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Dentistry

UNSCRAMBLING THE IMPLANT IDENTIFICATION ENIGMA THE TIMELINE OF DEVELOPMENT

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ABSTRACT The increasing use of dental implants worldwide has led to diverse implant systems and components, often making identification challenging when patients seek care from a third-party dentist unfamiliar with the original treatment. Accurate identification of existing dental implants is crucial for maintenance, restoration, and complication management. This review explores various methods used for implant identification including clinical and radiographic examination, implant recognition software, barcode or QR-coded components and use of databases such as the Implant Recognition Tool (IRT). Emerging technologies such as artificial intelligence and 3D radiographic analysis further enhance diagnostic accuracy. A systematic approach combining patient records, imaging, and digital tools is essential for effective implant identification, especially in interdisciplinary or referral-based practices. Early and accurate identification not only streamlines treatment planning but also minimizes patient risk and cost.

KEYWORDS : Implant identification, implant systems, third party dentist, dental tourism, forensic dentistry.

INTRODUCTION:

Dental Implantology is a rapidly expanding field that offers patients an exceptional level of oral rehabilitation that is effective, predictable, convenient, and reasonably priced, improving the lives of millions of people worldwide[1].Comparing dental implants to traditional prosthetic methods reveals substantial functional and biological benefits[2].

Around the world hundreds of implant manufacturers create a wide range of implant systems and prosthetic parts for various clinical applications. As a result, determining the implant system in patients is a significant challenge that has been getting worse recently. Individuals may undergo treatment from multiple dentists over time, making it difficult to identify dental implant systems in individuals with insufficient treatment records. Implant restorations are more durable, but as their lifespan increases, so do the related issues[3].

Hence the identification of dental implants is a critical component of contemporary dental practice and forensic science. With the global increase in dental implant placement-estimated at over 12 million annually-the diversity of implant systems now available has made accurate identification more challenging than ever. More than 1,500 implant designs exist worldwide, each varying in geometry, material, thread design, connection type, and platform features. When patients present without prior documentation-such as in third-party consultations, emergencies, or forensic cases-implant identification methods become essential to ensure appropriate clinical management and legal verification[4].

Various identification methods include radiographic analysis, surface analysis, implant designs, thread pattern, analysis of prosthetic components, implant interface, shape of implant apex, batch numbers, artificial intelligence and various commercial implant recognition software. Hence aim of this review is to provide the information on various methods used for identification of dental implant system in patient visiting to third party dentist.

Third Party Dentist's Role In Emergency Dental Implant Identification:

Dental tourism has become a trend today as patients travel globally for dental treatment based on cost and convenience. Patients may get dental implants placed at one place and may choose to restore or follow up at another region. However, when complications arise post treatment patients often face difficulty accessing their original providers. In such cases, they are compelled to seek care from third party dentists. The need to visit third party dentists in emergencies underscores the importance of improved communication, standardized implant documentation and global continuity of care in the context of dental tourism.

Methods of Dental Implant Identification:

Role of radiographs in identification:

Radiographic imaging is one of the most fundamental and widely used methods for dental implant identification in both clinical and forensic contexts. Dental radiographs—particularly periapical, panoramic, and cone-beam computed tomography (CBCT)—allow clinicians to visualize the morphological features of implants. These include thread patterns, platform designs, abutment interfaces, and apex configurations, which can be matched against known implant systems for classification and management[4].

Thread Design:

Implants have unique thread patterns (e.g., V-shaped, square, buttress, reverse buttress and corkscrew - **Fig. 1**), which are visible in radiographs and aid in manufacturer classification. V shaped thread design is present in Noble and ACE implant system. Square shaped threads are present in Adin and Bio horizon system, Corkscrew pattern is present in Osstem system, Reverse buttress is seen in Alpha-Bio system, buttress type thread pattern is seen in Straumann and genesis system. Whereas MIS system has Dual thread with triangular platform.

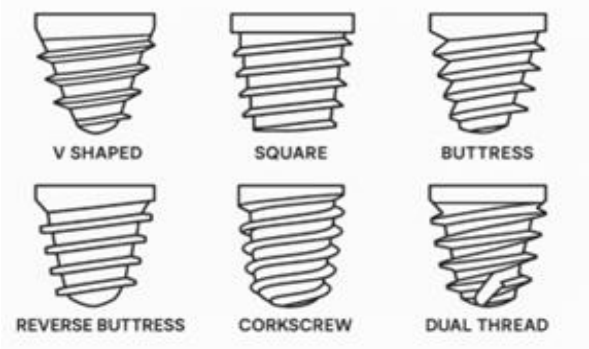

Fig. 1

Platform Switching –

Fig. 2: Some implant systems feature narrower abutments than the platform diameter, a feature identifiable on radiographs. Nobel Biocare was among the first to adopt platform switching. Straumann Bone level series offers narrower abutments than implant platform. Astra Tech has built-in platform switching with internal conical connection, Zimmer Biomet system has Internal hex platform-switched connection, whereas Megagen system uses tapered body and conical connection with platform offset[5].

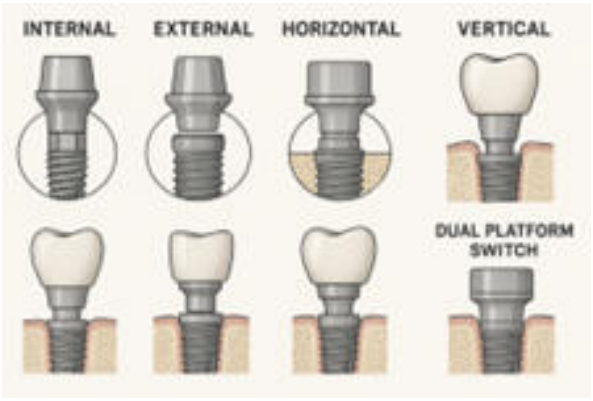

Fig. 2

Apex Shape:

Various apex shapes **(Fig-3)** helps to differentiate the different systems of implants such as Nobel Active, Astra EV, BLX, Bio Horizons systems has conical apex, Adin and Osstem implant has dome shaped apex, Zimmer TSV, Straumann Std+, ITI systems has flat apex shape, Biogenesis system has flared apex shape, Brånemark MkIII/IV, Osstem TS II has rounded apex, Nobel Active, MIS Seven, implantium has self-tapping apex, Ankylos, Bicon has screw tip/Drilling, whereas Xive S Plus, Alpha Bio NeO, Adin Touareg S has slightly beveled apex. Depending upon the different shapes of the implant apex on radiographic examination, the system of implant used can be identified[6].

Fig. 3

Implant Connection Type:

One of the most reliable ways to identify a dental implant is by analyzing its implant–abutment connection type **(Fig.4)**. The connection is where the prosthetic component (abutment or crown) joins the implant fixture, and each implant system typically uses a proprietary connection geometry. External hex has hexagonal interface on the outside of implant head which are present in Branemark (Nobel), Zimmer, Bio Horizons systems. Internal Hex has female hex slot inside the implant body which is there in Straumann, Zimmer TSV, Bio-Horizons systems. Morse Taper (Conical Connection) is present in Ankylos, Astra Tech, Straumann BLX, Megagen systems and internal octagon or tri-channel connection is there in Nobel Replace, Nobel Active. Various clues used for radiographic identification of the type of implant connection are external hex systems show a visible screw channel and platform margin. Morse taper systems often show a tight seal at the implant–abutment junction with no radiolucent gap. Internal hex or octagon may appear as subtle radiopaque lines at the abutment interface[7].

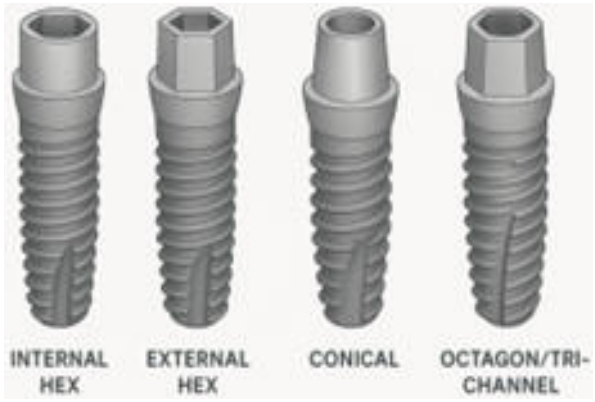

Fig. 4

Role Of Artificial Intelligence And Deep Learning In Dental Implant Identification:

Artificial intelligence (AI) and deep learning (DL) are transforming the landscape of dental implant identification, providing tools that enhance accuracy, speed, and consistency—particularly when conventional methods (e.g., visual inspection or radiographic comparison) are limited by poor image quality or lack of documentation. Various types of AI used are: Convolutional Neural Networks (CNNs) which detect features like thread pitch, apex shape, connection type. Object Detection Models (YOLO, SSD) can identify implant regions in full jaw radiographs[8]. AI has also been integrated into implant identification software and dental databases: Implant Detective, DDS Navigator and other platforms use AI to recognize implants from uploaded radiographs. Some models are trained on over 20,000 annotated implant images, enhancing precision across brands and generations[9].

Role Of Commercial Implant Recognition Software In Dental Implant Identification:

Several commercial software platforms offer automated or semi-automated implant recognition tools. Implant Detective software is AI-powered implant recognition which uses radiographs. ICR™ (Implant Connection Recognition) software focuses on prosthetic connection type[10].

Role Of Surface Analysis:

Various techniques used for analyzing surface features are Scanning electron microscopy (SEM), Optical microscopy, Surface profilometry, Energy Dispersive X-ray Spectrometry (EDS/ EDX). Straumann SLA can be identified via SEM/profilometry, Nobel BioCare Ti Unite is identified using SEM for Bio Horizons Laser-Lok identification Optical or SEM is helpful, whereas Zimmer TSV is visible in radiographs and SEM[11].

Role Of Prosthetic Component Inspection:

Careful inspection of the abutment interface, screw geometry, healing components, and crown attachment allows clinicians to: Determine implant brand and model, avoid incompatibility issues during prosthetic replacements, guide re-treatment or retrieval, ensure proper tool and driver selection. Abutment provides clue about implant interface, platform size. Prosthetic Screw gives information of Head shape (hex, star, unigrip), thread pitch. Healing abutment gives information on Platform markings, screw threads, collar height. Whereas crown base provides information regarding screw channel size, angulation, cement-retained vs. screw-retained[12].

Role Of Batch Numbers In Identification:

Batch numbers (also called lot numbers) – Fig. 5, are unique alphanumeric identifiers assigned by manufacturers to a specific group of dental implants or prosthetic components produced under the same manufacturing conditions. Batch numbers are typically: Laser-etched or engraved on the implant body, abutment or packaging and registered with the manufacturer along with the production date, material used, and quality control reports. These batch numbers can survive the incineration process sufficiently that their numbers can be identified. Also, the batch number is not damaged by the screwing and unscrewing of the abutment.

Fig. 5

CONCLUSION:

When a patient presents to a third-party dentist-a clinician not involved in the original implant placement-dental implant identification becomes a crucial step in delivering safe, effective, and compatible care. The absence of prior documentation such as radiographs, or component records creates challenges in restoring, repairing or revising the existing implant-supported prosthesis. To address this, various methods such as radiographic analysis, prosthetic component inspection, surface analysis, batch numbers and AI based software are present. Each of these tools offers valuable diagnostic insight, especially in unfamiliar clinical settings. Accurate implant identification not only ensures mechanical and biological compatibility but also prevents prosthetic misfits, component failure, and medico-legal complications. As implant systems diversify and patient mobility increases, third-party dentists must be equipped with both the knowledge and tools to identify implants confidently and manage care safely.

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