

# A better method of predicting face changes after cosmetic surgery: the partial least squares regression

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## Introduction

Accurate prediction of post-surgery face changes is an essential step in the treatment planning of cosmetic surgery. During cosmetic treatment in facial deformity patients, the face does not directly follow the surgical skeletal movements in the underlying bony structures. The algorithms of currently available commercial programs are all based upon the 1-to-1 correspondence ratio and/or the ordinary least squares methods, which is far from being accurate.

Predicting face changes after surgery requires a number of variables to consider. Human face landmarks in face photos and x-rays have a 2-dimensional entity. A landmark (or variable) has 2 measurements in the x-axis and the y-axis. A certain degree of vertical repositioning surgery induces horizontal relocation also and vice versa. Furthermore, the face response at a specific face landmark is highly dependent on its adjacent response, and its neighboring points are also dependent on each other. Applying the PLS method would be a solution for prediction and interpretation of this highly correlated 2-dimensional situation.

Therefore, the aim of the present study is to propose a better statistical method of predicting face changes after cosmetic surgery by applying the partial least squares regression.

In addition, we will also discuss a method to report error analyses for 2-dimensional data. Previously published error reports of 2-dimensional data sets have inappropriately applied 1-dimensional approaches, such as differences in distance or angular measurements. Our visualization method can be applied to 2-dimensional data sets. This method shows errors in both the x-axis and the y-axis simultaneously, which can also identify any between-group differences.

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