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A RETROSPECTIVE STUDY ON THE OUTCOMES OF DENTAL IMPLANTS IN ROUTINE CLINICAL PRACTICE.

Dr. Dipti Kumari[1], Dr. Alambusha Shukla[2], Dr. Ashish Mourya[3], Dr. Pinak Pani Kar[4], Dr. Prerna Anand[5]

[1] Assistant Professor, Department of Oral and Maxillofacial Surgery, Mithila Minority Dental College and Hospital, Laheriasarai, Darbhanga, Bihar, India.
[2] Post Graduate Trainee, Department of Prosthodontics and Crown Bridge, Hitkarini Dental College & Hospital, Jabalpur, Madhya Pradesh, India.
[3] MDS (Oral and Maxillofacial Surgery), Bokaro Steel City, Jharkhand, India.
[4] Consultant, Oral and Maxillofacial Surgeon, Desun Hospital, Kolkata, West Bengal, India.
[5] MDS (Pediatric and Preventive Dentistry), Consultant, Diya Dental Clinic, Kolkata, West Bengal, India.
[*] **Correspondence:** Dr. Dipti Kumari

ABSTRACT:
Objectives: Dental implants have evolved as new treatment modality for the majority of patients and are expected to play a significant role in oral rehabilitation. The present study was to evaluate the outcomes of dental implants in routine clinical practice at dental OPD of Mithila minority Dental College and Hospital, Darbhanga, Bihar, India. **Methods:** All the patients were clinically examined, diagnostic radiographs were evaluated and the patients were operated on general guide lines for implant therapy. On the day of surgery, a full thickness incision was utilised in the region of interest using #15c surgical scalpel. Following the primary incisions, flaps were elevated, implant sites were prepared and implants were inserted according to the manufacturer's instructions. In cases of need, appropriate grafts (xenograft/allograft or autologous bone) and collagen membranes were used. The flaps were repositioned and sutured with single interrupted sutures using non-resorbable silk sutures. Follow-up visits were planned as at 1, 3, 6, 12 months and yearly. Dental implant survival after at least 1 year of function, and marginal bone level (MBL) change around implants were evaluated. MBL changes were measured at each centre by an evaluator with expertise in radiographs assessment. **Results:** The study included 213 patients (110 male and 103 female) who had 403 implants inserted at dental OPD. Mean age was 52.54±15.23 years. The mean follow-up period from the date of the implant surgery was 44.23 ±10.45 months. The mean follow-up period from the date of loading with prosthesis was 43.35± 9.82 months. The mean healing period from the date of the implant surgery and the date of loading was 4.12±1.74 months. Maximum implant (19.05%) was inserted at site 16 of maxilla. While, maximum implants (19.69%) were inserted at site of 38 of mandibles. The overall survival rate of implants was 99.75%. **Conclusions:** Patient's age, gender, and associated diseases showed no significant influence on implant outcome. Proper diagnosis and patient-specific treatment plan can help to achieve successful oral rehabilitation outcomes for dental implants.

KEYWORDS: Dental Implants, Clinical Outcomes, Age, Gender

INTRODUCTION

Earlier the missing teeth were used to be replaced by either removable or fixed partial denture. Nowadays, dental implants have evolved as new treatment modality for the majority of patients and are expected to play a significant role in oral rehabilitation in the future. The success rate of 90%-95% has been reported over the 10 years [1]. A dental implant is a surgical component that interfaces with the bone of the jaw or skull to support a dental prosthesis such as a crown, bridge, denture, facial prosthesis or to act as an orthodontic anchor [1].

The primary stability, the bone-implant contact, the increased crown-implant ratio, and their combined effect on marginal bone loss, as well as the long-term success of the implant, are questionable. However, many factors have changed since the 1980s. Surface-treated implants appeared, new implant materials and different implant forms were developed, and new surgical techniques have been developed. However, the implant length and the definition of short implants are changing continuously. In the past, implants shorter than 10 mm placed in the lower jaw and shorter than 13 mm placed in the upper jaw were considered to be risk factors for implant success [2]. Furthermore, it was expected that short implants would have a lower success rate and an unpredictable survival rate. Even in the early 2000s, numerous publica tions described short dental implants as being less successful than standard implants of conventional length [3, 4]. Later, in 2016, at the European Association of Dental Implantologists (EDI) consensus meeting, a short implant was defined as being 8-mm long [5]. At the same meeting, the recommendation was issued that short implants should be a minimum of 3.75 mm in diameter. The term "ultrashort implant" has emerged, describing implants with a length of 6 mm. For ultrashort implants, there is insufficient evidence to make recommendations at this time. These definitions were confirmed in 2023 at the 18th EDI conference [6].

The investigation of patient-related outcome measures (PROMs) have become important due to the fact, that clinical success has to be in line with the satisfaction of the patients with the restoration. The degree of individual patient satisfaction is the result of psychological and physiological factors. But the choice of which PROMs to use should be restricted to those most appropriate for the study question and at a minimum, these data should be gathered at

two time points: at baseline and at a designated point post-treatment. Ideally, multiple assessments are desirable to discriminate short- versus long term treatment effects [7,8]. The objective of present study was to evaluate the outcomes of dental implants in routine clinical practice at dental OPD of Mithila minority Dental College and Hospital, Darbhanga, Bihar, India.

MATERIAL & METHODS

The present study was conducted in the Department of Oral and Maxillofacial Surgery, Mithila minority Dental College and Hospital, Darbhanga, Bihar, India during a period from February 2025 to March 2026.
A total of 403 implants of 203 patients inserted at Dental OPD of Mithila minority Dental College and Hospital, Bihar, India were included for the study.

MATERIALS AND METHODS

This retrospective research involved patients treated at dental clinics by experienced clinicians. All the patients were treated according to the manufacturer instructions for implant placement. The surgical procedures, as well as the patients' selection criteria, were followed the national guidelines for implant rehabilitation [9]. The implants were inserted between February 2025 to March 2026, and the patients are still at their routine follow-up.

Patient Selection:

Patients who received oral rehabilitation with dental implants with at least 1 year follow-up were included.

Inclusion Criteria:

- Patients who received at least one dental implant.
- Patients with a minimum 1 year of follow-up after implant insertion who had bone loss evaluation after 1 year of implant placement.
- Healthy patients according to the criteria of the American Society of Anesthesiologists (ASA-1 or ASA-2), that declared to have no contraindication for implant surgery.
- Diabetes under control, osteoporosis, bruxism or smoking habits were not considered as a contraindication.

Exclusion Criteria:

- Oncological patients, patients under chemotherapy/ radiotherapy.
- Pregnant subjects.
- Patients under anti-resorptive medications (e.g., bisphosphonate, denosumab).
- Patients suffering from acute periodontitis/gingivitis and/or active infection in head/neck or mouth which can have a negative effect on implant survival.

This study evaluated the results of titanium grade 5 (Ti6Al4V) implants with sandblasted and acid-etched surface (BWS, Blasted Wrinkled Surface). Due to a specific manufacturing process (sandblasting with pure aluminium oxide followed by etching with hydrofluoric and nitric acid), these implants are characterised by an extremely clean surface, with uniform and homogeneous roughness, potentially favouring fibrin and cell adhesion. The codes and brief explanations of the implant used in this study are listed as follows: IMPLASSIC FT3 (cylindric implant with conic apex 3.25–4.75 mm diameter, 8–16mm long), IMPLASSIC FT2 (submerged, cylindric short implant (6–7mm) with tapered apex), IMPLASSIC® TR2 (transmucosal, cylindric implant; internal design: cone with anti-rotational octagon), IMPLASSIC TRW2 (transmucosal, cylinder implants with wide prosthetic platform Ø 6.5mm), IMPLASSIC® TR3 (transmucosal implant with atraumatic apex; internal design: cone with anti-rotational octagon) and IMPLOGIC® AT (submerged, conical implants, active thread in cases immediate implantation at post-extraction sites, 3.25–4.75mm diameter, 8–13mm long).
All patients had surgical interventions according to the surgical recommendations of the manufacturer. Bone grafts and absorbable haemostatic gelatin sponge were placed in cases of need for post extraction alveolar ridge preservation. The list of grafts and dressings used in this study is Spongostan™ Dental, Exaflex resorbable membrane and MimetikOss™, Creos™ Syntogain Joins Creos™ Syntoprotect, Creos Xenoprotect, Creos Xenogain and Creos Mucogain.

Surgical Protocol:

The first step was the general and oral health anamnesis information collection. The patients were clinically examined, diagnostic radiographs were evaluated and the patients were operated on following general guide lines for implant therapy and rehabilitation, as also described previously [9]. For prophylaxis, antibiotics were prescribed according to current guidelines. On the day of surgery, a full thickness incision was utilised in the region of interest using #15c surgical scalpel. Following the primary incisions, flaps were elevated, implant sites were prepared and implants were inserted according to the manufacturer's instructions. In cases of need, appropriate grafts (xenograft/allograft or autologous bone) and collagen membranes were used. The flaps were repositioned and sutured with single interrupted sutures using non-resorbable silk sutures. Follow-up visits were planned as at 1, 3, 6, 12 months and yearly thereafter.

Evaluation of Data:

Primary outcomes were dental implant survival after at least 1 year of function, and marginal bone level (MBL) change around implants. The latter was calculated utilising periapical radiographs [9]. The baseline value corresponded to the measurements taken at prosthesis delivery. These were compared with those taken at subsequent follow-ups, at least 1 year after implant insertion and yearly thereafter. The difference between measurements taken at follow-up and at baseline was considered as the MBL change at a given time. The measurements were taken at

the mesial and distal aspect which was calculated as an average single value for each implant. In case of patients with multiple implants, a single per patient value was also obtained. The implant length and diameter served for calibration. MBL changes were measured at each centre by an evaluator with expertise in radiographs assessment. In the clinical follow-ups, patients were re-evaluated, and each data were noted on patient record with dates [9]. Peri implant soft tissue status was noted as healthy or mucositis/peri-implantitis.

STATISTICAL ANALYSIS

Data was analysed with the help of IBM SPSS software. Mean and Standard deviations were observed. Unpaired Student's t-test or Mann–Whitney test, and Pearson's chi square or Fisher's exact test were applied. P-value was taken less than or equal to 0.05 ($p \leq 0.05$) for significant differences.

RESULTS

The present study included 213 patients (110 male and 103 female) who had 403 implants inserted at dental OPD. Mean age of the study group was 52.54±15.23 years (age range: 25–75 years. Regarding the medical status of the study population two patients were suffering from osteoporosis (they were taking bisphosphonates as medication), one patient had lichen planus, two had type 2 diabetes (taking metformin), 10 had hypercholesterolaemia and 41 patients had hypertension (taking anti-hypertension drugs), while 157 patients were reported as medically healthy.

The mean follow-up period from the date of the implant surgery was 44.23 ±10.45 months. The mean follow-up period from the date of loading with prosthesis was 43.35± 9.82 months. The mean healing period from the date of the implant surgery and the date of loading was 4.12±1.74 months.

The implant distributions per site of implant insertion are listed in table 1 for maxilla and table 2 for mandible. Maximum implant (19.05%) was inserted at site 16 of maxilla. While, maximum implants (19.69%) were inserted at site of 38 of mandibles.

Table.1. Number of implants placed in the different sites (17–27) for maxilla.

Different sites of maxilla	No. of implants	Percentage
17	7	3.33%
16	40	19.05%
15	28	13.33%
14	26	12.38%
13	8	3.81%
12	19	9.05%
11	3	1.43%
21	2	0.95%
22	12	5.71%
23	3	1.43%
24	20	9.52%
25	18	8.57%
26	22	10.48%
27	2	0.95%
Total	210	100%

Table.2. Number of implants placed in the different sites (37–47) for mandible.

Different sites of mandible	No. of implants	Percentage
37	5	2.59%
36	36	18.65%
35	22	11.40%
34	16	8.29%
33	4	2.07%
32	6	3.11%
31	2	1.04%
41	5	2.59%
42	4	2.07%
43	3	1.55%
44	18	9.33%
45	20	10.36%
46	38	19.69%
47	14	7.25%

Total	193	100%

The implant numbers for the reason of extraction, immediate implantation or delayed protocol (at least 6 months after extraction), additional grafting or not, periodontal health situation after implant insertion (mucositis versus healthy peri-implantitis tissues, crestal or subcrestal implant insertion, can also be found in detail in Table 4.

Grafts: 35 sites had xenografts placed (either equine, bovine or porcine origine), and one received alloplastic graft. One case had an additional autogenous graft for bone augmentation. 17 patients had additional collagen membranes together with grafts, 5 had haemostatic medications to control excessive bleeding and two patients received connective soft tissue grafts.

Antagonist dentition: for 134 implants the antagonist was natural teeth, ceramic prosthesis: 32, full arch prosthesis: 20, edentulous: 1, monolithic disilicate: 18, Resin prosthesis: 25, Toronto: 138, veneer resin: 12. Prosthetic material: ceramic 144, Resin 58, vetro-ceramic (disilicate) 104.

Implant failure: Only one sub crestally placed implant (Implassic FT3, size 3.75×8mm, position 16) was lost after 1 year of function in a 71-years old female patient with periodontal problems who received bone graft (Creos) and a resin prosthesis. The overall survival rate of implants was 99.75%.

Table.3. Number and dimensions of implants that were inserted (in mm) (N=403).

Implant dimensions	Length 6	Length 8	Length 10	Length 11.5	Length 13	Length 16
Width 3.25	0	3(0.74%)	1(0.24%)	8(1.98%)	4(0.99%)	1(0.25%)
Width 3.75	0	10(2.48%)	80(19.85%)	82(20.35%)	50(12.41%)	5(1.24%)
Width 4.25	7(1.74%)	31(7.69%)	61(15.14%)	34(8.44%)	10(2.48%)	2(0.49%)
Width 4.75	0	9(2.23%)	4(0.99%)	1(0.25%)	0	0

Table.4. Showing the bone loss in mm.

Parameter	Soft tissue status (N=396		Implant positioning (N=285)		Implant insertion (N=396)		Grafting (N=396)		Prosthesis connection (392)	
	Mucositis	Healthy	Crestal	Subcrestal	Immediate	Delayed	Yes	No	Screwed	Cemented
Number of implants	16 (4.04 %)	380 (95.96 %)	84(29.47 %)	201 (70.53 %)	164 (41.41 %)	232 (58.59 %)	43(10.86 %)	353(89.14 %)	200(51.02 %)	192(48.98 %)
Mean ± S.D.	0.112 ±0.1324	0.2341 ±0.3357	0.5483 ±0.3248	0.1254 ±0.2312	0.3421 ±0.4364	0.1846 ±0.2438	0.2574 ±0.4376	0.2465 ± 0.3212	0.3269 ± 0.3582	0.1482 ± 0.1683
P-val	0.1482		<0.0001		<0.0001		0.8407		<0.0001	

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Table.5. Analysis of marginal bone loss according to the reason for extraction or edentulism status.

Parameter	Caries	Fracture	Edentulous	Periodontitis
Number of values	146	34	161	53
Mean ± S.D.	0.1427±0.1536	0.4837±0.3452	0.2439±0.3265	0.3168±0.4285
P-value	<0.001			
Sum	394			

DISCUSSIONS

Advancements in manufacturing and implant science have led to an expanded array of materials for dental implants. Biocompatible materials such as titanium, titanium alloys, ceramics, hydroxyapatite, and zirconia [10] are now widely used. Titanium's mechanical strength and high biocompatibility have made it a staple [11], while zirconia, valued for aesthetics and strength, particularly benefits patients with thin gingival phenotypes [12].

Albrektsson et al. [13] reported that implants with lower values of insertion torque and primary implant stability seem to be more prone to failure, particularly when using immediate or early loading protocols, compared to implants placed with higher primary stability. This can be explained by the different patterns of bone resorption that can occur in the first year after implantation, possibly due to bone remodelling, which is an adaptive bone response to both surgical trauma and a change in the mechanical forces to which bone tissue is exposed, once occlusal loading is applied [14]. A randomised controlled trial on outcomes of immediately loaded implants after 1-year follow-up found mean MBLs of 0.01mm for immediately placed and 0.06 mm for delayed implants, being the difference statistically significant [15]. A study on the primary and secondary stability of implants showed lower MBL values in the delayed implant placement compared to immediate placement group [16]. After the remodelling phase, the MBL often stabilises for about 0.2 mm per year, and the overall MBL is generally lower for delayed implant insertions when compared to immediately placed implants [17]. Another study conducted by Karni et al. [18] found relevant differences in peri-implant probing depth and MBL in cases with immediate implantation (significantly higher values for immediate versus delayed placement). Additionally, it was stated that during the first year, the immediately placed implants have a tendency for faster bone remodelling [17, 18]. Nevertheless, several other factors such as deep implant insertion with respect to ridge level, thin peri-implant mucosa and short abutments also seem to influence negatively the MBL [19]. The results of this work were consistent with the literature, as the implants immediately inserted after tooth extraction showed significantly more bone loss at 1 year (even though the size of the difference was small, about 0.2mm on average) than delayed protocol (implants placed after at least 6 months) [13–16].

A history of periodontal diseases can increase the risks of peri-implant mucositis and peri-implantitis, and implant failure [20, 21]. In this study, the incidence of mucositis was relatively low (4.04% at peri-implant level). However, subjects with healthy peri-implant tissues showed a slightly greater bone loss than patients with peri-implant mucositis (p=0.1482). However, this finding should be considered very cautiously because of the great difference in the sample size (16 cases of peri-implant mucositis versus 396 implants with healthy surrounding periodontal tissues).

According to the literature, preservation of crestal bone is a crucial factor for the success of the implants [38], and there are several reports comparing sub crestal and crestal implant insertions; however, the results are conflicting [22]. A recent meta-analysis showed a significantly greater MBL for crestal implants compared to subcrestal ones [23]. On the other hand, some studies showed higher bone loss for sub-crestal group [24]. Another systematic review and meta-analysis assessed overall clinical outcomes and found clinically acceptable peri-implant tissue parameters for both approaches (crestal versus subcrestal placements) [25]. In this study, subcrestal insertions had less MBL than crestal ones, which was in accordance with the result of the above-mentioned meta-analysis [23].

According to the results of this research, bone grafting had lower MBL values compared to sites without any grafts. A meta-analysis investigated the hypothesis that there is an effect of different bone graft substitutes on implant stability when used in patients undergoing immediate implant surgery and concluded that the use of grafts and immediate implant placement resulted with an increased bone gain (which is in agreement with findings of this research) [26]. According to the reports in literature, autogenous grafts such as iliac bone grafts mixed with demineralised dentin matrix provide improved implant stability and satisfactory functional results compared to commercially available bone grafts [27]. There are also a variety of reports about different types of grafts such as mixtures of xenografts (such as deproteinized bovine bone) and hydroxyapatite nanoparticles showing promising results for implant stability and bone remodelling [28]. There are several reports which highlight the positive outcomes of grafting during immediate implant placement for minimising horizontal buccal bone resorption and enhancing the aesthetics in the peri-implant soft tissues [29].

The interest of clinicians in immediate loading has been witnessed in the literature by a steadily growing number of publications in the past years [30]. Recent systematic reviews concluded that under well-defined circumstances, immediate loading seems to have long-term predictability and success rate [30]. Another popular topic in

implantology is immediate implant placement, which brings certain advantages like reduced treatment time, less surgical interventions, and better preservation of hard and soft tissues [31,32]. However, it also brings certain disadvantages such as higher risks of implant failure with respect to delayed placement, especially in the first year following surgery [31]. This is mostly due to the lack of stability in the early phase at the extraction site. On the other hand, delayed implants can show some advantages such as higher primary stability and lower risk of infection due to implant placement in completely healed tissues [32]. These results are in accordance with the results of this study, since delayed implant placement showed less bone loss. However, delayed implantations as highlighted in the literature have disadvantages like the need for additional surgeries and aesthetic challenges due to changes in tissue contour during healing [31, 32]. According to a systematic review that assessed the tissue changes, immediate implants had significant advantages like better preservation of alveolar bone and reduced gingival recession, which adds aesthetic benefits, especially in the anterior region [33].

Regarding the prosthetic connection, the choice of screwed or cemented prostheses largely depends on clinician's choice for the individual case [34]. A meta-analysis concluded that the cement-retained restorations showed lesser bone loss when compared to screwed [34], which is also in accordance with this study. Screw-retained restorations offer certain advantages like retrievability, passive fit and ease of repair, while one of the major disadvantages of them is risk of peri-implantitis due to residual cement [35]. Hamed et al. [36] compared cemented and screwed implants and concluded that screw retained implant supported reconstructions were shown to have fewer technical and biological complications such as peri-implantitis.

According to a recent meta-analysis, a history of periodontitis significantly impacts the implant survival rate, peri implantitis and mean bone loss [37]. However, the severity of periodontitis does not seem to influence the survival rate. In literature, a high survival rate and a comparable bone loss is reported both for crestal and subcrestal implants' placement regardless of the history of periodontal disease [38]. However, in cases, when the patient has thin mucosal tissue, a subcrestal implant placement should be preferred, to prevent further risks of peri-implant pathologies [37]. In this study, just one subcrestally placed implant was lost within 1 year of function in a patient who had a history of periodontal problems and underwent bone grafting. The overall implant survival rate was 99.75%.

The optimal timing for implant placement has evolved, with immediate post extraction placement gaining popularity. This method proves viable unless specific contraindications, such as purulent exudates, adjacent tissue issues, inadequate bone, or anatomical complexities, are present [39]. Implants can be placed at crestal (bone level), supra crestal (tissue level), or subcrestal levels [40, 41]. Evolving placement techniques, materials, and implant designs aim to bolster osseointegration success rates, influenced by numerous factors [42]. Age significantly impacts implant success [43], as does implant design (e.g., length and diameter) [43]. Implant location also affects osseointegration, with anterior implants generally displaying higher success rates than posterior ones [44]. Systemic diseases such as prediabetes, diabetes, obesity, cardiovascular diseases, and osteoporosis pose risks for implant complications like peri-implantitis [45]. In addition, infections, implant overload, and impaired healing contribute to potential complications [46].

CONCLUSIONS

The present study concluded that the Patient's age, gender, and associated diseases showed no significant influence on implant outcome. Proper diagnosis and patient-specific treatment plan can help to achieve successful oral rehabilitation outcomes for dental implants.

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