Videoimaging: The pros and cons

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The incorporation of videoimaging technology into orthodontic practice is indeed a hot topic these days. There has been an explosion of interest in this technology and how to apply it (or at least how to react or adapt to it!) to the orthodontic specialty. In the minds of most professionals, there are probably more questions than answers.

Videoimaging has the potential to touch almost every aspect of orthodontic practice: diagnosis and treatment planning, communication at consultations, data base maintenance (computerized images rather than photography), practice management, communication with other offices, and many other areas which have not been realized yet. Having been involved in the use of computerized imaging techniques since 1985, I have formed a fairly precise set of opinions on videoimaging, and will attempt to put forth in this commentary not only the positive aspects of this technology, but the negatives as well. Where I can, I will insert available data to help the reader recognize the science that has been applied to this merger of high technology and art.

Accuracy of hardware and software

Before hanging your diagnostic hat on any new technology, you should ask a simple question: is it accurate? In general, computers are very accurate in measuring things. As a matter of fact, that is exactly what they are best at, since they are infinitely precise, mathematically based beings. But are computers accurate in measuring things we see? In our 1988[1] study of a particular video software package, we found that the measurement of objects by the software package was very precise, and this is probably true of almost all quantitative software. In that study we noted that the measurement of the same objects on computer screens (i.e. what we see) was less accurate because of such hardware factors as screen curvature and distortion. Therefore, one of the most immediate potential pitfalls of visual computer technology is simply what we see is not what we get! For example, visualization of facial contours on a distorted screen could very well lead to erroneous patient or doctor interpretation of the images which would result in inadequate planning for a particular procedure.

Zernik's[2] paper in this issue of the Angle Orthodontist vividly illustrates the differences in doctor and patient interpretation of the changes which occur in this planning process. This problem can be overcome with appropriate choices of hardware, but the orthodontist should be cognizant of these pitfalls before making the decision to buy a particular software package, or the hardware being sold with it. Package A may have a software package which is totally off base as a quantitative unit, but have an excellent hardware setup which appears to make the entire package technically sound. Package B may have an excellent software system, but the choices of low grade hardware may hamper the performance of the software. An example is very simple: I spend big bucks to buy System B, but to save a few dollars, I choose as a display unit the TV set in the den which has a remarkable distortion ratio. So I measure in my treatment planning and

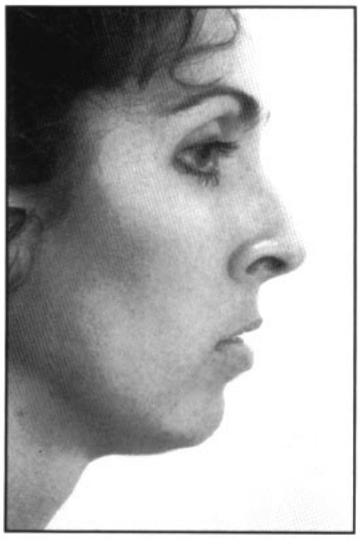

Figure 1

Figure 1
This patient's convex profile was characterized by a long lower facial height, lip incompetence, and deficiency of the mandible and chin. Dentally, the patient was on open bite

Figure 2

Figure 2
The orthognathic surgical plan, after quantitative integrated cephalometric and facial image planning, a specific final plan was agreed upon and quantified to produce this projected outcome. The orthodontic and surgical plan consisted of orthodontic decompensation followed by maxillary impaction, mandibular advancement, chin advancement with vertical height reduction, rhinoplasty, and submental liposuction.

Figure 3

Figure 3
The final profile after completion of treatment.

base my treatment objectives on images which are distorted. Very much like putting my new high performance car on retread tires.

PRO: Quantitative software is generally very accurate with good hardware.

CON: Selecting hardware and software can be difficult.

Patient interaction

The impact of videoimaging as a communication tool is tremendous, so much so that many clinicians are very cautious about its use from the medicolegal standpoint. Numerous questions arise in this area:

1. If I show the patient an image of an anticipated result, is this a warranty or implied guarantee?

PRO: In a study by Kiyak[3] at the University of Washington, 6 months after orthognathic surgery in a nonimaged population, only 45% of patients reported satisfaction with the esthetic outcome of their procedures. In the same time period postoperatively in an imaged population, we found that 89% of patients reported satisfaction with the esthetic outcome of orthognathic surgery. My conclusion is that because imaging provides a common visual template for both doctor and patient, realistic treatment plans and expectations of the outcome can be modelled. And our sample was studied before the technology enabled us to superimpose the cephalogram with the profile image. The surgical predictions we produced were done with image modification only. That is, we did not know the limitations of movements dictated by the functional demands placed on us by the underlying dentition.

The fact that we attained high patient approval may relate to the following possibilities:

a. As the Zernik[2] paper indicates, the ability of patients to recognize small differences in profile discrepancy is indeed small. The gross changes that occur with treatment are about all that are recognized, giving us a "cushion of recognizance" to work with.

b. Any visual imaging is certainly better than none at all. The large disparity between satisfaction of imaged and nonimaged patients despite the crudeness of technology used in the 1988 sample indicates that in the surgical population we tend to be at a great communication disadvantage without videoimaging[1]. Current data seems to support this contention (Sinclair[4], Hill[5]).

In Ackerman's paper[6] "Bioethics and Informed Consent-Applications to Risk Management in Orthodontics", the author discusses the absolute need for the orthodontist to "discuss with" the patient and parents the risks, benefits, and alternatives of treatment rather than to "tell them" what they need. He points out the uncertainty of verbal communication in that the orthodontist may have one picture in mind while the patient may have quite another. He further states that the use of computer imaging as a communication tool most certainly will become a routine practice in orthodontics because it will substitute pictures for words. Therefore, rather than being a risk management hazard, computer imaging may indeed be an excellent tool for informed consent.

CON: In the state of California, it is my understanding that the medical malpractice carriers forbid the use of videoimaging in patient care. I readily admit I do not know how they arrived at this recommendation, but I will hazard a few guesses:

a. Soft tissue surgery -- the type of procedure for which the rules were likely promulgated -- is not as readily quantified as is orthognathic surgery. For example, the response to nasal surgery may be

Figure 4

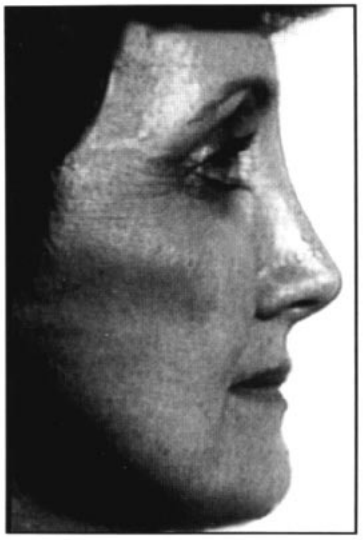

Figure 5

Figure 6

Figure 4
This patient exhibited a "europrosopic" skeletal pattern characterized by a concave profile and square jawed appearance.

Figure 5
The proposed surgical treatment plan of clockwise occlusal plane rotation via posterior maxillary impaction and ramus osteotomies was visualized and quantified through computerized videoimaging techniques. This is a surgical plan which is difficult to visualize and plan without video interaction.

Figure 6
Final treatment result.

affected by such factors as thick dermis, age and soft tissue elasticity, and functional considerations which may override esthetic decisions. Soft tissue response to bony and tooth movements tend to be much more predictable, at least to the degree discernible to patients and doctors.

b. As we all recognize, the patient who seeks treatment for purely esthetic reasons represents a whole subset of psychological considerations which we are probably not equipped to handle as well as we would like. Self image problems and neurotic behavior are big factors in the patient's decision process, and school is clearly out on how imaging interacts with this type of patient. Candidly, I am not sure how we as orthodontists can efficiently identify patients who would benefit from presurgical or preorthodontic psychological evaluation.

2. Will the patient sue me if the actual result does not match exactly with the projected result?

We just can't predict when or why a patient might decide to sue. And while this threat should not deter us from further development or use of videoimaging technology, we should be wise and use specific informed consent for imaging.

PRO: Present data does not support this fear. Again, patients who have been imaged before surgery report much higher satisfaction rates postoperatively than do nonimaged patients. After more than 500 surgical experiences I feel much less medicolegal pressure than before. However, this may be a result of other factors in addition to the procedure of videoimaging. Some of these factors will be addressed later in this paper.

CON: This particular legal concept has yet to be tested in court. But as we treat more patients, some unsatisfied patients will surely seek legal redress and this concept will be tested. Remember, while 89% of our imaged patients reported satisfaction, 11% were not satisfied. What percentage of this population will seek legal solutions? It will happen, and the determination of implied guarantee will be decided by a jury of our peers in spite of all good intentions. Who will be the first?

3. What other factors affect the predictive accuracy of videoimaging?

Like all endeavors in medicine, each question has many answers. Lets divide this question into many parts, and look at the pros and cons of each:

a. Surgical vs. adolescent treatment prediction . The predictive factors here are very different. In the adult surgical patient we are dealing with a certain amount of stasis. The patient is not growing and we are planning hard tissue movements and can plug in reasonably documented soft tissue responses in an effort to predict as closely as possible the final profile response. (Please notice I have specifically described the profile response. At this point, 3-D is an entirely different topic).

In the case of adolescent treatment prediction, we must accommodate hard tissue growth prediction, soft tissue growth prediction, cooperation, variability of treatment response, and a myriad of factors which affect outcome. Add to this the pressure of parental expectation that their child turn out beautifully.

CON: All the factors above add up to the fact that the accuracy of outcome projections for growing patients can be highly variable. We are just now generating studies of the accuracy of imaging in surgical prediction, and we simply do not know how accurate the projection of adolescent treatment is. There exists in my mind the certainty that all of us will experience a patient who feels that his or her particular outcome does not meet expectations.

PRO: Again, the use of pictures to communicate is worth a thousand words. We may miss a valuable point if we write off imaging as being unpredictable in adolescent care. The use of image modification in the Class II mandibular deficient child, for example, is a helpful tool in discussing treatment options such as growth modification (whatever is required to reposition the mandible forward), retraction of maxillary anterior teeth via extraction, surgery, genioplasty and/or rhinoplasty to esthetically camouflage skeletal dysplasia. The imager allows us to fluently discuss, through the use of pictures, treatment options and their effect on profile in a manner which the patient can readily understand.

b. Surgical and orthodontic accuracy. This is an area of discussion I like to label "the ability to deliver the goods". Computer imaging is a powerful and exciting instrument which has great promise for us. But, as clinicians we still have to treat patients! The "Robo-orthodontist" does not yet appear on the horizon. There is no question in my mind that the use of imagers increases not only the recognition of problems in the diagnostic phase of treatment, but also increases the need for accuracy in surgical cases (Figures 1-3). This entails a sort of bittersweet scenario: The use of computer aided treatment design greatly enhances the planner's ability to design a surgical plan very discreetly prior to entering the operating room, equipped with precise numbers which may contribute greatly to the ultimate success of the operation. But it also places the burden on the surgeon to be as accurate as possible.

CON: In the preparation of surgical predictions, the planners should be honest in their projections. The pressure to "sell the case" should be resisted and an honest attempt to communicate with the patient to arrive at the desired outcome should be the goal of an imaging session.

There may be the temptation to lose sight of that objective, so that the features of enhanced communication becomes potential factors of coercion.

Once a particular treatment plan is decided upon, the team should be able to deliver the goods. Once a surgical plan is quantified and agreed upon, it is important for the treatment team to be as precise as they can in achieving the movements as outlined.

Summary

I have tried to make some thoughtful points based on a fair amount of experience in the use of videoimaging, both in research and clinical application. The technical development of computerized videoimaging has progressed greatly in the past several years, in response to the profession's interest in it. While many orthodontists have become interested in this technology because of its potential in communication and marketing, I feel its greatest potential lies in the area of diagnosis and treatment planning. The use of integrated and facial images has allowed me to visualize the face (primarily in profile, although the frontal view can be useful when evaluated and manipulated properly) and recognize particular aspects and patterns of treatment options I had not recognized before (Figures 4-6).

Obviously, a great deal of research must be done in the future before we can completely integrate this technology into our treatment of patients. These studies are just beginning. I feel confident that computerized videoimaging will help expand our vision as we strive to deliver the best care possible; nevertheless, we must evaluate this technology rationally and define its strengths and weaknesses just as clearly as we have for our cephalometric tools.

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