colleges, to the level of experience and knowledge that students have clinically regarding specialty contact lens fitting.

One way to get an overall sense of prescribing practices for each school is to look at the recommended upper and lower limits for treating myopia. In Figure 4, recommendations for the lower limits of myopia range from −0.50 diopters (D) to −2.50 D. The average for the lower limit is −0.95 D and is represented by the dotted line.

Conversely when looking at the recommendations for the upper limitations for myopia treatment, the data range is much wider from −4.00 D to −10.00 D. The average for the recommended upper limit is −5.45 D. Therefore, on average, the schools/colleges are recommending treating at least approximately −1.00 D of myopia and upward of approximately −5.50 D of myopia. On average, the schools' recommendations for myopia treatment are consistent with FDA approvals in the United States. Although treating up to −10.00 D of myopia is performed regularly internationally, in the United States, treating above −6.00 D would be considered as "off label."

For those patients who do not achieve the full treatment effect with orthokeratology due to the patient having higher levels of myopia or when a patient does not respond to conventional treatment, another option called "partial correction" can be used. Partial correction refers to the overnight use of orthokeratology

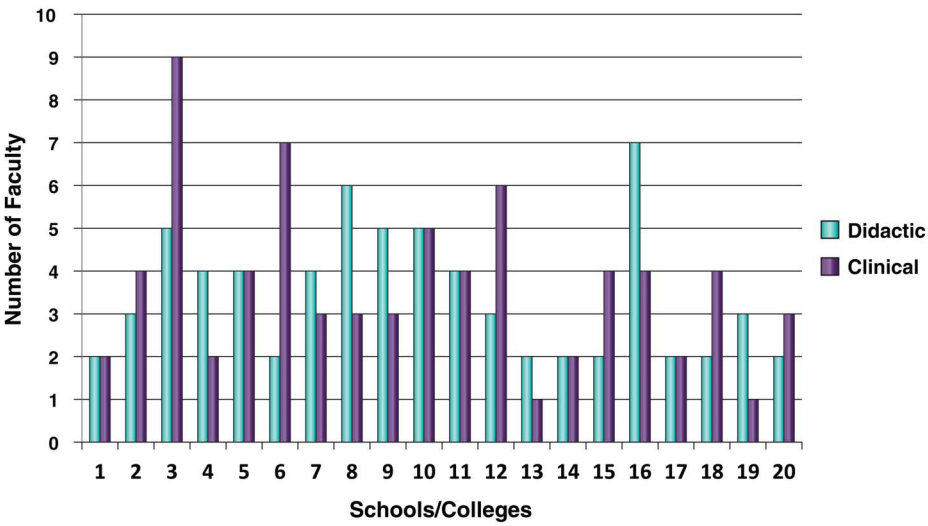

FIG. 2. Distribution of the number of faculty at each schools/colleges of optometry who teach orthokeratology didactically versus clinically. full color online

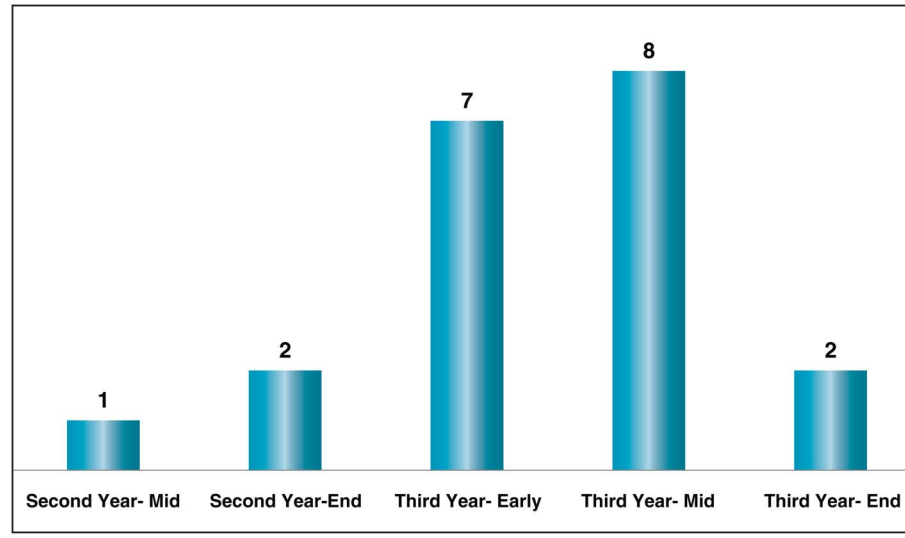

FIG. 3. Introduction of orthokeratology in the academic curriculum. full color online

lenses to reduce myopia and daily use of single-vision or multifocal glasses, soft contact lenses, or gas permeable contact lenses to correct the residual myopia. When surveyed on the topic of partial correction, 11 schools indicated that they teach students about partial correction, and nine schools do not include it in classroom instruction. One of the schools commented that partial correction is taught in the classroom but not practiced in the clinic.

Regarding age recommendations for treating myopia with orthokeratology lenses, 30% of the schools recommend treating myopia in children as young as 5 to 6 years of age, 35% recommend children 7 to 8 years of age, and 15% recommend fitting patients as young as 9 to 10 years of age. One school commented that the youngest patient who was treated in their clinic was 4 years of age (Fig. 5). Several schools commented, through free text, that the decision to treat depends more on the maturity level of the patient rather than age. In fact, three schools (15%) did not respond with a specific age. One school stated that in addition to the patient's maturity level, it also depends on the parent's level of participation.

Given the increasing interest in myopia control by patients and from a research perspective, the schools/colleges were surveyed on the preferred contact lens modality used for myopia control. As summarized in Figure 6, 70% of the schools use both orthokeratology and soft multifocal contact lenses, 10% of the schools use orthokeratology lenses exclusively, 5% of the schools prescribe soft multifocal lenses, and 15% do not use any of the modalities mentioned to control myopia. Comments from the 15% group stated that orthokeratology and soft multifocal lenses are not yet FDA approved for myopia control, and until such approvals are obtained, those modalities will not be used for the purposes of myopia control. However, those schools do fit both lens modalities in their clinics. In addition to using orthokeratology and soft multifocal lenses for myopia control, 1 school also uses gas permeable multifocals and atropine therapy. This particular school is the only school that has an official myopia control clinic. There are two schools that are also using gas permeable multifocal lenses, and two schools that are using gas permeable spheres for myopia control.

Orthokeratology instruction differs today versus 10 years ago partly because it has become more accepted at schools/colleges of optometry. The schools that responded to the survey indicate that overall, more patients are requesting the orthokeratology modality

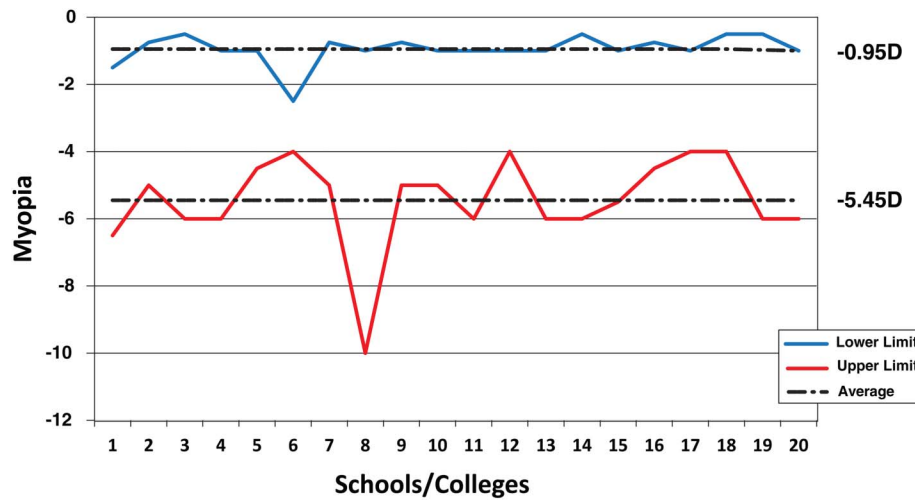

FIG. 4. Upper and lower limits of myopia treatment recommended by each schools/colleges of optometry. full color online

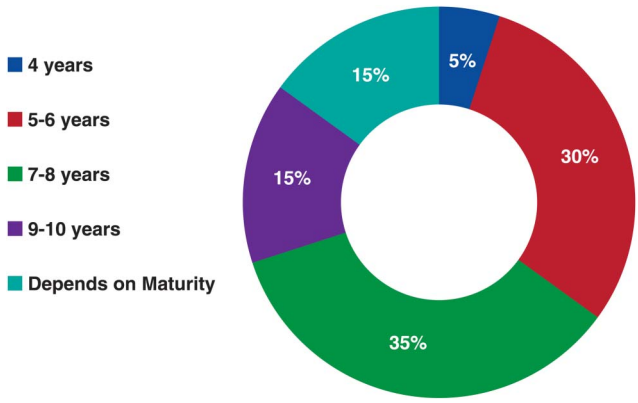

FIG. 5. Recommend age for the treatment of myopia using orthokeratology lenses by schools/colleges of optometry. full color online

as an option for myopia treatment. This provides an increase in patient interactions and additional experience for students and faculty. Coupled with advancements in lens design and newer materials, faculty are more comfortable using these lenses and present orthokeratology as more of a mainstream option for myopia correction and myopia control.

In Table 1, the average new fits per year at the schools are summarized. Four schools did not know how many new fits they averaged per year, seven schools have less than 20 fits per year, seven schools have between 20 to 100 new fits per year, and two schools have more than 100 fits per year. It is significant to point out that one of the schools in the ">100 average new fits" has a dedicated myopia clinic. These results are encouraging in that each school is now fitting new patients every year as compared to 10 years ago when the practice of orthokeratology within the schools/colleges was essentially nonexistent.

SUMMARY

Should there be more lecture hours involved in orthokeratology instruction? Today, each school is appropriately educating the students on the basics of orthokeratology with one to two lectures. Of course, not every student will be interested in orthokeratology or myopia control in their practice. What we need to consider is to have more schools offer orthokeratology course electives for those students who have a particular interest in gaining more experience in this type of specialty procedure.

It is promising to see that orthokeratology is being instructed in the classroom and being applied clinically at each of the optometry schools/colleges. Ten to 15 years ago, this was a different story. Orthokeratology was not widely accepted and in most schools was not included as part of the curriculum. There has been an evolution from 10 years ago to today, and it is now accepted as more of a viable option of for myopia reduction and, based on current research, myopia control.

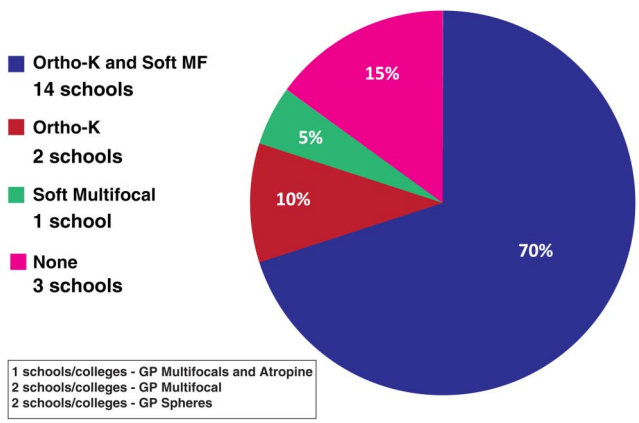

FIG. 6. Preferred contact lens modality for myopia control at schools/colleges of optometry. full color online

TABLE 1. *Average New Orthokeratology Fits per Year at the Schools/Colleges of Optometry*

New Fits	Schools/Colleges
>100	2
50–100	3
20–49	4
<20	7
Unknown	4

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