Simulation of the effect of dental modifications on facial soft tissues: a 3D stereophotogrammetric study

Marcio De Menezes[1], Alberto Rossetti[1], Ana Maria Bettoni[1,2], Giuseppe Lanza[1], Gianluigi Lodetti[1], Chiarella Sforza[1]

[1] Department Morfologia Umana e Scienze Biomediche "Città Studi", Università di Milano, Italy
[2] Department Odontologia Restauradora, Faculdade de Odontologia, Ribeirão Preto, Universidade de São Paulo, Brasil

Several dental treatments can change dental position, and modify lip support in the space. Current methods do not allow a non-invasive quantitative assessment of 3D lip dimensions and position, and no simulations of treatment effects can be made. In the current study we devised a method for the detection of the 3D dentolabial positions during simulated orthodontic and prosthetic dental treatments.

The dental arches of 10 adult healthy subjects were reproduced with stone models, and 1- and 2-mm thick resin blocks were modeled on the maxillary frontal teeth (from canine to canine) to simulate a prosthetic or orthodontic treatment. The facial soft tissues of the subjects with closed mouth were obtained using a 3D stereophotogrammetric imaging system (Vectra-3D, Canfield Scientific, Inc., Fairfield, NJ, USA), without/ with the two resin thicknesses. The relevant faces were superimposed, and the spatial displacements of selected facial landmarks without/ with the thicknesses were calculated. Additionally, upper and lower labial areas were individualized, and the relevant global distances without/ with the thickness were obtained.

Average displacements ranged from 0.39 (sn landmark with the 1-mm thickness) to 1.62 mm (left side ch landmark with the 2-mm thickness). On average, ch and cph landmarks had the largest displacements. In all occasions, the larger movements were obtained with the 2-mm thickness, but the difference was significant only for the ls and cph landmarks ($p<.05$). The upper lip area had average anterior displacements of 0.28 (1-mm thickness) and 0.5 mm (2-mm thickness; $p=.007$), while the lower lip area had posterior displacements in 6 (1-mm thickness) and 4 subjects (2-mm thickness).

In conclusion, the method devised in the current study allowed a 3D quantitative assessment of the effect of a simulated dental treatment without submitting the subjects to invasive or dangerous examinations. The method could be usefully employed for orthodontic treatment planning in children and adolescents, as well as for simulations of prosthetic oral rehabilitation in adults.

Key words
Face, soft tissue analysis, three dimensional, stereophotogrammetry