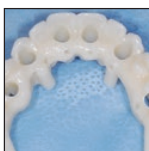


The “Scalloped Guide”: A Proof-of-Concept Technique for a Digitally Streamlined, Pink-Free Full-Arch Implant Protocol



Maurice A. Salama, DMD¹
Alessandro Pozzi, DDS, PhD²
Wendy Auclair Clark, DDS, MS³/Marko Tadros, DMD⁴
Lars Hansson, CDT, FICOI⁵/Pinhas Adar, MDT, CDT⁶

Inadequate restorative space can result in mechanical, biologic, and esthetic complications with full-arch fixed implant-supported prosthetics. As such, clinicians often reduce bone to create clearance. The aim of this paper was to present a protocol using stacking computer-aided design/computer-assisted manufacturing (CAD/CAM) guides to minimize and accurately obtain the desired bone reduction, immediately place prosthetically guided implants, and load a provisional that replicates predetermined tissue contour. This protocol can help clinicians minimize bone reduction and place the implants in an ideal position that allows them to emerge from the soft tissue interface with a natural, pink-free zirconia fixed dental prostheses. Int J Periodontics Restorative Dent 2018;38:791–798. doi: 10.11607/prd.3778

As life expectancy increases, so does the number of people with edentulous arches.¹ With higher expectations for quality of life, dentures often no longer meet patients' standards.² As such, many prefer an implant-supported fixed dental prosthesis (ISFDP).^{3,4} Patient demand, compliance, dexterity, financial capability, skeletal maxillomandibular relationship, and residual bone anatomy must be considered when determining the appropriate implant number, implant position, and type of prostheses.^{5,6}

The patient should be fully informed of the benefits and limitations of both fixed and removable prostheses, particularly patients classified as Cawood and Howell Class IV, V, or VI.⁷ For these patients, extensive prosthetic flanges are often needed to restore horizontal and vertical loss of soft and hard tissues and to guarantee the proper smile design and lip and cheek support. This can make daily hygienic maintenance of a fixed prosthesis challenging, and at times virtually impossible.⁸ As plaque accumulates, these restorations are associated with a higher rate of peri-implantitis and subsequent implant loss,⁹ contraindicating ISFDPs for these patients. Alternatively, at least four implants may allow for a bar-supported removable implant overdenture. This would allow for complete

¹Private Practice, Atlanta, Georgia, USA.

²Full Professor, Accolade Odontomatologic Sciences, Italy; Adjunct Associate Professor, Goldstein Center for Esthetics and Implants, Augusta, Georgia, USA; Private Practice, Rome, Italy.

³Assistant Professor, Department of Prosthodontics, University of North Carolina, Chapel Hill, North Carolina, USA.

⁴Private Practice, Atlanta, Georgia, USA.

⁵Digital Smile Design (DSD) Instructor, Valley Dental Arts, Stillwater, Minnesota, USA.

⁶Oral Design Center, Atlanta, Georgia, USA.

Correspondence to: Dr Wendy Auclair Clark, Department of Prosthodontics, University of North Carolina, Chapel Hill, NC, USA.
Fax: 919-537-3977. Email: waclark@unc.edu

©2018 by Quintessence Publishing Co Inc.

implant support, avoiding any bearing area on the soft tissues and reducing the denture base extension. Studies of implant-supported overdentures report high success and survival rates for both implants and prosthetics, with patient satisfaction rivaling that of ISFDPs.¹⁰

Even prior to implant-supported overdentures, Brånemark and his team developed a protocol for fixed-implant prosthetics with their “tissue-integrated prostheses.”¹¹ These consisted of a customized metal substructure overlaid with pink and white acrylic resin. Though this prosthesis revolutionized implant dentistry, by intrinsic nature of the restoration itself, it is not without drawbacks.¹² Maintenance due to acrylic wear and tooth debonding, as well as “retreading” (replacement of all acrylic), is a routine and expected part of treatment that carries a cost to the patient and/or provider.^{13–15} This often results from a lack of restorative space either at the onset of treatment, or as the vertical dimension of occlusion (VDO) decreases with material wear.^{3,15} With its many components and interfaces, a Brånemark-style resin-wrapped-to-metal (RWM) ISFDP requires a minimum restorative space of 15 to 18 mm (measuring from the crest of the bone to the opposite occlusal surface).^{3,16} This threshold range of functional clearance allows the prostheses to withstand functional loading while minimizing related biomechanical complications.

Ongoing research for esthetic and biocompatible materials has resulted in the use of zirconium oxide (ZrO₂ or zirconia) for ISFDPs as

an alternative to the conventional porcelain-fused-to-metal or RWM. Yttria-stabilized zirconium dioxide (Y-TZP) in particular has gained popularity in contemporary dentistry due to its high flexural strength and fracture toughness, absence of mucosal discoloration, and esthetic properties.^{17–19} It is more biocompatible than high gold-cast alloys, and its reduced bacterial and plaque adhesion help prevent soft tissue inflammation.²⁰ This lends towards healthy soft tissue integration of implant-supported restorations, thus improving long-term stability of the marginal bone.^{21,22}

Full-contour monolithic zirconia (FCZ) prostheses are particularly favorable, as they do not have the risk of ceramic veneer chipping and may have a lower frequency of framework fracture than ceramic veneered or layered zirconia prostheses.¹⁹ While FCZ full-arch ISFDPs do not yet have the same long-term data as other materials, encouraging recent literature shows it to be a viable, predictable alternative with favorable short-term clinical results.^{20,21,23} The advantage of a FCZ ISFDP is intrinsic in its monolithic nature—there are no dissimilar interfaces or minimizing fracture and/or chipping events, creating a greater bulk of material to improve the structural properties of the prosthesis, and enabling precise and efficient fabrication through computer-assisted manufacturing/computer-assisted design (CAD/CAM) processes. Thereby, even if not thoroughly documented in the literature, in the authors’ experiences the functional clearance range of 15 to 18 mm needed for the RWM and overdenture prostheses can

be reduced to 10 to 14 mm for FCZ ISFDP.²¹ This can be beneficial for patients with a terminal dentition or those who have not yet experienced significant resorption and have minimal restorative space.

Bone reduction for a complete-arch ISFDP is often utilized to gain restorative space, conceal the prosthesis-tissue junction in patients with excessive gingival display, improve the implant recipient site, and create a more cleansable surface at the tissue interface.^{16,24,25} Inadequate reduction can lead to prosthetic failure due to material fracture, poor esthetics, or inability to perform oral hygiene procedures due to unfavorable prosthetic contours.²⁶ Most often, bone reduction is completed with a surgical guide (typically CAD/CAM generated) that creates flat, level bone in the area of implant placement.²⁵ As guides have become more precise with CAD/CAM and as zirconia allows for less reduction, aggressive, flat bone reduction may no longer always be necessary.

The aim of this paper was to present a digitally integrated workflow, using three CAD/CAM surgical guides. These guides allow the clinicians to: (1) accurately obtain the desired bone reduction, (2) place prosthetically guided implants, and (3) load a polymethyl methacrylate (PMMA) provisional that replicates ideal tissue contours. Subsequently, a smooth, customized bony platform and soft tissue interface is developed for terminal dentition and completely edentulous patients with minimum bone resorption (Cawood and Howell Class I, II, and III). The clinical implications of the CAD/CAM

“scalloped guide” include streamlining the implant complete-arch protocol, helping clinicians accurately minimize bone reduction according to the functional clearance needs of the patient, placing implants in the ideal position to emerge from the soft tissue with a natural, pink-free fixed dental prostheses, and providing confidence that the diagnostic and digital treatment planning goals have been achieved.

Protocol

Diagnostic Records

Once a patient is deemed a candidate for implant surgery and a complete-arch ISFDP,^{3,11,27} diagnostic records are obtained. Per the proposed protocol, the following data are acquired:

1. Clinical digital photographs for digital smile design (DSD).²⁸ DSD is used to generate a smile design driven by an individual’s face and smile display. As such, it is critical to have at least two portraits representing (1) the lips at rest and (2) a broad smile.
2. Intraoral digital optical scan of both arches and the occlusion in centric relation (CR) (CS3600, Carestream; Trios, 3shape). It is important to capture as much soft tissue as possible (particularly the hard palate and the retromolar region), as it may be used to support surgical guides. Alternatively, polyvinyl siloxane (PVS) impressions may be made,

along with a bite registration in CR. The laboratory can scan the resulting master casts and convert the readings to a digital workflow if an intraoral scanner is not available.

3. Cone beam computed tomography (CBCT) scan of the dental arches (CS 9300, Carestream).
4. Documentation of the patient’s desired esthetic changes (tooth size, position, and shade).

Digital Planning (CAD) Clinical Protocol

The diagnostic records (the photograph of the broad smile and the intraoral optical and CBCT scans) are then aligned. The following steps outline the protocol:

Two-Dimensional DSD

A two-dimensional (2D) smile frame outline is designed over the patient’s full-face smile photos using smile design software (Smile Designer Pro; Digital Smile Design) or general photo-editing or presentation software (Photoshop Software, Adobe Systems; Keynote, Apple). This 2D smile frame outlines the desired teeth location, size, and esthetic proportions, and aids the laboratory technician in designing an accurate three-dimensional (3D) digital wax-up.

3D Digital Wax-up

The technician overlays the 2D frame (DSD) onto the 3D intraoral scan in a design software (Smile Design, 3shape or exoplan, exocad).

This is done by selecting similar points on the 2D photo and the 3D standard tessellation format (STL) file of the intraoral scan to accurately merge the two files. Once merged, the opacity of the 2D photo is decreased so the technician can see the 3D scans and digitally add teeth, following the 2D outline. The cervical area of the digital wax-up is contoured as ovate pontics to create the scalloping effect for planning the osseous contouring (step 4). A new STL file is generated from this digital wax-up, which is then aligned with the pretreatment STL to visualize the proposed changes (Fig 1).

CBCT Overlay

The pretreatment and digital wax-up STLs are merged with the digital imaging and communications in medicine (DICOM) files from the CBCT (Fig 2) using implant-planning software (Implant Studio, 3shape; exoplan, exocad; or Blue Sky Plan, Blue Sky Bio). Utilizing this data, the clinician and technician can visualize the available restorative space (from the crest of the bone to the proposed incisal edge position and posterior occlusal plane).

Osseous Planning

With this protocol, bone reduction is not arbitrary; it is based upon a predetermined, prosthetically ideal tooth position (3D digital wax-up). The distance from the prosthetic contour of each crown to the bone level must be 3 mm, leaving enough space for the biologic width at the pontic sites and the proper emergence profile at the implant sites. The 3-mm scalloping technique is

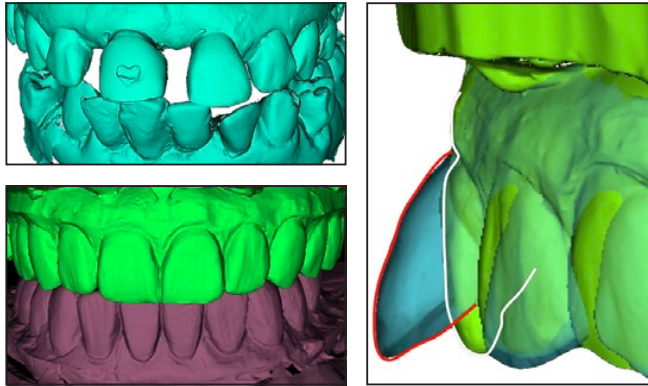


Fig 1 Pretreatment scan is merged with the wax-up scan for the smile design. These two scan files (both STL files) can be overlaid to assess the proposed changes.

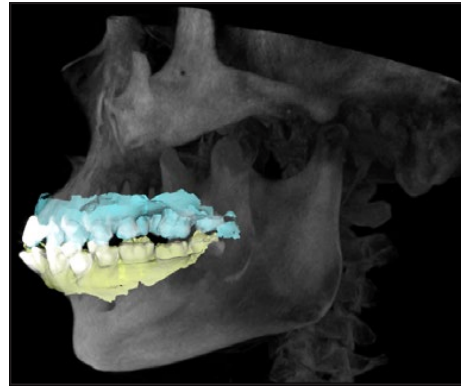


Fig 2 The pretreatment and wax-up scans (STL files) can then be merged with CBCT images (DICOM files).



Fig 3 After merging the wax-up and CBCT images, osseous recontouring is planned based on the proposed restoration's contours.

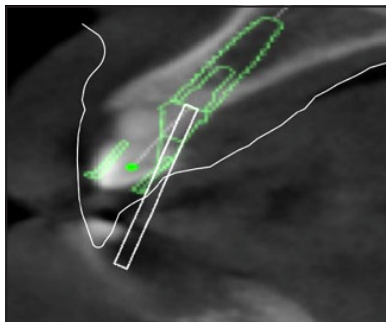


Fig 4 The planned implant position is based upon the proposed ideal tooth position (determined by the wax-up scan), not pretreatment tooth position. This will allow for biologic emergence profile of abutments and pontic sites.

accomplished by: (1) generating STL 3D bone models of the maxilla and mandible (Blue Sky Plan, Blue Sky Bio); (2) offsetting the intaglio surface of the pontic sites by 3 mm towards the bone models (Meshmixer, Autodesk); and (3) using a feature called "Boolean difference" in Meshmixer to subtract the offset pontic surface of the digital wax-up from the bone models of the maxilla or mandible. The result will be a model of how the bone should be scalloped and the corresponding surgical guides should be fabricated.

The amount of bone reduction that is necessary to meet the restorative requirements of the FCZ complete-arch ISFDP can be determined during digital planning by assessing each site's current soft tissue thickness and comparing it to the needed functional clearance of 10 to 14 mm. The surgical and prosthetic teams work hand-in-hand to establish contours, minimize bone reduction, and idealize prosthetic contours (Fig 3).

Implant Planning

As with the osseous contouring, the implants are not placed arbitrarily; they are placed ideally, allowing a natural emergence at the implant and pontic sites. This can improve both esthetics and accessibility for hygienic maintenance (Fig 4). The CAD/CAM surgical guide is firmly stabilized in the virtually planned position by utilizing at least three anchor pins, oriented perpendicular to the buccal cortical bone surface.

Digital Fabrication (CAM)

Clinical Protocol

After planning, the dental laboratory utilizes the clinician-approved data to fabricate the necessary models, guides, and prosthetics for the surgical appointment. The surgical guides and provisionals that are fabricated will all "stack" together. Once the first guide is pinned into place, the subsequent guides and provisional will pin into it, as described by Groscurth and Groscurth.²⁹



Fig 5 An osseous recontouring guide (scalped bone reduction guide) and a duplicate provisional are 3D printed.

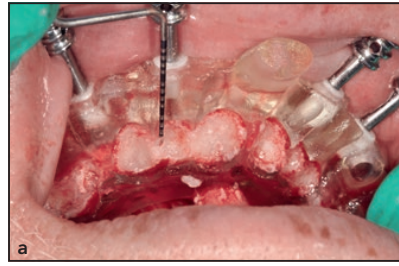


Fig 6 (a) The osseous structure can then be recontoured/scalped according to pretreatment planning. (b) Verification with the milled PMMA provisional. Note the 3-mm space under pontic sites for soft tissue fill.

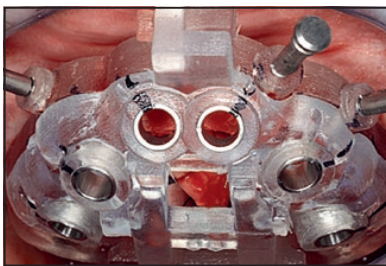


Fig 7 A surgical guide for implant placement is then pinned (stacked) into position, allowing implants to be placed per pretreatment planning.



Fig 8 (a) A PMMA provisional is milled following the wax-up scan. (b) Pins are incorporated into the provisional, allowing it to stack to the guide. These will be removed after the provisional is luted intraorally.



Scalped Guide (Osseous Recontouring Guide)

This guide has contours dictated by the prosthetic design at the cervical and interproximal interfaces (Fig 5). This design allows the surgeon to remove only the necessary amount of bone, leaving at least 3 mm of space underneath the prosthesis to allow for the development of a soft tissue interface with adequate thickness, while also achieving 10 to 14 mm of functional clearance between the bone surface and the occlusal plane (Fig 6). The bone reduction can be performed with the Piezotome insert OT4 (Piezosurgery touch, Piezosurgery) under copious irrigation after raising a full-thickness flap.

Implant Placement Guide

This next guide is stacked and/or pinned in the same position as the scalped guide, following the I BUR design.²⁹ Implants are placed following the 3D wax-up to allow ideal esthetic and biologic emergence (Fig 7).

Milled PMMA Provisional

The provisional is designed with ovate pontics and emergence from the implant sites per prosthetic planning (Fig 8). The contours of the provisional follow the scallop established by the osseous recontouring. This pre-designed shape and 3-mm space underneath allow for maintenance of the interproximal height

of bone and subsequent papilla formation^{5,22} (Fig 9).

Printed Models

Preoperative, extraction, and contoured models are included for guidance and verification throughout the procedures (Fig 10).

Finalization

Following an uneventful healing period of 3 to 4 months, definitive impressions can be obtained. An open-tray implant-level impression is made, with digital radiographs obtained to verify the complete seating of the impression copings. Definitive



Fig 9 The PMMA provisional is picked up following standard protocols. After finishing and polishing, it is seated and the access holes are filled. Note the soft tissue contour that will allow tissue to fill in the space.

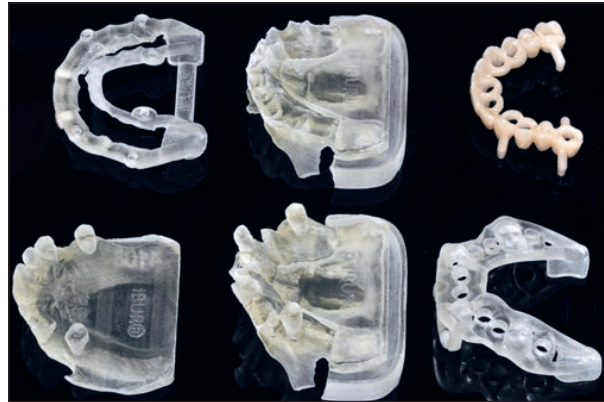


Fig 10 Lab work fabricated for surgical preparation and provision-alization includes 3D-printed pretreatment and osseous contoured models, a scalloped guide for osseous contouring, a surgical guide for implant placement, and a milled PMMA provisional with pins for positioning the surgical guide. These were all developed from surgical and prosthetic planning.



Fig 11 Final zirconia restoration before seating. Note the biologic emergence of abutments and pontics, as well as the lack of pink porcelain.



Fig 12 Seated zirconia restorations.

casts are subsequently poured, utilizing the interim restorations to transfer the models to a semi-adjustable articulator at the appropriate CR and VDO of the patient. At this time, the provisional prosthesis is evaluated for any desired changes. Esthetics, phonetics, VDO, and CR are reviewed by both the clinician and the patient. After changes are made or noted, the prosthetic volume and the related esthetic and phonetic information that were established during the healing period can be replicated from the tempo-

rary prosthesis using a silicone putty index or scanned with an intraoral or extraoral scanner.

Based upon the information, a PMMA duplicate of the definitive FMZ restoration can be made for intraoral verification of fit, function, and esthetics. The complete-arch FMZ ISFDP can then be milled with a five-axis milling machine (Milling Unit M5, Zirkonzahn) from a puck of Y-TZP (Prettau Zirconia 16er XH40, Zirkonzahn) (Fig 11). After placing the definitive restoration (Fig 6a), it should be evaluated for passive fit as described

by Rojas-Vizcaya³⁰ and the abutment screws torqued to the manufacturer's recommendation (Fig 12). The screw access openings are covered with polytetrafluoroethylene tape (Teflon, Traxco) and light-polymerizing composite resin (Z100 Restorative; 3M ESPE), and seating is confirmed with radiographs.

Discussion

Following standard protocols, clinicians often remove large quantities

Fig 13 Two-year radiographic follow-up on implants and prosthetics on the patient's (a) right, (b) anterior, and (c) left sides. Note the stability of bone contours in abutment and pontic regions.

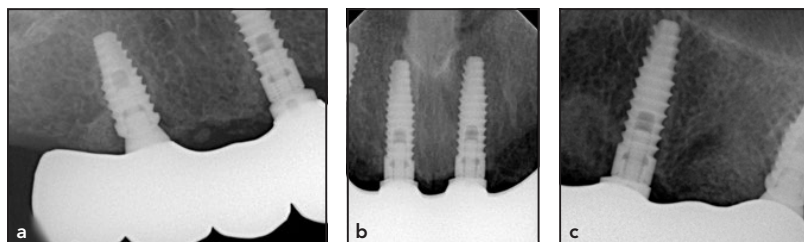


Fig 14 Two-year clinical follow-up. The prosthesis (a) was removed and screws were replaced as a maintenance procedure (b, c). Note the stability of soft tissue contours compared to the soft tissue model that was made based on patient-approved provisionals.



of bone and tissue, essentially modifying the patient's anatomy to fit the prosthesis and create restorative space. Recent technologies allow the design of an anatomy-driven prosthesis followed by a prosthesis-driven surgery, resulting in minimal and precise tissue removal. The workflow outlined in this article and use of the scalloped guide provide a means of preserving the patient's tissues. Additionally, utilizing monolithic zirconia reduces the required functional clearance of the restoration from 15 to 18 mm to 10 to 14 mm, compared to conventional RWM prostheses. This can significantly conserve bone and minimize surgery.

During treatment planning for full-arch implant prosthetics, bone reduction has been the standard practice to address the interface between pink restorative material and the edentulous ridge and to create restorative space. Clinically, the authors have seen an issue with the lack of cleansability when moving this transition zone very apically. By redesigning the prosthetic interface, and with accurate CAD/CAM-driven implant placement, it is no longer always necessary to reduce bone to hide this transition. Utilizing a crown and bridge design for abutments and pontics can increase esthetics (avoids matching pink) and create a much more cleansable interface.

The work of Pozzi et al defining the Biologic Pontic Design (BPD) and the "prosthetic biological width" underneath the pontics has helped establish a predictable protocol in the planning for these prostheses.^{21,22} The definitive gingival esthetics are a result of the adaptation of the soft tissue to the predetermined contour of the interim prosthesis—delivered the day of the implant surgery—in the space created between the prosthesis and the bone, as dictated by the scalloped shape of the guide. The scallop allows the maintenance of the interproximal height of bone (Fig 13), which subsequently supports and maintains papilla formation (Fig 14).

Conclusions

Combining technologies and advancements, clinicians can now achieve unprecedented precision and predictability at each step, from surgical planning to prosthetic delivery. The “scaloped guide” proof-of-concept technique allows clinicians to digitally streamline a pink-free complete-arch implant protocol while addressing some of the challenges of the traditional protocols, including restorative space, cleansability issues, and the need to hide the “transition zone.”

Acknowledgments

The authors report no conflicts of interest.

References

- Douglass CW, Shih A, Ostry L. Will there be a need for complete dentures in the United States in 2020? *J Prosthet Dent* 2002;87:5–8.
- Allen PF, McMillan AS. A review of the functional and psychosocial outcomes of edentulousness treated with complete replacement dentures. *J Can Dent Assoc* 2003;69:662.
- Misch CE (ed). Maxillary arch implant considerations: Fixes and overdenture prosthesis. In: *Contemporary Implant Dentistry*, ed 3. St Louis: Mosby; 2008: 367–388.
- Carlsson GE, Lindquist LW. Ten-year longitudinal study of masticatory function in edentulous patients treated with fixed complete dentures on osseointegrated implants. *Int J Prosthodont* 1994;7: 448–453.
- Zitzmann NU, Marinello CP, Berglundh T. The ovate pontic design: A histologic observation in humans. *J Prosthet Dent* 2002;88:375–380.
- Fueki K, Kimoto K, Ogawa T, Garrett NR. Effect of implant-supported or retained dentures on masticatory performance: A systematic review. *J Prosthet Dent* 2007;98:470–477.
- Cawood JI, Howell RA. A classification of the edentulous jaws. *Int J Oral Maxillofac Surg* 1998;17:232–236.
- Abi Nader S, Eimar H, Momani M, Shang K, Daniel NG, Tamimi F. Plaque accumulation beneath maxillary All-on-4 implant-supported prostheses. *Clin Implant Dent Relat Res* 2015;17:932–937.
- Serino G, Ström C. Peri-implantitis in partially edentulous patients: Association with inadequate plaque control. *Clin Oral Implants Res* 2009;20:169–174.
- Heydecke G, Boudrias P, Awad MA, de Albuquerque RF, Lund JP, Feine JS. Within-subject comparisons of maxillary fixed and removable implant prostheses: Patient satisfaction and choice of prosthesis. *Clin Oral Implants Res* 2003;14: 125–130.
- Zarb GA, Jansson T. Prosthodontic procedures. In: Branemark PI, Zarb GA, Albrektsson T (eds). *Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry*. Chicago: Quintessence, 1985: 241–282.
- Dhima M, Paulusova V, Lohse C, Salinas TJ, Carr AB. Practice-based evidence from 29-year outcome analysis of management of the edentulous jaw using osseointegrated dental implants. *J Prosthodont* 2014;23:173–181.
- Goodacre CJ, Bernal G, Rungcharasaeang K, Kan JY. Clinical complications with implants and implant prostheses. *J Prosthet Dent* 2003;90:121–132.
- Bidra AS, Tischler M, Patch C. Survival of 2039 complete arch fixed implant-supported zirconia prostheses: A retrospective study. *J Prosthet Dent* 2018;119: 220–224.
- Raigrodski AJ. Contemporary materials and technologies for all-ceramic fixed partial dentures: A review of the literature. *J Prosthet Dent* 2004;92:557–562.
- Bedrossian E, Sullivan RM, Fortin Y, Malo P, Indresano T. Fixed-prosthetic implant restoration of the edentulous maxilla: A systematic pretreatment evaluation method. *J Oral Maxillofac Surg* 2008; 66:112–122.
- Scarano A, Piattelli M, Caputi S, Favero GA, Piattelli A. Bacterial adhesion on commercially pure titanium and zirconium oxide disks: An in vivo human study. *J Periodontol* 2004;75:292–296.
- Jung RE, Holderegger C, Sailer I, Khraisat A, Suter A, Hämmerle CH. The effect of all-ceramic and porcelain-fused-to-metal restorations on marginal peri-implant soft tissue color: A randomized controlled clinical trial. *Int J Periodontics Restorative Dent* 2008;28:357–365.
- Guess PC, Att W, Strub JR. Zirconia in fixed implant prosthodontics. *Clin Implant Dent Relat Res* 2012;14:633–645.
- Al-Radha AS, Dymock D, Younes C, O’Sullivan D. Surface properties of titanium and zirconia dental implant materials and their effect on bacterial adhesion. *J Dent* 2012;40:146–153.
- Pozzi A, Holst S, Fabbri G, Tallarico M. Clinical reliability of CAD/CAM cross-arch zirconia bridges on immediately loaded implants placed with computer-assisted/template-guided surgery: A retrospective study with a follow-up between 3 and 5 years. *Clin Implant Dent Relat Res* 2015;17(suppl):e86–e96.
- Pozzi A, Tallarico M, Moy PK. The implant biologic pontic designed interface: Description of the technique and cone-beam computed tomography evaluation. *Clin Implant Dent Relat Res* 2015; 17(suppl):e711–e720.
- Abdulmajeed AA, Lim KG, Närhi TO, Cooper LF. Complete-arch implant-supported monolithic zirconia fixed dental prostheses: A systematic review. *J Prosthet Dent* 2016;115:672–677.
- Alzoubi F, Massoomi N, Nattestad A. Bone reduction to facilitate immediate implant placement and loading using CAD/CAM surgical guides for patients with terminal dentition. *J Oral Implantol* 2016;42:406–410.
- Jensen OT, Adams MW, Cottam JR, Parel SM, Phillips WR 3rd. The All-on-4 shelf: Maxilla. *J Oral Maxillofac Surg* 2010;68:2520–2527.
- Bidra AS. Technique for systematic bone reduction for fixed implant-supported prosthesis in the edentulous maxilla. *J Prosthet Dent* 2015;113:520–523.
- Mericske-Stern RD, Taylor TD, Belser U. Management of the edentulous patient. *Clin Oral Implants Res* 2000;11 (suppl):s108–s125.
- Coachman C, Calamita M. Digital Smile Design: A tool for treatment planning and communication in esthetic dentistry. *Quintessence Dent Technol* 2012;35: 103–111.
- Groscurth RC, Groscurth SU [inventors]. IBUR LLC, assignee. Edentulous surgical guide. US patent 9,504,533. 29 Nov 2016.
- Rojas-Vizcaya F. Full zirconia fixed detachable implant-retained restorations manufactured from monolithic zirconia: Clinical report after two years in service. *J Prosthodont* 2011;20:570–576.