

## CONVENTIONAL VS SIMPLIFIED COMPLETE DENTURES

Eleftheria Pani<sup>1a\*</sup>, Aspasia Sarafianou<sup>1b</sup>, Aspasia Chalazoniti<sup>1c</sup>, Ioli Ioanna Artopoulos<sup>1d</sup>, Gregory Polyzois<sup>1e</sup>

<sup>1</sup>Department of Prosthodontics, School of Dentistry, National and Kapodistrian University of Athens, Athens, Greece

<sup>a</sup>DDS, MSc; e-mail: [elpani@dent.uoa.gr](mailto:elpani@dent.uoa.gr); ORCIDiD: <https://orcid.org/0000-0003-1046-9470>

<sup>b</sup>DDS, MSc, Dr. Dent, Assistant Professor; e-mail: [sarafia@otenet.gr](mailto:sarafia@otenet.gr); ORCIDiD: <https://orcid.org/0000-0003-4826-2678>

<sup>c</sup>DDS, Postgraduate Student in Prosthodontics; e-mail: [ahal@dhal.com](mailto:ahal@dhal.com); ORCIDiD: <https://orcid.org/0000-0002-9833-1494>

<sup>d</sup>DDS, MSc, Dr. Dent; e-mail: [iartopoulos@gmail.com](mailto:iartopoulos@gmail.com); ORCIDiD: <https://orcid.org/0000-0003-1711-3143>

<sup>e</sup>DDS, MScD, Dr. Dent, Professor, Head of Department; e-mail: [gregpolyz@dent.uoa.gr](mailto:gregpolyz@dent.uoa.gr); ORCIDiD: <https://orcid.org/0000-0003-0828-3423>

### ABSTRACT

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**Background** Complete dentures are fabricated with the conventional protocol which requires two impressions -preliminary, final-, the recording of maxillomandibular relationships, two try-ins, and the delivery of the denture. The final impression is challenging, demanding, and time-consuming. Therefore, simplified methods with the omission of the final impression have been proposed.

**Objective** The aim of this systematic review is to compare the conventional with the simplified method according to masticatory performance and ability, patient satisfaction, oral health related quality of life (OHRQoL), denture quality, time, and cost.

**Data sources** An electronic search of the MEDLINE-PubMed, Scopus and Europe PMC databases was conducted by two researchers.

**Study selection** Randomized clinical trials, cohort clinical studies and clinical studies of complete dentures fabricated with the conventional or the simplified method were selected. Patients in need of a complete denture (Participants/Population) were divided in two categories, those who were treated with the simplified technique (Intervention) and those who were treated with the conventional technique (Comparison).

**Data extraction** Between these two categories various outcomes were examined: masticatory performance and ability, patient satisfaction, OHRQoL, denture quality, time, and cost.

**Data synthesis** 19 articles fulfilled the inclusion criteria. Moreover, two systematic reviews and one meta-analysis of the same topic were included. Cost and time differed significantly between the two methods favoring the simplified protocol.

### KEYWORDS

Conventional Complete Dentures; Simplified Complete Dentures; Patient Satisfaction; Clinical Outcomes; Oral Health Related Quality of Life (OHRQoL)

### 1. INTRODUCTION

Edentulism is the state of having lost all of the natural teeth and increases following the ageing of the population. According to the systematic review and meta-analysis of Roberto et al. [1], the prevalence of edentulism increases with age and in the elderly people this is influenced by demographic and socioeconomic factors. All this indicate the multifactorial etiology of edentulism [1].

Implant therapy is well documented and can provide a long term and efficient treatment for tooth loss. However, it is not always possible to proceed with implant rehabilitation for the edentulous patients due to medication, risks, cost and time. Complete dentures provide a solid rehabilitation for edentulism.

They reconstruct all the missing hard and soft tissues. The standard protocol for fabricating a complete denture requires six clinical sessions followed by five laboratory stages. The clinical sessions include preliminary and final impression, maxillomandibular records, try-in of the dentures with the anterior teeth, try-in with all the teeth, and finally delivery of the complete denture. The preliminary impression is made with alginate on a stock tray or with compound on a metal tray. The purpose of this impression is to create a cast which will be used to fabricate a custom tray. This custom tray combined with a variety of materials will reassure the most detailed impression. This clinical session (final impression) is of the highest importance, as the stability of a complete denture relies on the

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\***Corresponding author:** Dr. Eleftheria Pani, DDS, MSc; Thivon 2, Goudi, Athens, 11527, Greece

**Tel:** +306932710055; **Fax:** +30210645992; e-mail: [elpani@dent.uoa.gr](mailto:elpani@dent.uoa.gr)

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supporting tissues. On the final casts, base plates are fabricated with occlusal rims to proceed with the maxillomandibular records, in order to transfer the final casts to the articulator. The try-in of the complete dentures is also a two-stage approach: first only the anterior teeth are placed on the base plates and tried-in and then all of them. After the approval of both clinician and patient, the complete dentures are processed and delivered to the patient [2]. This is the conventional technique, which is the most widely taught technique for complete dentures worldwide. There is insufficient evidence for the necessity of the clinical step of the final impression. Are two impressions -a preliminary and a final one- a prerequisite for the success of a complete denture? This question was the incentive for fabricating complete dentures with a simplified technique.

There are protocols in the literature which suggest the fabrication of dentures with five, four, three or even two clinical visits. It is worth mentioning that combining the two sessions of try-in into one converts the conventional technique into a five-step procedure. However, this is still considered conventional. It is, therefore, important to clarify which steps are omitted in the simplified technique. As implied before, a simplified protocol does not include a final impression. The five-session simplified protocol is described by Lira-Oetiker et al. [3]. The only difference between the two protocols (conventional and simplified) used in this trial is the omission of the final impression. Reviewing the literature, the most common simplified protocol used is the four-session one, which includes a preliminary impression, maxillomandibular records, a try-in, and the complete denture delivery. The majority of the researchers omit besides the final impression also the second try-in session in the simplified protocol. That converts the simplified protocol into a four-session one. The four-session simplified protocol is thoroughly described by Duncan and Taylor [4]. In the first session the clinician makes an impression of alginate using a stock tray, either metallic or plastic. This is the only impression required for the fabrication of the complete denture. The prerequisite for this simplified technique to be successful is, according to the writers, the knowledge of the oral anatomy. The cast produced from this impression is the final cast on which the record bases with the occlusal rims are fabricated. The next session is the recording of the maxillomandibular relationship. In the try-in session the clinician and the patient evaluate the aesthetics of the denture and test the phonetics by the pronunciation of specific words and sounds. In order to continue with the delivery of the denture, both the patient and the clinician have to accept the denture at this session [4]. Owen and MacEntee [5] described a three-session simplified protocol defined as 'abbreviated complete denture technique' or 'minimum acceptable protocol (MAP) for complete dentures'. According to this, the anterior teeth are arranged by the clinician in the second session

simultaneously with the maxillomandibular records. Previously, with the assistance of a preformed anterior tooth arrangement guide (ANTAG) the position of the maxillary anterior teeth is defined. The rest of the teeth will be placed in the laboratory by the technician who continues with the setting of the denture. In the following clinical session, the denture is delivered to the patient. Interestingly, in this protocol the patient never tries the dentures with all the teeth before the delivery [5]. Ceruti et al. [6] used another version of a simplified protocol. This version consists of only two clinical sessions and is defined as 'simplified edentulous treatment (SET)'. The impression, the maxillomandibular records, the selection of the teeth and the try-in of the anterior teeth are performed in the first clinical session. After that, the technician completes the arrangement of the teeth and finalizes the denture. Therefore, in the next and last clinical session the denture is delivered. This protocol is possible only by using a specific material fabricated for this purpose, the multilayer impression tray (MIT) [6,7]. As we can conclude from all the different protocols, there are clinical steps which cannot be omitted. So, the steps of at least one impression, the maxillomandibular records, a try-in with all or some of the teeth selected and the delivery cannot be omitted. Some of them may be combined in one session, but they definitely have to be performed. The clarification of these protocols and their stages are shown in Table 1. The stages of the conventional and the most used four-session simplified protocols are shown in Fig. 1. The simplified protocol aims to a shorter procedure of fabrication of the complete denture. Therefore, the use of a facebow and the remount of the denture in order to perform selected grinding before delivery, are usually omitted.

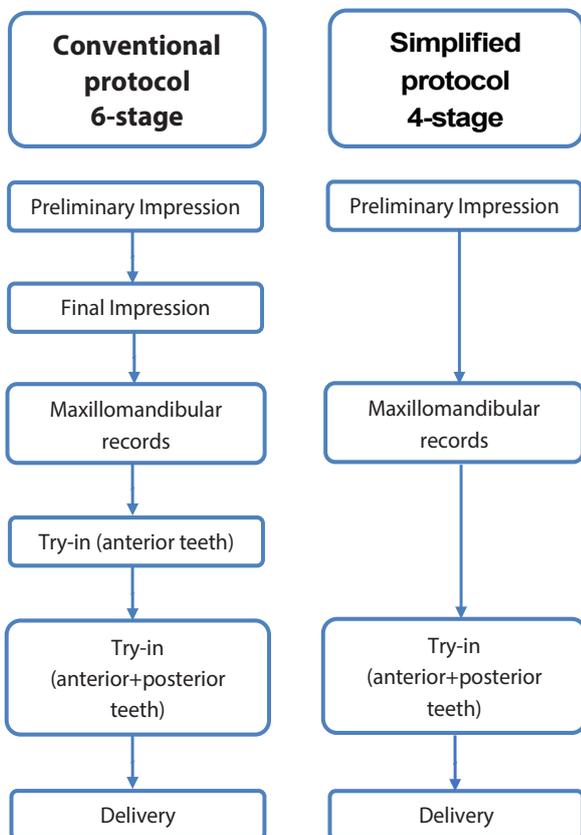
In order to replace an established protocol with a new one, it is necessary to have adequate evidence that the new protocol offers the same outcome as the previous one, if not better. The aim of this systematic review is to report on the current evidence and evaluate the differences between the simplified and the conventional method for fabrication of complete dentures and do a narrative comparison in order to conclude if the simplified technique is equal to or better than the conventional one. The outcomes to be evaluated are masticatory performance and ability, patient satisfaction, oral health related quality of life (OHRQoL), denture quality, time, cost, and cost effectiveness. The null-hypothesis is that the simplified protocol results in superior outcomes compared to the conventional protocol.

## 2. METHODOLOGY

The present systematic review has been conducted according to the PRISMA instructions [8]. The protocol of this systematic review was submitted to PROSPERO (ID 160603). An electronic search of the MEDLINE-PubMed, Scopus and Europe PMC databases was conducted by two independent researchers (PE and

**Table 1.** Stages of conventional and simplified complete denture fabrication protocol.

Sessions	Conventional protocol		Simplified protocol			
	6 stages	5 stages	5 stages	4 stages	3 stages	2 stages
Preliminary impression	X	X	X	X	X	X
Final impression	X	X				
Maxillomandibular records	X	X	X	X	X	X
Try-in (anterior teeth)	X		X		X	X
Try-in (anterior+posterior teeth)	X	X	X	X		
Delivery	X	X	X	X	X	X
Comments	Most common	Not common	Lira-Oetiker et al. [3]	Most common	Owen & MacEntee [5]	SET Ceruti [6,7]



**Figure 1.** Flowchart of the conventional and the simplified protocol.

SA). The inclusion criteria were randomized clinical trials, cohort clinical studies and clinical studies of complete dentures fabricated either with the conventional or the simplified method. The PICO details can be seen in Table 2. The PICO question was formed as such: 'Does the simplified technique for fabrication of complete dentures provide equal or even better outcomes to the treatment of the edentulous patients than the conventional technique?' All relevant studies should have been published in English from January 1950 to January 2020. The keywords used in the search included a combination of the following terms: Simplified OR conventional (technique OR method OR fabrication OR construction) AND complete dentures AND patient satisfaction AND/OR cost AND/OR time AND/OR masticatory ability AND/OR ability to speak AND/OR success of the complete dentures AND/OR performance ability. The results of the electronic search were screened based on the relevance of the titles to our topic. Any disagreement between the two reviewers was solved in consensus by discussion or by a third reviewer (CA). Articles that appeared multiple times during the search were considered only once. Following that, the abstracts of the articles chosen were read to identify if they met the inclusion criteria. The full-text articles were then obtained and reviewed if this determination could not be made only with the abstracts.

Articles written in other languages than English and studies referring to implants, overdentures, immediate dentures and/or fixed partial dentures were excluded. Furthermore, studies that did not compare the two aforementioned methods were excluded, even if they could provide information about each technique separately.

The main difference between the two protocols -conventional and simplified- is the session of the final impression. If the clinician performs two impression sessions-one preliminary and one final-then the protocol used is called conventional. When the clinician takes only one impression from which the final casts will be fabricated, then we have the simplified protocol.

The outcomes evaluated were masticatory performance and ability, patient's satisfaction, oral health related quality of life (OHRQoL), denture quality, time, cost, and cost effectiveness.

As part of the data extraction process, two reviewers (PE, SA) independently assessed the risk of bias in the included studies individually. In the present study, the risk of bias for randomized clinical trials was assessed according to ROBINS 2 (RoB 2) [9]. The study of Duncan et al. [10] was the only study included in this systematic review which was not randomized. Therefore, a different tool for accessing the risk of bias was used (ROBINS-I) [11]. The risk of bias across the studies was evaluated by GRADE, which is a system for rating the quality of a body of evidence in a systematic review [12].

The different studies included in the present review examined different factors. Due to this reason, they were compared in subgroups. A statistical analysis of the results was not feasible.

**Table 2.** PICO question.

Participants/Population	Patients in need of a complete denture.
Intervention	Patients treated with a complete denture fabricated by the simplified technique.
Comparison	Patients treated with a complete denture fabricated by the conventional technique.
Outcome	Masticatory performance and ability, patient satisfaction, oral health related quality of life (OHRQoL), denture quality, time, cost and cost effectiveness.

### 3. RESULTS

The electronic search of databases produced 474 titles of articles relevant to the topic. 403 articles were duplicated and therefore excluded. After reading the abstracts, 22 articles were rejected because they also referred to other prosthetic rehabilitations (apart from complete dentures) such as overdentures and fixed partial dentures. A full text was obtained from the remaining 49 articles and only 19 of these fulfilled the inclusion criteria. All of the included studies were clinical trials, 18 of which were randomized clinical trials (RCT). The electronic search resulted also in the identification of two systematic reviews and one meta-analysis on the comparison between the conventional versus the simplified technique for complete denture fabrication. Their limitation was that none of these papers examined all the outcomes, but rather they focused on some of them. Furthermore, additional

research has led to newer evidence on the topic since then. Our systematic review aims to overcome this limitation and include all the available information. We included these papers in the discussion section of the present review in order to compare their results with ours and identify any differences. The flowchart for the selected articles used in this systematic review can be seen in Fig. 2. The characteristics of the studies included are listed in Table 3.

In the same table the risk of bias of each study individually is presented. All the included randomized studies except for one, were at low risk of bias. For the study of Krishna et al. [22] there were some concerns about the risk of bias. This doubt was raised from the randomization process because of lack of information. The study of Duncan et al. [10] was the only one evaluated with a different risk of bias assessment tool (ROBINS-I). The authors of the present review concluded that the algorithm overestimated the risk of bias and the overall assessment for this study is 'no information' and its results should be presented with precaution.

Table 4 presents the impression techniques and the different materials used for final impression in each study.

The study of Mengatto et al. [23] could not be enlisted in any category of the materials used for the final impression, because the materials used were not clarified, but rather were mentioned under the general term 'compound with an impression material'. Interestingly, in the test group of the study of the de Resende et al. [15] group, the baseplate in the clinical session of the try-in was relined with zinc oxide and eugenol. However, the procedure was defined and considered as simplified by the authors.

As observed in Table 3, the included studies examined different variables. In an effort to assess the studies' outcomes more comprehensively, the different studies were categorized based on their examined outcomes (Table 5). It is worth mentioning that five outcomes were examined only by one different research each. This probably occurs because the definition of each outcome differs between the study groups. Therefore, we included studies, that examined similar variables but named them differently, in the same category in order to draw more robust conclusions (Table 6).

Komagamine et al. [21] focused on the masticatory performance of the patients but the authors also added two extra variables, i.e. the occlusal contact area and the maximum occlusal force. According to Lepley et al. [28], the greater the occlusal contact and the bite force, the better the masticatory performance. Horie et al. [29] also exhibited that the occlusal contact and the near occlusal contact areas related significantly with the mixing ability. However, the study involved dentate patients.

It is evident that the majority of the studies focused mainly on aspects of patient quality of life (patient satisfaction and OHRQoL).

The quality of evidence in this systematic review was high for each outcome, mainly due to the low risk of bias of all but two studies and the homogeneity in

their respective design. The fact that all studies did a power analysis to determine the study sample size and used a level of significance at 5% affected positively the quality of evidence.

### 3.1. Masticatory performance

Alves et al. [2] tried to associate the masticatory ability based on the method used (simplified versus conventional) and on some sociodemographic characteristics. No difference on masticatory ability was found between the two techniques. When evaluating the sociodemographic variables, only gender was found to have a statistically significant difference with women presenting lower masticatory performance than men.

Cuhna et al. [14] differentiated the masticatory ability from the masticatory performance. Although masticatory performance was measured according to different number of chewing cycles (20 and 40) the researchers could not find a difference between the two groups. However, there was an improvement when the patients with complete dentures chewed 40 rather than 20 times and this suggests that these patients can achieve a good masticatory performance if they have patience and persistence. Subjectively, patients with complete dentures fabricated with the simplified technique are presumed to have no difficulties in mastication in contrary to the control group. This was the only difference between the groups which did not affect the overall insignificant score.

Interestingly, Komagamine et al. [21] included as their study outcomes the occlusal contact area and the maximum occlusal force apart from the masticatory performance. Dentures fabricated by the conventional method had a statistically higher occlusal contact area than the simplified dentures, but this did not relate with a better mixing of the food. This was attributed to the fact that all the measurements were performed only 1 month after delivery and this interval may have been too short and that the final impression may provide more stable acrylic resin bases and occlusion rims during the following sessions.

Similar to de Villa Camargos et al. [13], Mengatto et al. [23] found no difference in the masticatory performance depending on the protocol used. In other words, there is evidence in all these studies that the method used to fabricate a complete denture does not affect the masticatory performance and ability and both techniques are held as equal.

### 3.2. Patient satisfaction

Many studies focused on the patient satisfaction and the influence that the fabrication method has on it. Only two of them found a significant difference between the two methods. Jo et al. [17] documented that the conventional method was preferred among the patients because the final impression ensured more detailed borders and therefore increased

stability and comfort of the complete denture. Hyde et al. [16] emphasized the impact of the impression material. His team fabricated two sets of complete dentures for each patient, one obtained after an alginate impression and the other obtained from a silicone impression. He concluded that the patients preferred the dentures fabricated from a silicone impression. All the other studies proved the two methods to be equal (Komagamine et al. [21], Kawai et al. [18,20], Krishna et al. [22], Lira-Oetiker et al. [3], Mengatto et al. [23], Nunez et al. [25], Regis et al. [26]). The only difference was that the satisfaction increased in both groups respectively following the time and the use of the complete dentures (Nunez et al. [25], Regis et al. [26]). Kawai et al. [18] on the other hand concluded that there is increase of satisfaction in 3 months compared to the baseline, but they found a significant decrease in 6 months. This phenomenon was noticed in both categories making them not to differentiate. It is remarkable that after 10 years Kawai et al. [20] still found no difference between the control and test group except for esthetics. Patients with simplified dentures were significantly more satisfied with the maxillary denture's esthetics after 10 years. Komagamine et al. [21] and Krishna et al. [22] failed to prove the improvement over time because of the short-term follow up.

### 3.3. Oral Health Related Quality of Life (OHRQoL)

The OHRQoL test is performed by a series of questionnaires. The basic questions are universal (OHIP-Edent) but every country has added questions relevant to their population and their lifestyle in order to get more specific answers. OHRQoL showed no difference between the two examined methods among all the studies.

### 3.4. Quality of complete dentures

The complete dentures included in each trial were fabricated by the same technicians, therefore it was highly improbable to find a difference among the complete dentures. Impeccable proof for this was provided by the study group of Kawai et al. [18]. They let prosthodontists, blinded the trial, to objectively examine the quality of the dentures and the results were similar for conventional and simplified dentures.

### 3.5. Time

Five clinical trials focused on the time spent for the treatment plan. Kawai et al. [19] used a more general term and measured the time spent for the treatment plan. On the other hand, Ceruti et al. [6] measured the time needed for each step, such as clinical time, number of clinical sessions but also the laboratory time and the laboratory returns.

The research group of de Resende et al. [15] separated time in two major categories: the time needed from the consultation until the delivery of the dentures and the time needed for adjustments. If the number of visits for adjustments was outnumbered for one method, then this could be a critical clinical issue. Such a differentiation in time was also made by Duncan et al. [10]. The researchers calculated the visits needed to fabricate the complete denture and separately the visits needed for adjustments. The results in both outcomes were statistically significant favoring the simplified protocol. Krishna et al. [22] limited their evaluation to the number of visits. Generally, it was agreed in all studies that the simplified method was faster in clinical time and clinical sessions than the conventional method.

### 3.6. Cost

The cost of denture fabrication was evaluated in three clinical trials. All of them agreed that the cost of a conventional method was significantly higher than the cost of the simplified one. Kawai et al. [19] attributed the difference in cost to the final impression step and to the remount of the denture before the delivery. Miyayasu et al. [24] and Vecchia et al. [27] considered also under the term of cost the time spent from the professionals. Vecchia et al. [27] evaluated also the time that a patient needs to spend for their

treatment from the time a patient exits their house until their return. Although the interpretation of cost differs between the studies, all three came to the same conclusion, that conventional method costs more than the simplified method.

### 3.7. Cost effectiveness

It is rational to think that studies which examined cost and time would have also evaluated cost effectiveness. However, the only study group that referred to cost effectiveness was Miyayasu et al. [24]. According to them cost effectiveness is a combination of cost and patient satisfaction where time is also considered under the term of cost. Cost and patient satisfaction have to be quantified, as cost effectiveness is the result of the division of the cost by the satisfaction. The authors concluded that cost effectiveness is higher for the conventional group.

### 3.8. Need for relines

The study by Duncan et al. [10] was the only one referring to the need of relines. This need and more specifically the time when this occurs, reflects not only the quality of the denture but also the effectiveness and precision of the impression technique. Although the thought is very good in this case, we cannot draw any conclusion because the evaluation happened three months after the delivery.

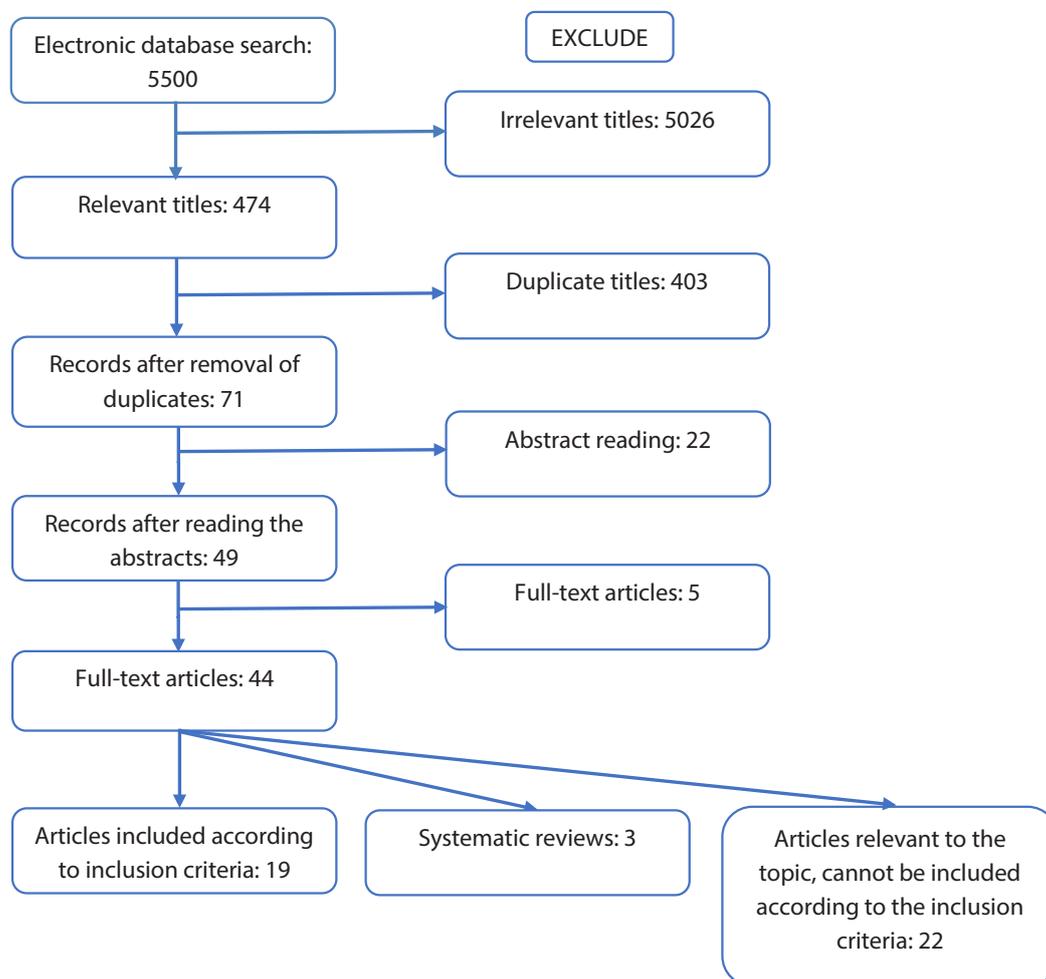


Figure 2. Flowchart illustrating study selection process.

**Table 3.** Summary of the study characteristics included in the systematic review.

Study	Study size	PICOs	Baseline	Follow up period	Risk of bias
Alves et al. [2]	38(19 C, 19 S) pt completed the study: 29 (15 C, 14 S)	P: edentulous for at least 1 year I: S C: C O: masticatory performance	After adjustments (3-4 weeks)	4 weeks after the last adjustment=2 months after the delivery	Low
de Villa Camargos et al. [13]	38(18 C, 18 S) pt completed the study: 12 C, 12 S	P: edentulous for at least 1 year I: S C: C O: OHRQoL, Satisfaction, Denture functional quality, masticatory performance	After adjustments (2 weeks)	1, 3, 6 months after the last adjustment Masticatory performance only at 3 months.	Low
Ceruti et al. [6]	64 (32 C, 32 SET)	P: edentulous for at least 2 years I: SET=S C: C O: Clinical time, number of clinical sessions, lab time, lab returns, patient satisfaction, quality of CD	Delivery	6 months after the delivery	Low
Cuhna et al. [14]	42(21 S, 21 C) pt completed the study: 19 S, 20 C	P: edentulous for at least 1 year I: S C: C O: masticatory performance and ability	After adjustments (2 weeks)	3 months after the last adjustment	Low
de Resende et al. [15]	92(42 T=C, 50 S) pt completed the study: 30 C, 38 S	P: edentulous I: S C: C O: Quality of CD, clinical outcomes, PROMs, time, OHRQoL		3 months for the questionnaires	Low
Duncan et al. [10]	80(40C, 40S)	P: edentulous I: S C: C O: number of visits for fabrication, number of visits for adjustments, need for relines	Delivery	3 months after the delivery	No information
Hyde et al. [16]	85 pt completed the study: 72	P: edentulous I: dentures made from silicone impressions C: dentures made from alginate impressions O: Preference of silicone or alginate, OHRQoL, comfort, stability, chewing ability, patients' experience		Impression Habituation period Adjustment period Confirmation period	Low
Jo et al. [17]	27(14 C-S, 13 S-C) pt completed the study: 13 C-S, 11 S-C	P: edentulous I: S C: C O: General satisfaction, OHRQoL	After adjustments= 4 times a week	1 <sup>st</sup> phase: C/S 1 month after adjustments ASSESSMENT Wash out phase=1 month wearing old CD 2 <sup>nd</sup> phase: S/C 1 month after adjustments ASSESSMENT	Low
Kawai et al. [18]	119(58 T=C, 61 S) pt completed the study: 3m 53 C, 55 S, 6m 51 C, 54 S, after 6m 42 C, 44S(quality)	P: edentulous I: S C: C O: General satisfaction, satisfaction, comfort, stability, esthetics, ability to speak, ease to clean, ability to chew bread/hard cheese/raw carrot/sausage/lettuce, quality of denture	Delivery	3 and 6 months after the delivery	Low

Kawai et al. [19]	119(58 T=C, 61 S) pt completed the study: 3m 53 C, 55 S, 6m 51 C, 54 S	P: edentulous I: S C: C O: Cost, time	Delivery	(3 and) 6 months after the delivery The statistical analysis was done at 6 months, the 3-month recall was counted as clinic time and cost.	Low
Kawai et al. [20]	54 (25 T, 29 S) same CDs 14 T, 21 S	P: edentulous I: S C: C O: General satisfaction, comfort, stability, esthetics, retention, ease to clean, ability to chew, OHRQoL	Delivery	10 years	Low
Komagamine et al. [21]	24(13 C-S, 11 S-C)	P: edentulous I: S C: C O: Masticatory function, occlusal contact area, maximum occlusal force	After adjustments (4 times a week=1 month)	1 <sup>st</sup> phase: C/S 1 month adjustments ASSESSMENT Wash out phase=1 month wearing old CD 2 <sup>nd</sup> phase: S/C 1 month adjustments ASSESSMENT	Low
Krishna et al. [22]	70 (35 c, 35 s)	P: edentulous I: S impression C: C impression O: Retention, stability, perception		2 months after the delivery	Some concerns
Lira-Oetiker et al. [3]	40(18 C, 22 S) pt completed the study: 17 C, 21 S	P: edentulous I: S impression C: C impression O: Satisfaction, comfort, stability, esthetics, ability to speak, facility of cleaning, ability to chew raw carrot, raw apple, sausage, white bread, lettuce	Non defined but 2 adjustments on 7 <sup>th</sup> and 14 <sup>th</sup> day	3 and 6 months	Low
Mengatto et al. [23]	20(10 C, 10 S) pt completed the study: 10 C, 9 S	P: edentulous I: S impression C: C impression O: Masticatory performance, chewing ability	1 adjustment after delivery	Before (old dentures) 3 months with new CD 6 months with new CD	Low
Miyayasu et al. [24]	27(14 C-S, 13 S-C) pt completed the study: 13 C-S, 11 S-C	P: edentulous I: S impression C: C impression O: Cost= time+materials, cost effectiveness	After adjustments= 4 times a week	1 <sup>st</sup> phase: C/S 1 month after adjustments ASSESSMENT Wash out phase=1 month wearing old CD 2 <sup>nd</sup> phase: S/C 1 month after adjustments ASSESSMENT	Low
Nunez et al. [25]	50(25 C, 25 S) pt completed the study: 23 C, 22 S	P: edentulous I: S impression C: C impression O: OHRQoL, satisfaction	Last adjustment	1 week before insertion, 30 days and 6 months after last adjustment	Low
Regis et al. [28]	42(21 C, 21 S) pt completed the study: 20 C, 19 S	P: edentulous I: S impression C: C impression O: OHRQoL, satisfaction, denture quality		Before treatment, 3 and 6 months	Low
Vecchia et al. [27]	42(21 C, 21 S) pt completed the study: 21 C, 20 S (insertion), 20 C, 19 S (adjustments)	P: edentulous for at least 1 year I: S impression C: C impression O: direct cost, indirect cost		Before insertion (from 1 <sup>st</sup> appointment till insertion), adjustment time (from 1 <sup>st</sup> session till the end)	Low

S: simplified method, C: conventional method, SET: simplified edentulous treatment, pt: patients, CD: complete denture, PROMs: patient-reported outcome measurements, OHRQoL: Oral Health Related Quality of Life

**Table 4.** Impression technique and materials.

Conventional technique		Simplified technique
Preliminary impression	Final impression	Impression
<b>Alginate+stock tray</b> Alves et al. [2], de Villa Camargos et al. [13], Ceruti et al. (no report about trays) [6], Cuhna et al. [14], de Resende et al. [15], Jo et al. [17], Kawai et al. (same group) [18-20], Mengatto et al. (no reports) [23], Nunez et al. [25], Regis et al. [26], Vecchia et al. [27]	<b>Custom tray+compound+silicone</b> Jo et al. (2 compounds) [17], Komagamine et al. (2 compounds) [21], Miyayasu et al. [24]	<b>Alginate+stock tray</b> Alves et al. [2], de Villa Camargos et al. [13], Cuhna et al. [14], de Resende et al. (+functional impression) [15], Jo et al. [17], Kawai et al. (same group) [18-20], Mengatto et al. [23], Nunez et al. [25], Regis et al. [26], Vecchia et al. [27]
<b>Alginate+metal edentulous impression tray</b> Komagamine et al. [21], Lira-Oetiker et al. [3], Miyayasu et al. [24]	<b>Custom tray+compound+polyether</b> Alves et al. [2], de Villa Camargos et al. [13], Kawai et al. (same group) [18-20]	<b>Alginate+metal edentulous impression tray</b> Komagamine et al. [21], Lira-Oetiker et al. [3], Miyayasu et al. [24]
<b>Compound</b> Krishna et al. [22]	<b>Custom tray+wax+zinc oxide impression paste</b> Cuhna et al. [14]	<b>Multilayer impression tray (SET)</b> Ceruti et al. [6]
	<b>Custom tray+compound+zinc oxide impression paste</b> De Resende et al. (no report on compound) [15], Krishna et al. [22], Lira-Oetiker et al. [3], Regis et al. [26], Vecchia et al. (no report on compound) [27]	<b>Silicone (putty+light)</b> Krishna et al. [22]
	<b>Custom tray+compound+polysulfide</b> Ceruti et al. [6], Nunez et al. [25]	

**Table 5.** Summary of the studies and the outcomes they studied.

Outcomes	Studies
Masticatory performance/ability	Alves et al. [2], de Villa Camargos et al. [13], Cuhna et al. [14], Komagamine et al. [21], Mengatto et al. [23]
Patient satisfaction	Ceruti et al. [6], de Villa Camargos et al. [13], de Resende et al. [15], Jo et al. [17], Kawai et al. [18], Kawai et al. [20], Krishna et al. [22], Lira-Oetiker et al. [3], Nunez et al. [25], Regis et al. [26]
OHRQoL	de Villa Camargos et al. [13], de Resende et al. [15], Hyde et al. [16], Jo et al. [17], Kawai et al. [20], Nunez et al. [25], Regis et al. [26]
Denture Quality	Ceruti et al. [6], de Resende et al. [15], Kawai et al. [18], Regis et al. [26]
Time	Ceruti et al. [6], de Resende et al. [15], Duncan et al. [10], Krishna et al. [22], Kawai et al. [19]
Cost	Kawai et al. [19], Miyayasu et al. [24], Vecchia et al. [27]
Comfort/stability/esthetics/ability to speak/ease to clean/ability to chew specific foods	Hyde et al. [16], Kawai et al. [18], Kawai et al. [20], Lira-Oetiker et al. [3], Mengatto et al. [23]
Complete dentures' functional activity	de Villa Camargos et al. [13]
Clinical outcomes	de Resende et al. [15]
Occlusal contact area/maximum occlusal force	Komagamine et al. [21]
Cost effectiveness	Miyayasu et al. [24]
Need for relines	Duncan et al. [10]
Impressions	Hyde et al. [16], Krishna et al. [22]

**Table 6.** Summary of the studies and the outcomes they studied revisited.

Outcomes	Studies
Masticatory performance/ability, Occlusal contact area/maximum occlusal force	Alves et al. [2], de Villa Camargos et al. [13], Cuhna et al. [14], Komagamine et al. [21], Mengatto et al. [23]
Patient satisfaction, Comfort/stability/aesthetics/ability to speak/ease to clean/ability to chew specific foods	Ceruti et al. [6], de Villa Camargos et al. [13], de Resende et al. [15], Hyde et al. [16], Jo et al. [17], Kawai et al. [18], Kawai et al. [20], Krishna et al. [22], Lira-Oetiker et al. [3], Mengatto et al. [23], Nunez et al. [25], Regis et al. [26]
OHRQoL	de Villa Camargos et al. [13], de Resende et al. [15], Hyde et al. [16], Jo et al. [17], Kawai et al. [20], Nunez et al. [25], Regis et al. [26]
Denture Quality, Complete dentures' functional activity, Clinical outcomes	Ceruti et al. [6], de Resende et al. [15], Kawai et al. [18], Regis et al. [26], de Villa Camargos et al. [13]
Time	Ceruti et al. [6], Duncan et al. [10], de Resende et al. [15], Kawai et al. [19], Krishna et al. [22]
Cost	Kawai et al. [19], Miyayasu et al. [24], Vecchia et al. [27]
Cost-effectiveness	Miyayasu et al. [24]
Need of reline	Duncan et al. [10]
Impressions	Hyde et al. [16], Krishna et al. [22]

## 4. DISCUSSION

### 4.1. Masticatory performance

The primary goal when fabricating a denture is to evaluate the patients' masticatory performance. The comparison of the two methods could not omit the evaluation of the masticatory performance. This evaluation is objective and subjective. Interestingly the results of the objective and subjective test do not always coincide. In other words, there is a difference between the masticatory performance and the assessment of their chewing ability [30]. The level of bone resorption did not influence the masticatory ability of the patients according to Marcello-Machado et al. [31]. This is in agreement with the results of the study of Alves et al. [2] and our results.

### 4.2. Classification systems of complete edentulism

The majority of the studies included used the classification system for complete edentulism of the American College of Prosthodontics (ACP) [32]. They focused on the ridge resorption as the main factor of a compromised case. However, this classification system categorizes the edentulous patients based on the complexity of the case which depends not only by the residual ridge. Only a minority belonged to the most favorable class (class I). This indicates that the results are not biased as they would have been if only patients with the most ideal oral condition were included [32]. Lira-Oetiker et al. [3] used the classification system of Cawood and Howell [33] and included patients of class II, III and IV. We could imply that the results may be optimized [33].

### 4.3. Patient satisfaction

Huunonen et al. [34] indirectly associated the ridge resorption with the patient satisfaction. In their study patients with severe ridge resorption complained about the stability of the mandibular denture and that caused reduced satisfaction. Instead, Pan et al. [35] did not find a significant association between

ridge height and patient satisfaction which comes in agreement with our result. The included studies did not evaluate patient satisfaction based only on the denture fabrication technique, but also assessed all other factors that may influence it, such as the remaining ridge height. No differences in patient satisfaction were found between all the included groups.

### 4.4. Oral Health Related Quality of Life (OHRQoL)

Following patient satisfaction, the oral health related quality of life (OHRQoL) was examined. OHRQoL was measured using different versions of the Oral Health Impact Profile (OHIP). OHIP-Edent is a shortened version of OHIP and focused on the edentulous patients. Moreover, OHIP-Edent can detect the differences in the quality of life of the patients after receiving a new rehabilitation. De Souza et al. [36] proved the validity of the Brazilian version of the OHIP-Edent as well as the validity of the Geriatric Oral Health Assessment (GOHAI). They compared the answers of these two OHRQoL inventories with the answers of a denture satisfaction questionnaire and they found a strong correlation [36]. Likewise, Sato et al. [37] found that the Japanese version of OHIP-Edent (OHIP-Edent J) demonstrated good reliability and validity [37].

It is important to mention the study of Stober et al. [38]. They correlated OHRQoL measured with OHIP-Edent with the patient satisfaction measured with questionnaires. Although they emphasized that patient satisfaction cannot per se predict the OHRQoL, they found a significant association between the two factors [38], strengthening the conclusion that the method used did not affect either the OHRQoL or the patient satisfaction.

#### 4.5. Cost and time

The simplified and the conventional technique differed significantly in two outcomes, named cost and time. The simplified technique did have a significant lower cost than the conventional technique. The cost of the conventional is higher as the clinicians use extra materials. The session of the final impression includes an acrylic resin custom tray, a compound for border molding and a wash material. The use of these three additional materials inevitably increases the cost [39]. The time needed for the conventional technique was longer, since the protocol included an extra clinical session. The time increases more if we take into consideration the difficulty of the final impression. Moreover, a randomized clinical trial of Kimoto et al. [40] revealed a difference in time needed based on the experience. Although Kimoto et al. [40] did not mention the years of experience of each clinician, the time difference in the stage of the final impression was statistically significant [40]. In the studies included in the present review, the practitioners varied from undergraduate students to experienced prosthodontists. No study compared students and prosthodontists directly. That means that the time difference was valid in all studies regardless of the clinician and therefore the simplified method is quicker.

#### 4.6. Cost effectiveness

Cost effectiveness analysis is an economic analysis which aims to give an answer between alternative treatments. Its calculation is mathematical [41]. The simplified technique differs from the conventional only in terms of cost and time. This could lead to the assumption that the simplified technique is more cost effective. However, the analysis revealed the superiority of the conventional method. Only one study examined this factor and therefore we cannot draw a conclusion.

#### 4.7. Post-insertion visits and need for relines

Duncan et al. [10] concluded that the simplified technique required less visits for the necessary adjustments and there was no difference in the need for relines. During the first three months patients still try to adjust to the new rehabilitation so it is impossible to testify the need for relines. Less post-insertion visits for the simplified technique may be explained by the fact that the final impression with border molding leads often to overextended dentures.

#### 4.8. Facebow

In a lot of studies in the intervention group face bow record was also omitted besides the final impression. Farias-Neto et al. [42] and Prakash et al. [43] concluded in their systematic review accordingly that the use of a face bow does not result in a better outcome for the complete dentures. This comes in agreement with our results, but it logically raises the question if the results are valid as there is no included study which examines the use or not of only the facebow. Kumar

and Souza [44] provided the answer with their study where the only difference between the two groups was the use of the facebow. According to them the complete dentures fabricated without the use of the facebow were better than the dentures of the control group, proving that a complete denture can also be fabricated with simple methods avoiding the use of a facebow. The differences found between the two groups were also attributed to the fact that the mandibular cast of the control group was articulated with centric, lateral and protrusive records. This is very demanding especially in edentulous patients where the records are made with record bases and occlusal rims which are impossible to be stable during the procedure [44].

#### 4.9. Remount

A valid evaluation about the importance of the remount could occur if that was the only difference between the control and the test group. Such a study was performed by Shigli et al. [45] and they found the statistically significant superiority of the remount process. The patients of the test group needed less post-insertion visits, experienced less pain and discomfort during mastication and presented less sore spots. In the present review such a difference was not noticed. However, we have to see this result with precaution as the influence of the remount could be lost among the influence of other factors.

#### 4.10. Systematic reviews and meta-analysis

Paulino et al. [46] concluded that the simplified technique does not compromise patient satisfaction and masticatory ability with the complete dentures, nor does it affect the quality of the denture. Ye et al. [47] found differences between the two techniques only in cost and time. The most recent-in the searching period of the present review- publication comparing the two methods is a meta-analysis of Al-Ansari et al. [48]. They included 11 studies and drew conclusions about patient satisfaction, quality of life, cost, and time. For the first two outcomes the researchers found no statistically significant difference between conventional and simplified technique contrary to the other two. The results of our systematic review are more comprehensive and they are in agreement with the results of the aforementioned studies. Cost and time are the only outcomes with a difference in favor of the simplified dentures. Apart from that, conventional and simplified method of fabrication of complete dentures have equal outcomes.

#### 4.11. Limitations

There is also a lot of heterogeneity among the studies because of the different materials used, the different factors examined with a variety of tests, the differences between the groups, the level of experience of the clinician and the short follow up. CAD/CAM complete dentures are out of the scopus of the present review.

## 5. CONCLUSION

The conclusions of the present systematic review are the following:

1. Our systematic review is in agreement with the literature of the topic.
2. The null-hypothesis was confirmed in terms of cost and time but rejected in all the other factors.
3. Cost and time differed significantly between the two methods favoring the simplified protocol.
4. Masticatory performance and ability, patient satisfaction, Oral Health Related Quality of Life (OHRQoL) and denture quality are not affected by the method of fabrication.
5. The impression of the edentulous jaw is not a simple task and requires profound knowledge of the oral

anatomy. Moreover, there is the need to establish a standardised simplified protocol in order to consider it as an alternative.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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## AUTHOR CONTRIBUTIONS

GP, EP: conceptualization. EP: methodology, software. EP, AS, GP: validation. EP, AS, GP: formal analysis. EP, IA: investigation. EP, AS, AC: resources. EP, AC, IA: data curation. EP: writing-original draft preparation. EP, AS, GP: writing-review and editing. GP: visualization. AS: supervision. GP: project administration.

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## Eleftheria PANI

DDS, MSc  
Department of Prosthodontics  
School of Dentistry  
National and Kapodistrian University of Athens  
Athens, Greece



### CV

Eleftheria Pani graduated from the Dental School of the National and Kapodistrian, University of Athens, Athens, Greece in 2014. She was accepted in the postgraduate program of Prosthodontics in the National and Kapodistrian University of Athens, Athens, Greece from which she graduated in 2021 after presenting her master thesis.

### Questions

#### 1. What is the difference between conventional and simplified complete dentures?

- a. Omission of the final impression;
- b. Omission of the final impression and the try-in;
- c. The use of different materials;
- d. Omission of laboratory stages.

#### 2. What is mainly used as impression material for the simplified complete dentures?

- a. Alginate;
- b. Silicone;
- c. Polyether;
- d. Compound.

#### 3. Simplified complete dentures differ significantly from the conventional in:

- a. Cost;
- b. Cost and time;
- c. Cost, time, patient satisfaction;
- d. Cost, time, patient satisfaction, OHRQoL.

#### 4. The majority of the studies examined:

- a. Cost and time;
- b. Patient satisfaction;
- c. Patient satisfaction and OHRQoL;
- d. Cost, time, patient satisfaction and OHRQoL.