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A New Complexity Index in Implant Dentistry: Position Statement of the Implant Dentistry Study Consortium

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ABSTRACT

Introduction: The growing complexity of implant dentistry necessitates advanced frameworks to guide treatment planning, enhance clinical outcomes, and streamline surgical execution. This article proposes the IDSC Complexity Index, a novel classification system.

Materials and Methods: A retrospective study was conducted using data collected from 4,201 patients who underwent 20,154 dental implant procedures between January 2002 and October 2024. Patients aged 18–95, including both medically healthy and compromised individuals, smokers, and diverse socioeconomic and ethnic groups, were included. Exclusions were limited to contraindications for implant surgery. The IDSC classification system divides implant sites into five zones, starting with simpler areas like the anterior mandible and progressing to the most complex regions such as the posterior maxilla with sinus lift requirement.

Results: Analysis of 20,154 samples revealed variations in implant placement by location and classification. The highest percentage of implants was in the posterior mandible (32%, Class III), while the posterior maxilla requiring sinus elevation (5%, Class V) was the lowest. Surgical time ranged from 19 minutes (Class I) to 50 minutes (Class V). Treatment costs spanned from $790 (Class I) to $1,251 (Class V). The number of procedures per implant also varied, with Class I requiring one procedure on average, increasing to 3.0 procedures for Class V, which involved the most ancillary interventions.

Conclusion: Implant placement in different areas of the oral cavity has an escalating effect on time, cost and number of ancillary procedures.

Keywords: Implant site classification; IDSC Complexity Index; Treatment planning; Implant dentistry; SAC classification.

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INTRODUCTION

The anatomical variations in different parts of the oral cavity dictate various considerations in dental implant treatment planning.[1-3] This impacts diagnosis, surgery, impression techniques, restoration methods, radiographic needs, and long-term maintenance of treatment. The factors contributing to early implant failures during the osseointegration phase encompass inadequate bone and soft tissue quality or volume,[4-12] underlying medical conditions of the patient,[9,11,13,18] and harmful habits such as bruxism, prolonged heavy smoking, and poor oral hygiene.[6,7,9,11,14] Other contributing elements include insufficient surgical planning or technique,[6,10,11,14,18] errors in prosthetic design and execution,[6,10,11,14,16,17] suboptimal implant features, including design and surface properties,[9,17,18] improper implant placement or positioning,[19] as well as unexplained causes.

The multitude of anatomical diversity between specific sites points to the requirement for different clinical preparations at each level[1] and behooves a complexity criteria that includes time, cost, steps, armamentarium, skills, medication and postoperative complications to be considered during the diagnostic phase.

Although previous classifications have served as a basic guideline for evaluating case complexity, they have not addressed the typical questions raised by patients or dentists. Hence, a need for a more granular and multi-faceted approach has become evident. This article introduces the IDSC Complexity Index, a novel framework designed to provide a comprehensive, region-specific, and dynamic assessment of all possible procedural challenges in implant dentistry.

The new system allows clinicians to identify the appropriate diagnostic tools needed and clarifies the complexity of each case, ensuring that both the surgical team and the patient have a clear understanding of the procedural demands. Furthermore, the classification aids in determining the necessary materials and equipment, providing a structured approach to resource allocation. This system also helps estimate the cost and duration of treatment, enabling more accurate patient counselling and financial planning. Importantly, with a time estimate inherent in the classification, it offers predictive insights into intra and postoperative pain levels,[20] helping to set realistic expectations and improve patient compliance.

Clinically, it also serves as a valuable framework for training the practitioners in the early stages of their implantology learning curve or universities structuring their curricula.

The intent of this classification is not to diminish or compare with other existing ones. It is merely to introduce a novice technique for identifying the complexity of each case with more parameters that can overcome the limitations of the existing classifications.

MATERIALS AND METHODS

Data collection

A retrospective study has been performed by 441 dentists based on evidence gathered from a database of 4,201 patients, who had received 20,154 dental implants from January 2002 to October 2024. Each individual case was categorized according to the new proposed classification system.

Data collection criteria for each class I-V was as follows:

a- Time required: All cases were documented with digital photos capturing each treatment step, including the initial surgery, all the way to the final suture. The time required for each individual surgery, including ancillary procedures, was tracked. The total time for each class was calculated by summing the minutes and dividing by the number of cases in that category.

b- Treatment Cost: The cost of all purchases for each implant was calculated in US dollars. The amount for every class was added and divided by the number of cases including the implant with its parts, augmentation materials, and the dental laboratory invoice.

c- Number of procedures: The data, relating to the number of ancillary procedures in each class, noted for each of the 20154 implants.

Cone beam computed tomography imaging and 3 -dimensional (3D) computer software were used for improved understanding of bone anatomy and efficient restorative planning.

Inclusion, exclusions

The study included a diverse patient population aged 18 to 95, with varied ethnicities, medical histories, lifestyles and socioeconomic backgrounds.[21] Both medically compromised patients

and healthy individuals, as well as smokers and non-smokers, were represented. Exclusions were limited to those with contraindications to dental implant surgery, such as untreated severe periodontal disease, active infections, IV bisphosphonates, pregnancy or conditions that preclude surgical intervention.

Data resources

The data for this study were collected from patients treated at two dental clinics: Oral Implantology Medical Center, Dubai, UAE, and Marina Dental Center, Dubai, UAE. All procedures were performed by dentists of different age groups and specialties who hold licenses with a minimum of 3 years of experience, under the supervision of all required specialties, with extensive experience in implant dentistry. The collected data span a broad time frame, ensuring a comprehensive evaluation of diverse clinical cases across varying complexity levels, ensuring reliability. These clinics provided a well-documented database of cases, enabling the retrospective analysis required for this study.

Classification Method (Table 1, Figure 1)

The proposed classification system is established according to implant position in the mouth. It divides the oral cavity into five main classes (I-V) to guide practitioners in selecting treatment approaches. It assesses complexity and risk, outlines necessary skills, estimates cost and duration, addresses post-operative concerns, lists materials and equipment, and helps manage patient expectations.

The five classes are as follows:

Class I: The mandibular anteriors.

Class II: The maxillary posterior area.

Class III: The mandibular posterior teeth.

Class IV: The maxillary anterior teeth.

Class V: The maxillary posterior teeth that require sinus elevation.

Each class is separately color coded - Class I: green, Class II: yellow, Class III: blue, Class IV: orange, and Class V: red.

These classifications (Areas/Classes I–V) align closely with the bone quality categorization initially proposed by Lekholm and Zarb.[22]

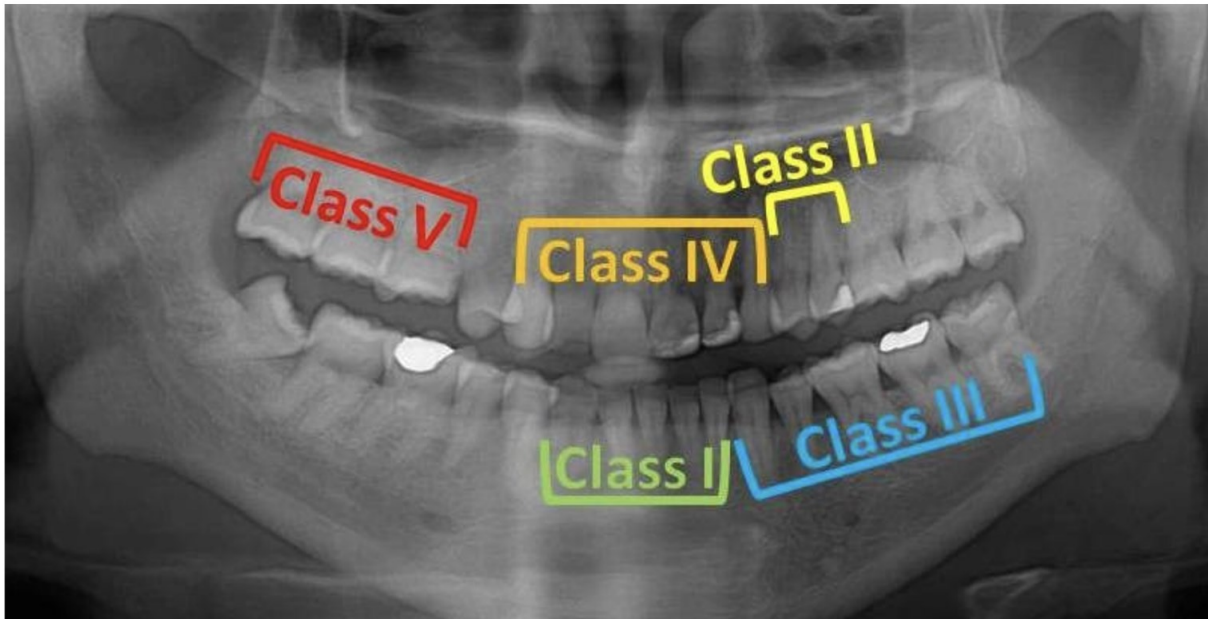

Figure 1: Orthopantomogram with color coded IDSC classification I-V.

Classification	Described area
Class I	Mandibular anterior region
Class II	Maxillary posterior region without sinus elevation requirement
Class III	Mandibular posterior region
Class IV	Maxillary anterior region
Class V	Maxillary posterior region with sinus elevation requirement

Table 1: IDSC classification I -V, color-coded.

Auxiliary procedures (table 2)

Seven subcategories have been added to this classification to be able to visualize all possible ancillary treatments.

1. Class + R (right side) or L (left side) + the number of implants required. E.g., for 3 implants in the right posterior mandible it is classified as: IIIR3.
2. Class + R or L + capital letter "B" (Bone block): When any bone block is added to the surgery anywhere in the allotted region in the mouth, the letter "B" is added to the classification. E.g., if a block graft is to be placed in the anterior right maxilla followed by two implants, it is classified as IVRB2.
3. Letter "b" is utilized when bone augmentation to be performed is particulate bone.
4. Class + R or L + capital letter "S" (open sinus lift): When a lateral window approach sinus lift with bone graft is added to the surgery, the letter "S" is added to the classification. E.g., an open sinus lift followed by an implant in the 2nd left maxillary molar is classified as VLS1.
5. Letter "s" when an internal sinus lift procedure is to be performed with a bone graft.
6. Class + R or L + capital letter "X": when an extraction is required immediately or within 2 weeks before implant placement, the letter "X" is added to the classification. E.g., three extractions followed by immediate implant placement in the anterior mandibular area, including both right and left side. It is classified as: IXRL3.
7. Letter "x" is used when an extraction will have an anticipated healing period of 2 months or more prior to implant placement during consultation, diagnosis, and treatment planning.

Note:

Either fixed restoration with a pontic (P) or a removable overdenture (O) is designated at the end of the formula.

Class V without "s" or "S" denotes that a sinus lift was performed without a bone graft procedure.[23]

The sequence of writing the formula is as follows:

Class [I-V] - right or left side of the mouth - the number of implants - ancillary procedures - number of Pontics / O: [overdenture prosthesis]

I,II,III,IV&V - R or L - # - B, b, S, s, X, x, F, T, t - P#/O

For example, a bone block graft procedure in the right anterior maxilla with a single implant is categorized as Class IVR1B, while a sinus lift with a maxillary left molar implant is designated as Class VL1S.

AUXILIARY PROCEDURES	
B	Any block bone added to the surgery
b	Augmentation with particulate bone
S	Lateral window approach
s	Internal sinus lift
F	Platelet rich Fibrin
T	Autogenous connective tissue graft
t	Alloplast and xenograft mucocutaneus graft

Table 2:

X	extraction is required immediately or within 2 weeks to implant placement
x	extraction with healing period of 2 months or more prior to implant placement

P	pontic
O	overdenture

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Additional tools (figure 2)

To further enhance ease of use for clinicians, a web application, found at https://diagnosiskey.com/keyindex/#/patient, has been developed to streamline the process of implant procedure planning. This user-friendly tool guides clinicians through the entire workflow, from assessing case complexity to identifying required materials and equipment. It provides procedure details, suggests a list of necessary instruments, and allows customization based on individual preferences. Auxiliary procedures can be integrated, and a full report with estimated costs is generated for sharing and coordination. The app also supports translation, making it accessible globally. More in-depth explanation can be found at https://diagnosiskey.com/wp-content/uploads/2023/12/Final-video-1.mp4.

Statistical Analysis

An inferential and qualitative Statistical analysis was done by computing and using Sample means, Sample Standard Deviation. Student's T Test is used to compare means and proportions, inference given on the basis of value of P (Statistical significance was denoted when $P < 0.05$).

The Mann-Whitney test is used to compare differences between independent classifications under minimum, maximum and average of time and number of procedures.

One Way ANOVA is used to find significant differences between time and number of procedures.

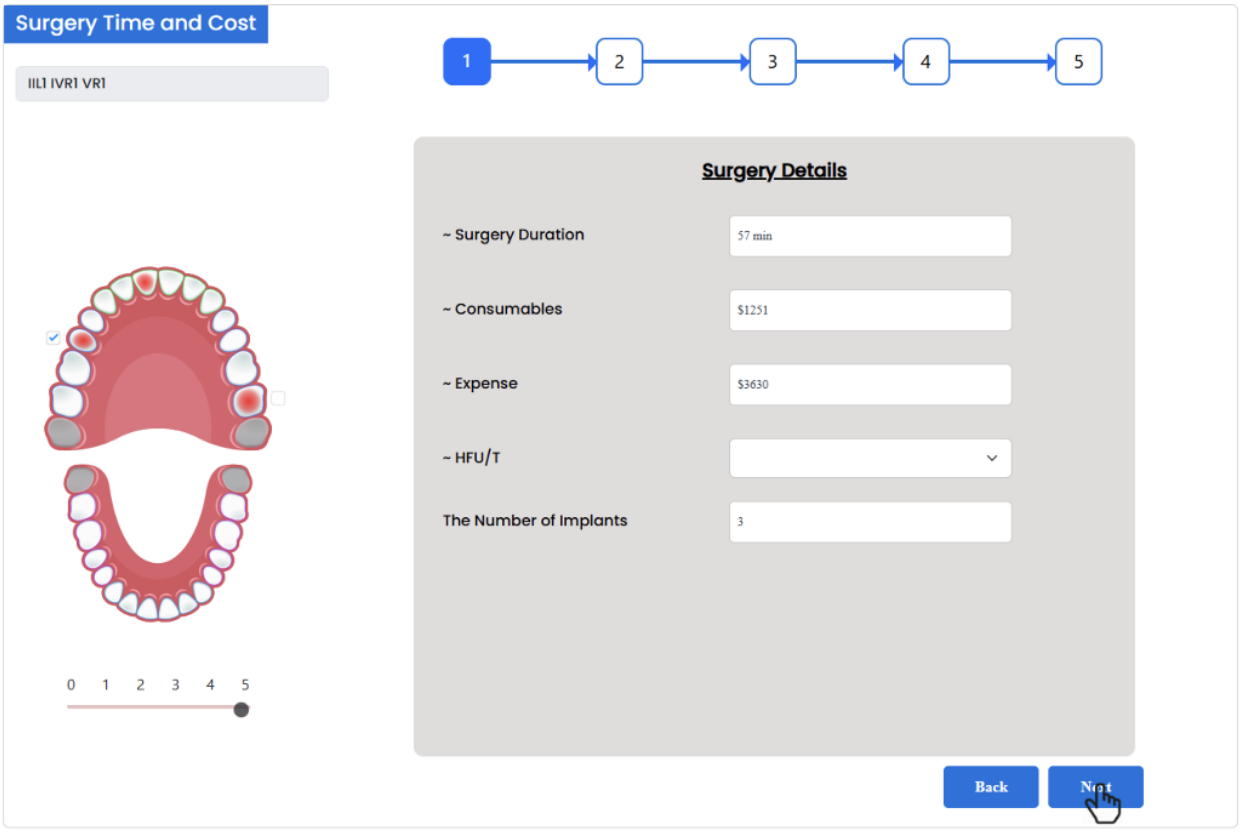

Figure 2: After choosing the implant sites, the app takes the user through 5 steps, ending with generating a full report.

RESULTS

The data demonstrates, out of 20154 samples, the percentage of missing teeth that required implant placement is as follows. The maximum area was in the posterior mandible and the minimum was in the posterior maxilla that additionally required maxillary sinus elevation with the following sequence, III 32%, IV 29%, II 24%, I9% and V 5% respectively.

a- Time required for each class: The data demonstrates that Class I area required the minimum time for placing an implant and completing the surgical phase and Class V required the maximum time to complete the surgery including all related ancillary procedures. The time distribution among the class is as follows V- 50 minutes for each implant placed with sinus lift procedure, IV- 41 minutes, III- 36 minutes, II- 28 minutes and I- 19 minutes to complete the surgery including all related ancillary procedures respectively.
b- Treatment Cost: The cost of surgery and restoration with all ancillary procedures was as follows, Class V- $1,251, IV- $979, III- $892, II- $932 and I- $790 respectively.
c- Number of procedures: The data, relating to the number of procedures in each class, demonstrated that out of 20154 samples Class V- required an average of 3.00 procedures for each implant including all ancillary procedures that was required to complete the treatment, followed by Class IV that required an average of 1.92 procedures, class III- an average of 1.56 procedures, class II- an average of 1.78 procedures and class I - 1 procedure, respectively.

DISCUSSION

The proposed implant site classification system offers a structured progression that supports both clinician training and improved patient outcomes. For practitioners in the early stages of implantology, Class I and Class II procedures provide an ideal starting point, as these involve the safest implant sites. If all the required adequate measures for diagnosis and treatment planning are taken and appropriate surgical protocol is followed, the mandibular anterior region is no doubt a preferable area for implant placement. The maxillary premolar area showed the highest survival rate (96.2%).[24] These cases are characterized by minimal risk to vital structures, excellent accessibility, and the absence of complex auxiliary procedures. With procedure times ranging from 7 to 30 minutes per implant, these early-stage surgeries enhance predictability, minimize patient discomfort, and yield high success rates (97%+). The limited need for CT scans (especially if the midline area is avoided), and minimal postoperative recovery further contribute to their appeal for novice clinicians.

As clinicians progress to more complex cases (Classes III–V), the classification aligns procedural complexity with growing expertise. Class III, involving the mandibular posterior teeth, introduces additional considerations such as vital structures (e.g., inferior alveolar nerve, mental foramen), necessitating more diagnostic tools like CT scans and longer procedural times. Similarly, Class IV and Class V sites, including the maxillary anterior and posterior regions, demand specialized techniques and armamentarium, such as soft and hard tissue augmentation, sinus lifts, and angulation correction. These cases involve significant aesthetic and functional challenges,[25,26] increased postoperative pain, and the need for advanced equipment and experienced surgical teams.
From the patient's perspective, this classification improves trust and transparency by setting realistic expectations.
As complexity increases, the system ensures clear communication of potential risks and benefits, empowering patients to make informed decisions.

Area/Class [C] I: Anterior Mandible

Commonly referred to as the inter-foramina region, this area warrants careful diagnostic attention due to its unique features. Bone density here is notably high, increasing the risk of thermal injury during osteotomy if proper irrigation and sharp osteotomy drills are not used. The risk of penetrating the thin lingual mandibular cortex during implant placement must be noted, as this can occasionally result in severe bleeding and expanding sublingual hematomas.[27-32,34-37] Hemorrhage can arise from branches of the sublingual, submental, or mylohyoid arteries or their anastomoses, potentially compromising the airway.[30-32,34] Preoperative CT imaging is recommended, as Tepper et al.[32] highlighted the frequent presence of lingual perforating vascular bone canals[33] Successful placement of two to four implants in this area provides a stable foundation for a variety of implant-retained or implant-supported prostheses.

Area/Class [C] II: Posterior Maxilla

This region includes the first and second premolars and occasionally the first and second molars if sinus augmentation is unnecessary. Despite not being part of the anterior maxilla, this area remains significant for patient aesthetics during speaking and smiling. The cortical bone density in this area, as reported by Park, Hyo-Sang, et al.,

ranges between 810 and 940 HFU, with the highest density found in the canine and premolar zones.[38] These implants provide critical support anterior to the maxillary sinuses, ensuring functional and aesthetic outcomes.

Area/Class [C] III: Posterior Mandible

This bilateral zone spans the alveolar ridge from the first premolar to the retromolar pad, limited by the mental foramen anteriorly and the inferior alveolar canal below. The quality and quantity of bone, as well as masticatory demands, are key factors influencing implant success here.[39,40] Given its significant masticatory function, the placement of two to three implants is usually necessary to support the replacement of missing premolars and molars.

Area/Class [C] IV: Anterior Maxilla

This zone, often referred to as the aesthetic area, includes the six upper front teeth. The thin labial cortical plate and thick palatal cortical plate are characteristic of this region. Trauma or tooth loss frequently affects this area, leading to bone resorption, particularly on the buccal side. Post-extraction healing progresses through specific stages, with significant bone loss occurring within the first year.[40-42] If implants or bone grafting are not promptly performed, the resorption of the buccal plate can severely compromise the alveolar ridge, complicating implant placement in a prosthetically favorable position. The importance of cortical bone for maintaining implant stability and reducing stress on the surrounding bone is vital.[43]

Area/Class [C] V: Posterior Maxilla with sinus lift

This bilateral region encompasses the posterior maxillary alveolar ridge from the first molar to the pterygoid plates, located beneath the maxillary sinus. Tooth loss in this area often leads to sinus pneumatization and vertical bone deficiency, necessitating sinus lift procedures for successful implant placement. The posterior maxilla is known for its lower bone density (types 3 and 4), which may contribute to higher implant failure rates.[44] Injuries to the Schneiderian membrane during sinus augmentation procedures can result in perforation, requiring surgical expertise.

CONCLUSION

There is a trend of escalating levels of complexity in different parts of the oral cavity. The simplest being anterior mandible, posterior maxilla, posterior mandible, anterior maxilla and posterior maxilla sinus lift procedure respectively. The time, cost, and number of procedures for dental implant surgery vary across different areas of the oral cavity. These factors can be estimated during the diagnostic phase, allowing for a classification that distinguishes patients based on the complexity of their treatment.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy.

Conflicts of Interest: The authors declare no conflicts of interest.

FUTURE DIRECTIONS

The authors aim to establish a simplified implant site classification system as a standard in dental implantology through a certification program for practitioners and educational institutions. The program provides guidelines and training to integrate the system into workflows, ensuring improved outcomes and also enhancing global access to advanced implant treatment.

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