

Establishing Photographic Standards for Facial Transplantation: A Systematic Review of the Literature

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Background: Photography provides a means for objective assessment and dissemination of clinical information. The American Society of Plastic Surgeons (ASPS) and Plastic Surgery Foundation (PSF) published photography guidelines in 2006 to optimize its clinical use. However, photographic documentation of outcomes in facial transplantation (FT) continues to lack standardization. We therefore appraised the current state of FT photography in the peer-reviewed literature.

Methods: A PubMed search was conducted from July 2005 to July 2019. Studies containing photographs of partial or full FT recipients were included. Non-English language articles, cadaveric and animal studies, technique papers, and case reports were excluded. Data were extracted from 91 articles. Adherence rates were calculated to determine whether published FT photographs followed ASPS/PSF guidelines. Proposed photographic standards particular to FT were then formulated to guide standardization of practice.

Results: Only 28.6% (26/91) of articles adhered to the photographic conventions of preparation, positioning, and views. Of 162 patient appearances in the 91 articles, 95% (154/162) met the criteria for preparation, 98.8% (160/162) met the criteria for positioning, but only 24.7% (40/162) met the criteria for views.

Conclusions: Photographic documentation of FT outcomes in the peer-reviewed literature is limited, with inconsistent adherence to ASPS/PSF guidelines. There is substantial deficiency in provision of alternative views, with the majority of publications only depicting the frontal view. FT photography standards should specifically incorporate alternative views, proper lighting and framing, and elimination of distractions, and accommodate for remote patient self-photography. This will promote a transparent and consistent longitudinal evaluation of the surgical results. (*Plast Reconstr Surg Glob Open* 2020;8:e2834; doi: [10.1097/GOX.0000000000002834](https://doi.org/10.1097/GOX.0000000000002834); Published online 14 May 2020.)

INTRODUCTION

According to Sir Harold Gillies, one of the most profound historical advances in the field of plastic surgery was the introduction of photography.¹ Photography has allowed for an accurate visual record of clinical subjects, and the subsequent advent of the digital camera enabled efficient dissemination of clinical photographs. Photography today has widespread applications in research, education, procedural planning, and objective evaluation of outcomes.^{2,3} Standardization of

photographic technique is critical to achieving accurate, high-quality, and consistent images. In 2006, the American Society of Plastic Surgeons (ASPS) and the Plastic Surgery Foundation (PSF) published *The Photographic Standards in Plastic Surgery*, providing general guidelines for photographic documentation.⁴ Subspecialties of plastic surgery have also established subspecialty-specific standards.^{5,6} Facial transplantation (FT) is a newly evolving arena in which proper documentation requires capturing structure and function over a long period of follow-up, and often in the setting of long-distance posttransplant care.⁷ Each FT case is unique, with substantial heterogeneity in operative indications, technique, and outcome.⁸ As the field matures, photographic documentation of FT outcomes would benefit from standardization, to optimize quality control and improve reporting. However, no published standards specific to photographic documentation in FT exist to date. This study aims to assess the quality of medical photography in the FT literature, and to adapt existing ASPS/PSF photography guidelines for FT-specific

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photographic documentation, for use in both on-site clinical and remote care settings.

METHODS

Search Methods

A systematic review of the literature was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines.⁹ The PubMed electronic database was queried from July 1, 2005, to July 10, 2019, with the following search terms: “facial transplantation” OR “face transplant” OR “facial transplant” OR “face transplantation” OR “face allotransplantation” OR “facial allotransplantation” OR “facial vascularized composite allotransplantation” OR “face vascularized composite allotransplantation” OR “face allograft” OR “facial allograft” OR “face composite tissue allotransplantation” OR “facial composite tissue allotransplantation” OR “face composite tissue allograft” OR “facial composite tissue allograft” OR “face vascularized composite allograft” OR “facial vascularized composite allograft”.

Selection Criteria and Screening Process

All resulting articles were compiled, and duplicate titles were removed. Two independent reviewers, E.M.W. and G.N.S., screened the remaining titles and abstracts on Covidence (www.covidence.org). All included studies contained photographs of partial or full FT recipients. Non-English articles, cadaveric studies, descriptive technique papers, and animal and xenotransplantation studies were excluded. Other forms of publication such as abstracts, conference presentations, and videos were also excluded. If relevance could not be determined from the abstract alone, the full text was retrieved and reviewed against the specified inclusion criteria. Any disagreements between reviewers were mediated by consensus.

Data Collection

Clinical photographs were reviewed from the full texts of 91 published articles. Quality of clinical photographs was evaluated based on the criteria outlined in ASPS/PSF photography guidelines. The following data points were collected: patient preparation, patient positioning, and framing. Additional information was collected on facial expressions, excessive jewelry or makeup, and clarity of the photograph. When available, information on the photographic guidelines used in the article was documented.

Analysis

Images were evaluated for focus, framing, positioning, background uniformity, shadow, clothing, accessories, and exposure. Adherence rates to ASPS/PSF guidelines were calculated, with additional emphasis on parameters specific to FT. Lack of adherence included clothing, accessories, or makeup that distracted, altered, or obscured the area of interest. Cast shadows were defined as any dark shadows concealing the patient’s features. Lighting was considered poor if it resulted in excessive shadow or loss of detail such as surface texture.⁴ Photographs were categorized as

overexposed when there was either loss of highlight detail or when parts of the image were effectively washed out. Images were considered underexposed when critical areas were either darkened or indistinguishable from the background. Focus was defined as a crisp, non-blurry image.¹⁰

In accordance with the ASPS/PSF guidelines, photographs were categorized into (1) preparation, (2) positioning, and (3) views. Preparation included appropriate backdrop, adequate lighting, and absence of distractions. Positioning included appropriate camera-to-patient distance and the absence of factors that would alter the position of the face, such as placement of hands underneath the chin to support the chin or close the mouth. Views included at least 2 alternative views of the patient. All definitions were derived from the ASPS/PSF guidelines.⁴

Photographs were further organized into sub-categories within the framing and views category: (1) positional views, (2) anatomical subunit views, and (3) functional views. Positional views consisted of frontal, lateral (left and right), and oblique (left and right) views. Anatomical subunit views consisted of separate images depicting the eyes, ears, nose, mouth (intraoral and soft tissue envelope), and neck. Functional views consisted of facial expressions (eg, fear, anger, happiness) and actions such as voluntary blink and smiling.

RESULTS

Database Search Results

The database search identified 709 articles, with 705 articles remaining after duplicates were removed (Fig. 1). Initial screening of titles and abstracts excluded 388 articles. Full text screening of the remaining 317 articles excluded 226 articles. All included studies evaluated at least 1 FT recipient. Data from 91 articles were independently extracted by the 2 reviewers. Thirty-five FT recipients appeared 162 times in these 91 articles. This accounts for 79.5% (35/44) of all FT recipients reported to date. Of the total articles reviewed, 28.6% (26/91) adhered to the 3 main photographic conventions proposed by ASPS/PSF. The other 71.4% (65/91) failed to meet at least one of the photographic guidelines. Of the 162 patient appearances, 95.0% (154/162) met criteria for preparation, 98.8% (160/162) for positioning, but only 24.7% (40/162) for views.

Factors contributing to suboptimal adherence to specific photographic standards varied widely among the 162 patient appearances. Adherence was 88.3% (143/162) for lighting standards, 97.5% (158/162) for focus, 77.2% (125/162) for background uniformity, 64.2% (104/162) for absence of cast shadows, 93.2% (151/162) for absence of clothing obscuring the face, 97.5% (158/162) for absence of accessories such as jewelry or glasses, 90.7% (147/162) for exposure, and 97.5% (158/162) for absence of excess makeup (Fig. 2).

Lack of alternative views was a consistent issue across all representations of individual FT recipients, with 96.3% (156/162) displaying frontal views, but only 16.0% (26/162) showing profile and 14.8% (24/162) showing oblique views (Fig. 3). Only 12.3% (20/162) of all

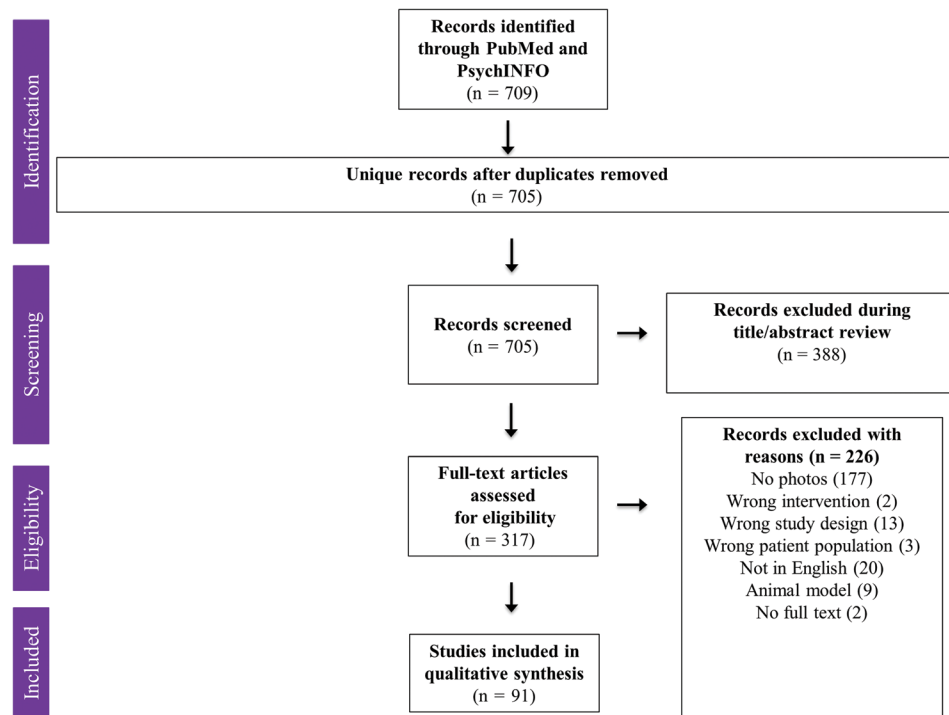


Fig. 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) diagram.

photographic representations of FT recipients included views of specific anatomical subunits, including 10.5% (17/162) showing the mouth and 0.62% (1/162) showing the ears. There were no photographic representations specific to the eyes, nose, or neck. Only 8.6% (14/162) included functional views, with 5.6% (9/162) showing smiling, 1.9% (3/162) showing voluntary blink, and 1.2% (2/162) showing facial expressions for anger, fear, and happiness.

DISCUSSION

Use of photography has become ubiquitous in the field of plastic surgery due to the need for objective visual documentation of outcomes. The purpose of this study was to evaluate the quality of published photographs in the FT literature and to propose guidelines to facilitate standardization of photographic documentation of FT. Our review revealed a lack of consensus in photographic documentation of FT recipients, indicating substantial disparity between photographic conventions described in the published plastic surgery guidelines and the clinical photography presented. Most images met the recommended criteria for patient positioning; however, heterogeneity was observed for several subcategories of preparation. Lower adherence was observed for cast shadows and views. The only view consistently used was frontal, likely because it is standard and presents the most complete depiction of the patient's appearance. Profile and oblique views were used less commonly, perhaps for lack of space or for avoidance of redundancy.

The ASPS/PSF guidelines also propose documenting views of specific anatomical subunits.⁴ Because FT involves

intricate dissection and reconstruction of many different structures, these views may provide considerable information. The observed lack of representation of functional views may be due to the limitations of static photographs in capturing dynamic motions. Future studies may support the use of standardized videography to corroborate the implications of static images.

Our study has several limitations. We recognize that there likely exist additional photographs in patient charts that were not included in each publication, and which may offer a more complete assessment; however, as these are not publicly available, they were not considered in our analysis. It is also typical of journals to allow a certain maximum number of figures, thereby limiting the amount of views shown. We suggest including an addendum or a supplemental index to provide access to these images. Additionally, although efforts were made to capture all relevant articles through a systematic methodology, we acknowledge that some papers may not have met our inclusion criteria. Although it is beyond the scope of this study, we also acknowledge the need for standardized guidelines for 3-dimensional photography and videography of FT outcomes.¹¹

RECOMMENDATIONS

We hereby propose standardized photographic guidelines specific to FT recipients, derived from those put forth by ASPS/PSF, with FT-specific modifications to clinical photographic standards and suggestions for remote patient self-photography (Fig. 4). Details such as camera type, lenses, and lighting techniques have been previously described.^{10,12-15} Of utmost importance remains

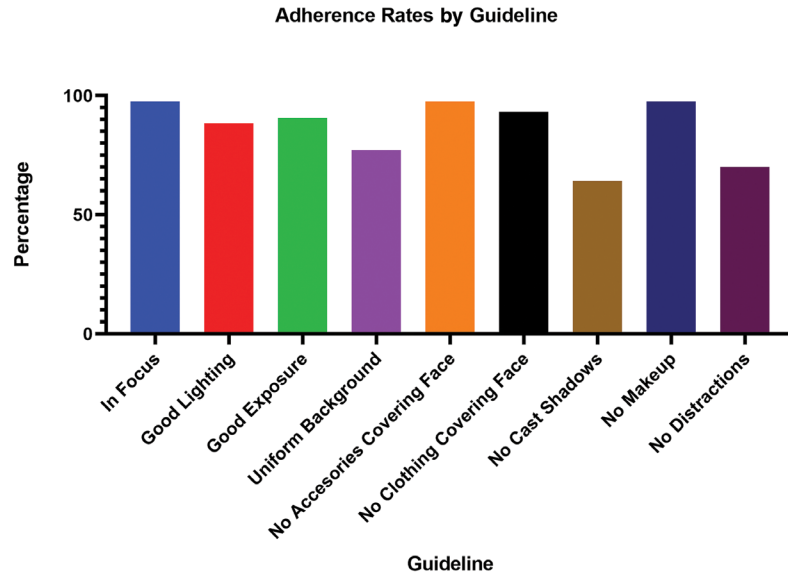


Fig. 2. Adherence to photographic standards, by guideline. The percentage of patient appearances with correct photographic documentation per guideline. Most published photographs met the criteria for patient preparation and relevant sub-categories such as lighting and background. The guideline least frequently met was that for cast shadows (64%).

consistency, regardless of parameter. Consistency of elements, even greater than image quality, ensures a comparable longitudinal record.

Shadow

Light and shadows allow for identification of prominences and depressions of the face, which is important for evaluating contours and irregularities affecting aesthetic outcomes of FT. Lateral illumination produces a longer or shorter shadow depending on the angle of illumination.¹⁰ An angle should be chosen so as not to result in cast shadows, which can obscure topography and texture. Cast

shadows can be prevented with appropriate lighting, such as dual lighting source placed at 45-degree angles from the patient.^{14,16,17}

Illumination, Exposure, and Focus

Lighting is imperative to distinguish changes in skin pigmentation and scarring. Skin color and texture are current criteria for FT donor–recipient matching, and studies have shown that changes in skin pigmentation can indicate immune rejection.^{18,19} Appropriate exposure, dictated in part by camera shutter speed, which is a controllable camera setting, is also necessary to reveal adequate detail and focus.²⁰ A full range of detail is important for a thorough evaluation of esthetic outcomes of FT.²¹

Background

A uniform background minimizes distraction and focuses attention on the subject. Background color should provide appropriate contrast. A light blue or gray background is recommended and should be nonreflective and free of distracting features, such as patterns, cables, or windows.^{3,4,10,22}

Makeup, Clothing, and Accessories

Makeup, clothing, and accessories can be distracting and can conceal key features, such as scars or color mismatch; therefore, patients should be instructed to come to appointments without makeup applied or to remove it before photography. Clothing covering the neck, jewelry, and accessories should also be removed.^{23,24} Glasses may obscure eyelid ptosis, and collared or high-neck shirts can obscure jowl ptosis.

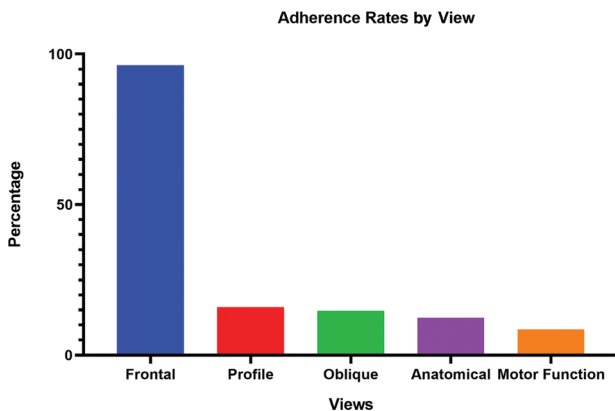


Fig. 3. Adherence to photographic standards, by view. The percentage of patients with photographic documentation by view. While patient preparation and positioning were adequate, sufficient alternative views were lacking. While most patients had a frontal view (96.3%), few had accompanying profile (16.0%), oblique (14.8%), anatomical (20%), or functional views (8.6%).

Photographic Standards for Facial Transplantation Adapted from ASPS/PSF Guidelines

1. Patient Preparation

Photographic Principles:

I. Appropriate Background

- Solid light blue or gray, non-reflective

II. Remove Distractions

- No excessive makeup, clothes, or jewelry

III. Good Lighting

- Good lighting, with the same lighting for each photo
- Good exposure and focus
- No cast shadows

2. Patient Positioning

- Camera-to-patient distance: (3 feet) from the patient
- Same camera setting for every picture.

Face Transplant–Specific Guidelines

- No distractions, ie, hands positioned on face
- No alterations, ie, tape on eyelids

3. Patient Framing/Views

I. Positional views:

- All patients: frontal, profile, oblique (both sides)

I. Positional views:

- Case dependent: basilar, posterior scalp

II. Functional views:

- Facial expressions, blinking, opening/closing mouth

III. Anatomical subunit views:

- May vary depending on nature of patient's injury and face transplant: Mouth (intraoral and soft tissue envelope), ears, eyes, nose, neck, sentinel flap

4. Time Points

- Preoperative, intraoperative, immediate postoperative, 3, 6, 12, 18 months, annual
- Intraoperative – solid blue drape, remove surgical lighting from field

5. Remote Patient Self-photography

- Solid backdrop
- No distractions (clothes, jewelry, makeup)
- Good, consistent lighting
- Positioning: Stand straight, consistent camera distance
- Views: Frontal, profile, oblique

Fig. 4. Proposed photographic standards for facial transplantation.

Framing and Views

A representative facial photographic series (Figs. 5, 6) should include, at minimum, a standard full-face frontal anterior-posterior (AP) view, left and right profile, and left and right three-quarter oblique views. Depending on the nature of the injury and surgical intervention, close-up views of specific

anatomical features are recommended to better document individual details of the FT. The subject should be framed correctly to capture individualized information. Functional views are also recommended, such as smiling, frowning, voluntary blinking, lip puckering, eye movement, jaw occlusion, elevation of the eyebrows, and puffing out the cheeks.^{25,26}



Fig. 5. Representative FT recipient image series. Images in this series were taken directly from the patient's medical record, with copyrights retained by the senior author as stated. Images are representative of patient appearance 1-year status post partial facial transplantation after injuries sustained from high-energy ballistic trauma. This 25-year-old patient had undergone multiple reconstructive procedures before presentation, including maxillary, mandibular, zygomatic, and right orbital floor open reduction and internal fixation with bilateral anterolateral thigh and supraclavicular flaps to the midface and lower face. In preparation for partial facial transplantation, he required removal of exposed hardware, debridement of facial fractures, bilateral naso-orbito-ethmoid osteotomies, medial canthal tendon repositioning, and bilateral orbital floor reconstruction with alloplastic titanium implants. Partial face, double jaw, and teeth transplantation were performed in January of 2018. A, Frontal view, neutral expression (published with permission from and copyrights retained by Dr. Rodriguez). B, Frontal view, smiling (published with permission from and copyrights retained by Dr. Rodriguez). C, Profile view, right (published with permission from and copyrights retained by Dr. Rodriguez). D, Profile view, left (published with permission from and copyrights retained by Dr. Rodriguez). E, Oblique view, right (published with permission from and copyrights retained by Dr. Rodriguez). F, Oblique view, left (published with permission from and copyrights retained by Dr. Rodriguez). G, Vertex view (published with permission from and copyrights retained by Dr. Rodriguez). H, Basal view (published with permission from and copyrights retained by Dr. Rodriguez).

Positioning

Patients should be seated at least 1 foot in front of the background and 3 feet away from the camera to avoid cast shadows on the backdrop.²⁷ Variations in neck position can affect photographic interpretation and should be avoided.²⁸ Neck extension and head protrusion can alter the jawline or the appearance of submental tissue, leading to a “photographic neck lift”.^{27,28} A grid display in the viewfinder can be used to align the Frankfort horizontal plane with the mid-sagittal plane.¹⁷ Use of the Frankfort horizontal can help standardize the position of the head and mitigate deviations that can lead to distortion of outcomes.^{23,25}

Remote Patient Self-photography

Consistent long-term follow-up office visits may not be feasible or desired by FT patients, especially in the setting of long-distance care.⁷ With the ubiquitous use of smart phones with built-in cameras, patients are equipped to perform remote self-photography. This option can be used to communicate acute concerns or provide information in circumstances where in-person evaluation is not feasible or practical. To ensure consistency and quality in these photographs, patients should take their photographs with a uniform background such as a plain wall, with bright and consistent lighting, different views (frontal, oblique, profile), and adequate positioning without distractions, free

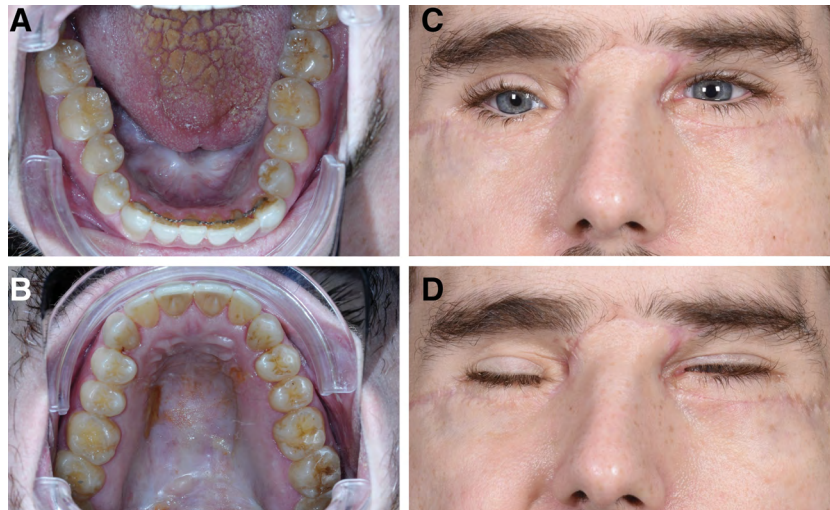


Fig. 6. Representative FT recipient image series. Images in this series were taken directly from the patient's medical record, with copyrights retained by the senior author as stated. Images are representative of patient appearance 1-year status post partial facial transplantation after injuries sustained from high-energy ballistic trauma. This 25-year-old patient had undergone multiple reconstructive procedures before presentation, including maxillary, mandibular, zygomatic, and right orbital floor open reduction and internal fixation with bilateral anterolateral thigh and supraclavicular flaps to the midface and lower face. In preparation for partial facial transplantation, he required removal of exposed hardware, debridement of facial fractures, bilateral naso-orbito-ethmoid osteotomies, medial canthal tendon repositioning, and bilateral orbital floor reconstruction with alloplastic titanium implants. Partial face, double jaw, and teeth transplantation were performed in January of 2018. A, Intraoral: floor of mouth (published with permission from and copyrights retained by Dr. Rodriguez). B, Intraoral: palate (published with permission from and copyrights retained by Dr. Rodriguez). C, Subunit: eyes, open (published with permission from and copyrights retained by Dr. Rodriguez). D, Subunit: eyes, functional: voluntary blink (published with permission from and copyrights retained by Dr. Rodriguez).

of clothing, jewelry, and makeup. Photographs should be taken at a standard distance such as arm's length, and use of either front or rear-facing smartphone camera should be kept consistent.

CONCLUSIONS

Consistent, high-quality medical photography is essential for documenting complex visual information. We present a systematic review evaluating image quality and standardization across the FT literature. Our findings show that published clinical FT images are largely inconsistent with general photographic guidelines previously established for the field of plastic surgery. Published images also do not optimally communicate photographic information specific to FT. These findings highlight the need for quality improvement, which can be accomplished by establishing FT-specific standards. It is important to note that these deficiencies are not exclusive to the FT literature; however, an investigation of this nature focuses on an actionable issue within the field, while it is still of limited size on its way toward maturation. Our proposed guidelines incorporate basic standards for clinical documentation derived from ASPS/PSF photographic guidelines and include recommendations for documentation of motor function and suggestions for remote patient self-photography. The proposed guidelines can allow for

more consistent, longitudinal evaluation of outcomes and more effective research and development in FT.

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PATIENT CONSENT STATEMENT

The patient provided written consent for the use of his image.

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