Smart digital denture conversion (SDDC), a technique for full arch immediate loading.

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I. Abstract

State of the Problem

In full arch implant rehabilitations, immediate loading is one of the advantageous aspects of these interventions. However, the conventional denture conversion technique is troublesome for both practitioner and the patient.

Aim of the Study

This article presents a smart digital approach to design and construct a screw retained immediately loaded full arch implant supported bridge based on the pre-treatment complete denture.

Materials and Methods

After intra oral scanning of the ridge form, implant positions, the denture is used to scan the intermaxillary relation and tooth positions and the fixed interim is designed and milled from PMMA. This technique is applicable when a single arch is treated or for bimaxillary implant rehabilitation cases. In this study 30 patients were grouped into two groups; group I in which a converted denture was made conventionally and Group II in which a converted denture was made digitally. General satisfaction, chair side working time, and esthetic outcome of the prostheses were recorded and quantified with a verbal rating scale following insertion of implant-supported prosthesis.

II. Background

Immediate implant loading has been a reliable procedure for rehabilitation of edentulous and prospective edentulous arches. It shortens the treatment time, reinstate esthetics, function, and endorses the patient acceptance to the treatment. [1,2]

Using a rigid material for construction of the immediately loaded fixed interim is an absolute requirement for the overall success of the treatment as it ensures splinting, cross arch stabilisation and proper force distribution.[3-5] Denture conversion technique was proposed by Balshi and Wolfinger for provisionalization of full arch implant rehabilitation cases with success rate of 80%. Most of the failures were in the form of fractures of the converted dentures due to hollowing and the holes made in the denture to ensure passive seating and pickup of the titanium sleeve abutments using self-cure acrylic resin. These different material phases and compromised flange thickness are the main causes of fractures.[6,9]

Using a highly cross-linked resins such as Polymethyle Methacrylate PMMA would reduce the incidences of interim fractures and thereby enhancing the success rate of the implant treatments.[7]

An alternative workflow for construction of the fixed interim requires impressions, model production, and jaw relation records then digitizing all these data then designing and milling the restoration. Fulfilling these steps is inconvenient and time consuming in addition to the limitations of the physical records.[10] So, a digitalised workflow would be time and cost effective in such cases. However, acquisition of the ridge form, implant positions and jaw relation in edentulous patients are difficult and unpredictable. So, a modified workflow is presented in this article which is specifically tailored for immediate loading of full arch cases resulting in significant improvement of the treatment outcomes.

III. Research Question

Will the digital conversion of the pre-treatment complete dentures in immediately loaded full arch implant cases, introduce a more time saving solution and better patient satisfaction?

Problem	the conventional denture conversion technique is troublesome for both practitioner and the patient
Intervention	An alternative workflow for construction of the fixed interim requires impressions, model production, and jaw relation records then digitizing all these data then designing and milling the restoration.
Comparator	A conventional denture conversion will be done following the conventional fabrication technique.
Outcome	General satisfaction, chair side working time, and esthetic outcome of the prostheses with a verbal rating scale following insertion of implant-supported prosthesis.
Time of Follow-up	One week for fabrication of the denture digitally, but no follow-up is needed.
Study Settings	Removable Prosthodontics Department, Faculty of Dentistry, Ain Shams University.

IV. Aim of the Study Outcomes and Clinical Relevance

Aim

The objective of this study is to find out if a digitalised workflow will be time and cost effective when converting the pre-treatment complete denture into a screw retained immediately loaded full arch implant supported bridge.

Outcome

General satisfaction, chair side working time, and esthetic outcome of the prostheses with a verbal rating scale following insertion of implant-supported prosthesis.

Clinical Relevance

Providing proof for the use of a modified workflow which is specifically tailored for immediate loading of full arch cases resulting in significant improvement of the treatment outcomes.

V. Hypothesis

The null hypophysis considered for this study is that there will not be a significant statistic difference in patient satisfaction between the digitalized modified workflow presented in this article and the conventional one.

IV. Ethical Considerations

In this study each patient will be rehabilitated with a full arch implant supported prosthesis when immediate loading will be the chosen protocol in which a fixed interim prosthesis should be properly constructed after the conversion of a pretreatment complete denture either following the conventional fabrication technique or following the digitalized technique proposed.

• **Risks and Discomfort to Patients**: There are no serious risks regarding this study, however, mucosal irritation, slight pain, and discomfort are commonly related to conventional procedures during denture conversion.

• **Minimization of Risk:** mouth rinses and oral gel medications will be prescribed in case of mucosal irritation.

• **Criteria for Discontinuation of Study or Enrollment or Modification of Intervention:** In case of patient sickness, incompliance, or refusal to continue in treatment.

• **Benefits to the Patients and to the Community:** Digitized database for the patient's ridges, implant positions and intermaxillary relation will save time, and effort for both the dentist and the patient.

• **Privacy:** Privacy for participants is protected by several procedures, such as informed consent and transparency in how patient data is accumulated and analyzed. Data will be kept in a specific folder on a computer with passwords known only by the main operator.

• **Confidentiality:** Confidential data of the patients will be privately kept with the main operator.

• **Data Management:** Data will be saved in a specific folder with passwords known only by the main operator on his personal computer.

• **Consent Procedures if Applicable**: Before the provision of the treatments, each patient will read and sign a consent form supplied by the ethical committee of the Faculty of Dentistry, Ain Shams University, written in the Arabic language. The consent describes the steps of each procedure, their rights, and their role in the study. The consent will be kept with the main operator.

• **Adverse Event Reporting**: Any adverse reaction will be reported and written in the patients' data folder.

V. Study Design

This is a clinical cross over study.

VI. Materials and Methods

Study Settings

Faculty of Dentistry – Ain Shams University.

Sample Size Calculation

Sample size calculation was performed using G*Power version 3.1.9.7 based on the results of previous studies. A power analysis was designed to have adequate power to apply a two-sided statistical test of the null hypothesis that there is no difference between the tested items. By adopting an alpha level of (0.05) and a beta of (0.2), i.e., power =80% and an effect size (d) of (1.050) calculated based on the results of previous studies. (23,24) The predicted sample size (N) is (30), i.e., 15 samples per group (n = 15).

Study Procedures

1. Sample Grouping

This study will comprise two equal groups of converted dentures based on their fabrication techniques in pateintes rehabilitated with a full arch implant supported prosthesis as follows:

Group I: fifteen dentures were converted conventially to be used as a fixed interim prosthesis for immediate loading.

Group II: fifteen dentures were converted digitally to be used as a fixed interim prosthesis for immediate loading.

2. Patient selection

Thirty patients will be selected from the outpatient clinic of the Oral and Maxillofacial Prosthodontics Department, Faculty of Dentistry, Ain Shams

• Inclusion criteria

-Nonsmokers

-Free from any systemic disease

-Non-bruxers

-With sufficient quality and quantity of bone

-Prepared to comply with the follow-up and maintenance program

• Exclusion criteria

- Patients with bad oral hygiene.
- Patients with limited mouth opening.
- Vulnerable groups.
- Uncooperative patients.

• Patient evaluation

* History

Precise medical and dental history will be taken from all patients.

* Examination

Comprehensive extraoral and intraoral examinations will be carried out to verify patients fulfilling the selection criteria.

3. Clinical and Laboratory Procedures

For both groups, multiunit abutments will be inserted for each implant and secured to them according to the recommended torque. A small amount of putty rubber base will be mixed and

placed into the fitting surface of the pre-treatment denture, which then will be seated intraorally to mark the sites of the multiunit abutments. The denture will then be relieved over the marked sites until it was fully seated without interference.

For group I a conventional denture conversion will be made. For group II; the denture will be scanned extraorally using intraoral scanner. An intra oral scan will be made for the ridge form and multiunit abutments scan bodies and the scan will be extended to include the buccal and labial aspect of the ridge following the continuous scanning strategy.[8]

A scan of the opposing arch will be done then a large vent hole will be drilled in the denture, removing a portion of the flange and anterior teeth while maintaining the integrity of the lingual / palatal aspect to connect to the other side base and teeth. The denture will be inserted intraorally and the patient will be instructed to bite in centric occlusion to make an intra oral bite scan which records the exposed area of the ridge, the opposing arch, and the remaining portion of the denture. Alignment of scans will be done on Medit compare application. These scans will be exported to the design software and alignment will be done by a software as well, virtual alignment of all scans to each other will be performed except for the denture scan which will be loaded separately as a pre-operative wax up. On the aligned scans, multi-unit abutments scan bodies will be matched to the digital library scan bodies and virtual multiunit abutment analogues will be generated then, titanium sleeves abutments will be selected. Alignment of denture scan to the jaw scan guided by the bite scan will be done and then teeth will be arranged, guided by the denture scan. Design of virtual gingiva will be made with flat fitting surface without overhangs or ridge lap parts.

The screw access holes will be aligned and the area surrounding these channels will be thickened.

The STL file will be exported for millin from shaded PMMA disc A 3.5. After milling, the gingival portions will be coated with pink or red resins, NextDent Base and curing will be done. Titanium sleeve abutments will be cemented with the proper length to their respective sites with resin cement and cured. The interim fixed PMMA bridge will be delivered intra orally by sequential screwing of the prosthetic screws after verification of the seating and the proper tissue contact. Occlusion will be checked and equalised intraorally to establish centric balance with the opposing arch. Then the prosthetic screws will be torqued, and screw access holes will be sealed with flowable resin.

4. Methods of Evaluation

General satisfaction, chair side working time, and esthetic outcome of the prostheses were recorded and quantified with a verbal rating scale following insertion of implant-supported prosthesis.

Questionnaire about patient satisfaction level with different techniques of denture conversion:

	Questions	0	1	2	3	4	5
1	How do you feel about the pleasure you get from food compared to your complete denture?						
2	With respect to appearance, how satisfied are you with your fixed restoration in comparison to your denture?						
3	With respect to speech, are you satisfied with your current fixed prosthesis?						
4	How comfortable were you during the process of denture fixation?						
5	With respect to time, how satisfied are you with the process of denture fixation?						

IV. Data Management

The data will first be recorded manually and then transferred into digital form. The obtained data will be stored in the Oral and Maxillofacial Prosthodontics Department, Ain Shams University library.

V. Statistical Analysis

The obtained data will be recorded, tabulated, and statistically analyzed using the Mann-Whitney U Test was used for comparison between the two groups. Statistics was done with IBM SPSS statistics v20. Data was presented as median and interquartile range.

VI. Funding

This study will be self-funded.

VII- References

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