A novel method of morphological and metrical assessment by 3D-3D superimposition for the assessment of facial mimicry: a pilot study

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The assessment of facial mimicry has a relevant importance not only in anatomy, but also in clinics for the evaluation of facial performances in patients affected by neurological or muscular impairments, and in forensic medicine, for the standardization of individualizing markers useful for personal identification. The application of modern 3D image acquisition systems may provide reliable results, especially for what concerns the analysis of facial surfaces: however, the comparison of anatomical structures needs standardized, reproducible protocols in order to provide comparable data. This study aims at exposing a novel and promising method for comparing 3D profiles, useful for quantifying alteration of facial structures in different conditions.

Ten male adults, aged between 30 and 40 years underwent to four acquisitions by stereophotogrammetry (VECTRA-3D®: Canfield Scientific, Inc., Fairfield, NJ) with different expressions (neutral, happy, sad, angry, surprised). On each 3D facial model, 9 landmarks (right and left endocanthion, exocanthion, cheilion: on the midline, selion, pronasale, subnasale) were identified using VAM® software; the acquisition of each individual performed with happy, sad, angry and surprised expression was then superimposed to the neutral one, in order to reach the best match between the corresponding landmarks. This procedure allowed the operator to obtain also a chromatic sheet of the face, where in blue are colored the growing zones and in red the zones which showed a decrease. In all the cases, the RMS value (Root Mean Square) between the two models was calculated as well.

The highest difference in comparison with the neutral standard was shown by the happy expression (mean RMS 4.11 mm, SD 1.13 mm), followed by the surprised expression (mean RMS 2.74 mm, SD 1.02 mm) and the sad (mean RMS 1.3 mm, SD 0.49 mm) and angry ones (mean RMS 1.21 mm, SD 0.37 mm). The happy and surprised expressions showed a wide modification of the mouth, chin and cheek regions, whereas the sad and angry expressions were affected by slight and more variable alterations. This pilot study shows that the 3D-3D superimposition may provide reliable results concerning facial alteration due to mimicry, which may be useful for clinical purposes: further studies are needed in order to test the variability of morphological and metrical parameters according to age and sex.