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Assessing facial recognition after orthognathic surgery at automated border controls in airports

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Abstract

The aim of this paper was to find out whether orthognathic surgery affects facial recognition at automated border controls in airports, and whether we should recommend that patients update their photographic identification postoperatively. We collected data on all 82 patients who had orthognathic surgery between August 2013 and June 2017. They were contacted by telephone and asked about any difficulties they had encountered when passing through automated or human-operated border controls or when using other forms of photographic identification such as driving licences. All questions were asked with reference to experiences before the operation. A total of 50 patients responded, of which 35 had travelled by aeroplane since their operations. Six of them had had problems passing through passport control (two human-operated and four automated) but after additional security checks had successfully continued their journeys. Four had had bimaxillary surgery, one had had maxillary advancement, and one mandibular advancement. Orthognathic surgery does affect identification at border controls, and most of our patients had had difficulties at automated checks because of the differences between the biometric data within the e-passport chip and the live biometric that was scanned. These findings will enable us to improve the information we give to our patients before operation, but further studies are required to increase the sample size and improve reliability.

Keywords: Orthognathic surgery; facial recognition; airport automated border control; biometrics

Introduction

By 2035 it is estimated that the number of flights will have increased by 40%,[1] and more airports are now introducing automated border controls to improve efficiency and safety.[2,3] The technology uses pattern recognition to acquire and compare a person's biometric data,[4] and different methods are used in European airports (such as facial, fingerprint, or iris recognition). Facial recognition, however, is accepted by passengers, and is the chosen method in all second-generation passports, and the primary biometric identifier.[1] Automated e-passport gates consist of four parts: an electronic passport reader, biometric readers, an electronically opened door, and a device to display visual instructions.

There are four stages: enrolment, template creation, identification, and verification. First, the passenger scans the e-passport in which a radio-frequency identification (RFID) chip is embedded, which contains the biographical and biometric information of the holder.[5] The facial biometric features are captured (enrolment) and the data converted into a template using critical standard facial points and an algorithm (template creation). The biometric features are then compared with saved templates of the enrolled user

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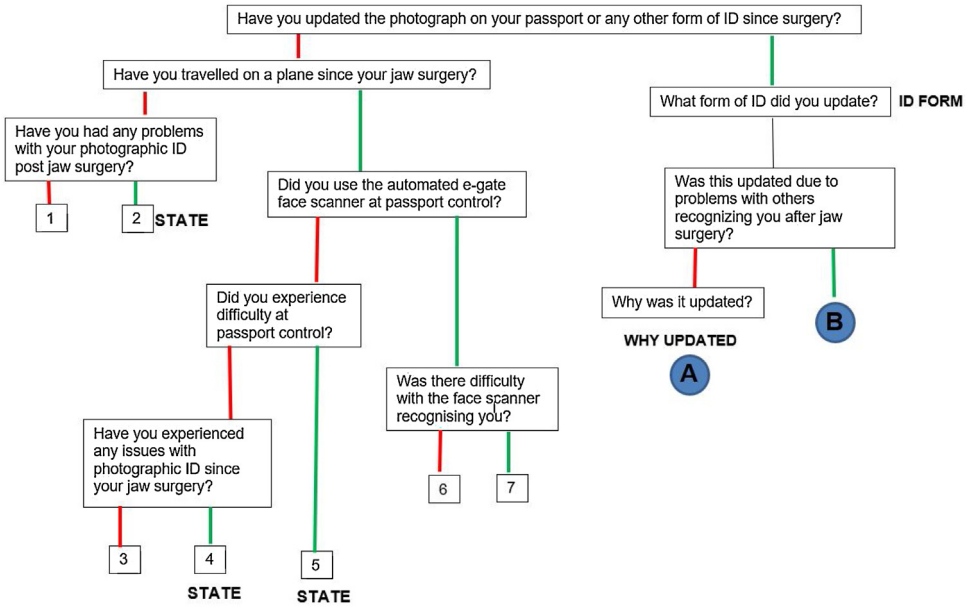

Fig. 1. Questionnaire flowchart used for telephone interviews.

(identification) and to old samples taken from the same user (verification). Finally, once a positive match is found between all templates, the electronic gates open.

Airports worldwide use different human recognition scanners and different configurations of facial points. The Airports Council International (ACI) provides advice and assistance to ensure professional excellence in management and operations.[6]

Changes that result from orthognathic surgery can have an impact on the identification and verification processes. To find out whether we should advise patients to update their photographic identification postoperatively, we have explored how orthognathic surgery can affect the ability to use automated controls.

Material and methods

We collected data on patients who had had orthognathic surgery at Chase Farm Hospital over a period of three years (August 2013 to June 2017). All the patients were contacted by telephone and asked about difficulties they had encountered when passing through automated or human-operated border controls, and problems they had had with recognition using other forms of photographic identification such as driving licences. All the questions related to identification with photographs that had been taken before their operations (Fig. 1).

Results

Of the 82 patients contacted, 50 responded to the telephone interview (two of the contact numbers were no longer valid, and 30 patients did not answer their phone on three occasions over a two-week period). All of those who answered agreed to participate. A total of 35 had flown since orthognathic surgery and six of them had had problems passing through passport control (Table 1). Two had used human-operated controls and four, automated controls. After additional security checks, they had all successfully continued their journeys (Table 1).

Of the 29 who had had no problems, 20 had had bimaxillary surgery. The remaining nine had had mandibular advancement (n = 8) or maxillary advancement (n = 1).

The median (range) age of the six patients who were stopped at border control was 23 (21–30) years. The median (range) age of the 29 who had had no problems was 22 (21–33) years.

Discussion

The index of functional treatment need (IOFTN) helps to prioritise patients with severe malocclusions who require orthodontic treatment in conjunction with orthognathic surgery.[7] The aim is to identify those with limited function, physical pain or disability, and problems with chewing, as well as psychological discomfort and social disability, with the latter two improving most after operation.[8] Repositioning of the facial skeleton, which is required to correct the malocclusion, has an impact on the positioning of the soft tissues.

A letter to the editor published in the British Journal of Oral and Maxillofacial Surgery (BJOMS) in 2014 recommended that as part of the consent process "all orthognathic patients are informed that the operation might invalidate their biometric passport".[9] The surgeon should offer to provide a supporting letter for the application for a new one. This is

Table 1
Summary of malocclusions in patients who had problems at border control.

Preoperative malocclusion	Preoperative overjet or overbite	Orthognathic surgery	Border control
Class III	2 mm reverse overjet	Maxillomandibular advancement	Automated
Class III	7 mm reverse overjet	Maxillomandibular advancement	Automated
Class III	4 mm reverse overjet	Maxillomandibular advancement	Automated
Class III div 1	10 mm overjet	Mandibular advancement	Automated
Class III	9 mm reverse overjet	Maxillary advancement	Human-operated
Class III	Class III & anterior overbite	Maxillomandibular advancement	Human-operated

based on advice from HM Passport Office: "If the patient's facial profile alters, the patient would need to consider applying for a new passport".[9] Our results, which showed that 29 of the 35 patients who travelled after their operations were not stopped at border control despite travelling with preoperative biometric identification, call into question the sensitivity of current border controls.

To our knowledge, no studies have been published on the effect of orthognathic surgery on facial recognition, but biometric systems that can recognise people after plastic surgery are being investigated. In 2012 a system using a SIFT (scale invariant feature transform)-based ocular matcher and multi-channel local binary pattern ocular matcher was introduced, which achieved a recognition accuracy of 87.4% overall.[10] This system, however, is not used at border control so HM Passport Office advises "if you cannot be recognised from your passport photo any more (for example, you've had plastic surgery)" the passport should be renewed.[11]

Orthognathic surgery can compromise facial recognition, but we found no correlation between the type of operation and the ability to pass through border control without a problem. We also found that age did not seem to have an effect as the ages of patients who did and did not have problems were similar.

During the consent process it is important to inform all patients that their biometric data could become invalid after orthognathic surgery and could cause problems at border control. They should also be told of the passport renewal fee, which at present is £75.50 for an online application or £85 for a paper application.[12]

Rapid technological advancements mean that facial recognition is becoming more common and android phones now offer these features. Larger studies are needed to validate our findings and find out whether the results are applicable to these phones. It would be advantageous if future studies considered factors such as the degree of surgical movement, changes in vertical or horizontal positions, and age.

Ethics statement/confirmation of patients' permission

Ethics approval not required. Verbal consent was gained before the questionnaire was given to each patient.

No patient-identifiable details were included.

Conflict of interest

We have no conflicts of interest.

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