ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

Guided Implant Surgery: Evolution, Accuracy, and Clinical Relevance

Dr. Sakshi Kadu[1]; Dr. Meenakshi Khandelwal[2]; Dr. Niraj Yadav[3]

Author[1]; Co Author[2]; Reader[3]

[1]Post Graduate, Department of Prosthodontics,
Crown and Bridge and Oral Implantology Rajasthan Dental College and Hospital
[2]Professor and Head, Department of Prosthodontics,
Crown and Bridge and Oral Implantology Rajasthan Dental College and Hospital
[3]Department of Prosthodontics,
Crown and Bridge and Oral Implantology Rajasthan Dental College and Hospital

Publication Date: 2025/10/25

Abstract: The advent of surgical guides has revolutionized implantology by enhancing the precision, safety, and predictability of implant placement. Surgical guides act as a crucial link between digital planning and clinical execution, translating virtual implant positioning into an accurate intraoral reality. With advancements in cone-beam computed tomography (CBCT) and computer-aided design/computer-aided manufacturing (CAD/CAM) technologies, various types of guides—conventional, partially guided, and fully guided—have been developed to cater to different clinical needs. These guides assist in achieving optimal three-dimensional implant positioning, ensuring ideal prosthetic outcomes, and minimizing intraoperative complications. Moreover, the integration of 3D printing and digital workflows has significantly reduced fabrication time and improved customization. Despite their numerous advantages, limitations such as technique sensitivity, cost, and potential deviations during clinical transfer still exist. Continuous innovations in digital design software, navigation systems, and material science are expected to further refine the accuracy and clinical applicability of surgical guides. This article reviews the evolution, classification, fabrication techniques, advantages, limitations, and future perspectives of surgical guides in implant dentistry.

Keywords: *Surgical Guide, Implantology, Digital Dentistry, Guided Implant Surgery, CAD/CAM, 3D Printing.*

How to Cite: Dr. Sakshi Kadu; Dr. Meenakshi Khandelwal; Dr. Niraj Yadav (2025) Guided Implant Surgery: Evolution, Accuracy, and Clinical Relevance. *International Journal of Innovative Science and Research Technology*, 10(10), 1227-1232. https://doi.org/10.38124/ijisrt/25oct760

I. INTRODUCTION

Dental implants are the most often used replacement option for missing teeth. In the past, dental implant failures were more frequent; this could be due to a treatment plan that wasn't implemented correctly during the process. Surgical templates were established to ensure correct deployment of the treatment plant and to prevent errors during placement. Prior to implant installation, the dentist can receive information about tooth position using surgical guides, also known as stents. Prior to now, residual bone availability was the primary factor in determining dental implant position and placement [1].

As a result, prosthesis planning becomes extremely challenging following implant insertion. Implantology driven by prosthetics was developed to get around these problems. This prosthetic-driven implantology comprises surgical templates or guidance. Surgical guide templates help with accurate implant location and angulation in the bone in addition to aiding in diagnosis and treatment planning [2]. Furthermore, reduced clinical and laboratory problems may arise with restoration-driven implant placement carried out using a surgical guide template. As a result, newer and more sophisticated techniques for creating these templates have been developed in response to the growing demand for dental implants [3].

➢ *Definition: According to GPT9 Surgical Guide can be Define as:*

- Any device used as a guide for surgically shaping the alveolar process or positioning of gingival tissues;
- A guide used to assist in proper surgical placement and angulation of dental implants.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

- A guide used to assist in establishing the desired occlusion during orthognathic or grafting surgery [4].

➤ *Optimal Conditions*

It need to be rigid in its proper location such as Mesiodistally buccolingually, apicocoronally.

➤ *Surgical Guides Expansions*

In order to stabilize and position the guide stent, the template should fit over and/or around enough teeth in the treated arch, if any teeth are still present. The palate and tuberosities in the maxilla, as well as the retromolar pads in the mandible, are examples of unreflected soft tissue regions that the template should cover in the absence of any residual teeth. This allows the guide template to be employed both in the process of getting ready for the implant osteotomy and after the soft tissue has been reflected from the implant location [5, 6].

➤ *Implant Angulation*

During osteotomy, the optimal angulation for implant insertion should be seen. Each implant needs a minimum of two reference points. The surgical guide needs to be raised above the edentulous spot in order to achieve that. There is at least 8 mm separating the crest of the ridge from the occlusal surface of the abutment crown. These two points of reference therefore line up with the optimal course for implant implantation. Perpendicular to the occlusal plane and parallel to the most anterior abutment connected to the implant is the optimal angulation [7].

➤ *Gingival Preparation*

The optimal gingival contour position should be reflected in the surgical template. During implant implantation, an onlay graft of dense hydroxyapatite and demineralized freeze-dried bone may be used to replace lost bone and gingival breadth. The surgical template can be used to calculate the amount of augmentation needed to support the tissue.

➤ *Uses*

- To instruct the osteotomy drills at the proper depth, angulation, and position.
- To navigate the implant fixings into the proper depth, angulation, and location.
- Recommendations for the quantity of bone reduction or, if required, bone harvesting (soft and hard tissue) [3].

➤ *Advantages*

• Reduces human error related to implant implantation using the free hand • Less intrusive techniques that reduce postoperative surgical complications and benefit patients and clinicians psychologically • Accuracy - Since implants are prosthetic-driven parts, any departure in their functioning could have unexpected consequences. The use of surgical guides has improved the accuracy of implant placement. • Safety: When implanting dental implants in vital regions of the mouth, safety is a crucial consideration. Serious difficulties can arise from even the smallest mistake. These kinds of mistakes can be avoided with the use of surgical guidelines. Surgical guides can help safeguard important structures. • Predictability; using surgical guidance increases predictability. Aesthetics: precise and simple treatment planning implementation, along with computer-aided treatment planning, produce excellent aesthetic outcomes. • Hygiene – Appropriate implant placement ensures the maintenance of optimal dental health. • Implant-supported prostheses should be positioned in predetermined locations for optimal survival. Guidelines can aid in such high-quality implant placements. • Shortening of the time needed for implant surgery; • Ease of fabrication: computer-aided designs make the manufacturing process simple; • Special surgical guide types, including bone reduction guides, are available that can facilitate graft harvesting; • The guide itself can function as a temporary prosthesis for cases where all teeth are lost. • Accessibility: Enhanced visibility of the operating area and simple access for flap exposure. Patient visits can be decreased due to fewer treatment plan implementation errors and precise execution [8, 9].

➤ *Disadvantages*

Surgical guidelines do not permit the dental implant to be placed in its specified position if adjustments are needed throughout the procedure. Any tissue changes, whether they are hard tissue changes like lost abutment teeth or soft tissue changes like swellings, have the potential to affect the stent's fit and cause the dental implant placement to fail. Dislocation guided at the time of surgery. Drill lodgement in stents: When drilling is meant to penetrate hard bone, torsional pressures are applied to the sleeves, which lifts off the guide. This also leads to guide dislocation. • Higher learning curves; initial costs related to software purchases [9].

➤ *Classification of the Surgical Guides [10-12]:*

- Based on the area of operation

➤ *Guides for partially edentulous sites*

- Tooth supported
- Bone supported

Surgical guides supporting teeth can be utilized for short span partially edentulous arches, and guides supporting both teeth and bone can be used for long span partially edentulous arches.

- Guides/stents for completely edentulous site: Mucosa or bone supported.
- Based on the support: The surgical guides derives support from Teeth, Bone and Mucosa.

Guidelines for organizing the use of several surgical guides.

Guides that are supported by teeth: In order to support the guide during surgery, at least three stable teeth must be present. Mucosa supported guides are utilized in totally edentulous sites. There is less postoperative discomfort since tissue reflection is either unnecessary or advantageous.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

During surgery, a scan prosthesis and surgical guides will be needed. Bone-supported guides are utilized in both fully and partially edentulous locations. In partially edentulous sites, three teeth would need to be replaced if there was not at least 3cm of supporting bone. In cases where edentulous locations have thin bone, bone guides are particularly useful. An excellent view of the implant sites and guide insertion should be possible with a raised flap.

- Based on the accessibility: open sleeve & closed sleeve, accessibility is high with closed sleeve implant surgical guides.

➢ *Based on Utility Pilot Guides*

Only pilot drills are permitted by these surgical guides, allowing only angulation control to be accomplished. Drill marks must be examined in order to manually determine depth control. The surgical guide must be removed following pilot drilling, and in its place, the osteotomy site is extended.

➢ *Complete Drill Guides*

It has various drill bits or sleeves. Different drill sleeves fit different drill diameters, and these are changed simultaneously with the enlargement of the osteotomy. The osteotomy's angulation and size are guided, while the depth is manually adjusted.

➢ *Safe Guides/Easy Guides*

Uses the same drill key or sleeves as previously mentioned plus an extra implant stopper to regulate the drilling depth. allows for implant implantation as well as osteotomy.

➢ *Based on Material*

Metal-reinforced acrylic templates, self-curing or light-curing acrylic resin, vacuum-formed polymers, milling, CAD-CAM prosthetics, and stereolithographic models. Surgical accuracy is higher with vacuum- formed guides and manually processed resin than with the previously stated milling, CAD-CAM prosthesis, or stereolithographic models.

➢ *Classification of Design Concepts for Fabrication of Surgical Guide [13-17]*

Depending on how much surgical constraint the surgical guide templates provide:

- *Non-Limiting Design*

A clear vacuum-formed matrix was drilled through to create a guide pin hole, as described by Blustein et al. and Engelman et al. The appropriate placement of the dental implant was suggested by this hole. On the other hand, the angulation was established by using the opposing and neighboring teeth.

- *Partially Limiting Design*

In these designs, the surgeon completes the remaining osteotomy and implant placement freehand after utilizing the surgical guide to guide the initial drill used for the osteotomy. Methods based on this design idea include creating a radiographic template, which is subsequently evaluated radiographically and transformed into a surgical guide template. This method did not succeed in fully limiting the surgical drills' angulation.

- *Completely Limiting Design*

All of the instruments used in the surgical procedure during implant implantation are restricted by this design. Drill stops restrict the preparation's depth. A decreasing amount of decision-making and subsequent intraoperative surgical execution occurs as the surgical guidelines become more restrictive [18].

- *This Includes 2 Popular Designs:*

✓ Cast-based guided surgical guide
✓ Computer-assisted design and manufacturing (CAD/CAM) based surgical guide.

➢ *Cast Based Guided Surgical Guide*

Combination of periapical radiographs, bone sounds, and an analog approach used in a traditional flapless guided implant procedure. Digital software is used to alter the periapical radiograph in order to assist with the transposition of the root structure onto the cast. After that, the cast is sectioned at the intended implant location, and measurements of bone sounding are transferred to aid in the drill bit's position during a cast osteotomy.

A laboratory analog is inserted into the site, and wires are used to modify a guide sleeve to match the implant width and form a framework around the teeth. The superstructure is formed using occlusal registration material made of vinyl polysiloxane.

➢ *CAD/CAM Based Implant Surgical Guides*

The following steps make up the process for fabricating CAD/CAM-based surgical guides:

- Using interactive implant surgery planning software,
- The radiographic template,
- The computerized tomography scan,
- The stereolithographic drill guide,

➢ *Fabrication of the Radiographic Template [18-21]*

Because the radiographic template helps the doctor understand the site of proposed implants from an esthetic and biomechanical aspect, it must be an identical reproduction of the anticipated prosthetic end result.

The creation of an interocclusal index comes next, enabling the intraoral insertion of the scan template with consistency.

Following their conversion into a file format suitable with the 3D planning program, the two sets of 2D CT data (Digital Imaging and Communication in Medicine [DICOM files]) are superimposed over one another in accordance with the radiographic markers. An accurate three-dimensional representation of the patient's scanned denture and bone structure is the outcome of this fusion. The virtual surgical operation can now be carried out. The position, angle, depth,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

and diameter of the virtual implants can be virtually planned with the use of 3D implant planning software, which also enables the simultaneous observation of the arches and the radiography scan template in three spatial planes.

Table 1 Fabrication of the Radiographic Template

First Scan	Second Scan
The patient is scanned wearing the radiographic scan template and radiographic index (interocclusal index)	The second scan is performed without the index.
The first scan is used to visualize the bony architecture and anatomy of the site of interest	second scan is performed to visualize the nonradiopaque radiographic guide

It simultaneously creates a succession of cross- sectional images, a panoramic image, and an axial image on the screen. There are several commercially available implant planning software products. These include codiagnostix (IVS Solutions AG, Chemnitz, Germany), implantmaster (i-dent imaging Ltd, Hod Hasharon, Israel), simplant, surgicase (materialise dental Inc, Leuven, Belgium), procera (nobel biocare, Göteborg, Sweden), and easy guide (Keystone dental, Burlington, MA).After computer planning is complete, the plan is saved as a ".sim" file and submitted to the processing facility so that stereolithography can be used to fabricate the surgical guide. In order to create a unique 3D transparent resin model that closely matches the hard and/or soft tissue surface, stereolithography is a computer-guided, laser- dependent, rapid prototyping polymerization process that can replicate the precise shape of the patient's skeletal anatomic landmarks in a sequential layer of a special polymer. The polymeric prototype has holes for titanium or stainless steel drill-guiding tubes after it has solidified. The pilot drills are not necessary because these tubes accurately guide the osteotomy drills.

➢ *Advantages of Completely Limiting Design*

The surgeon can see the surgical bone site before implants are placed thanks to virtual three-dimensional (3D) views of the bony morphology. This helps to reduce the danger of essential anatomic structures being compromised or receiving insufficient osseous support. From a prosthodontic and biomechanical perspective, the treatment can be enhanced by including prosthetic planning utilizing a scanographic template. This method encourages flapless procedures, permits the master cast and temporary restorations to be constructed beforehand, and makes instant loading easier [22].

➢ *Disadvantages of the Completely Limiting Design*

It takes specialized training to become familiar with the complete system and the unique equipment. A sizable number of issues connected to the approach were noted. The several issues that were noted had to do with improper planning, radiographic stent error, intrinsic mistakes that occurred during scanning, software planning, quick guide stent fabrication, and information transfer for the prosthesis. Nonetheless, measures can be taken to reduce mistake and improve patient care if the physician is aware of these sources of inaccuracy [23].

➢ *Implant Surgical Guide Kit*

Surgical guide kit contains drill handle, guide tubes, c handle, template fixation pins, retentive anchor driver, stop key for guided implants, mucosal punch, T- sleeve.

➢ *Selection of Retentive Anchor Pins*

Primarily depends on the kind of surgical guidance, the number of implants, the edentulous site's location, the existence of any anatomical restrictions (mandibular nerve, maxillary sinus), and the length of the fixation screws. The fixation screws should ideally be positioned vertically because this orientation maximizes guide stability and has the added benefit of easy placement accessibility. [24]

➢ *Considerations for Selection Retentive Anchor Pins For Mucosa Supported stents*

Three, at the very least. One anchor is placed in the middle of the edentulous arch, and two anchors are placed at the distal ends. Important features like the maxillary sinus and mandibular nerves are typically found in the distal or posterior locations. We must plan as distantly as feasible under these circumstances and take these structures into account. The undercuts are eased in the labial region where the fixation anchors are affixed when employing mucosa-supported guides. The guide can be raised out of the mucosal tissues by screwing into these locations. The latter can be avoided by first holding the guide until at least one screw is in place [25].

➢ *For Tooth Supported Guides*

The fixation anchor is placed in the center of the edentulous site if it is bordered on both sides by teeth. Fixation anchors are placed in the arch as far away from the distal edentulous location as feasible; they are not always placed next to it.

➢ *For Bone Supported Guides*

To firmly secure the guide to the bone, two fixation anchors are sufficient. One is to the left, and the other is on the right. Tilting off or lifting off of the guide when screwing is tightened might happen in the undercut area. Holding the guide while tightening the second anchor prevents the latter. The guide should not always come into contact with bone tissue.

➢ *Steps in Usage of Implant Surgical Guide*

- Step 1: Making a diagnosis and a strategy for therapy.
- Step 2: Use CT software to virtually design the treatment of dental implants and prostheses.
- Step 3: carefully choosing the specific implant system and its parts.
- Step 4: Making plans for a surgical guide that works with a certain implant system. A bone- or mucosa- borne surgical guide must be chosen if there are fewer than three

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

teeth. If there are more than three teeth, a tooth- borne surgical guide must be used.

- Step 5: Anchor selection based on anatomical limitations, angulation, implant number, and place
- Step 6: Fabrication of surgical guides (most soft goods can be ordered online)
- Step 7: After receiving surgical guidance, disinfect them and evaluate them. Surgical guides supported by teeth need to be assessed in the patient's mouth and on a cast. It is necessary to assess mucosa-supported surgical guides on patients in a cast. In order to sustain the guide during fixation, a surgical index should be made. In order to devalue the digital bone model for bone support.
- Step 8: Checking the accuracy of particular surgical drills and drill keys.
- Step 9: Verify the stability of the guides after stabilizing them in the patient's mouth using anchor pins. Drill sequence is Step 9.

Installing the fixtures (possible with safe guidance) is step 10 [26–28].

Robot-assisted implantology represents a significant advancement in dental implant surgery, combining digital planning and robotic precision to enhance surgical accuracy and patient outcomes. These systems utilize preoperative CBCT data and intraoral scans to create a precise surgical plan, which is then executed with real-time robotic guidance. Clinical studies demonstrate that robot-assisted implant placement achieves sub-millimeter accuracy in coronal and apical positioning and minimal angular deviation, surpassing conventional freehand techniques and equaling or exceeding static guided surgery. The main advantages include improved precision, minimally invasive procedures, reduced surgical complications, and better prosthetically driven implant positioning. However, the technology presents challenges such as high cost, technical complexity, need for operator training, and limited clinical availability. As integration with digital workflows and AI continues to evolve, robot-assisted implantology is expected to become an increasingly reliable and accessible tool, promoting predictable outcomes and enhanced esthetics in implant dentistry.

II. CONCLUSION

In the modern era, dental implants are the preferred method of replacing lost teeth. The correct implementation of the treatment plan is critical to the success of dental implants. Numerous studies have demonstrated that using surgical guides to guide the placement of dental implants is a more successful method than using traditional methods.

REFERENCES

[1]. Abd El Salam El Askary. (2003). Reconstructive Aesthetic Implant Surgery. Vol. 2. Ames, Iowa: Blackwell Munksgaard. 33-34
[2]. Akça, K., Iplikçioglu, H., & Cehreli, M. C. (2002). A surgical guide for accurate mesiodistal paralleling of implants in the posterior edentulous mandible. J Prosthet Dent. 87:233-235.
[3]. Orentlicher, G., & Abboud, M. (2011). Guided surgery for implant therapy. Oral Maxillofac Surg Clin North Am. 23:239-56.
[4]. Ferro, K. J., Morgano, S. M., Driscoll, C. F., Freilich, M. A., Guckes, A. D., & Knoernschild, K. L. (2017). The glossary of prosthodontic terms. J Prosthet Dent, 117(5S), e1-e105.
[5]. Drill guides for every case scenario: Surgi Guide Cookbook. Available from: http://www.materialisedental.com/materialise/view/en/2395185.SurgiGuide+dental+drill+guide+Cookbo ok.html. [Last cited on 2013 Aug 25].
[6]. Abd El Salam El Askary. (2003). Reconstructive Aesthetic Implant Surgery. Vol. 2. Ames, Iowa: Blackwell Munksgaard. 33-34.
[7]. Fortin, T., Champleboux, G., Lormée, J., & Coudert, J. L. (2000). Precise dental implant placement in bone using surgical guides inconjunction with medical imaging techniques. J Oral Implantol. 26:300-303.
[8]. Martins, R. J., & Lederman, H. M. (2013). Virtual planning and construction of prototyped surgical guide in implant surgery with maxillary sinus bonegraft. Acta Cir Bras. 28:683-690.
[9]. Huh, Y. J., Choi, B. R., Huh, K. H., Yi, W. J., Heo, M. S., Lee, S. S., & Choi, S. C. (2012). In-vitro study on the accuracy of a simple-design CT- guided stent for dental implants. Imaging science in dentistry, 42(3), 139-146.
[10]. Khanna, Dr & Munde, Dr & Baisane, Dr & Shujaulla, Dr & Tabasum, Dr & Mohammed, Shammas. (2020). Surgical Guides in Implants: A Review. Saudi Journal of Oral and Dental Research.5.425-430. 10.36348/sjodr.2020.v05i09.001.
[11]. Lal, K., White, G. S., Morea, D. N., & Wright, R. F. (2006). Use of stereolithographic templates for surgical and prosthodontic implant planning and placement. Part II. A clinical report. J Prosthodont. 15:117-22.
[12]. Moslehifard, E., & Nokar, S. (2012). Designing a custom made gauge device for application in the access hole correction in the dental implant surgical guide. J Indian Prosthodont Soc. 12:123- 129.
[13]. Implants retrieved from patients with and without osteoporosis. Int J Oral Maxillofac Surg. 2008;37:321–327.
[14]. Slagter, K. W., Raghoebar, G. M., Vissink, A. (2008). Osteoporosis and edentulous jaws. Int J Prosthodont. 21:19–26.
[15]. Kido, H., Schulz, E. E., Kakura, K., Yamamoto, K., Morinaga, K., & Matsuura, M. (2011). Human mandibular trabecular bone density correlation with mechanical strength: implications for implant dentistry. Implant Dentistry, 20(4), 323-326.
[16]. Amorim, M. A., Takayama, L., Jorgetti, V., & Pereira, R. M. (2007). Comparative study of axial and femoral bone mineral density and parameters of mandibular bone quality in patients receiving dental implants. Osteoporos Int. 18:703–709.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct760

[17]. Friberg, B., Ekestubbe, A., Mellstro¨m, D., & Sennerby, L. (2001). Bra˚nemark implants and osteoporosis: a clinical exploratory study. Clin Implant Dent Relat Res. 3:50–56.
[18]. Shi, Y., Wang, J., Ma, C. et al. A systematic review of the accuracy of digital surgical guides for dental implantation. Int J Implant Dent 9, 38 (2023). https://doi.org/10.1186/s40729-023-00507- w
[19]. Madrid, C., & Sanz, M. (2009). What impact do systemically administrated bisphosphonates have on oral implant therapy? A systematic review. Clin Oral Implants Res. (suppl 4):87–95.
[20]. Pazianas, M., Miller, P., Blumentals, W. A., Bernal, M., & Kothawala, P. (2007). A review of the literature on osteonecrosis of the jaw in patients with osteoporosis treated with oral bisphosphonates: prevalence, risk factors, and clinical characteristics. Clin Ther. 29:1548–1558.
[21]. Gómez, F. R., Martínez, G. M., & Olmos, M. J. (2008). Osteochemonecrosis of the jaws due to bisphosphonate treatments. Update. Medicina oral, patologia oral y cirugia bucal, 13(5), E318-324.
[22]. Woo, S. B., Hellstein, J. W., & Kalmar, J. R. (2006). Narrative [corrected] review: bisphosphonates and osteonecrosis of the jaws. Ann Intern Med. 144:753–761.
[23]. Fugazzotto, P. A., Lightfoot, W. S., Jaffin, R., & Kumar, A. (2007). Implant placement with or without simultaneous tooth extraction in patients taking oral bisphosphonates: postoperative healing, early follow-up, and the incidence of complications in two private practices. Journal of periodontology, 78(9), 1664-1669.
[24]. Marx, R. E. (2007). Oral and Intravenous Bisphosphonate-Induced Osteonecrosis of the Jaws Etiology, Prevention, and Treatment. 1st ed. Hanover Park, Ill: Quintessence.
[25]. Starck, W. J., & Epker, B. N. (1995). Failure of osseointegrated dental implants after diphosphonate therapy for osteoporosis: a case report. Int J Oral Maxillofac Implants. 10:74-78.
[26]. Jeffcoat, M. K. (2006). Safety of oral bisphosphonates: controlled studies on alveolar bone. Int J Oral Maxillofac Implants. 21:349–353.
[27]. Wang, H. L., Weber, D., & McCauley, L. K. (2007). Effect of long-term oral bisphosphonates on implant wound healing: literature review and a casereport. J Periodontol. 78:584–594.
[28]. Yuan, K., Chen, K. C., Chan, Y. J., Tsai, C. C., Chen, H. H., & Shih, C. C. (2012). Dental implant failure associated with bacterial infection and long-term bisphosphonate usage: a case report. Implant dentistry, 21(1), 3-7.