THE JOURNAL OF PROSTHETIC DENTISTRY

RESEARCH AND EDUCATION

Implementation of a surgical safety checklist for dental implant surgeries in a prosthodontics residency program

David P. Remiszewski, DMD[a] and Avinash S. Bidra, BDS, MS[b]

ABSTRACT

Statement of problem. Surgical safety checklists are commonly used in medical surgery to reduce errors, yet they are rarely used in the dental office. Presently, research on the implementation of surgical safety checklists in implant dentistry and user adherence is lacking.

Purpose. The primary purpose of this quality assessment study was to evaluate user compliance by using a surgical safety checklist for dental implant surgeries in a postgraduate prosthodontics program at the University of Connecticut School of Dental Medicine. The secondary purpose was to identify and analyze the nature, number, and frequency of omitted items on the surgical safety checklist.

Material and methods. All surgical safety checklists completed by 8 prosthodontic residents from 120 dental implant surgeries over the course of 1 academic year were collected as part of the program's quality assessment. Each surgical safety checklist contained 12 preoperative items and 14 postoperative items, giving a total of 26 items to be analyzed for each dental implant surgery. The collected data were then analyzed for user compliance, as well as the nature, number, and frequency of omitted items.

Results. Surgical safety checklists from 120 dental implant surgeries encompassing 262 implants were accessed for the academic year cycle from July 2017 to June 2018. There were 6 additional dental implant surgeries whose checklists were inaccessible. There was a 100% compliance rate for surgical safety checklist completion by all 8 prosthodontic residents across 120 dental implant surgeries. Within the checklists, the rate of incomplete responses or omissions was 2.4% (n=77). The 5 most commonly omitted items on the checklist by residents were preoperative photographs (0.29%), postoperative analgesics or steroids (0.26%), preoperative oral antiseptic rinse (0.22%), postoperative prescriptions (0.19%), and signed prosthodontic treatment plan forms (0.16%).

Conclusions. There was excellent compliance with the implemented dental implant surgical safety checklist across 8 prosthodontic residents, and the number of omitted items was small. Surgical safety checklists appear to be a straightforward method of helping prosthodontic residents in their dental implant surgical training to provide consistent and high-quality safe treatment for patients. (J Prosthet Dent 2019;122:371-5)

In recent decades, the risks, errors, and surgical complications related to dental implant surgeries have increased throughout the world.[1] Reasons for this include an increase in the number of dentists with varying experience in performing implant surgeries, an increased awareness of dental implants among the general population, and increased treatment volume by all dentists.[2] As implant surgery is an elective procedure with multiple steps, it is the obligation of the treating dentist to mitigate all potential risks and ensure that there are no surgical errors associated with this treatment. Most dental implant surgeries around the world are elective and occur in an office (outpatient) setting, where the treating dentist is solely responsible for ensuring all perioperative steps are followed. Therefore, the likelihood of procedural errors and subsequent complications may be higher and may also have medico-legal consequences.[2]

Medical errors have been largely classified as either errors of omission (failure to do something that should have been done) or errors of commission (doing something that should not have been done).[3] In medicine, a

[a]Resident, Post-Graduate Prosthodontics, University of Connecticut Health Center, Farmington, Conn.
[b]Program Director and Maxillofacial Prosthodontist, Post-Graduate Prosthodontics, University of Connecticut Health Center, Farmington, Conn; and Private practice, Meriden, Conn.

Clinical Implication

With increasing numbers of dental implants being placed globally by clinicians with varying levels of experience, the potential for surgical errors also increases. Implementing a surgical safety checklist in training programs can help future clinicians provide quality and safe treatment for their patients.

surgical safety checklist is recognized as a straightforward, inexpensive, and effective way of reducing errors that occur before, during, and after surgery.[4-6] Specifically, surgical safety checklists have been shown to encourage communication within the surgical team, ensuring that no part of the treatment is omitted or forgotten and warning the treating doctor of potential complications.[3,7,8] The World Health Organization (WHO) surgical safety checklist published in 2008 has been tested at 8 sites globally, decreasing patient mortality from 1.5% to 0.8% and inpatient complications from 11% to 7%.[5] The rate of performing essential preoperative tasks such as administering antibiotics, evaluating vital signs, and confirming patient information increased from 34.2% to 56.7% after the implementation of the checklist.[5] In a recent systematic review of surgical adverse events, Anderson et al[9] reported that adverse events occurring before, during, or after surgery are preventable and concluded that surgical checklists helped deliver consistent care and improved patient safety.

In the United States, the Accreditation Council of Graduate Medical Education has made patient safety a mandatory component of resident education, and numerous medical specialties have published their experiences with incorporating patient safety into their training programs.[10] In a recent large-scale study from a surgical training program, the use of a surgical safety checklist helped improve communication in the operating room and reduced surgical complications after high-risk surgery by more than 15%.[11] In another large-scale survey distributed to 118 surgical residency program directors across various disciplines, 85% of the program directors who responded (57) reported that education in quality improvement is essential for the future of surgery. The authors of this study concluded that program directors recognized the importance of quality improvement efforts in surgical practice and the need to use quality assurance protocols for safety and consistency in surgical training.[12]

In dentistry, checklists have mostly been used to prevent wrongful tooth extractions, track errors of omission in fixed and removable prosthodontics, and track quality assurance in the dental laboratory.[6,13] Presently, only 3 surgical safety checklists have been published in the dental implant literature. Al Faraje[14] published a series of treatment planning and procedural surgical checklists in a textbook. Christman et al[15] developed a surgical checklist by using a Delphi method survey administered to a panel of 24 board-certified periodontists to determine whether consensus existed regarding the critical steps involved in implant placement. The authors concluded that further research was needed to assess the acceptance and effectiveness of this type of checklist in a clinical setting. Bidra[2] developed a surgical checklist for clinical use, which included separate components for preoperative, intraoperative, and postoperative aspects of dental implant surgery. This checklist included the detailed surgical elements and steps often considered consequential by clinicians. However, a validation of this checklist has not been published.

To the author's knowledge, no studies in the dental literature have described the feasibility, acceptance, compliance, or effectiveness of using a surgical safety checklist in an outpatient environment or in dental education. Therefore, the purpose of this quality assessment study was to evaluate user compliance with a surgical safety checklist for dental implant surgeries in a postgraduate prosthodontics program at the University of Connecticut School of Dental Medicine. The secondary purpose was to identify and analyze the nature, number, and frequency of omitted items on the surgical safety checklist.

MATERIAL AND METHODS

A surgical safety checklist[2] was introduced in a postgraduate prosthodontics program at the University of Connecticut School of Dental Medicine in January 2017 to be used for all dental implant surgeries by all residents. The purpose of this surgical safety checklist was to ensure that all safety aspects of dental implant surgery were met and to allow consistency and accountability in the preoperative and postoperative management of patients. There were 12 preoperative items and 14 postoperative items on each checklist (Tables 1 and 2).[2] More than a year after the implementation of the checklist, a quality assessment study was conducted to analyze the compliance and rate of data entry into the checklists. An institutional review board waiver and Health Insurance Portability and Accountability Act (HIPAA) waiver was first obtained for this study after assessment of human subject research guidelines set forth by the university. This was because the study was a quality assessment and improvement study, and no patient-related information was analyzed or recorded.

Using the database of electronic chart records available at the University of Connecticut School of Dental

Table 1. Description of preoperative surgical safety checklist used by prosthodontics residents in this study

Item	Check Off
Review and update changes to medical/dental history	
Signed prosthodontic treatment plan form	
a. Consent for oral anxiolysis	
b. Consent for teeth extraction (in immediate implant situations)	
c. Consent for implant surgery	
d. Consent for bone grafting (if needed)	
e. Consent for sinus membrane lift (if needed)	
Availability of prosthetic guide ("surgical guide")	
Availability of updated radiographs/CBCT images	
Preoperative photographs	
Blood pressure reading (with time of recording)	
Oral anxiolysis medication (if needed)	
Preoperative antibiotics	
Preoperative analgesics (if needed)	
Administer local anesthetics (long duration and short duration)	
Preoperative oral rinse with chlorhexidine	

Table 2. Description of postoperative surgical safety checklist used by prosthodontics residents in this study

Item	Check Off
Postoperative local anesthetics (long duration/short duration)	
Use of ice pack extraorally to minimize swelling	
Postoperative radiograph	
Postoperative photographs	
Blood pressure reading (with time of recording)	
Postoperative analgesics/steroids (if needed)	
Prescriptions for antibiotics, analgesics, and antiseptic mouth rinse	
Video/verbal postoperative wound care patient instructions	
Written postoperative wound care patient instructions	
Recording patient's updated mobile phone number for follow-up phone call	
Adjustment of interim fixed or removable partial denture or occlusal device (if necessary)	
Delivery of sterile gauze in the mouth and to take home to maintain hemostasis	
Scheduling patient's follow-up appointment	
Entry of implant and bone graft material records into patient chart record	

Table 3. Description of the total number of dental implant surgeries and surgical safety checklists from electronic chart records accessed from June 28, 2017, to June 28, 2018

Total number of prosthodontics residents	8
Total number of records with dental implant surgeries performed	126
Total number of accessible records	120
Total number of dental implants placed	262
Total number of surgical safety checklists available in the electronic chart records (indicator of compliance)	120
Total number of 6-implant surgeries	5
Total number of 5-implant surgeries	5
Total number of 4-implant surgeries	12
Total number of 3-implant surgeries	5
Total number of 2-implant surgeries	46
Total number of 1-implant surgeries	47

Table 4. Description of the total number of omissions in a surgical safety checklist with respect to the number of implants placed at time of surgery

Type of Surgery	Number of Surgeries	Number of Omissions	Percentage of Total Omissions (%)
1-implant surgery	47	31	40.25
2-implant surgery	46	33	42.85
3-implant surgery	5	3	3.89
4-implant surgery	12	4	5.19
5-implant surgery	5	3	3.89
6-implant surgery	5	3	3.89

Medicine, all patients who had dental implants placed in the postgraduate prosthodontics program by 8 residents during the calendar year June 28, 2017, to June 28, 2018, were identified. Each of these electronic chart records was accessed to identify whether there was a scanned copy of a surgical safety checklist and whether the results were recorded in a yes/no format. Thereafter, each of the checklists was analyzed for any missing items. There were 12 preoperative items and 14 postoperative items on each checklist, giving 26 items per checklist for data collection related to compliance and omissions. The number of implants placed at the time of surgery was also recorded for each checklist. All data were recorded into a standardized data spreadsheet (Excel; Microsoft Corp), and the data were analyzed.

RESULTS

A total of 126 electronic health records were identified for patients who had dental implant surgeries performed over the course of 1 academic year at the postgraduate prosthodontics program at the University of Connecticut School of Dental Medicine. Of these, 6 records were not accessible for reasons such as patient inactivation or chart access restriction and electronic errors related to access. From the 120 available electronic records, a total number of 262 dental implants were placed by 8 prosthodontics residents. In each of these electronic records, a scanned copy of the surgical safety checklist was accessible, indicating a 100% compliance rate for usage and submission by the prosthodontics resident (Table 3).

There were 5 surgeries where 6 implants were placed, 5 surgeries with 5 implants, 12 surgeries with 4 implants, 5 surgeries with 3 implants, 45 surgeries with 2 implants, and 47 surgeries with 1 implant (Table 4). When attempting to analyze the rate of omissions in relation to the total number of dental implants placed per surgery, linear correlations to draw statistical comparisons were not found.

Of the 3120 items from all the checklists evaluated, 77 responses were omitted for a 2.4% rate of incomplete responses (omissions). This accounted for an omission

rate of 0.64% per checklist. The 5 most commonly omitted items from the checklist by residents were preoperative photographs 0.29% (n=9), postoperative analgesics or steroids 0.26% (n=8), preoperative oral antiseptic rinse 0.22% (n=7), postoperative prescriptions 0.19% (n=6), and signed prosthodontic treatment plan form 0.16% (n=5) (Table 3). The 5 most commonly omitted responses accounted for 45% (n=35) of the total omitted responses (Table 5).

No correlation was found between the number of omitted responses and the year of training for a resident (year: 1, 2, or 3) or the month in which the surgeries were performed. However, it was apparent that with an increased number of surgeries, the number of omissions increased for both categories.

Table 5. Description of 77 omissions encompassing 22 items in descending order

Checklist Item Omitted	Total Number of Omissions	Percentage of Total Omissions (%)
Preoperative photographs	9	11.69
Postoperative analgesics/steroids (if needed)	8	10.39
Preoperative oral rinse with chlorhexidine	7	9.09
Prescriptions for antibiotics, analgesics, and antiseptic mouth rinse	6	7.79
Signed prosthodontic treatment plan form	5	6.49
Availability of updated radiographs/cone beam computed tomography (CBCT) images	5	6.49
Availability of prosthetic guide ("surgical guide")	4	5.19
Blood pressure reading (with time of recording)	4	5.19
Administer local anesthetics (long duration and short duration)	4	5.19
Use of ice pack extraorally to minimize swelling	3	3.90
Blood pressure reading (with time of recording)	3	3.90
Recording patient's updated mobile phone number for follow-up phone call	3	3.90
Entry of implant and bone graft material records into patient chart	3	3.90
Review and update changes to medical/dental history	2	2.60
Postoperative photographs	2	2.60
Video/verbal postoperative wound care patient instructions	2	2.60
Scheduling patient's follow-up appointment	2	2.60
Oral anxiolysis medication (if needed)	1	1.30
Preoperative analgesics (if needed)	1	1.30
Postoperative local anesthetics (long/short duration)	1	1.30
Postoperative radiograph	1	1.30
Adjustment of interim fixed or removable partial denture or occlusal device (if necessary)	1	1.30

Note that 4 items did not have any omissions.

DISCUSSION

The main purpose of this quality assessment study was to evaluate the resident's compliance with a surgical safety checklist for dental implant surgeries in a postgraduate prosthodontics program. Prosthodontics residents presented a unique opportunity to study user compliance because of their natural inclination toward learning and improvement, focus on precision and quality, diversity of approach, and diversity of patient treatment. The medical literature has shown that clinicians who perform the same procedures routinely and frequently (known as high-volume clinicians) have fewer complications than clinicians who do not perform the same number of procedures routinely.[16-18] In this regard, prosthodontics residents can be considered as low-volume clinicians for performing dental implant surgeries as they perform various other procedures during their training. In addition, prosthodontics residents are in training and can be regarded as inexperienced clinicians compared with experienced clinicians who routinely perform high-volume procedures. Therefore, using a surgical safety checklist in a residency program may help standardize the multifaceted procedure of dental implant surgery, compensate for any lapses in human memory and attention, reduce or eliminate errors, and offer a consistent predefined standard of practice across all residents. Recently introduced educational standards for prosthodontics residents in the United States mandate training in the surgical placement of implants at a competency level[19]; thus, early adoption of a surgical safety checklist can improve patient safety and quality of treatment.

In dental implant surgery, common examples of errors of omission include failure to create a treatment plan, failure to obtain patient's informed consent, failure to obtain vital signs, failure to obtain or review proper radiographs, and failure to use a prosthetic guide. Common examples of errors of commission include prescribing incorrect medication or dosage, use of incorrect biologic materials, inappropriate implant placement site, and treatment other than that consented to. Negligence is the primary cause of medico-legal litigation against dentists involved in dental-implant–related complications.[1] When used in a training program, surgical checklists could help inexperienced clinicians prevent complications and also foster a philosophy of practicing safety and high-quality treatment by using checklists in their future private practices. As patient safety and improved access to educational tools are an increasing focus of educational teaching programs, a surgical safety checklist is an excellent way for novice clinicians to improve their skills in implant placement.[4,20]

Overall findings from this study showed excellent compliance with the surgical safety checklist across 8 residents with varied levels of clinical experience, age, and sex. Various explanations for the 77-item omissions

observed in this study are possible. In surgeries with nonapplicable items, there is a potential for leaving the field blank instead of writing "not applicable." Some residents may have omitted to check off preoperative photographs because they had photographs from the initial patient visit. Another likely scenario could have been, if the patient had teeth extracted, there could have been photographs before the teeth were extracted but not of the healed ridge before implant placement. One-implant surgeries, despite being less time-consuming and less complex, had a higher rate of omissions than more complex surgeries such as 5-implant or 6-implant surgeries. This is probably because of the higher sample size in this group. Further research is needed to draw definitive conclusions.

Some advantages of the surgical safety checklist used in this study include its simplicity, scientific basis, cost-effectiveness, and user compliance.[4-6] The disadvantages of the surgical checklist include the additional time required to complete the checklist and the availability of the checklist during the time of surgery.[2] However, findings from the present study indicate that the additional time (few minutes) required to complete the checklist did not affect user compliance. These findings appear promising and serve as a first step in assessing and confirming compliance across various users. The present study provides foundational information as to whether a surgical safety checklist is feasible or even necessary in a formal training program for implant surgery. These findings showed that they were well received by the residents, as indicated by the 100% compliance rate and low rate of omissions at 2.4%. Future studies in different residency programs across different disciplines would be needed to study user compliance and user satisfaction with the checklist. In addition, future studies should compare patient outcomes with and without the use of surgical safety checklists by either a randomized clinical trial or through retrospective chart reviews. Prosthodontics residency programs are uniquely qualified to conduct these studies because of their traditional focus on precision and quality and their contemporary focus on implant surgery.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. There was excellent compliance related to the implemented dental implant surgical safety checklist across 8 prosthodontic residents, and the number of omitted items was small.
2. Surgical safety checklists appear to be a straightforward way of helping prosthodontic residents in their dental implant surgical training to provide consistent, safe, and high-quality treatment for patients.
3. This is the first study in the dental implant literature to assess the feasibility, acceptance, and compliance of using a surgical safety checklist. Future studies are needed to validate the findings of this study and to study patient outcomes resulting from the use of surgical safety checklists.

REFERENCES

1. Froum SJ. Dental implant complications: etiology, prevention, and treatment. 2nd ed. Hoboken, NJ: Wiley Blackwell; 2016. p. 1603.
2. Bidra AS. Surgical safety checklist for dental implant and related surgeries. J Prosthet Dent 2017;118:442-4.
3. Garrouste-Orgeas M, Philippart F, Bruel C, Max A, Lau N, Misset B. Overview of medical errors and adverse events. Ann Intensive Care 2012;2:2-9.
4. Bailey E, Tickle M, Campbell S, O'Malley L. Systematic review of patient safety interventions in dentistry. BMC Oral Health 2015;15:1-11.
5. Haynes A, Weiser T, Berry W, Lipsitz S, Breizat A, Dellinger P. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009;360:491-9.
6. Lee JS, Curley AW, Smith RA. Prevention of wrong-site tooth extraction: clinical guidelines. J Oral Maxillofac Surg 2007;65:1793-9.
7. Treadwell JR, Lucas S, Tsou AY. Surgical checklists: a systematic review of impacts and implementation. BMJ Qual Saf 2014;23:299-318.
8. Arriaga AF, Bader AM, Wong JM, Lipsitz SR, Berry WR, Ziewacz JE, et al. Simulation-based trial of surgical-crisis checklists. N Engl J Med 2013;368:246-53.
9. Anderson O, Davis R, Hanna GB, Vincent CA. Surgical adverse events: a systematic review. Am J Surg 2013;206:253-62.
10. McCormick ME, Stadler ME, Shah RK. Embedding quality and safety in otolaryngology-head and neck surgery education. Otolaryngol Head Neck Surg 2015;152:778-82.
11. Bliss LA, Ross-Richardson CB, Sanzari LJ, Shapiro DS, Lukianoff AE, Bernstein BA, et al. Thirty-day outcomes support implementation of a surgical safety checklist. J Am Coll Surg 2012;215:766-76.
12. Kelz RR, Sellers MM, Reinke CE, Medbery RL, Morris J, Ko C. Quality in-training initiative–a solution to the need for education in quality improvement: results from a survey of program directors. J Am Coll Surg 2013;217:1126-32.e1-5.
13. Moghadam M. Electronic laboratory quality assurance program A method of enhancing the prosthodontic curriculum and addressing accreditation standards. J Prosthet Dent 2015;114:254-9.
14. Al-Faraje L. Oral implantology surgical procedures checklist. 1st ed. Chicago, IL: Quintessence Publishing; 2012. p. 19.
15. Christman A, Schrader S, John V, Zunt S, Maupome G, Prakasam S. Designing a safety checklist for dental implant placement: a Delphi study. J Am Dent Assoc 2014;145:131-40.
16. Morche J, Mathes T, Pieper D. Relationship between surgeon volume and outcomes: a systematic review of systematic reviews. Syst Rev 2016;5:204.
17. Davies JM, Ozpinar A, Lawton MT. Volume-outcome relationships in neurosurgery. Neurosurg Clin N Am 2015;26:207-18.
18. Mowat A, Maher C, Ballard E. Surgical outcomes for low-volume vs high-volume surgeons in gynecology surgery: a systematic review and meta-analysis. Am J Obstet Gynecol 2016;215:21-33.
19. Commission of Dental Accreditation. 2018 Accreditation standards for advanced dental education programs in prosthodontics. Available at: https://www.ada.org/~/media/CODA/Files/prostho.pdf?la=en. Accessed December 1, 2018.
20. Spence J, Goodwin B, Enns C, Vecherya N, Dean H. Patient safety education: an exploration of student-driven contextual learning. J Nurs Educ 2012;51:466-70.

Corresponding author:
Dr Avinash S. Bidra
University of Connecticut Health Center
263 Farmington Avenue, L7041
Farmington, CT 06030
Email: avinashbidra@yahoo.com

https://doi.org/10.1016/j.prosdent.2019.03.004