

Identification of dental implants through the use of Implant Recognition Software (IRS)

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Aim: To develop computer software to allow general dental practitioners and others to identify unidentified implants in patients' mouths using a range of criteria. **Methods:** Internet searches for implant manufacturing companies worldwide in all languages using terms: *dental implants*, *dental implant manufacturers* and *dental implant companies*. Once identified, all relevant information including images regarding dental implant products was collected even that for discontinued products. A program was then devised using key design factors to enable identification of individual implants. **Results:** The searches produced details for 87 implant manufacturers based in 21 countries with 231 different implant designs. The resultant program has been successfully trialled and used in both general dental practice and for forensic identification. **Conclusion:** The program developed provides a valuable adjunct to the identification of implant systems present in patients' mouths.

Key words: Dental implant systems, identification, forensic odontology

The identification of dental implant systems in patients without available records is often a considerable problem due to increased mobility and also due to the large number of implant systems with different designs available worldwide. Some studies have looked at whether identification of implants once *in situ* is possible by radiographic means¹⁻³. Although these studies suggested that implants could be identified from radiographs alone, they did only examine 28 implants. Clearly there are many more systems than this available on the market. Indeed, a recent extensive critical appraisal of the research documentation combined with a systemic search of promotional material and Internet sites revealed more than 220 implant brands produced by about 80 manufacturers⁴. Radiographic identification is one method by which an implant could be identified but other clinical features such as its connection type, length and diameter may also help. With this in mind it was considered that if data about all known implant systems could be stored on a database then several leading questions with regards to the implant being identified may well reduce the number of possibilities significantly.

Identifying the particular implant system therefore presents a significant challenge to the dentist. Also each system has several widths of implant and four or five lengths of implant often with different surface coatings. This therefore compounds the problem. At present when such patients present, valuable clinical time is often spent doing detective work, using whatever information the dentist has, clinical expertise of colleagues, help from implant company representatives etc. to help identify the system. This is potentially time consuming and costly.

The next big area of expansion in the field of dental implantology is implant maintenance. This will result in dentists currently not involved with dental implants having to provide maintenance for dental implant fixtures. Ideally patient passports outlining the system and size used, at time of placement should be mandatory. However this is rarely the case and therefore it is essential that dentists and technicians can accurately identify the system that has been used.

Aim of project

The innovation was based on the problem that patients commonly present with dental implants but are often unaware which system has been used in their mouth. The aim of this software is to allow general dental practitioners to identify unidentified implants in the patient's mouth. Dental implant work has expanded from being a very specialist procedure carried out by a limited number of dentists ten years ago to being widely available from a large number of dentists worldwide. The tremendous increase in the availability of different implant systems is depicted in the growth rates of the implant markets around the world⁵⁻⁷. There are over 30 commercially available systems in the United Kingdom and over 230 implant systems worldwide. The United Kingdom dental implant market grew at the highest rate in Europe for 2001 (over 30%)⁵. Last year over 5 million of one implant system alone had been placed.

Materials and methods

The Google search engine www.google.co.uk and the AltaVista search engine www.altavista.com were utilised for a comprehensive search of the World Wide Web for implant manufacturing companies around the world.

The initial search period spanned from November 2002 until June 2003 and the search for updates commenced in February 2004 and ended April 2004, a total of 10 months' search period. The search criteria were worldwide and in all languages and the terms searched were: *dental implants*, *dental implant manufacturers* and *dental implant companies*. Once a webpage of an implant manufacturing company had been identified, all relevant information regarding its dental implant products were collected (*Table 1*). All available images of the dental implants were copied from the respective site and stored in a file. An attempt was made to collect all data available for root-formed implants of all configurations, even those that their production has been discontinued over the years.

Results

Over the 10 month period, 87 implant manufacturers were identified. These were based in 21 different countries and produced a total of 231 different implant designs. *Tables 2* and *3* present a summary of the findings in relation to the country in which the manufacturer is based, prevailing implant body shape, surface characteristic and abutment connection.

Table 1 Data collection form.

Implant type (implant body shape)
Implant description (abutment connection)
Threaded or not
Surface type
Collar (polished or not)
Diameter
Length

Table 2 Number of dental implant manufacturers per country.

COUNTRY (Number of manufacturing companies based)	
USA 18	Sweden 2
Germany 13	Finland 2
Italy 10	Hungary 2
Spain 7	Korea 2
France 5	Czech Republic 1
Canada 4	South Africa 1
Switzerland 4	Bulgaria 1
Brazil 4	Austria 1
Israel 3	Argentina 1
UK 2	Netherlands 1
Japan 2	

Table 3 Distribution of implant design characteristics

Implant Body Shape	Surface Type	Abutment Connection
109 cylindrical implants (47.5%)	Etched (23%)	95 External hexagonal connection (41%)
58 bullet implants (25%)	Sandblasted/Gritblasted (18%)	66 Internal hexagonal connection (28.5%)
52 tapered implants (22.5%)	RBM (6%)	25 Morse taper connection (11%)
7 stepped cylindrical implants (3%)	TPS (9%)	20 Not known / Other (8.5%)
5 Not known / Other (2%)	HA coated (17%)	19 One piece (8.5%)
	Machined (10%)	6 Internal octagonal connection (2.5%)
	Not Known / Other (17%)	

The present dental implant software was developed, Implant Recognition Software (IRS), (*Figure 1*) to work on the principle of a dataset being stored in a stand alone database and several questions being used to detect possible implant systems. Once the nine questions have been answered (*Figure 2*) even if not all the information is known then the databank will be searched and those implant systems which meet the criteria outlined will be listed below (*Figure 3*).

To check if this is indeed the implant system being searched for, then radiographic images of the system (*Figure 4*), clinical images of the implant from above showing the trans-mucosal connector, and clinical images of the implant itself (*Figure 5*) can be checked against the patient. If the search has identified the system then a summary report of that implant system outlining all the implant features, contact details for the implant manufacturer (e-mail addresses, web- page and conventional address and phone numbers) is provided (*Figure 6*).

The program is both simple to load and easy to follow, using drop down menus. A web site has been developed as well (www.whichimplant.com). Its purpose is to inform the dental profession about the use of the software. Future aims include providing news and updates on the database and the potential to download the software through the Internet.

The software is Windows 2000/NT/XP compatible but does not require any additional software to run it. The computer disc contains all the information required to run the program along with links to both the University Dental Hospital of Manchester and Manchester Computing web-pages.

The computer software has been piloted using attendees at the 2003 and 2004 annual international implant course, run at the University Dental Hospital of Manchester and Mandec, who provide dental implants both in a hospital and practice setting⁷. It has also been

presented as a poster presentation at the 2004 annual British Society for the Study of Prosthetic Dentistry (BSSPD) conference and at the 11th meeting of the International College of Prosthodontists (May 2005). So far the response has been very favourable with over 50 dentists having used the software. As a result of the feedback received from the users some minor modifications to the software and a Windows 98 version are being produced.

Discussion

For this product to be clinically useful in the long term and possibly commercially viable, then the databank of implant systems would need an annual update. The program has been developed with a front and back end to allow for the addition of a new databank of implant systems and images without having to rewrite the intrinsic search package and table format.

This software tool can also be used in the field of forensic dentistry. Body identification, after mass disasters or single murders can often be complex and frequently the facial bones and teeth are the only clue to identity. If a body has a dental implant present, the forensic dentist could identify which system, the site, length and diameter of implant used and this would be a significant lead in terms of body identification. This software program could therefore be a major asset to forensic dentists who may possess limited knowledge in this field and has recently been used in such a case (*Figure 7*). A body was found in the North West of England after a house fire and although provisional identification was possible it needed confirmation. The jaws had four implants present (*Figure 8*) which were identified by the forensic dentist using IRS and the dentist of the suspected deceased was contacted. The body identity was thus confirmed.



Figure 1. Initial screen with links to the Manchester Dental School website, the Manchester Computing website and the IRS software website.

Figure 2. Search screen exhibiting the 9 drop-down menus

Figure 3. Search screen exhibiting results for a search



Figure 4. Radiographic image linked to a search result



Figure 5. Image of an implant linked to a search result

Bicon

Print Form Return to Search

Close Form

<p>Type: Tapered</p> <p>Description: Morse Taper</p> <p>Collar: ▼</p> <p>Threaded: Threaded ▼</p> <p>Diameter and Lengths (mm)</p> <table border="1"> <tr><td>3.50:</td><td>8 ; 11 ; 14</td></tr> <tr><td>4.00:</td><td>8 ; 11 ; 14</td></tr> <tr><td>4.50:</td><td>8 ; 11</td></tr> <tr><td>5.00:</td><td>8 ; 11 ; 14</td></tr> <tr><td>6.00:</td><td>8</td></tr> </table> <p>Surface</p> <p>HA Coated</p> <p>Machined</p> <p>TPS</p>	3.50:	8 ; 11 ; 14	4.00:	8 ; 11 ; 14	4.50:	8 ; 11	5.00:	8 ; 11 ; 14	6.00:	8	<p>Manufacturer</p> <p>Bicon Dental Implants BICON 501 Arborway Boston USA MA 02130</p> <p>Telephone (800) 882-4266</p> <p>Fax (800) 282-4266</p> <p>Email bicon@bicon.com</p> <p>URL www.bicon.com</p>
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Figure 6. Implant and manufacturer details screen



Figure 7. Forensic photograph depicting an implant identified using IRS.

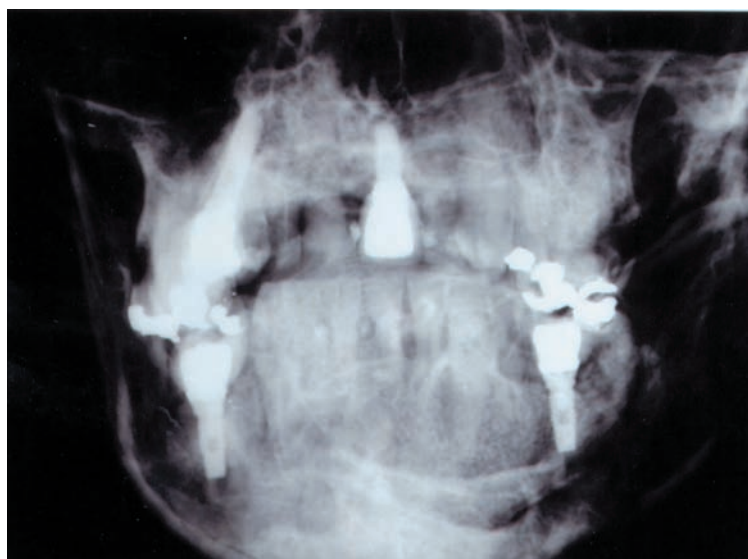


Figure 8. Cephalometric radiograph showing the implants in the upper and lower jaw.

Conclusions

The Implant Recognition Software (IRS) should simplify clinicians' and technicians' jobs when identifying any dental implant systems which a patient may present with as well as having potential uses in the field of forensic dentistry.

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