

USE OF PORTABLE SPECTROPHOTOMETER SOLVES COLOR MATCH PROBLEM

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INTRODUCTION AND BACKGROUND

Custom high-definition silicone restorations and cosmetic covers for prostheses are intended to match the appearance of the user's sound-side limb. In addition to the physical characteristics, the cover must match the user's skin color. This color match is a difficult process and traditionally has been done subjectively by the practitioner attempting to match standard color swatches to the patient's skin tone. Ambient light and the practitioner's judgment affect this process. A new portable spectrophotometer has been developed to solve this problem. It measures the color, removing the subjectivity from the process. These measurements have 5 times greater resolution than the color swatch approach. It also blocks ambient light and provides its own broad-spectrum light to assure a good color match across the entire optical spectrum. As a result, the color match will be good regardless of the lighting condition during the evaluation. This approach substantially improves the process, resulting in a better color match and greater acceptance by the user.

PROCESS

A successful cosmetic cover or restoration requires three factors; 1) good fit, 2) high definition and 3) accurate color match. Fit can be assured if the final cover is verified first with a silicone check socket. Definition is dependent on the skills of the artists/sculptor who produces it and their ability to capture the details of the client's limb. It also requires the practitioner to provide this information through pictures or sketches. Finally, there is the color match issue. This is often the reason clients reject the cover/restoration. It is very difficult to get an accurate color match to the client's skin tones. Typically, this is done by matching various color swatches to areas on the client's sound-side limb. This approach has three potential weaknesses; 1) the number of swatches (up to 50) limits the range of colors available; 2) the color selection is based on the practitioner's judgment of the color which can vary considerably; and 3) the color perceived is affected by the ambient light in the area where the matching is being done. Any of these factors can result in a miss-match and a cover that is unacceptable to the client.

Spectrophotometry eliminates all three of these weaknesses. This is a measurement, thus eliminating the subjectivity of the person evaluating the patient. Presently, the number of colors stored in the instrument is 500 rather than 50 color swatches. This represents a ten-fold increase in the color resolution. As a result of the broad variety of skin tones available, more realistic cosmetic cover can be produced. As more colors are collected, these will be added to the color data base in the instrument, thus further increasing the resolution.

Different individuals often choose different colors for the same skin area, demonstrating the weakness of the subjective approach. Practitioners may recruit a colleague when selecting swatch colors to get a consensus rather than making the decision on their own. Spectrophotometry eliminates this uncertainty and assures that the cosmetic color will match the patient's skin color.



Fig 1 – SpectroMatch® Instrument

The portable spectrophotometer (Fig 1) is placed against the patient's skin blocking out ambient light and providing its own broad-spectrum light to measure the color of the skin surface. This quantitative process replaces the subjective assessment by a clinician. These color measurements are made on various areas of the limb and recorded on a chart for use by the custom silicone fabricator.

The ambient light in the area where color matching is done affects the perception of color (Fig 2). Various light sources such as; florescent, incandescent, tungsten, mercury-vapor, natural sunlight, filtered sunlight, etc. change the perceived color. As a result, when using the color swatch approach, the practitioner can only match the swatches to the skin tone for the type of light present during the evaluation. Once the cosmetic cover is fabricated and the client enters an area with a different light source, the colors in the cosmetic cover will appear different and not match those of the sound-side limb.



Fig 2 – Tungsten vs. daylight measurements

* SpectroMatch is manufactured by Minolta and is a registered product of RSLSteeper to be used in measuring skin tones for high-definition silicone restorations/covers. SpectroMatch is available through Liberating Technologies, Inc.

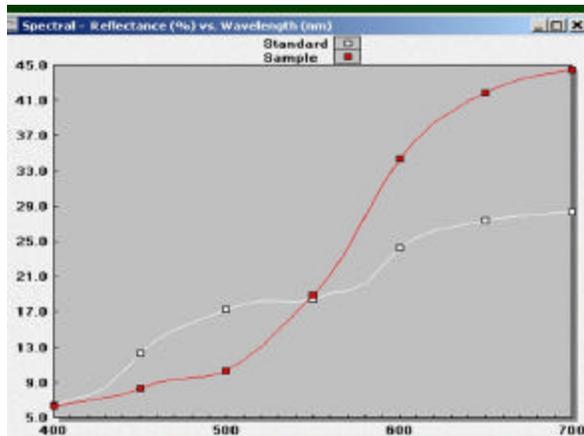


Fig 3 – Poor Color Match

Fig 3 – Demonstrates a condition where the color at two specific wavelengths match, but does not match at other wavelengths in the optical light spectrum. This was done under certain ambient lighting conditions, thus affecting the color match process.

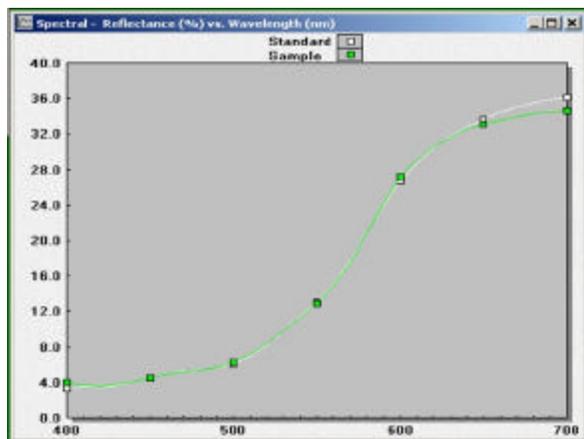


Fig 4 – Good Color Match

Fig 4 - Exhibits good color match across the entire spectrum which means that regardless of the ambient light, the color will be a proper match to the patient's skin tone. This demonstrates the benefit of a spectrophotometer measurement over subjective assessments.

Spectrophotometer measurements relate to a specific formula for adding color pigment to silicone. Each color number generates a recipe for the amount of color pigment to be added to clear silicone to produce the desired color. These pigments are “blended” into the silicone to mimic various colors present in the sound-side limb. This is not a painted surface, but rather color pigment throughout the silicone material itself for greater durability and more realistic skin tones.



Fig 5 – Cosmetic Restoration

Fig 5 - Various blended silicone colors, representing the color of each region of the cosmesis, are combined to create the finished cosmetic restoration or cover. This results in a realistic representation of the missing limb.