

An Exploration into the History and Plausibility of Clinical Photography as it Relates to Physical Therapy.

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Photography provides the physical therapist with the ability to accurately record clinical data in a way no other medium can provide. For over 150 years photography has provided us with an image record of historical events, scientific discoveries, the wonders of nature, and the depths of humanity. To date; photography is part of every human being's life. Every day the average person in the United States is exposed to over 1000 camera images.¹ In 2002 alone, there were an estimated 75,000,000,000,000 images recorded on film.² It is estimated that, as of 2002, there were 900 billion photographs archived throughout the world with an estimate of 75 to 100 billion being added yearly.² These images invoke memories, record events, document science, and provide us our world view from both a literal and a figurative standpoint. They identify us and they define us. One of the major ways in which we interpret the world is through vision. As visual technology advances and proliferates, our world is bombarded and dominated by visual imagery. As our technology propels our society forward, we rely less and less on oral and textual media for the acquisition of knowledge.³

At the time of its invention, photography was looked upon as the ultimate tool for capturing reality. In the mid nineteenth century it was called the "mirror with the

¹ MSN Encarta. "History of Photography", 2006.

http://encarta.msn.com/encyclopedia_761575598/History_of_Photography.html

² Regents of the University of California, "How much information? 2003" 27 Oct 2003, <http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/photo.htm>

³ Sturken M. & Cartwright L., 2001, Practices of Looking. Oxford University Press, Oxford.

memory.”^{4,1} From the time of its inception, photography was lauded for its benefits as a completely objective scientific research tool. The Camera had the ability to faithfully record whatever data was placed in front of it. It can be argued that the camera is an irreplaceable tool in *every* field of scientific study. A few examples of this are: criminology, forensics, ethnology, social sciences, biology, physics, mathematics, geology, archaeology, anthropology, ecology, oceanography and, of course medicine. As a research tool the benefits of photography’s are undisputable, as evidenced by significant body of research discovered by this author. With specific regard to physical therapy, examples of this were found in the areas of ergonomics, posture, wound management and range of motion.^{insert references here, 1 or 2 per example} But, what about benefits of photography to the physical therapist for clinical documentation. Recent advances in technology have made photography’s accessible to every clinician. Advances in digital recording technology have removed significant barriers to the practicality of the use of photography within clinical practice. Advances in record keeping modalities provide a realistic conduit for the inclusion of photographs in the clinical record. This paper seeks to explore the clinical benefits of including photographs in patient record.

A Brief History of Photography

A review of the history of photography reveals that the camera was invented 300 years before the film that would make recording images possible. The “Camera Obscura” (from the Latin meaning *dark room*) was, in fact a very large room with a pin hole on one side and a glass plate or canvas on the other. Artists would direct the pinhole side of the

⁴ Washanbaugh, William. 2004, Essay: Anthropology, Photography & Popular Culture, <http://www.uwm.edu/~wash/302photo.htm>, University of Wisconsin, Milwaukee

“camera” at their subject and an image of that subject would project on the opposite wall. Although earlier versions of the device had no optics, lenses were added later.⁵⁶ In the renaissance period, it was Leonardo Divinci that developed the camera obscura to assist artist in gaining a realistic aspect to their work.⁷ Immediately, the camera obscura was viewed by the scientific community as a miracle device for the accurate recording of data. This is evidenced in the work of Jonathan Crary: *“This highly problematic object was far more than simply an optical device. For over two hundred years...it stood as a model, in both empiricist and rationalist thought, of how observation leads to truthful inferences about the world, at the same time the physical incarnation of that model was a widely used means of observing the visible world, an instrument of popular entertainment, of scientific inquiry, and of artistic practice.”*⁸ As science developed an understanding of light sensitive materials, the reality of preserving the images provided by the camera obscura became a reality. The first usable and sustainable light sensitive recording media is credited to a French artist; Louis Jacque Mandé Daguerre. In 1839 he presented the French Academy of Science with a process for recording the images from the camera obscura on a copper plate treated with silver iodide exposed to mercury fumes and finally washed with a salt solution. The process was known as a *daguerreotype* and marks the first use of photographic technology. Newspaper accounts of the discovery remarked that this new process provides “a truth which nature alone can give to her works.”¹

⁵ Leggat MA M.Ed Ph.D. FRPS FRSA, Robert. 1995, “A history of photography from its beginning till the 1920” , <http://www.rleggat.com/photohistory/> , London, England

⁶ Gernsheim, Helmut. The Concise History of Photography: Thames & Hudson, 1986

⁷ Kiang, Tanya. “Dark Wonder” *CIRCA* 96, Summer 2001, pp. 22-24

⁸ Jonathan Crary, Techniques of the Observer: on Vision and Modernity in the Nineteenth Century, MIT Press, 1991

Photography and the Absolute Truth

From its inception, photography has been lauded for its ability to record the natural world exactly as it is. As mentioned previously, in the mid nineteenth century it was called the “mirror with the memory.”^{9,1} It is a long held cultural belief that the camera is almost magical in the way it can record our world. Evidence of this cultural paradigm can be seen at every turn in history and in our contemporary world. The old adages; “seeing is believing.” and “I’ll believe it when I see it.” both speak to our cultural trust in the visual image. The ability of the camera to create a faithful representation of reality has always made it an attractive medium for scientific documentation. Medical research using photography has been documented as early as 1852 with the work of Dr. Guillaume Duchenne.¹⁰ Duchenne was a French physiologist and psychiatrist. During the years 1852 – 1856, he conducted a series of experiments which he called “electrophysiology.” As a component of these experiments, he photographed the faces of psychiatric patients as he administered electric stimulation to the facial muscles. The result was an extensive record of the reaction of facial expression to electric stimulation. It is clear that it would be difficult if not impossible to convey detailed observations of these expressions without a graphic representation of the data. Prior to the use of photography, this would have been accomplished through the artist’s pen.¹¹ It was clear that photography had ushered in an entirely new age of scientific and medical research. With western culture already relying

⁹ Washanbaugh, William. 2004, Essay: Anthropology, Photography & Popular Culture, <http://www.uwm.edu/~wash/302photo.htm>, University of Wisconsin, Milwaukee

¹⁰ Mauro, Peter Hayes, 2000, Duchenne: Discourses of Aesthetics, Sexuality, and Power in Nineteenth-Century Medical Photography, *ATHANOR XVIII*, Press of the FSU Museum of Fine Art, Tallahassee, FL

¹¹ Martin Kemp, 1997 “A Perfect and Faithful Record: Mind and Body in Medical Photography before 1900,” Yale University Press, New Haven & London

heavily on visual documentation¹², photography solidified the paradigm that it was an absolute and indisputable record of the world. Duchenne describes his experiences with photography as a perfect mirror of reality.¹³

Photography and the Relative Truth

Even with only a basic intuitive understanding of photography, the ability of a photograph to accurately record the physical world was intuitive most 19th century observers.¹ This concept has endured and is perpetuated by the exponential growth of the visual media in our society.² It seems almost innate to us to simply take what we see at face value. It is this deeply imbedded cultural precept that is the basis for some great misuses and misinterpretations of photography in medicine. As photography was gaining popularity, the prevalence of photographic data allowed for a research base into the validity of photography as a science. Was photography *absolute*? Was it always *faithful*? Clearly it had the potential to record a complex array of data in snapshots of time that measured in fractions of a second, but what of the perspective of the photographer or researcher. Has our almost primal trust in what we see opened us up to deception? Susan Sontag, in "On Photography" remarks: "*The photographer was thought to be an acute but non interfering observer--a scribe, not a poet. But as people quickly discovered that nobody takes the same picture of the same thing, the supposition that cameras furnish an impersonal, objective image yielded to the fact that photographs are evidence not only of what's there but of what an individual sees, not just a record but an evaluation of the*

¹² Riley, Robin G., 2004, The uses of Photography in Clinical Nursing Practice and Research: a Literature Review, Journal of Advanced Nursing, 48(4), 397 - 405

¹³ Duchenne, Guillaume-Bejamin, The Mechanism of Human Facial Expression, (pp. 39-40) trans. Cuthbertson, Andrew, 1990, Cambridge University Press, Cambridge.

world."¹⁴ Alan Trachtenberg, in his work; "Reading American Photographs" writes:

"Photographs transcribe, not "reality", but the world as it was seen and recorded...in the picture we see the world from the angle of the camera's partial vision, from the position it had at the moment of the release of the shutter." As photography has become part of our culture, our culture has been changed by it. We have begun to realize that; contrary to all outward appearances, photography has a large subjective component. This dichotomy of a device, so widely accepted as science having the ability to record both the reality of a subject while simultaneously subjectifying it is difficult to grasp. We are subjects of this kind of visual deception whether we realize it or not. If you have ever been intrigued by the progressive series photographs in cosmetics literature, weight loss literature, plastic surgery literature and even posture photographs of the chiropractic and physical therapy literature, you have been subject to the perspective of the author of the photograph. Although, we are essentially subject to the perspective of the author of any presentation of data, the visual data (especially photographs) are particularly difficult to be critical of. This first case in point is significant because it is the most prevalent and identifiable example of how we *can* be manipulated by the perspective of the photographer. It is not implicit that this manipulation occurs, but the potential is there. Often we see technically inferior "before" photographs compared to technically superior "after" photographs. This is a basic instance where simple (even unintentional) manipulation of the data can lead to misinterpretation. This seems to be the most prevalent in settings under which the photographer stands to make gains from photographic manipulation. Marketing practices often forego the objective potential of the photograph in favor of its ability to sell. Examples of this can be seen in hair re-growth advertisements, ads for skin cream and

¹⁴ Sontag, Susan, 2001, *On Photography*, Picador, NY, NY

especially weight loss campaigns. As technology advances, our ability to be fooled seems to be outpacing our awareness that we are being fooled. Hewlett Packard has introduced the "SlimCam." The HP Photosmart R727 digital camera has a "slim" setting. As reported by the London Daily Mail: "The 'slimcam setting' on the gadget uses high-tech digital trickery to shave a few inches off its subject. Marketed at women, the feature squeezes the picture in the middle, so the main object in focus looks thinner - but its surroundings are left unchanged."¹⁵ Software has even been developed to allow an average computer user the illusion of a flawless face. As NewScientistTech reports: "We ALL know that pictures of models and celebrities are given a little digital "enhancement" before they appear on magazine covers. Well now you too could enjoy such treatment: an algorithm has been developed that morphs photographs of human faces into subtly more attractive versions of themselves. By making tiny adjustments to the distances between hundreds of different facial features, the "digital beautification" algorithm is designed to make a face more attractive in just a few minutes without significantly altering the person's appearance."¹⁶

Far more dangerous to the scientific world than simple photo-trickery is false assumption. Duchenne's work, for example was the basis for his theories on how a person looked at a particular moment in time predicated their mental state. His research, and the photographic data was the basis for his theories that insane people looked insane. He used the preception of the camera as a "perfect mirror" to propagate the notion that a person's

¹⁵ Daily Mail 24 hours a day, 16th August 2006 "Camera which comes with a slim-fast setting"
http://www.dailymail.co.uk/pages/live/articles/news/news.html?in_article_id=400814&in_page_id=1770&in_a_source=

¹⁶ Biever, Celeste. 10 August 2006. "From snapshot to cover model in a single click." issue 2564 of New Scientist magazine, page 26

mental state could be derived from how they looked. This notion propagated current stereotypes about people that fell out of social norms. Although his photographs and accompanying research were highly subjective and based on social predispositions of the time, his photographs were understood to be in truthful support of his thesis. His work even caught the attention of his contemporaries like Charles Darwin.¹⁰ Alan Sekula sees the cultural functions of photography and he sees that photography, especially in the 19th and early 20th centuries, was the perfect medium for reinforcing social hierarchies.¹⁷ One of the most expansive bodies of research employing the use of photographs was the work of W.H. Sheldon.¹⁸ This extensive study spanned over 20 years from the 1940s to the 1960s. It involved the practice of taking nude "posture photographs" of every entering freshmen to some of America's most prestigious ivy league schools and their sister institutions. As Ron Rosenbaum, an editor for the New York Times and subject of the study, remarks of a letter received by George Hersey, a respected art history professor at Yale. Hersey declared that the photos "had nothing to do with posture . . . that is only what we were told." Hersey went on to say that the pictures were actually made for anthropological research: "The reigning school of the time, presided over by E. A. Hooton of Harvard and W. H. Sheldon" -- who directed an institute for physique studies at Columbia University -- "held that a person's body, measured and analyzed, could tell much about intelligence, temperament, moral worth and probable future achievement. The inspiration came from the founder of social Darwinism, Francis Galton, who proposed such a photo archive for the British population."¹⁸ Sheldon, who also had propagated theories about the limited intelligence capacities of African-Americans and

¹⁷ Sekula, Alan. 1986, "The Body and the Archive" *October (Journal Name)* Vol 39:6

¹⁸ Rosenbaum, Ron. "The Great Ivy League Nude Posture Photo Scandal." *New York Times Magazine*. 15 January 1995: 26, 31.

Mexicans, had developed elaborate theories about how identification of body types could predict success in life. According to Sheldon's "somatotype" theory, human beings can be divided into three distinct body types: skinny, nervous "ectomorphs", fat and jolly "endomorphs", and finally confident, buffed "mesomorphs." Although his research was far more extensive and complex, his basic conclusions asserted that every individual harbored within him different degrees of each of the three character components. By using body measurements and ratios derived from nude "posture" photographs, Sheldon believed he could assign every individual a three-digit number representing the three components, components that Sheldon believed were inborn, genetic and remained unwavering determinants of character regardless of transitory weight change. In other words, physique equals destiny. In other words, your physique (somatotype) determined your future. Bolstered by his massive database of photographic data, his pseudoscientific "somatotype" theory received popular acclaim. In fact, Life Magazine ran a cover story about the findings in 1951.^{18, 19} In 1977, William Henry Sheldon died at the age of 79. At the time of his death he had been completely discredited as a scientist even though he was the author of numerous papers and eight books.¹⁹

Photography as the Mother of Modern Medical Imaging

Although Nikola Tesla and Heinrich Hertz each experimented with cathode rays as early as 1887, it was Wilhelm Conrad Röntgen, in 1895, who coined the term "x-rays" to describe a new kind of radiation produced from cathode tubes. He noticed that images of varying light intensities were produced when objects of various densities were exposed to the x-ray beam. It was instinctive for him to place a photosensitive plate at the plane of

¹⁹ Hewett, David; 1998, The Amazing Fall from Grace of William Sheldon, Maine Antique Digest

this image so that it may be recorded. Within 8 months of his first discovery of the phenomenon, Wilhelm Röntgen had successfully recorded the first X-Ray image of his wife's left hand. By 1901, his work with x-ray imaging had earned him the very first Nobel Prize for physics.^{20,21} It is from these beginnings that all medical imaging technology finds its origins. As physical therapists begin to increasingly draw their clinical and research knowledgebase from x-rays, ultrasound, DEXA scan, MRI, CT and other imaging technologies, we need to be sensitive that they all have their roots in the camera obscura of early history. This is an important footnote to the study of clinical photography even though further discussion on this topic exceeds the scope of this paper.

Benefits of the use of Photography in Physical Therapy Practice

Photography as an Alternative to X-rays.

It can be argued that x-rays provide objective quantification of posture. Chiropractors typically use x-ray to evaluate the posture of their patients. As it states in one chiropractic Journal: "Of course, radiographic examination may also be helpful in evaluating a patient's posture since the x-ray passes through the patient's three-dimensional posture and is captured as a two-dimensional artifact on the x-ray film."²² Historically, however, physical therapists have had limited access to x-ray equipment and personnel. In the state of New York, as with all other states, physical therapists are specifically prohibited

²⁰ X-RAY, In *Wikipedia, The Free Encyclopedia*. Retrieved August 10, 2006, from: <http://en.wikipedia.org/wiki/X-ray>

²¹ Mould, R F. "The early history of x-ray diagnosis with emphasis on the contribution of physics 1895-1915", 1995 *Phys. Med. Biol.* 40 1741-1787

²² Troyanovich, Steve & Seaman, David. *The Chasm Between Posture and Chiropractic Education and Treatment*. Dynamic Chiropractic, January 1, 2000, Volume 18, Issue 01

exposing patients to x-rays as part of their practice.²³ even if physical therapists had the ability to evaluate by x-ray, the cost of the equipment, the time in positioning and exposing the patient to the x-rays as well as the frequent dosing of radiation to the patient makes radiological examination impractical for the serial data collection required for clinically significant postural analysis. In orthodontia, it is common for orthodontists to evaluate the natural head posture of their clients while assessing the effectiveness of their orthodontic treatments. Currently, photography is being considered as a viable alternative to postural evaluation by radiologic examination. In one study, the author proclaimed: “replacement of the radiographic method with the photographic method for assessing natural head posture reproducibility appeared justified.”²⁴

Photography as a method of improving inter-tester reliability

Photography offers archival objective data and appears to improve intertester reliability with regard to clinically relevant observations. The inter-tester reliability of photography has been demonstrated with the recording of range of motion data^{25,26, 27} and postural data²⁸, as well as, with the classification and staging of wounds. In the latter example, it has also been suggested that photography may decrease the differences between novice

²³ New York State Education Law, Article 136, and section 6731-b.

²⁴ Bister, D., Edler, R, Tom, D. and Prevost, A, natural head posture considerations of reproducibility, European Journal of orthodontics 24 (2002) 457 – 470.

²⁵ Anderson, S. Fryer, G. McLaughlin, P. The effect of Talo-Crural joint manipulation on range of motion at the ankle in subjects with a history of ankle injury, Australia Chiropractic and Osteopathic volume 11 number 2 July (2003) 57 – 62

²⁶ Fryer, G. Mudge, J. McLaughlin, P. the effect of Talo-Crural joint manipulation of range of motion at the ankle joint. Journal Manipulative Physiotherapy (2002) 25:384 – 90

²⁷ Moseley, A. & Adams, R. Measurement of Passive Ankle Dorsiflexion: Procedure and Reliability, the Australian Journal of physiotherapy(1991) 37 3, 175 – 8

²⁸ McEvoy, M. & Grimmer, K. reliability of upright posture measurements in primary school children, BMC musculoskeletal disorders (2005) 6:35

and expert when comparing visual cues²⁹, thus implicating photography as a catalyst for the improvement of clinical observation as well as simple clinical documentation.

Significant decrease in time required during data collection. Most physical therapist would agree that when they are in front of the patient; time is an ultimate premium. This is particularly true during the evaluative process. Moments that may be recorded in a fraction of a second with a camera may take minutes to observe measure and record by conventional means. Photography offers significant benefits, with regard to time and management during evaluation. This is especially true when evaluating populations in which attention span is a concern.²⁹ Furthermore, the photographic record is available for future securitization by third parties.

Photography as a tool to improve third-party reimbursement

photography provides a tool for the clinician to include an indisputable piece of clinical data into the patient record. As previously mentioned photographs are very often taken at face value as well they should be, when produced under strict scientific standards. It is this understanding that allows third-party payers to evaluate photographs in patient's chart with complete objectivity. Given this objectivity, the photographs included in the patient chart have the ability to help support the case for the reimbursement of the care provided to the patient.

Photography Provides an Improved Perspective

During the evaluation of the patient, the physical therapist is very often limited in his ability to step back from the patient by the length of his arms. An example of this is a

²⁹ McGuinness, B. & Axford, R. Exploring Nursing Knowledge by Using Digital Photography, Stud Health Technol Inform. (1997) 46:281 - 7

physical therapist observing the position of anterior superior iliac spines, while simultaneously palpating the landmarks. In this case, the therapist is limited on how far he can remove himself from the patient by the length of his arms. This impairment of perspective often leads to errors and observational judgment. The same can be said during the evaluation of range of motion using conventional goniometric techniques. During the acquisition of range of motion measurements the physical therapists perspective is limited by the length of his arms. With photographic evaluation, the physical therapist is limited only by the preset patient to lens distance. This distance can be altered to suit the needs of a specific evaluation thus allowing the physical therapist a tailor-made perspective during the acquisition of data. This tailor-made perspective, may provide for improved accuracy during the physical therapy evaluation. This in conjunction with the ability of the physical therapists to reevaluate the same data. More than once, makes photography, a potentially valuable clinical documentation tool.

Multiple and intricate data available from a single photograph.

Once a photograph is taken multiple measurements can be obtained from that single exposure. In a study published in February of 2003 NASA evaluated the neutral body posture of a shuttle mission. During this study, three simultaneous photographs were taken of astronauts in their neutral body posture under microgravity conditions. Photographs were taken one from the side one from the front and one from the top, thus providing a three-dimensional analysis of neutral body posture. From this data, which took a mere fraction of a second to record now so was able to study 16 distinct indicators

of neutral body posture, through measurements of multiple joint angles.³⁰ Another study conducted by the motorcycle industry used photography to evaluate several parameters of the sitting posture of the rider of motorcycles. The multifaceted data collected in this study allowed biomechanical engineers ultimately improve the overall safety and comfort of motorcycles.³¹ The ability of photography to capture massive amounts of data for later analysis could provide the physical therapists with an invaluable clinical documentation tool.

The Need for Standardization

With the recognition of the importance of accurate and appropriate use of photography in medical practice, a relatively new profession has emerged. Biomedical photographers are professionals with a minimum of a two year degree and may possess certification from either the Biocommunications Association or the Ophthalmic Photographers' Society. These education standards and professional organizations seek to raise the standards of medical photography. The knowledge base of a true medical photographer includes all the technical aspects of photography as well as an acute sensitivity to the best practices of science.^{32, 33} Using a certified medical photographer usually provides the highest standard of clinical relevance.³⁴ Clinicians do not necessarily need the services of a biomedical photographer in order to achieve clinically significant results. If the clinician seeks to understand the technological basics of his equipment as well as some common

³⁰ Mount, F., Whitmore, M. & Stealey, S., (2003) Evaluation of Neutral Body Posture on Shuttle Mission. NASA TM – 2003 - 104805

³¹ Zellner, J. & Rogers, N, (2006) Presentation: International Motorcycle Safety Conference

³² Biocommunications Association Website; <http://www.bca.org/>

³³ Ophthalmic Photographers' Society Website: <http://www.opsweb.org/index.htm>

³⁴ Naylor, JR. 2003, Clinical Photography: A Guide for the Clinician, Journal of Postgraduate Medicine; 49:256-262

sense standardization techniques, acceptable results are attainable. In order to achieve the highest standard of clinical relevance the construct of supreme objectivity must be established. It must be understood that the accuracy of the data recorded should always remain the principle priority of the photograph and that aesthetics are not generally maintained. The photographs must be simple, uncluttered and focus on the data collection. Photo trickery and photo-manipulation have no relevance to clinical documentation. Very often serial photographs taken over time have the greatest clinical potential. Photographs taken in series can show the progression of disease or the response to treatment. Photographs that are too dark, too light, have obscuring shadows, are unsharp, have color variations, have important details obscured, have inconsistent or indeterminate scale or serial photographs that just don't match will greatly impair their clinical value. Clinicians armed with even the simplest equipment and some basic conventions can achieve acceptable results.

Basic Techniques for Maintaining Clinically Relevant Photographs

Keep Accurate Records

When photographing for the clinical record is important to keep accurate written records. Meticulous record-keeping is paramount to success of a clinical photography program. Data collected about the circumstances under which the photograph was taken are tremendously important to the reproducibility and reliability of the data. Type of camera, lens to subject distance, lens type and exposure data are all helpful in recreating an

analogous future photograph.³⁵ Additionally, careful records will help explain inconsistent data and allow for extrapolation of clinical relevance and value.

Patient Positioning

Ambiguous positioning of patients can lead to confusion in the interpretation of clinical photographs. This is especially true of close-up photographs and photographs taken in series.³⁶ As in the study of anatomy, the anatomical position is considered the industry standard during acquisition of clinical photographs. The top of the photograph should always be nearest the head. Although this works for most situations, some parts of the anatomy are best viewed from other angles or perspectives. Arms are often photographed in extension and in a horizontal position. The palms however, should still face ventrally, so the back of the forearm should be photographed with the patient facing away from the camera. Close-up views, which can be easily misorientated may be accompanied by an overall view to establish a frame of reference. For obvious reasons, photographs evaluating faulty posture may not lend themselves to the anatomic position. In these cases position as standardization should be observed as best as possible. It is difficult to produce satisfactory full body photographs of normal stature adults wall by air and prone or supine. It is rare that photographs of this nature can be taken with a normal lens given the short working distance from the subjects to the lens. Although a clinician and may be tempted to use a wide angle lens, under the circumstances. It is ill advised, because of the distortion endemic to these lenses.

³⁵ L'HommeDieu, Russ, 1990, The Effects of Spontaneous Visual and Verbal Training Vs. Verbal Training Alone to Make Positive, Lasting Changes to the Posture of People with Parkinson's Disease. Master's Thesis, Touro College School of Health Sciences.

³⁶ Williams, AR. Positioning and lighting for patient photography. Journal biological photography (1985) 53:131-43

Magnification

The preservation of scale through the standardization of magnification is critical to accurate clinical photography. For the purposes of physical therapy documentation, it may be appropriate to simply keep constant and document the magnification of the lens used and the lens to subject distance. Biomedical and a photographers often refer to a table known as the “Westminster Scale” to standardize the magnification of anatomical photography. This scale provides biomedical photographers with a table of standards for commonly photographed anatomical views.³⁷

Perspective

The perspective of a photograph refers to the literal point of view from which the photograph is taken. The focal length of the lens length and the angle at which the photograph is taken are major contributors to the perspective of the photograph. The focal length of a lens is defined by the distance (often in mm) from the end of the lens to the film plane. The same focal length lens should be used for all photographs in a series. The focal length determines the amount of optical distortion in a photograph. The shorter the focal length, the greater the distortion is at the edges of the frame. This can be observed when viewing a photograph taken with a fisheye lens. The term fisheye comes from the extreme distortion found at the edges of these photographs. The convexity of the lens collects and “bends” the light it captures so that it view a large visual field.

Unfortunately, while in the pursuit of this goal of obtaining a large visual field, significant distortion of the perspective of the photograph occurs. Lenses under 28mm of

³⁷ McCausland, TM. A method of standardization of photographic you points for clinical photography. *Journal Audiov Media Med* (1980) 3:109-111

focal length are often prone to this type distortion. The least lens distortion is noted at a focal length is 100mm.³⁴ This focal length however, is impractical when space is limited secondary to the amount of magnification it produces. Based on this premise, a focal length of 50 – 60mm would be acceptable for clinical documentation.

Depth of Field

The **depth of field** (DOF) within a photograph is the distance in front of and beyond the subject that appears to be in focus. There is only one distance at which a subject is precisely in focus, but focus falls off gradually on either side of that distance, and there is a region in which the blurring is imperceptible under normal viewing conditions.³⁸ The smaller the aperture of the lens, the greater the distance of acceptable focus. On conventional lenses, the aperture size is denoted by the f-numbers. The higher the f-number, the smaller the aperture and the greater the depth of field. Given the fact that the aperture of the lens controls the amount of light striking the film plane, it is intuitive that achieving greater depth of field is directly proportionate to the amount illumination of the subject. The less light available at the time of photograph more impaired the depth of field. Since the accurate focus of a photograph improves its clinical significance, depth of field is an important consideration. Depth of field is particularly important when photographing objects close up. Every attempt should be made to maximize the depth of field when performing close-up photography. Given the relationship between lighting and depth of field, it is important to use a flash during clinical photography.

Lighting

³⁸ Depth of Field. (2007, Jan 01). In *Wikipedia, The Free Encyclopedia*. Retrieved January 02, 2007, from http://en.wikipedia.org/wiki/Depth_of_field

As mentioned in the previous section, lighting is very important in the maintenance of the depth of field. Additionally, lighting plays an important role in the color balance of the photograph. Our eyes and brain have the ability to adjust to different lighting conditions. We are able to move through highly variable light conditions with little perception as to the extreme ranges of light intensity and color balance. Photographs however, are not as forgiving. Light that is produced by conventional incandescent bulbs casts an orange hue on photographs. Light that is produced by fluorescent bulbs will have a green cast. In the case of mixed lighting situations accurate color balance is even more difficult to achieve. Photographs taken on film are particularly vulnerable to this type of color shifting. Films are available that have been specifically balanced to accommodate certain lighting situations. In digital photography this color balance is often achieved electronically. There is no substitute however, for the brilliant light produced by a flash. Flash photography has the ability to meet all the lighting requirements for both light intensity and light balance. It is recommended that all clinical photography be taken with a flash. When a detachable flash device is available, care should be taken to place the flash device at an angle that minimizes the production of shadows on the photographic subject. Shadowed areas within a photograph may obscure clinically relevant data.

Correct Exposure

Photographs that are too dark or too light are always disappointing. The exposure of a photograph not only determines its aesthetics, but also its clinical accuracy. Clinical detail is easily lost in an over or under exposed photograph. Although with the advent of advanced automatic exposure camera equipment it is difficult to take a poorly exposed photograph, clinical photography may present exposure challenges to this technology. It

is helpful to familiarize yourself with your camera and flash combination by experimenting with the manual exposure setting for your pre-determined stereo-typical clinical photographs. The knowledge you gain about correct exposure in these environments will help you to use your equipment to its maximum benefit.

Predetermined exposures that can be manually set are more reliable than automatic exposures, because automatic metering can be influenced by the background causing your primary subject area to be incorrectly exposed.^{39, 40}

Backgrounds and Surrounds

Keep the background uncluttered and a neutral color. Cluttered backgrounds will detract from your main area of interest. Complicated backgrounds may be confused as being part of the subject you are focusing on. This confusion can lead to false clinical assumptions thus impairing the clinical relevance of the photograph. For backgrounds simple, solid colors work best. In addition to being definitively uncluttered by nature, neutral colors need in the automatic metering and exposure control of your subject. Although a color of 18% gray works best,⁴¹ a white or a black background may suffice. Often a plain treatment booth curtain or a sheet will work very nicely.³⁴

Measurements from Photographs

Photographs can be particularly useful the practice of physical therapy when measurements are taken directly from the photographs. When the standards of; subject to

³⁹ Pan, ML, TTL auto flash – Part 2: the TTL auto system as a manual flash meter for close-up photography. *Journal of Biol Photogr* 1992;60:131-4

⁴⁰ Teplica D, Bundy M, Guidelines for photographing physiologically sensitive anatomical regions. *Journal of Biol Photogr* 1996;64:27-9

⁴¹ Clifford, Doug. The tool for better exposure how to use an 18% gray card, *ACE camera Photography Magazine*, February 17, 2000

lens distance, camera angle and lens focal length are adhered to and held constant these measurements can be particularly accurate. To assist the completion of his master's thesis in 1989 - 1990, this author developed a grid attachment that can be placed at the film plane at any 35mm camera to assist in the measurement of posture from photographs. To achieve this, the author placed a transparency etched with a grid at the film plane of a 35mm camera. When the film was placed on top of this grid and light exposed through it, each photograph had a standardized imprint of the grid upon it. Assuming the standards of subject to lens distance, focal length of lens, and camera angle remained constant each grid square held a predetermined value. That predetermined value could be scientifically ascertained by extrapolating data from photographs taken through the grid of known standards such as tape measures. This work is outlined in great detail in this author's 1990 thesis (pages 38 to 42).³⁵ In 1992, the Cambridge, Massachusetts-based company, Polaroid began packaging and marketing its specialized camera to health professionals.⁴² This camera employed the same principles known to this author from the work on his 1990 thesis. Although it is impossible to prove, the Polaroid HealthCam may have come as a result of correspondence between this author in the Polaroid Corp. in late 1990. If used correctly, the Polaroid health can has been shown to produce clinically relevant and reproducible results.^{43,44} This adaptation of the film plane grid device for the Polaroid camera possesses significant advantages over the SLR version in that it provides the clinician with instant results that can be entered directly into the patient's chart. This precise adaptation was the subject of the correspondence between this author and

⁴² Brady, Lorraine. Health industry today. August 1994

⁴³ Clarke, Gwen. Recording wounds: Polaroid's new medically-designed cameras. *British Journal of community nursing*, volume 5, issue 11, 13 November 2000. pages 578-580

⁴⁴ Davini, MA. The reliability of the Polaroid HealthCam system for the measurement of shoulder tilt. *Journal of the American chiropractic Association*, December 1995 (35:12)

Polaroid in late 1990. This system may possess some advantages over current digital technology, because Polaroid images are less prone to computerized manipulation and are therefore may provide an additional level of security to the acquisition of data.

Relative Importance

While adhering to standards is always important in the acquisition of scientific and clinical data, it is important to understand the relative importance of strict adherence to these standards. While color may not be of primary importance to the physical therapist recording posture, it may be the most relevant factor in a photograph used to document a skin lesion for a dermatologist. When considering photographic documentation for your clinic it is important to keep the standards most relevant to you under the strictest control.

Advances in Digital Technology

Advances in digital technology offer the physical therapist unprecedented access to photography as a clinical documentation tool. Digital cameras make a data acquisition both inexpensive and easy to achieve. Digital image storage is easily achieved through conventional computer technology. Many electronic medical records software packages include provisions for storing digital image data. This allows for easy organization and retrieval of patient data. These software products also enhance the security of storing, reproducing and transmitting digital data. Very often it is this security protection provides complete compliance with the governmental HIPAA standards.

The Application of Photography in Physical Therapy Practice.

Although it is quite possible that additional uses of photography in physical therapy may exist or will exist in the future this author has identified the following areas as being particularly promising to physical therapy practice. Applying the use of serial photography to measure improvements in posture as they relate to physical therapy treatment outcomes is one possible use of photographic technology in physical therapy practice.^{24,25,28,35} Additionally, photography can be shown to be quite helpful in the accurate recording and analysis of range of motion measurements^{26,27} for virtually every joint in the body. Although most prevalent in nursing literature, photography has been shown to be quite helpful in documenting improvements in the staging and classification of healing wounds.^{43,45} Wound care is historically well within the scope of practice of physical therapy. Photography would also be quite helpful in establishing changes in body composition. This would be a helpful tool in helping physical therapists understand how their treatments affect the body composition of their clients. This has particular value in the area of weight loss and weight maintenance. Weight loss and weight maintenance is an area well within the practice of physical therapists and on the cutting edge of physical therapy, in the opinion of this author. Serial photographs of weight-loss / weight maintenance clients will help the physical therapist identify trends in changes in body composition.⁴⁶ These photographs could also be used as a motivational tool and perpetuating weight-loss therapy. This would be especially helpful in instances where a client's body composition is improving while their weight remains unchanged. When considering photography for your clinical practice, it might be helpful to have a few

⁴⁵ Phillips, Kathleen. Incorporating digital photography into your wound care practice. Wound care Canada, Volume 4, Number 2, 2006

⁴⁶ Borud, L & Warren, A. Body contouring in the post-bariatric surgery patient. Journal of the American College of Surgeons, Volume 203 • Number 1 • July 2006

items on hand. Of course a quality camera is essential to use photography in physical therapy. Advances in digital photography, make digital cameras without preferred equipment. If possible, choose a digital camera with a macro (close-up) capability. Macro capability allows the practitioner to focus a very close distances. Make sure the camera you choose has a robust set of manual features, which will allow you to manipulate key parameters of the photographic process. Manipulation of these parameters will allow you to maintain the scientific standards previously mentioned. It may also be helpful if your digital camera comes equipped with the ability to accept an external flash unit. This is not a critical feature, because stand-alone flash units can be purchased and are activated photo electrically by the built-in flash on any camera. A tripod is essential for standardization of photographic data. A tripod removes variability in camera angle and lens to subject distance. A level or plumb bob would also be a valuable in establishing credible and reproducible results. Plumb bobs are extremely simple devices used for vertical reference. Levels equipped with adhesive backing are inexpensive and are readily available at any camping supply. A digital camera equipped with a level gives the photographer a constant reference as to the horizontal orientation and azimuth of the camera. As previously mentioned, a clear and uncluttered background of a neutral color is a very useful tool for photographic clinical documentation. A goniometer to measure angles, and a tape measure to measure distances are easily accessible to the physical therapists and proved to be quite helpful.

Barriers to the use of photography in Physical Therapy Practice.

Until recently significant barriers existed to the use of photography in physical therapy practice. Traditional film-based cameras required the therapist to wait for an entire roll of

film to be exposed before it is processed. In addition film based photographic documentation is more expensive than the digital alternative. Additionally, there is a significant time delay from the time the exposure is taken until the film is processed and placed in the patient's record. Older camera technology required a significant working knowledge of film, film properties and optics in order to achieve acceptable results. In spite of the superior attributes of digital cameras, some barriers to their use in physical therapy still remain. Some physical therapists may not wish to invest in a digital camera for their clinic. High quality automatic digital cameras are becoming more and more affordable, and thus more accessible to every clinician. Physical therapist may be resistant to learn new technologies. As computers become more prevalent in physical therapy practice, familiarity with their use will improve the willingness of physical therapists to use digital imaging technology. Some physical therapist may not wish to take the time in ensuring scientific standards for clinical digital imagery. This paper seeks to explore the time savings and durability of the documentation, as compared to the time taken in setting up and exposing the photograph. It is the assertion of this author that the use of digital imagery in documentation is well worth the consideration of this time taken to acquire the visual data. Confidentiality and privacy issues may deter the physical therapist from employing this form of documentation. If the appropriate consent forms are obtained by the patient and his main clear to the patient the photographs will be used for treatment and/or educational purposes only and that their privacy will be maintained is essential to the success of the photographic documentation program. Furthermore, with the correct software and minimal computer skills personal identification features of the patient can be obscured further or shoring their personal privacy. With the emergence of

new federal regulations (HIPAA) safeguarding patient confidentiality all credible electronic medical records software packages comply with these requirements.

In conclusion, the use of photographic clinical documentation should be a serious consideration for the practicing physical therapist. This paper has sought to increase the understanding of photographic documentation to the physical therapist, while maintaining sensitivity to the historical significance of medical photography. The physical therapist should understand that as with any evaluated tool photographs can be misleading. With an understanding of scientific standardization procedures and some basic of photographic techniques, most physical therapists should be able to achieve quite usable results.

Respectfully Submitted January 11, 2007

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