Relationship between complete dentures and swallowing ability

[1]Mohamad Zaid Novialdi, [2]Muslita Indrasari
Student of Prosthodontic Specialist Program
Prosthodontic Department
Faculty of Dentistry, Universitas Indonesia
Jakarta, Indonesia
Corresponding author: **Muslita Indrasari**, e-mail: **muslita.indrasari@ui.ac.id**

ABSTRACT
The aging process causes changes in the anatomical structures of the oral cavity and pharynx that are closely related to the ability to chew and swallow. The use of a complete denture may prevent this to happen, but a lower mastication pressure is visible in complete dentures compared to natural teeth. This may have an impact on swallowing ability. In general, a complete denture improves the swallowing process and prevents oral cavity and pharynx changes. Several factors, such as denture thickness, the interaction of oral musculatures with the denture, and occlusal contacts will affect the effectiveness of the swallowing process. A proper and stable denture will improve the pharyngeal movement involved in swallowing, thus avoiding airway obstructions. It is concluded that the use of a proper complete denture is important as all four phases of the normal swallowing process are affected by the denture. Untreated edentulous jaws may cause oropharyngeal expansion which increases the risk of food bolus penetration into the hypopharynx and ultimately delay the pharyngeal swallowing process.
Keywords: aging, complete dentures, rehabilitations, swallowing

INTRODUCTION

Aging is an unavoidable process that will be experienced by all the living things. This process is associated with progressive changes related to time and will affect the increased susceptibility to disease. In the mouth, the presence of hard tissue disease and periodontal disease usually leads to tooth loss, which if it doesn't replace by the use of dentures can generate impaired mastication, swallowing, and malnutrition.[1]

Complete denture (CD) is one of the restorations indicated for patients who have lost all their natural teeth. This denture can be removed and installed by the patient himself, the purpose of using these dentures is to restore the masticatory function that is disrupted due to tooth loss. In addition, CD plays an important role in swallowing function.[2] The swallowing process involves the anatomical structures of the oral cavity, lips, teeth, hard palate, soft palate, uvula, mandibular bone, tongue, the floor of the mouth, larynx, pharynx, and esophagus.[3]

The aging process causes a decreased swallowing function in the elderly, this can occur due to changes in the anatomy of the oral cavity and pharynx which is associated with mastication and swallowing. In the elderly, the wearing of CDs become commonplace. Because it plays an important role in maintaining swallowing function.[4] The maxillary CD which covers most of the palatal mucosa where the mechanoreceptors are distributed, can cause physiological and functional disturbances such as discomfort, gag reflex, and poor tongue adaptation.[5] In addition, the difference in chewing pressure produced by lower dentures compared to natural teeth can have an impact on the ability to swallow.[6]

A denture wearer in the elderly has a role in maintaining the anatomy of the oral cavity properly so that it can contribute to the process of transporting food boluses from the oral cavity during swallowing. This scoping review was made to describe the effect of CD wearing on swallowing processes with the aim of knowing the relationship between CD wearing on swallowing ability.

LITERATURE STUDIES

The writing of this literature is in the form of a scoping review that summarizes and shows the results of existing research on a part of a particular topic or field of science. The steps taken in the preparation of this scoping review are determining study questions, determining the appropriate type of research, conducting study selection, collecting data in a chart, compiling and making a summary of the study results report. This scoping review was written based on Arksey's staging framework and the Preferred Reporting Items for Systematic Review Extension for Scoping Review (PRISMA-ScR) guidelines.[7,8] The research question used in the literature is *Is there a relationship between the use of CD and the ability to swallow*?.

To identify questions and objectives in this scoping review, the PCC formula was used. P (population) in patients wearing complete dentures, C (concept) is the effect of wearing CD on the ability to swallow, and C (context) is the patient's swallowing ability when wearing CD and the patient's reported condition. This formula was used in this scoping review to see the relationship between the

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Table 1 Literature search keywords

PubMed	((((swallowing) OR (deglutition)) AND (((((removable denture) OR (denture)) OR (complete denture)) OR (removable prostheses)) OR (removeable prosthesis))) AND ((effect) OR (impact))) AND (dysphagia)"full text,2011-2021"
Ebsco	(((((removable denture) OR (denture)) OR (complete denture)) OR (removable prostheses)) OR (removeable prosthesis))) AND ((effect) OR (impact))) AND ((Swallwoing) OR (Deglutition)" *Full text,* 2011-2021
Scopus	"((removable denture) OR ((Prostheses) OR (Prosthesis))) AND ((Swallwoing) OR (Deglutition) AND ((Effect))" *Full text*

Table 2 Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Period	In the last 10 years period	Outside the last 10 years period.
Language	English	Other than English.
Subject	Patients wearing complete dentures	Other than complete dentures, not wearing dentures, implanted dentures and complete dentures with implant support
Concept	The effect or impact of wearing dentures on the swallowing process	Does not discuss swallowing, does not include the impact or effect of wearing dentures on swallowing
Context	Patient's condition or ability to swallow while wearing complete dentures and reported general health	Does not discuss the patient's condition and ability to swallow and the health of the reported patient
Design	Randomized clinical trial, Cohort	case reports, studies, and meta-analyses.
Type of Publication	Full text, free full text	Does not have full text

wearing of CD and the patient's swallowing condidition and ability.

The literature review in this scoping review will focus on the impact or effect of dentures on the swallowing process. Literature searches were performed on three electronic databases (Pubmed, Ebsco, Scopus). The keywords used to search the literature are "((Denture)) OR ((Prostheses) OR ((Prosthesis) AND ((Swallowing) OR ((Deglutition) AND ((Effect)))" as shown in table 1, published in English for the last ten years and has the full text. Identification of relevant literature requires the existence of eligibility criteria in the form of inclusion and exclusion criteria in table 2.

After the literature was searched according to the criteria in table 1, screening was carried out because there are some duplicated literatures. The screening is also done by reading abstracts in each journal to pay attention to the inclusion and exclusion criteria. Appropriate literature will be included in this scoping review. Information such as author's name, year of publication, study design, data collection method, number of subjects, age, and treatment outcomes from the literature used will be reported in tabular form.

From the search strategy carried out, it was found 58 articles using the keywords summarized in table 1. A total of 38 literatures were obtained from PubMed, 6 articles from Scopus, and 14 articles from Ebsco. After the duplication check, there were 10 duplicated articles, 1 textbook article, and 1 non-journal article. The existence of articles that are considered relevant to the topic of scoping review is selected based on the title and abstract. Elimination is carried out with predetermined criteria and then read again to produce 7 final articles that will be used in this scoping review. The article search flow is shown in Fig.1. The results of the article review are presented in tabular form.

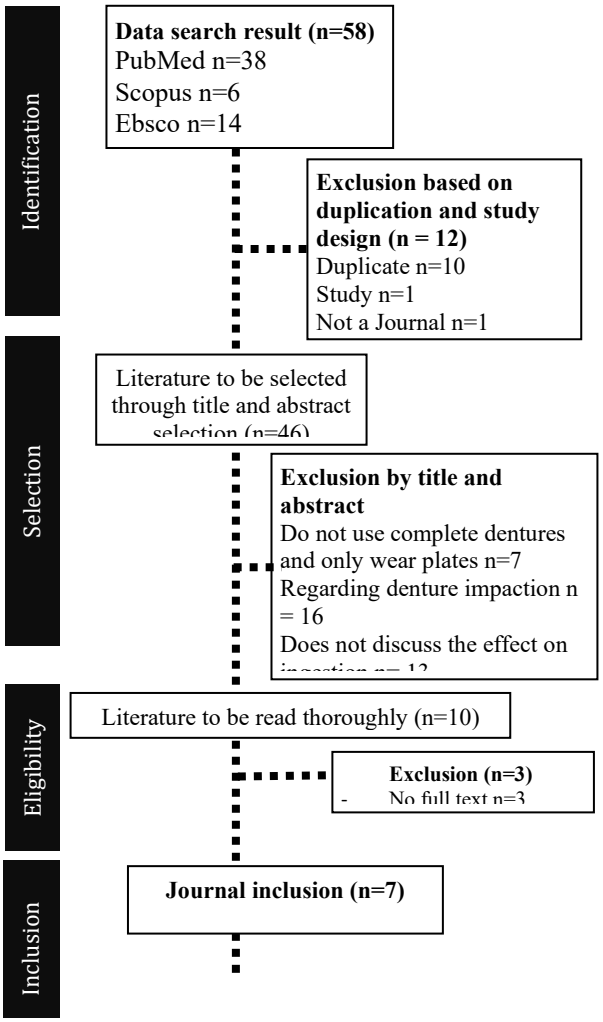

Figure 1 Diagram of the literature search and selection process based on PRISMA-ScR

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Scoping review

Table 3 The included studies and the effects of wearing dentures on swallowing

No	Author and year of publication	Research	Types of dentures	Number of subjects and mean age	Evaluation method	Effects of wearing dentures on swallowing
1	Onodera S, et.al (2016)	clinical experiment	complete denture	25 study participants aged 68 - 84 years	Observation of swallowing and eating, analysis of movement during eating and swallowing	The range of motion and duration of movement from the mandible can be shortened by wearing dentures, the elevation of the hyoid bone can be maintained by fixation of the mandibular bone by the occlusal contacts of the upper and lower dentures.
2	Gokce HS, et.al[5](2012)	clinical experiment	complete denture	23 study participants were edentulous with a mean age of >59 years and 23 participants were dentate with an average age of study participants >45 years	Observation of swallowing using MRI	The wear of dentures reduces the movement of the hyoid bone and larynx in edentulous subjects despite an increase in swallowing time in the oral phase with liquid boluses.
3	Yamamoto H, et.al[9] (2013)	clinical experiment	complete denture	15 study participants were edentulous and aged >72 years	Observation of feeding order with Videofluoroscopy	The wear of dentures helps maintain stability by normalizing oral function, then the bolus can be collected in the vallecular area controlled by the glossopharyngeal nerve so it will stimulates the receptive field enough to cause pharyngeal swallowing as soon as the bolus penetrates into the hypopharynx.
4	Kondoh J, et.al[4] (2015)	clinical experiment	complete denture	19 study participants aged 62 -90 years	Repetitive Saliva Swallowing Test, tongue pressure measurement	There is an increase in laryngeal movement from patients who wear complete dentures, the value of tongue motor skills is greater in patients who wear dentures compared to those without dentures.
5	Monaco A, et.al[10] (2011)	Clinical experiment	complete denture	20 study participants were edentulous and aged 54 – 70 years with 20 control group dentate and aged 51 – 69 years	Surface electromyography examination, computerized kinesio graphy examination of mandibular movement, recording of spontaneous swallowing of saliva	wearing of unstable dentures can prolong the duration of oropharyngeal swallowing, an increase in the duration of swallowing is also seen in new complete denture wearers compared to patients with complete natural teeth.
6	Furuya J, et.al[1] (2015)	Clinical experiment	complete denture	17 study participants were edentulous and aged 62 – 82 years	CBCT examination of the oral and pharyngeal mucosa, 3d measurements and pharyngeal description	wearing of dentures prevents changes in the shape of the oropharynx in an anteroposterior direction
7	Ibrahim AM[11] (2020)	Clinical experiment	complete denture	30 edentulous study participants aged 50 – 70 years	Evaluation of mastication duration, number of masticatory cycles, number of swallows, oropharyngeal residue by videofluroscopic	The wear of dentures prevents compression of the larynx and loss of occlusal support which can lead to decreased coordination of swallowing movements of the hyoid, larynx and tongue.

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DISCUSSION

The aging process will continue throughout life and occur naturally, this takes place gradually and is characterized by physiological and psychosocial changes. The changes in the body will affect the immune system, not to mention the oral cavity which as we grow old the immune system will graduate the oral cavity to become susceptible to diseases, such as inflammation, damage to the tooth structure, and tooth loss.

Tooth loss will affect the ability to masticate, swallow and speak. If not replaced, tooth loss can cause other health problems such as reduced food intake to malnutrition, or unhealthy food choices, which can lead to cardiovascular disease.[12] Tooth loss is thought to have a close relationship with swallowing disorders. Lim et al[13] stated that age, number of remaining teeth, and masticatory function have a relationship with each other and with symptoms of dysphagia or swallowing disorders.

To rehabilitate or prevent swallowing problems due to tooth loss, wearing CD is often chosen especially in geriatric patients.[1] The wear of dentures has a beneficial effect during the swallowing process because it can reduce the risk of laryngeal penetration, unstable swallowing movements, and stable palatal-tongue contact.[2]

Swallowing is a complex coordinated neuromuscular activity of structures in the oral cavity such as the pharynx, larynx, and esophagus that occurs rapidly. This process begins with a bolus of food that travels from the mouth to the stomach through the pharynx and esophagus, which is divided into 4 phases; they are the preparation-propulsive, oral, pharyngeal, and esophageal.[3]

In the preparation phase, the food bolus enters the mouth to be chewed and mashed. The process of mastication is a repetitive pattern, this process forms a lateral rotation of the muscles in the mandibular and labial regions. In this phase, the tongue moves the food over teeth and when the upper and lower teeth are in contact. The movement will destroy the bolus above it which is then returned again and helps the food bolus to mix with saliva. There is pressure on the buccal muscles, causing the food bolus to be stuck in the middle, so it can be continued to the next phase.

The oral phase begins when the food bolus starts moving posteriorly. The tongue will push the bolus posteriorly, which will trigger the next phase. In this phase, the cortex and brainstem will receive sensory information that comes from the stimulation of sensory receptors on the tongue and oropharynx, so that a swallowing reaction will occur which initiates the next phase.

In the pharyngeal phase, there is some activity of velum elevation, retraction, and complete closure of the velopharyngeal fortifications, preventing the food bolus from moving toward to the nose. The anterior movement and elevation of the larynx and hyoid, make the sphincter closes the larynx so that the food bolus does not enter the respiratory tract. The sphincter opens so the food bolus can go to the esophagus, then the base of the tongue tilts so the food bolus that goes to the pharynx will touch the anterior part of the posterior pharyngeal wall so the pharyngeal constrictor muscles will contract.

In the esophageal phase, the food bolus enters the esophagus and passes through the upper esophageal sphincter, then the food bolus enters the stomach through the lower esophageal sphincter. Peristalsis in the esophagus will push the food bolus to move toward the stomach.[14]

Based on the 7 articles obtained, the effect of wearing CDs on the swallowing process was discussed in all the literature used in this scoping review. In the study of Onodera et al[2] it was reported that when wearing CDs there was an adjustment in the movement of the hyoid bone, larynx, posterior pharyngeal wall, and upper esophageal sphincter. With the adjustment of these movements, wearing CD can help the swallowing function of the pharyngeal phase in edentulous patients when eating solid food in the perspective of spatial movement.

The range stability of motion was also reported in the study of Yamamoto et al.[9] In the denture absence, food boluses are retained in the hypopharynx because when swallowing the bolus, it cannot adequately stimulate the receptive fields in the valleculae and hypopharynx, and with increased hypopharyngeal transit time during swallowing without wearing dentures, the bolus will be fragmented in the pharynx and receptive pharyngeal mucosa is reduced when not wearing dentures.

Transit time on ingestion is another matter of concern. The study of Gokce et al[5] reported that in the oral phase, decreased swallowing time was found in subjects after wearing their dentures by swallowing 10 mL of water. This comes due to the sensation of the tongue and the palatal mucosal area being covered by the denture, so the thickness of the maxillary denture base is something that needs to be considered. The same thing was also reported by Monaco et al,[10] that the duration of swallowing was increased in subjects with occlusal contacts compared to subjects without occlusal contacts, apparently, the dentures were unstable,

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thus prolonging the swallowing time.

As reported by Jugo et al[4] and Abdalah[11] despite the shorter swallowing transit time, swallowing without wearing dentures can be dangerous in edentulous patients. The frequency of laryngeal penetration in subjects who did not wear dentures was higher than in subjects who wore dentures, this allows the entry of food into the respiratory tract becomes larger. The presence of occlusal contacts and intraoral deformities are thought to have an important role in this. The contours of the hard palate and maxillary teeth are coordinated with the movement of the tongue during bolus formation.[4] Anatomical changes in the oral cavity and pharynx also have a relationship with mastication and swallowing. Furuya et al[1] reported a significantly greater oropharyngeal volume in subjects who did not wear dentures than in subjects who wore dentures so if continued, the expanded oropharynx could worsen swallowing ability.

It is concluded that the changes in the structure of the oral cavity can affect its functions, the swallowing function is one of them. Impaired swallowing function due to tooth loss requires rehabilitation. Wearing CDs is expected to improve or rehabilitate swallowing function.

The presence of support in the occlusal contact and proper contact of the tongue with the palate will increase pharyngeal movement and prevent pharyngeal penetration. However, if there is a condition where all teeth are lost and they are not replaced with dentures, this can increase the penetration of the food bolus into the hypopharynx and delay the swallowing of the bolus in the pharynx during meals. Therefore, wearing CDs will avoid this and can maintain proper oral and pharyngeal anatomy and contribute to the transport of the bolus from the oral cavity through the pharynx for swallowing.

The quality of the CD needs to be considered. The thickness of the base plate in the palatal area affects the swallowing function. Impaired stability in CDs can prolong the duration of swallowing. The manufacturer of CDs must pay attention to the complex interactions between the muscle activity of the tongue, lips, and cheeks to avoid an imbalance of muscle strength exerted during swallowing. Unstable occlusal contacts can also affect the swallowing process because even though it is not visible, during the mastication process it they can affect the duration of the swallowing process.

It is suggested that wearing CDs has an effect on the swallowing process, it can prevent the decrease in swallowing ability due to tooth loss. Although the lack of research on CDs related to swallowing ability restricts this scoping review, further investigation is needed to provide a better understanding.

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