

# The Effect of Incobotulinumtoxin A and Dermal Filler Treatment on Perception of Age, Health, and Attractiveness of Female Faces

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## ABSTRACT

**Objectives:** Facial age, health, and attractiveness assessments play a major role in human social interaction and affect the way we perceive and think about others. Modern cosmetic dermatology provides a bewildering array of facial treatment procedures with botulinum toxin type A and dermal filler application being the most requested. The authors sought to determine the effect of facial rejuvenation procedures, such as application of incobotulinumtoxin A and dermal filler injections, on people's perception of age, health, and attractiveness. **Methods:** Ten women underwent three consecutive facial rejuvenation procedures with incobotulinumtoxin A, calcium hydroxylapatite, and a hyaluronic acid. Digital facial images were taken before treatment and after each subsequent treatment and presented to a total of 150 third-party assessors who judged the images for age, health, and attractiveness. **Results:** Each procedure was associated with a significant reduction in perceived age and an increase in perceived health and attractiveness compared with pre-treatment images. The effects were cumulative such that faces perceived as the youngest, healthiest, and most attractive had received all three treatments, followed in descending order by incobotulinumtoxin A and calcium hydroxylapatite treatment, and incobotulinumtoxin A alone. **Conclusion:** The authors demonstrate that naïve judges are readily able to perceive the effect of nonsurgical facial rejuvenation procedures with incobotulinumtoxin A, calcium hydroxylapatite, and hyaluronic acid in terms of age, health, and attractiveness judgments. These effects were greatest when incobotulinumtoxin A and dermal filler treatments were combined. (*J Clin Aesthet Dermatol.* 2014;7(1):36–40.)

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Although difficult to define, perceived attractiveness plays a major role in the initial evaluation of an individual's "quality" as a potential partner.<sup>1-4</sup> Research shows that attractive people have more dating experience than their less attractive counterparts and more occupational success.<sup>5-7</sup> While society places great importance on beauty, and cultural factors inevitably influence our perception of attractiveness, several lines of research also suggest that there may be neural correlates of attractiveness.<sup>8</sup> There is evidence that a preference for attractive faces emerges early in life. For example, infants look longer at attractive faces from within a week of birth before their perception has been modified by experience,<sup>9,10</sup> and adults and children within and across cultures show

high rates of agreement in judgments of facial attractiveness.<sup>11</sup> With attractiveness so deeply encoded in our biology,<sup>12</sup> it is not surprising that with the expanding range of products for noninvasive facial rejuvenation, patient demand for cosmetic enhancements to preserve their looks is increasing,<sup>13</sup> particularly in the younger generation who seek interventions at the earliest signs of aging.<sup>14</sup>

Human attractiveness perception is highly dependent on age and health assessments.<sup>2,12,13</sup> A youthful female face is generally regarded as having volume and elevation in the upper regions and tapering toward the chin.<sup>15</sup> Evenly colored, smooth, pliant skin is viewed as attractive and healthy.<sup>16</sup> Studies have demonstrated that skin surface

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topography and skin coloration affect the perception of facial age, health, and attractiveness in both men and women.<sup>17-22</sup>

In the last two decades, improved understanding of the structural changes involved in face aging has led to the development of improved techniques for facial rejuvenation. Since Carruthers and Carruthers first reported the benefits of botulinum toxin injections for glabella rhytids,<sup>23</sup> the aesthetic uses of botulinum toxin A and dermal fillers have evolved. As Carruthers et al<sup>24</sup> highlighted in their consensus recommendations, the focus of facial rejuvenation is changing from a two-dimensional approach that concentrates on removing facial lines and improving skin tone and texture to a three-dimensional approach that also addresses both soft and hard tissue facial volume loss. By combining treatments to target all aspects of facial aging, physicians can not only address the visible signs of aging, but also their underlying cause.

The focus of treatment has therefore shifted from just concentrating on isolated problem areas of the face, primarily aiming to reduce lines and wrinkles, to targeting the entire face for a more harmonious and natural effect.<sup>25,26</sup> This can often be achieved noninvasively with a combination of treatment modalities, such as botulinum toxin A, to remove mimic wrinkles and dermal filler to restore facial volume<sup>26</sup> and restore facial shape to a more youthful look.<sup>15</sup>

The aim of this study was to determine the effect of facial rejuvenation procedures with incobotulinumtoxin A, calcium hydroxylapatite (CaHA) and hyaluronic acid (HA) on the perception of age, health, and attractiveness in women. Botulinum toxin A and dermal fillers are the two most popular nonsurgical cosmetic procedures performed worldwide for treating age-associated facial changes.<sup>27,28</sup> As the outcomes of these procedures are largely subjective in nature, most studies in the medical literature examining outcomes in facial aesthetics have concentrated on patient- and physician-reported satisfaction. Thus, in this present study, the authors assigned third-party individuals to assess the results of treatment rather than patients or physicians themselves.

## METHODS

**Aesthetic procedures.** Ten women ranging in age from 30 to 65 years underwent three consecutive facial rejuvenation procedures over a period of three months with approximately one month between treatments. Treatment began with incobotulinumtoxin A (Xeomin®/Xeomeen®/Bocouture®/XEOMIN Cosmetic™; botulinum toxin type A [150 kDa], Merz Pharmaceuticals GmbH, Frankfurt, Germany), followed by calcium hydroxylapatite [CaHA] (Radiesse® Merz Pharmaceuticals GmbH, Frankfurt, Germany), and finally hyaluronic acid [HA] (Belotero®, Merz Pharmaceuticals GmbH, Frankfurt, Germany). There was no fixed treatment protocol as the number of injections and injection volumes for each product differed for each woman depending on the degree of lines and folds and volume loss. Patient satisfaction with the final result was the desired treatment outcome and was reported verbally to the

practitioner.

**Facial images.** The stimulus material comprised digital images of the 10 women who had received the three different rejuvenation procedures between the beginning of January and the end of March 2011 by two dermatologists with expertise in a range of facial rejuvenation procedures at two different treatment centers in Germany.

Subjects' images were divided into the following four groups: Group 1 (pre-treatment), Group 2 (after incobotulinumtoxin A), Group 3 (after incobotulinumtoxin A and CaHA), and Group 4 (after incobotulinumtoxin A, CaHA, and HA). Figure 1 illustrates the cumulative effects of the three treatments on one woman's face.

At both treatment centers, high-resolution photographs were shot with a Phase One P 45+ Digital Back Camera System (Phase One®, Copenhagen, Denmark). Photographs were standardized as to framing, lighting, and head orientation. A special table was designed for use at all centers to maintain the same posing position at each session, and the women were asked to maintain a neutral facial expression. The women's hairstyle was kept constant and they wore no make-up. Lighting was achieved with two compact flashes with white photographic umbrellas. Pretreatment photos were taken before injection of incobotulinumtoxin A. The second photo was taken immediately prior to injection of CaHA, the third immediately prior to injection of HA, and the final photo was taken approximately 10 days after the final treatment. There was no post-production retouching. All subjects provided consent for their photographs to be used for the purpose of scientific study.

**Rating study.** The images were rated for age, health, and attractiveness by a total of 150 naive male and female judges ages 17 to 61 years (mean [±SD] age 23.3±5.1 years), mainly undergraduate students from the University of Göttingen, Germany. Fifty participants (25 men and 25 women) judged the images on age (years), 50 rated the images for health, and 50 rated the images for attractiveness.

Images were viewed on color-calibrated TFT monitors (LaCie 324, LaCie Inc., Portland, Oregon; Paris, France), set to a resolution of 1920x1200 pixels at 32-bit ("true color") color depth. Using a forced choice paradigm, omnibus pairwise combinations of facial images in the four treatment conditions were presented—Group 1 (pre-treatment), Group 2 (after incobotulinumtoxin A), Group 3 (after incobotulinumtoxin A + CaHA), and Group 4 (after incobotulinumtoxin A + CaHA + HA). For each of the three attributes (age, health, attractiveness), independent rating experiments were conducted and image pairs were presented in randomized order using Medialab software (Empirisoft Corp., New York, New York). The sides of presentation were counter-balanced for the two image sets. For each face pair, raters were asked to select the face that they considered as younger, healthier, and more attractive by clicking on a corresponding button on the screen below the respective face.

**Statistical analysis.** Data were analyzed for normal distribution by the one-sample Kolmogorov-Smirnov test. All



**Figure 1.** Cumulative effects of treatments on one woman's face. a) Pre-treatment; b) after incobotulinumtoxin A; c) after incobotulinumtoxin A + CaHA; and d) after incobotulinumtoxin A + CaHA + HA.

rating data were normally distributed for all three attributes and across treatment conditions (age: all  $Z < 1.04$ ,  $p > 0.23$ ; health: all  $Z < 1.14$ ,  $p > 0.14$ ; attractiveness: all  $Z < 0.58$ ,  $p > 0.21$ ). Parametric statistics (repeated measures ANOVA) were therefore used to test for differences in the raters' perceptions of age, health, and attractiveness between the four treatment conditions.

## RESULTS

There was a significant effect of treatment on age perception ( $F = 67.06$ ,  $p < 0.001$ ) such that the faces of women who received treatment were judged to be younger than those who did not receive treatment (Figure 2). Pairwise comparison showed that treatments were significantly different from each other in terms of positive effects on age perception in ascending order—Group 1, Group 2, Group 3, and Group 4 faces (all  $p < 0.05$ ). A similar pattern emerged in terms of health perception with a main effect of treatment ( $F = 47.54$ ,  $p < 0.001$ ), such that Group 4 faces were judged most healthy, followed by Group 3, Group 2, and then Group 1 faces (in descending order; all  $p < 0.05$ ). There was a significant effect of treatment on attractiveness perception ( $F = 21.74$ ,  $p < 0.001$ ). Group 4 faces were considered most attractive, followed by Group 3 and then Group 2 and Group 1 faces (all  $p < 0.001$ ). Unlike the age and health preference data, there was no statistically significant difference in attractiveness perception between Group 1 and Group 2 faces ( $p = 0.71$ ).

## DISCUSSION

Age and health are key features that influence people's perceptions of each other<sup>2,12,13</sup> and can be derived from facial skin features.<sup>16,29</sup> The authors' data demonstrate a significant and consistent reduction in perceived age and an increase in perceived health and attractiveness of female faces after nonsurgical rejuvenation procedures to remove lines and wrinkles and restore facial volume with incobotulinumtoxin

A, calcium hydroxylapatite (CaHA), and hyaluronic acid (HA). The effects were more pronounced with cumulative treatments such that incobotulinumtoxin A + CaHA + HA faces were perceived as the youngest, healthiest, and most attractive followed in descending order by incobotulinumtoxin A + CaHA, incobotulinumtoxin A alone, and pre-treatment faces.

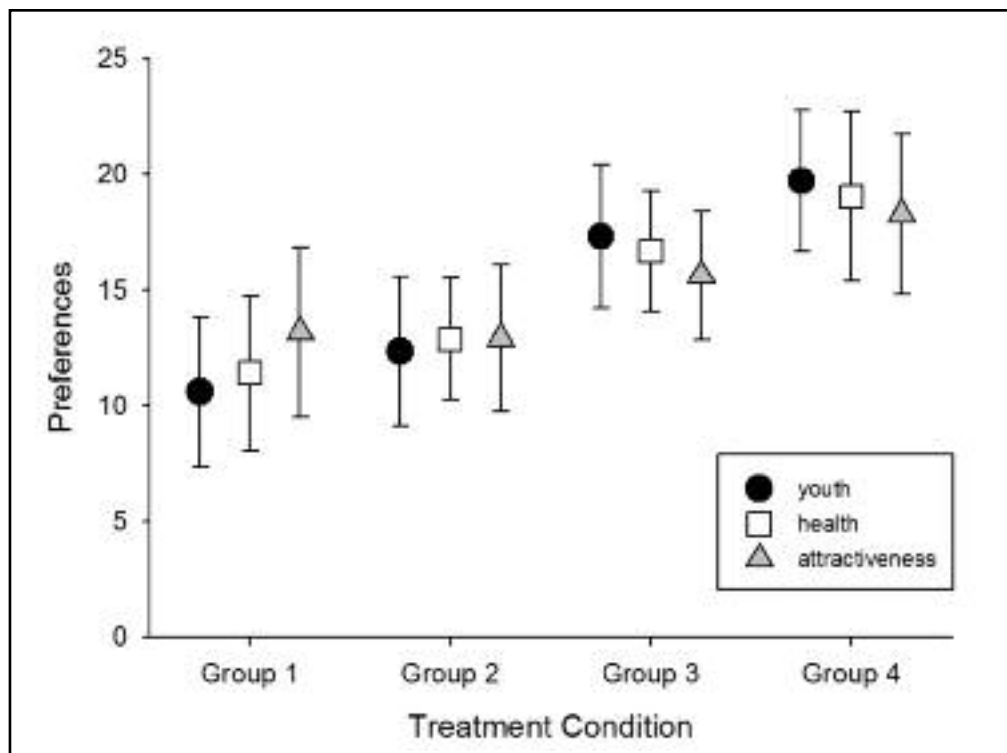
The combined effect of botulinum toxin A and dermal filler treatments removes fine lines and wrinkles, restores youthful facial contours, and replenishes age-associated volume loss. Increased number of facial lines and folds and greater wrinkle depth are associated with looking older for one's age.<sup>20,22,29</sup> Previous studies demonstrated that faces with skin surface topography cues digitally removed are judged significantly younger and more attractive than their original (unmodified) counterparts.<sup>30</sup> In these studies, assessors were able to detect at least a 20-percent visual change in skin surface topography suggesting that even small treatment effects on skin topography can influence age perception. The results also showed that perception of female facial age was more strongly affected by the removal of skin surface topography cues than by changes in skin color distribution, whereas the smoothing of uneven skin color distribution had a stronger effect on the perception of female facial health.<sup>22</sup> While our study only assessed two areas of skin aging (wrinkles and lines and loss of volume and contour), it is possible that the addition of treatments that target skin surface and textural changes (including pigmentation changes) may influence perceptions even further.<sup>31</sup>

Most studies assess the results of aesthetic treatments using subjective measures of patient satisfaction. To provide a more objective measure of treatment success, the authors recruited a large number of independent assessors to rate the results. The advantage of such an approach is that it provides subjects and physicians with a reliable measure of treatment results and can provide realistic treatment

expectations. A similar measure of treatment success following facial cosmetic surgery has recently been reported by Chauhan et al.<sup>32</sup> These authors presented before and after photos of 54 women and six men aged 45 to 72 who had undergone cosmetic surgery on their face to 40 medical students who were asked to guess the age of the person in the photo. There was a significant reduction in perceived age with the third-party assessors estimating patient ages to be an average of 7.2 years younger than their chronological age after surgery and unrelated to the preoperative age of a patient. The effect was more substantial when the number of surgical procedures increased.

To the authors' knowledge, this present study is the first to use a large number of independent third-party assessors to grade the aesthetic effects of nonsurgical facial rejuvenation procedures. They did not quantify the degree of perceived age change after treatment, but used a large sample of individuals representative of the general population to show that the use of incobotulinumtoxin A, CaHA, and HA dermal fillers, particularly in combination, can significantly alter perceptions of age, health, and attractiveness. In the past decade, there has been an increase in the number of nonsurgical interventions, such as botulinum toxin A and dermal fillers, such that these procedures are now the two most popular nonsurgical cosmetic procedures performed in the United States.<sup>28</sup> The natural aging process affects both the skin and underlying facial structures resulting in a gradual change in facial appearance (for review, see Matts and Fink 2010;<sup>13</sup> Samson et al 2010<sup>21</sup>). The authors' study confirms that optimal results are achieved when treatments that target all these structures are used in combination.

The influence of particular features on the perception of age and health depends on the context in which a subject is viewed. Particular care was taken to ensure that the photographs used in this study were consistent by using a specially designed table to allow the same posing position and main-taining the same hairstyle and using no make-up. The benefit of using photographic images is that the cues present for age estimation can be controlled and standardized. In addition, estimating age from images has been shown to be highly reproducible particularly when using a large number of assessors as in the current study.<sup>33</sup>



**Figure 2.** Mean perceptions for age, health, and attractiveness. Group 1: pre-treatment; Group 2: after incobotulinumtoxin A; Group 3: after incobotulinumtoxin A + CaHA; and Group 4: after incobotulinumtoxin A + CaHA + HA.

The main issue that was encountered when photographing women over several sessions was maintenance of a similar facial expression.

In the field of facial aesthetics, there are a large number of outcome measure scales, suggesting a lack of consensus and confidence as to a reliable, validated, and reproducible scoring system. While two-dimensional photography is currently the predominant method for generating perceived age, three-dimensional (3D) analysis of facial volumetric analysis may provide a more objective measure of treatment success,<sup>34</sup> particularly given the importance of age-associated volume loss in the structural changes of the aging face. This preliminary study illustrates how the general population perceives attractiveness. Further studies are now warranted to determine how these results correlate with those from subjective patient satisfaction studies and studies using clinical rating scales.

In conclusion, facial rejuvenation with incobotulinumtoxin A, CaHA, and HA dermal fillers is an important procedure in the armamentarium of anti-aging techniques. This study provides important evidence of treatment success in particular when incobotulinumtoxin A, CaHA, and HA dermal fillers are used in combination.

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