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Publication date:
2017-06

Permanent link:
https://doi.org/10.3929/ethz-b-000235134

SP52

Using artificial intelligence to evaluate the impact of orthognathic therapy on apparent age and facial attractiveness

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Background

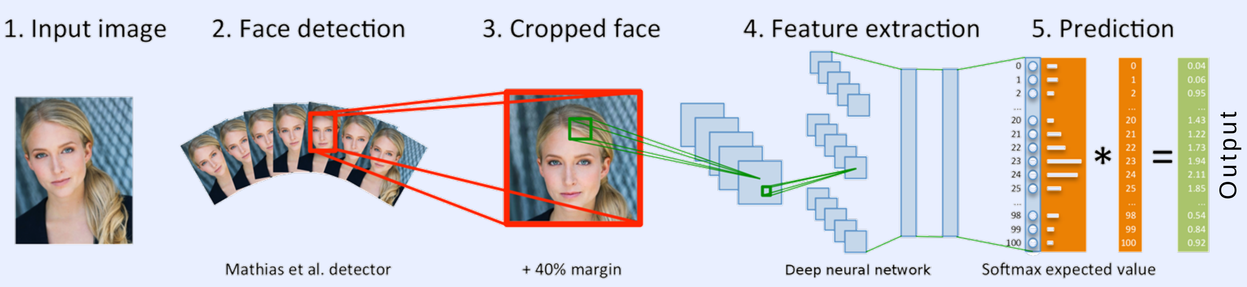
Improvement of facial appearance is one of the prime reasons why patients seek orthognathic treatment.[1,2] While it is extremely difficult to quantify beauty, artificial intelligence enables the estimation of attractiveness (i.e. characterizing the attractiveness of particular facial traits) and of apparent age from a single face image.

Aim of study

The aim of this study was to apply an established and validated algorithm on facial images[3,4] of orthognathic patients before and after therapy, in order to assess the impact of orthodontic-orthognathic treatment on apparent age and facial attractiveness.

Subjects and methods

Pre- and post-treatment photographs (n=2175) of 148 consecutive orthognathic patients (females: 79 [53.4%]; males: 69 [46.6%]; mean age before treatment: 23.1 years) were collected for this longitudinal retrospective single-center evaluation. Heterogeneity of sample was validated, both for underlying malocclusion (prognathia, 46.5%; retrognathia, 42.4%; anterior open bite, 39.0%; asymmetry, 28.7%), and type of surgery (LeFort 1, 84.9%, BSSO, 83,5%; chin plastic, 48.6%). For every photograph, apparent age and facial attractiveness were established with a computational algorithm comprising a face detector, convolutional neural networks for the extraction of deep features, and support vector regression for apparent age and facial attractiveness. The computational algorithm was trained on >13'000 face images with more than 17 million ratings for attractiveness, and on >0.5 million images for age estimation.



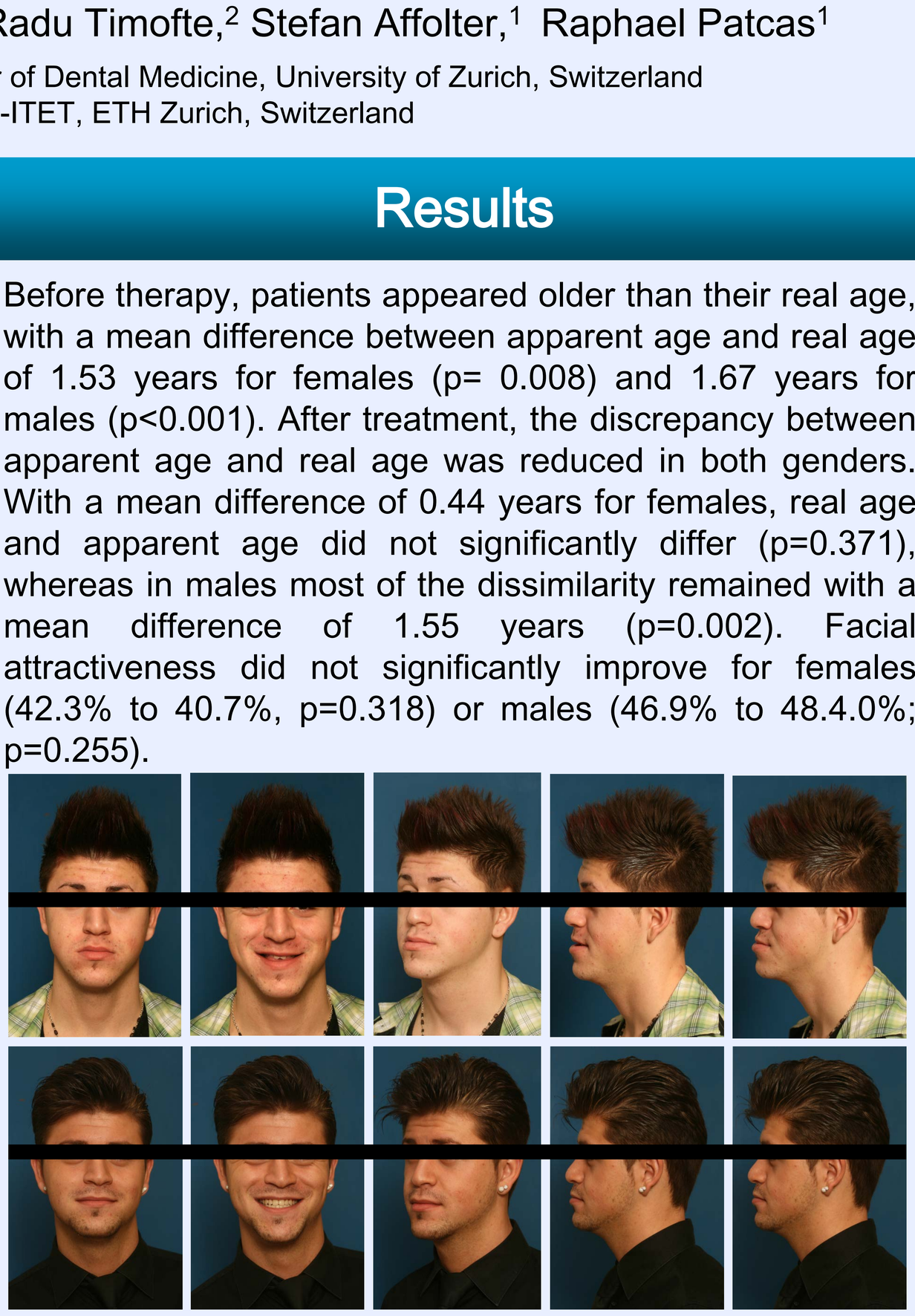
Processing pipeline: the face is detected in the input image and fed through a deep convolutional neural network for features extraction and to further predict the attractiveness and the age.

Statistical analyses

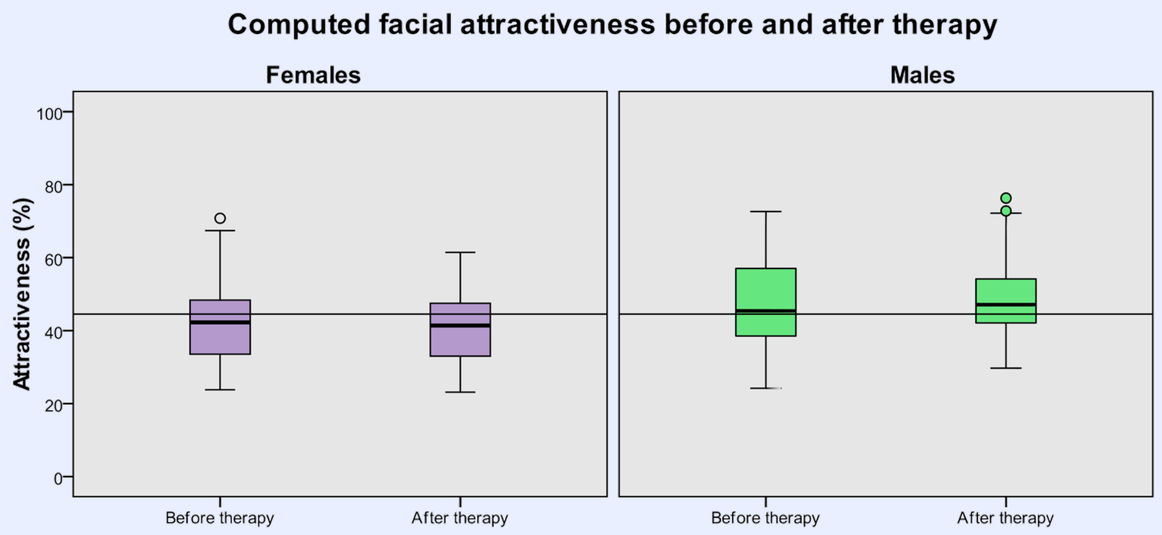
All statistical analyses were performed in SPSS (Version 23). Results for pre- and post-treatment photographs were averaged for every patient separately, and compared to real age. Differences between real age and apparent age, and changes in facial attractiveness due to orthognathic therapy were investigated using a Wilcoxon signed-rank test.

Results

Before therapy, patients appeared older than their real age, with a mean difference between apparent age and real age of 1.53 years for females (p= 0.008) and 1.67 years for males (p<0.001). After treatment, the discrepancy between apparent age and real age was reduced in both genders. With a mean difference of 0.44 years for females, real age and apparent age did not significantly differ (p=0.371), whereas in males most of the dissimilarity remained with a mean difference of 1.55 years (p=0.002). Facial attractiveness did not significantly improve for females (42.3% to 40.7%, p=0.318) or males (46.9% to 48.4.0%; p=0.255).



Representative Class III patient: Averaged computed facial attractiveness before therapy: 35.0% (upper images) after therapy: 48.7% (lower images).



Box and whiskers plots for changes in facial attractiveness according to gender. Horizontal line: Mean attractiveness over entire sample.

Conclusions

Orthognathic therapy changes facial features and, especially in females, **makes the face appear younger**. **Facial attractiveness, as assessed with artificial intelligence, however, seems to remain unaffected**. Potential patients for orthognathic therapy should be made aware of this fact.

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