Detection of orthopaedic implants by airport metal detectors

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ABSTRACT

INTRODUCTION We performed a questionnaire study to establish the frequency and consequences of the detection of orthopaedic implants by airport security and to help us advise patients correctly. All published literature on this subject is based on experimental studies and no 'real-life' data are available.

PATIENTS AND METHODS A total of 200 patients with a variety of implants were identified. All patients were sent a postal questionnaire enquiring about their experience with airport security since their surgery.

RESULTS Of the cohort, 154 (77%) patients responded. About half of the implants (47%) were detected, but the majority of patients (72%) were not significantly inconvenienced. When detected, only 9% of patients were asked for documentary evidence of their implant. We also found that patients with a total knee replacement (TKR) had a greater chance of detection as compared to those with a total hip replacement (THR; 71% versus 31%; $P = 0.03$).

CONCLUSIONS All patients, and in particular those with a TKR, can be re-assured that, although they have a fair chance of detection by airport security, a major disruption to their journey is unlikely. We advise that documentation to prove the presence of an orthopaedic implant should be offered to those who are concerned about the potential for inconvenience, but such documentation is not required routinely.

KEYWORDS

Airport security – Orthopaedic implants – Metal detectors

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Patients frequently ask if their orthopaedic implants will raise the alarm when walking through airport metal detectors. This has become a particular concern in the current era of heightened anxiety about air travel. Previous research^{1–4} has shown that some implants can be reliably detected under study conditions, but it is not clear what proportion of patients actually do trigger security alarms in real-life settings. The aim of this study was to determine if implants are routinely detected by airport security and to establish the effect of such detection in terms of the degree of inconvenience caused for the patients. This can help clinicians to advise their patients accurately and in deciding whether they should routinely supply them with documentary evidence of their implant.

Patients and Methods

A total of 200 patients who had an orthopaedic prosthesis implanted over a 14-month period were identified from the hospital database and contacted by post. All patients had had their surgery at least 1 year previously to allow time for travel post surgery. Four different implant groups were studied (50 patients in each): total hip replacements (THRs), total knee replacements (TKRs), intramedullary nails (IMNs) and fracture fixation plates and screws (P&S). No patient had more than one implant *in situ*.

The prostheses used were Exeter femoral stems (Stryker) and Ogee sockets (DePuy, Leeds, UK) in the THR group and Press-Fit Condylar (PFC – Johnson & Johnson)

Table 1 Number of detected verses undetected implants

Implant	Number detected	Number undetected	Total	Detection rate (%)
TKR	12	5	17	71
THR	4	9	13	31
IMN	4	6	10	40
P&S	5	8	13	39

knee implants in the TKR group. The osteosynthesis implants were universal femoral and tibial nails (IMN group) and standard small and large fragment plates and screws (P&S group; Synthes).

Patients were sent a postal questionnaire enquiring about their experience with airport security since their surgery. They were asked the following questions:

1. Did the airport security device detect the implant?
2. What was required once the implant was detected?
(A) Simple explanation; (B) proof by showing scar;
(C) proof by providing a letter; or (D) something else?
3. Did the detection of the implant cause significant delay or inconvenience?

Results

A total of 200 patients with an average age of 52.3 years (range, 17–73 years) were contacted. Responses were received from 154 patients (77%); of these, 53 had travelled by air since their surgery. The majority of the non-responders (41 out of 46) were in the IMN and P&S groups.

Twenty-five patients (47%) reported detection of their implant. The detection rate for the different implant groups is shown in Table 1. Of the knee prostheses, 71% were detected, as compared to 31% of the hip implants. This difference reached statistical significance ($P = 0.030$; chi-squared test).

When implants were detected by the archway detectors, all patients underwent further examination by hand-held detectors and a body search was performed. This is the expected practice in most airports following detection by archway detectors. Eighteen (72%) of the patients were then allowed through security, without delay, after explaining that they had an implant *in situ*. Of the remaining seven patients, one was required to produce a medical letter, two were asked to show their scar and four had to show both their scar and a letter. Only one of these patients was taken to a separate area for a full body and luggage search resulting in a major delay in his journey.

Table 2 Mass and composition of hip and knee implants

Implant	Alloy	Average size mass (g)	Percentage of magnetic metal
PFC (Tibia)	Ti ₆ Al ₄ V	45	0.2
PFC (Femur)	Co-Cr-Mo	230	59.1
Exeter Stem	Orthonox®	260	61

From the 53 patients who had flown since their surgery, therefore, only 5 (9%) were required to provide documentary evidence of their implant and 1 (2%) was significantly inconvenienced.

Discussion

Airport metal detectors use electromagnetic fields to detect metals. When placed in a magnetic field, magnetic metals such as iron, nickel and cobalt produce induction currents, which are detected by the device. Detection is known to depend on a variety of factors: sensitivity setting of the detector, metallurgical composition, mass and even the side of the implant have all been implicated.^{1–4}

Whilst in one study all implants with a mass greater than 145 g were detected,² we have shown that, in practice, just under half of our patients report detection. This is despite having implants of greater masses.

We also found that the knee prostheses are significantly more likely to be detected than hip prostheses. Interestingly, both implants have similar weight and magnetic metal composition (Table 2). The difference in the detection rate might, therefore, be because hip prostheses are deep, intramedullary implants that have a greater degree of shielding by way of cement, bone and soft tissues. This is despite the fact that, in one experiment, shielding of implants with a 1-inch wax shield had no effect on the detection rate.⁵ Although this is an interesting trend, we believe a larger study would be required to confirm our finding.

Our main aim was to establish the consequences of detection for our patients. As shown in this study, a large proportion of patients are body searched by hand or hand-held detectors and need only a simple statement of explanation before being allowed through security.

Patients can, therefore, be re-assured that, although there is a real chance of being detected by airport security, they will not be significantly inconvenienced and that, in most instances, a body search and a simple statement of explanation is all that is required.

We advise that documentation to prove the presence of an orthopaedic implant should be offered to those who are concerned about the potential for inconvenience, but that such documentation is not required routinely. This is because only a fraction of patients actually fly (35% of our responders, at least 1 year after surgery) and, of these, an even smaller proportion are required to provide written evidence of their implants (9% in this study). From the 156 responders in this study, therefore, only 5 (3%) would have required documentary evidence for the presence of their implant.

A patient with an extramedullary implant such as a TKR who is also a frequent flyer will clearly have a much greater

chance of detection and may benefit from possessing some form of documentary evidence. A copy of the postoperative clinic letter may be a simple way of providing them with this.

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